ENCYCLOPEDIA
BRITANNICA

THE UNIVERSITY OF CHICAGO

The Encyclopædia Britannica
is published with the editorial advice of the faculties
of The University of Chicago and of a
committee of members of the faculties of Oxford, Cambridge
and London universities and of a committee
at The University of Toronto

*

"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

A New Survey of Universal Knowledge

ENCYCLOPÆDIA BRITANNICA

Volume 12

HYDROZOA TO JEREMY, EPISTLE OF

ENCYCLOPEDIA BRITANNICA, INC.

WILLIAM BENTON, PUBLISHER

CHICAGO. LONDON · TORONTO · GENEVA · SYDNEY

©

1929, 1930, 1932, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962

1963

BY ENCYCLOPÆDIA BRITANNICA, INC.

COPYRIGHT UNDER INTERNATIONAL COPYRIGHT UNION

ALL RIGHTS RESERVED UNDER PAN AMERICAN AND UNIVERSAL COPYRIGHT CONVENTIONS BY ENCYCLOPÆDIA BRITANNICA, INC.

PRINTED IN THE U. S. A.

FOUNDED A.D. 1768

ENCYCLOPÆDIA BRITANNICA

Volume 12

HYDROZOA *TO* JEREMY, EPISTLE OF

HYDROZOA. The Hydrozoa (sometimes called Hydromedusae) are a class of animals, the vast majority of which are marine, and which belong to the still greater assemblage known as the Coelenterata (*q.v.*). The Hydrozoa include not only polyps, but also medusae or jellyfish (these terms are defined in the article COELENTERATA). They are, in fact, that group of Coelenterata in which neither the one nor the other of these two forms of body predominates, and in this respect they contrast strongly with the other main classes (Scyphozoa and Anthozoa). Moreover, both polyp and medusa have a simpler plan of structure than in the other classes. The polyp itself is frequently (though not always) small. Its mouth leads directly into the internal cavity of its body (coelenteron), without the intermediary of a definite throat or gullet of any kind, and the ectoderm and endoderm (*see* COELENTERATA) meet at the lips. The coelenteron is a simple cavity lined by endoderm; it is not subdivided by partitions into lesser cavities, nor does it contain definite organs of any kind. With these limitations the actual form of the polyp varies very greatly. The medusa presents infinite variety of form, but it too lacks a throat, and although its coelenteron sends out radiating canals which run from the central cavity through the solid tissues of the bell, it is otherwise simple in that it contains no definite organs. The medusae of Hydrozoa are, generally speaking, smaller and more slightly built creatures than the medusae belonging to the related class, Scyphozoa, although in certain cases they attain a larger size than the average, which is a matter of millimetres. The Hydrozoa are also characterized by the fact that the sex cells, when they ripen in the clusters known as *gonads*, typically lie in or under the ectoderm. although the site of their original formation may be in either ectoderm or endoderm. It is among the Hydrozoa above all other Coelenterata that the phenomenon, briefly characterized elsewhere (article COELENTERATA), and known as *polymorphism*, attains its height. The details of this condition are described in parts of the present article and a summary of the question is given after the section on Siphonophora.

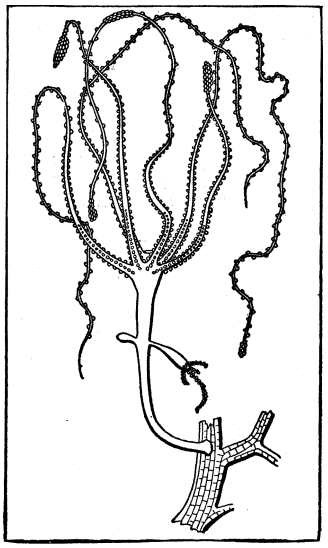
The infrequency of brackish or fresh-water forms among the Coelenterata makes their occurrence of interest. The ordinary marine Hydrozoa are either pelagic (swimming or floating organisms) or sedentary, according to their nature, and many of either kind exist. The brackish and fresh-water forms exhibit the same diversity, though few in number. One of the most interesting is a minute creature, *Protohydra*, the length of which is about 3 mm. This organism inhabits the surface layer of mud, rich in diatoms, which is to be found in the bottom of pools in certain tidal marshes: it also occurs in oyster beds and similar places. It is carnivorous, and reproduces freely by transverse fission. It possesses no tentacles, and is as simple in structure as any known Coelenterate.

The best known of the nonmarine Hydrozoa, however, are the genera *Limnocodium, Limnocnida, Cordylophora* and *Hydra*. Of *Hydra* more details are given below, and the chief interest of *Cordylophora* lies in the fact that it may flourish in water of different degrees of salinity as well as in fresh water; it is otherwise ordinary. *Limnocodium ryderi* possesses a feebly developed polyp generation (up to about 2 mm. long) which produces small colonies containing about 2–7 individual polyps without tentacles. These colonies can produce buds of two kinds; some become separated from the parent, form polyps and produce new colonies, others develop into medusae, and these are liberated and swim away. The species of *Limnocodium* (with which is now included *Microhydra*) are not very clearly recognized; but representatives of the genus occur in lakes, millstreams and similar places in the United States, Germany, China and Japan, and have appeared in water lily tanks at various botanic gardens, and in other tanks and aquaria. The genus *Limnocnida* contains medusae which have been found in several river systems in Africa and in some of the great lakes, as well as in India. The Hydrozoa comprise three large orders which from this point will be treated separately.

ORDER I. HYDROIDA

The Hydroida are, roughly, those Hydrozoa which possess a definite alternation of the polyp and the medusa in their life history, and in which one generation (the polyp) is sedentary and usually constructs a fixed colony, the other being free-swimming when fully developed. There are exceptions to this general statement, but they are not characteristic of the group as a whole. The variety of form and life history exhibited, however, is great The common and well-known but quite untypical fresh-water genus *Hydra* (fig. 1),

is the only thoroughly successful freshwater Coelenterate: *Hydra,* of one species or another, occurs in ponds and ditches and similar situations in many parts of the world. It consists of small isolated polyps, each with a pillar-like body and a limited number of tentacles. The length of the body is a matter of millimetres, and the tentacles in some species may be longer when stretched out than the body, although both they and the body can contract into rounded knobs. The *Hydra* attaches itself to stems and water-weeds, or floats beneath the surface film. It catches prey, often of a large size compared with its own bulk, in the manner characteristic of the Coelenterata (this is described in the article COELENTERATA) by stinging and then swallowing it. From the body of the *Hydra* there grow out buds, each of which acquires tentacles of its own and ultimately becomes separated from the parent; but no medusae whatever are produced, this being quite exceptional among the Hydroida. There are usually developed separately, on different parts of the body, ovaries and testes which give rise to the sex-cells. Whether this represents a degenerate condition, and there was once a medusa-stage in the life-cycle, or whether it is a primitively simple condition, cannot be determined.



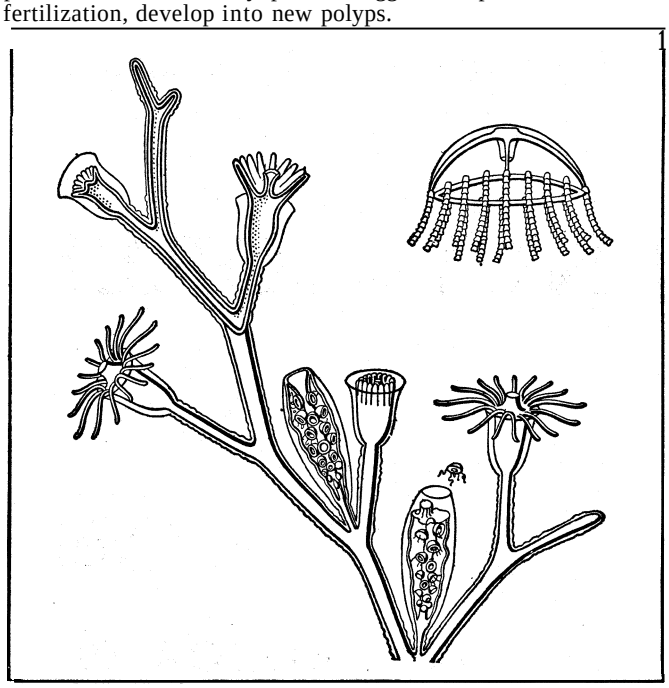
FROM DELAGE AND HEROUARD, "ZOOLOGIE CONCRÈTE" (REINWALD) (COPR BONNAIRE)

FIG. 1.—FRESH-WATER POLYP (HYDRA), ENLARGED

The specimen is shown attached to a plant-stern. Its tentacles are well extended and it bears two buds on its side, one of which has acquired tentacles of its own

The few other simple genera which are known, such as *Protohydra,* may be related to *Hydra,* or may be primitive or degenerate forms of separate origin. With the above preliminary, the characteristics of the group as a whole, without reference to these special forms, may be considered.

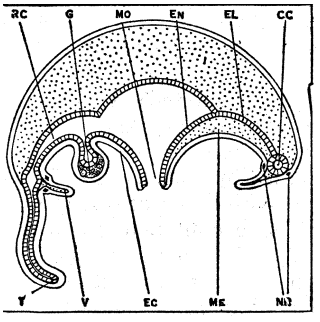
Structure.— The following is a description of the structure of a typical Hydroid, provided by the genus *Obelia* (fig. 2). *Obelia* begins its life, after the embryonic stages which succeed fertilization of the egg have transpired, as a single polyp, possessing a number of simple tentacles in a circlet around the base of its conical *peristome* or *manubrium.* The polyp sends out roots which attach it to the surface of a stone, the frond of a sea-weed, or other suitable support, and grows a stalk which raises it somewhat in the water. From this stem a bud arises from which, although it is at first a mere knob, a new polyp is gradually developed. This process of growth proceeds in a definite and regular manner, until a small tree-like colony, from less than an inch to several inches in height, is formed; the branches are definitely arranged, and all bear polyps. If one of the colonies be examined in detail, it will be found that each of the polyps possesses, outside its body, a little transparent cup of relatively stiff, horny material, into which it can withdraw when alarmed; and that not only are the polyps connected with each other by a stem composed of soft tissues, but the cups also are connected by a horny layer, outside the soft stem, which stiffens and supports the latter. The cups are known as *hydrotkecae,* the soft stem as *coenosarc,* and the horny layer (including stem and cups) as the *perisarc.* The new polyps develop only from the tips of a branch of coenosarc, and not from one another; and in a well developed colony it will be seen that some additional branches have grown out, mostly in the lower part of the colony, each of them similar in structure to a developing polyp, and usually regarded as representing one. These branches (known as *blastostyles)* do not develop a mouth and tentacles; instead each produces a number of buds which gradually develop into small medusae, and which are known as *medusoid buds.* The blastostyle, like an ordinary polyp or *hydranth,* has a covering of perisarc known as a *gonotheca,* but this is at first imperforate. In due course it becomes open at the end, and the medusae separate off from the blastostyle and swim away into the sea, where, after a period of free life, they produce eggs and sperms which, after fertilization, develop into new polyps.



FROM (LARGE FIGURE) DELAGZ AND HEROUARD "ZOOL. CONCRETE" (REINWALD) (COPR. BONNAIRE); (SMALL FIGURE) PARKER AND HASWELL, "TEXT BOOK OF ZOOLOGY" (MACMILLAN & CO.)

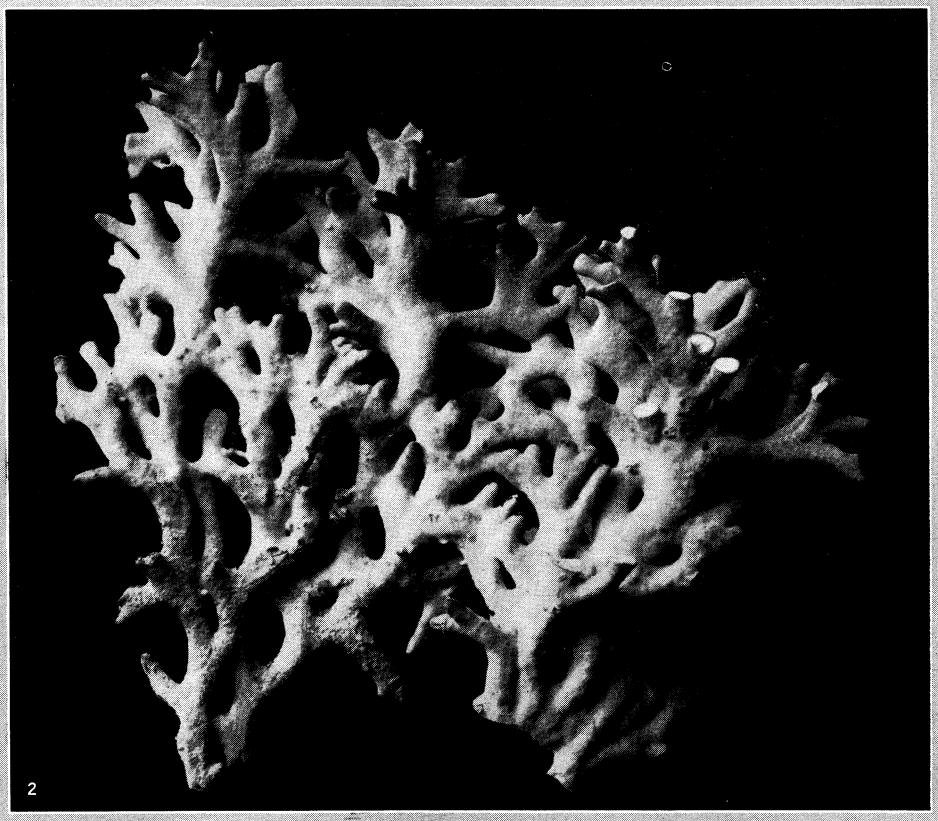
FIG. 2.—OBELIA (ENLARGED) SHOWING PART OF A COLONY OF THE POLYP GENERATION AND ALSO A MEDUSA. THE COLONY BEARS BOTH ORDINARY POLYPS AND BLASTOSTYLES, THE LATTER PRODUCING MEDUSOID BUDS

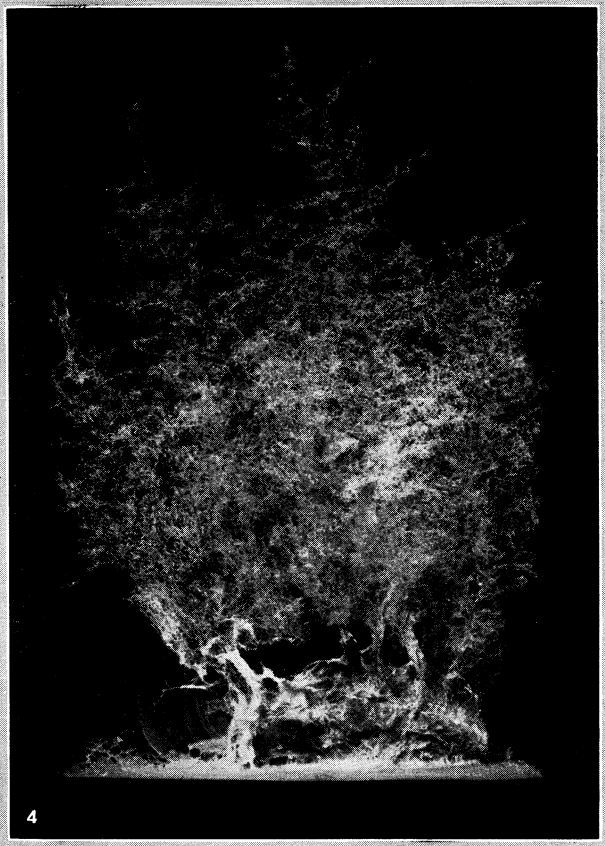
The structure of one of these fully developed medusae must now be considered in more detail (fig. 3). The body has the form of an umbrella, with a manubrium similar to that of a polyp hanging down inside it and bearing the mouth at its end. The manubrium is lined by endoderm, and contains a cavity, the main part of the coelenteron. The substance of the umbrella consists of mesogloea with ectoderm on both external surfaces; but the layer of mesogloea is penetrated. by four narrow tubes or canals. lined by endoderm, which run out from the base of the manubrium like the four arms of a cross. Connecting these *radial canals* with each other is a flat sheet of endoderm like a web *(endoderm lamella)* and also a *circular canal* which runs round the edge of the umbrella close to the bases of the tentacles. The latter are solid, both in medusa and polyp. At the edge of the bell, on the inner side of the ring of tentacles, is a little circular shelf (the *velum*) which projects inwards and slightly narrows the opening of the bell. Round the margin of the bell, at the bases of certain of the tentacles, lie the sense organs, minute sacs, formed by the ectoderm, and each containing a calcareous particle (the *statolith).* They are known as *sfatocysts* (fig. 5), and are eight in number, two being definitely placed in each of the quadrants between the radial canals; they probably initiate and control the swimming-contractions of the bell. The sex-cells of the medusa ripen in the ectoderm of four gonads which occur on the course of the four canals, and which, when ripe, shed their products into the sea. The fertilized eggs develop into new polyps



FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE" (DE GRUYTER)

FIG. 3.—DIAGRAM OF A VERTICAL SECTION THROUGH A MEDUSA
EC, ectoderm; EN, endoderm; G, gonad; ME, mesogloea; MO, mouth; CC, circular canal; NR, Inner and outer nerve rings; RC, radial canal; T, tentacle; V, velum; EL, Endodermai Lamella





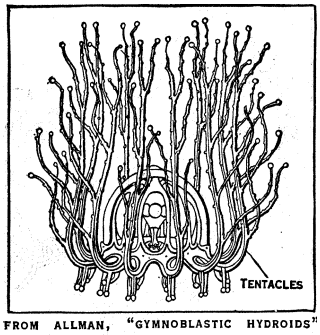
HYDROIDS AND HYDROID CORAL

1. *Aglaophenia,* showing featherlike form of the colonies which bear the minute polyps along the side branches
2. *Millepora, a* hydroid coral, bearing the polyps in minute tubular pits in the hard calcareous skeleton
3. Colonies of ***Pennaria,*** showing polyps borne on small lateral branches
4. Colonies of ***Obelia,*** showing complex tree-like branching

which initiate fresh colonies.

The story of *Obelia* is typical of the Hydroida, with modifications of one kind and another. In some cases the polyp-generation includes a single nutritive individual only, but usually it forms a colony. The form of the individual polyps and medusae, as also that of the colony, undergoes great modification however.

The polyps sometimes possess cups of perisarc as does *Obelia;* but often they are without these. Their tentacles are sometimes simple, sometimes knobbed at the tip or branched; sometimes arranged in one circlet, sometimes in two (one round the lip, one at the base of a conical manubrium), in other cases arranged irregularly over part or most of the surface of the polyp.

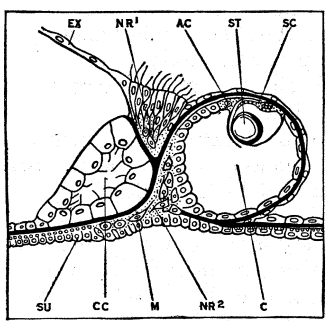


FROM ALLMAN, "GYMNOBLASTIC HYDROIDS" (COUNCIL OF THE RAY SOCIETY)

FIG. 4.—MEDUSA OF CLADONEMA (ENLARGED)

This is an example of a jellyfish with branched tentacles. The gonads here form swellings on the manubrium; and the medusa adheres to surfaces through knobs on the basal branches of its tentacles

The medusae vary even more than the polyps, both in shape and structure, and some idea of the diversity which occurs among them may be gained by reference to figs. 2–4 and 7–8. The shape of the bell may be shallow or almost flat, or on the other hand may be a high dome, and naturally varies with the movements of the animal. The number, arrangement and structure of the tentacles is widely various. The living medusae are some of the most beautiful of marine creatures. Their transparency, which is often touched with definite colour in given parts, and the regularity of their structure are responsible for this, and in some cases their movements also are extremely graceful. The sense organs vary from one kind of medusa to another. Statocysts are present in a number of cases, and these exhibit varying degrees of complexity of structure, with this in common to all of them—that the epithelium of the statolithic sac or pit (for the simplest of statocysts consist of an open pit) is derived from the ectoderm, and no endoderm takes part in its formation. Many medusae possess sense-organs of another nature, known as *ocelli,* and these are sensitive to light. In their simplest condition they consist of a clump of sensory cells mingled with pigment cells; but the more complicated ones possess a definite lens. These ocelli may be situated close to statocysts, but many medusae possess ocelli only, and others statocysts only. Another important variation in structure is, that in some medusae, as in *Obelia,* the gonads are situated on the radial canals; but in many others the sex-cells ripen instead on the manubrium.



FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE" (DE GRUYTER)

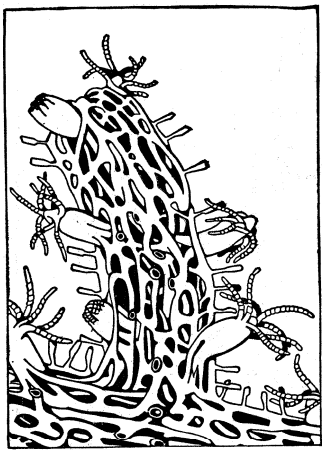
FIG. 5.—SECTION THROUGH A STATOCYST, MUCH ENLARGED

AC, sensory cell with sensory hair; C, statoiithic sac; CC, circular canal; EX, ex-umbrella; M, mesogloea; NR¹, outer nerve ring: NR², inner nerve ring; SC, statolithic cell; ST, statolith; SU, sub-umbrella

Colonies.—The next consideration must be that of the kinds of colonies which Hydroids construct. These colonies are frequently small and relatively soft, the horny perisarc giving a considerable amount of support, but not constituting a really rigid skeleton. Many such colonies are an inch or less in height, although colonies several inches long are common. Only rarely does the colony become actually large, but in a few cases it achieves a size and solidity which give it rank with the reef-forming corals; in these cases the skeleton is massive and calcareous, and is in fact "coral."

Hydroid colonies are roughly speaking of two kinds—mat-like and tree-like structures. The mat-like forms consist of a network of rootlets, attached to a stone, sea-weed or other support, from the upper surface of which arise the polyps. The network is sometimes straggling, sometimes compact, and may form *a* continuous sheet.- The tree-like forms are mostly delicate feathery structures, resembling rather the fronds of a finely divided sea-weed than any animal. The general aspect of some of them is shown in the accompanying Plate. The size of the whole colony, the exact way in which it branches, and the way in which one polyp after another is added upon a branch, affect the general appearance of the ultimate result. Sometimes the branches themselves are thick and are composed of a dense network of branching rootlets *(Clathrozoon,* fig. 6), the polyps projecting at the surface. This condition, which is achieved in a manner different from that which produces the average tree-like colony, leads on to the state of affairs found in the massive, limy colonies.

These massive forms deserve special mention. They have been considered in time past as a separate group of Hydrozoa, the *Hydrocorallina;* but it has become evident that they may be simply Hydroids with a more than usually solid skeleton, and that some of them are probably related to one series of Hydroid ancestors, others to a different series. A good example of these creatures is found in *Millepora.* This animal constructs a colony containing innumerable minute individual polyps, which are connected with each other by a continuous surface-sheet of ectoderm and by a network of ramifying tubular rootlets. The colony secretes a massive, limy skeleton which may become a foot or more in height, and which, though varying in form in different species, is often branched somewhat like the antlers of a stag, but in more compact fashion. The polyps inhabit little pits in the surface of the skeleton, and can retire into these completely when alarmed. The network of rootlets is lodged in a network of canals in the surface layers of the skeleton, the deeper parts consisting of coral only and containing no soft parts; this internal portion was secreted by the soft parts originally, but as growth proceeded and further skeleton was formed, these retired to the surface-layers. One can imagine that a similar state of affairs would be produced if a colony such as that of *Clathrozoon* were to secrete limy material into the meshes between its network of rootlets. *Millepora* is extraordinarily interesting in one respect. When the time comes for sexual medusae to be produced by the colony, these are not formed from buds as in *Obelia* and other Hydroids. Instead the sex-cells, which are migratory, move from the rootlets into one or other of the polyps. Each polyp so affected loses under their influence its characteristic structure, and becomes transformed by degrees into a medusa. The pit surrounding it enlarges and becomes closed in, so that it forms a cavity cut off from the outer world, and until the medusa is ready to escape it remains so; finally the cavity opens again and the medusa comes out. It is a weak swimmer and cannot feed; it swims a very little distance before shedding its ripe eggs or spermatozoa, the union of which gives rise to a polyp so that the life-cycle begins once more.



FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE" (DE GRUYTER)

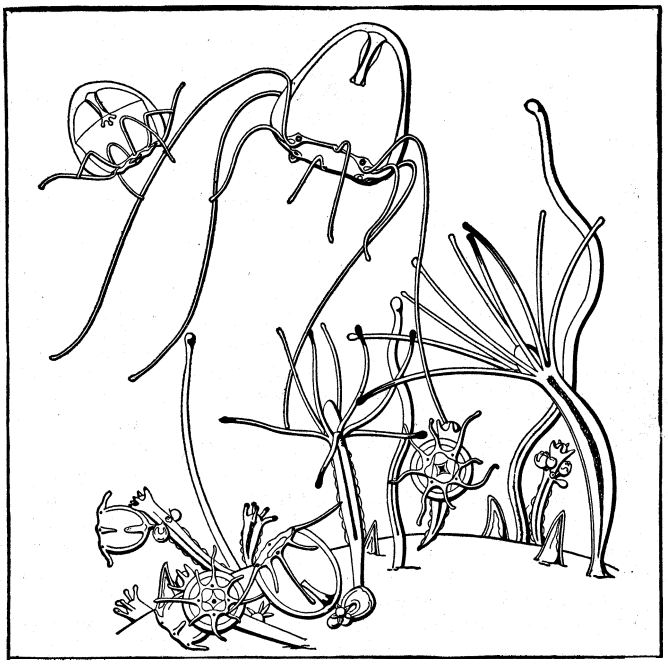
FIG. 6.—**PART OF A** COLONY OF **CLATHROZOON**

Diversities Exhibited by the Polyps and Medusae.—We may now pass on to some of the interesting diversities which the polyps and medusae exhibit. To begin with, in certain colonies, such as those of *Millepora* and *Hydractinia* (fig. 7), the hydranths are not all alike. Some of them *(gastrozooids)* possess mouths as well as tentacles, and inside these polyps digestion of food takes place. Other polyps on the contrary possess no mouths, but may have tentacles and are well provided with stinging capsules such as are described in the article COELENTERATA. These polyps themselves cannot feed, but they play a defensive part in the colony and assist the others in the capture and paralysing of food; they are known as *dactylozooids.* This is

a simple example of the phenomenon of polymorphism, which has been previously mentioned and which will be further discussed later. It is carried to greater lengths in *Hydractinia* than in *Millepora,* since in this case the colony produces also *blastostyles* similar in principle to those of *Obelia.* These may be regarded as modified polyps with a body but without mouth or tentacles, which produce sexual buds. Therefore a Hydractinia colony possesses four kinds of individuals — gastrozooids, dactylozooids, blastostyles and sexual buds.

To turn to the medusae, we find here a most curious state of affairs. To begin with, medusae may arise from blastostyles or direct from ordinary polyps; and the blastostyles may arise from the root or stem of a colony or from a polyp itself. Moreover, a medusa may itself bud off others from its manubrium, or from its tentacle-bases or other parts. The most remarkable fact connected with the medusae, however, is that despite the fact that a medusa is obviously an advantageous development, in that it can swim away and spread the eggs and spermatozoa over an area vastly wider than they could otherwise reach, there is yet a strong tendency among the Hydroida toward a condition in which the medusa not only remains permanently attached to the colony whence it sprang, but also becomes much reduced and simplified in structure. A series of medusae can be traced, in which at one end there is found the fully formed free-swimming jellyfish, at the other end a degenerate sac-like structure, devoid of any medusa-like features, and resembling the gonad of an active medusa, such as that of *Obelia.* This degenerate formation, which remains attached to the colony, is known as a *sporosac,* and consists of a layer of ectoderm containing or covering the sex-cells, and surrounding an endodermal core. Between these two extremes all intermediate stages may be found.

It has been considered by some authors that the sporosacs represent, not a reduced but a primitive condition, and that the other stages are to be regarded as developments leading up to the fully formed medusa. This would seem reasonable from the

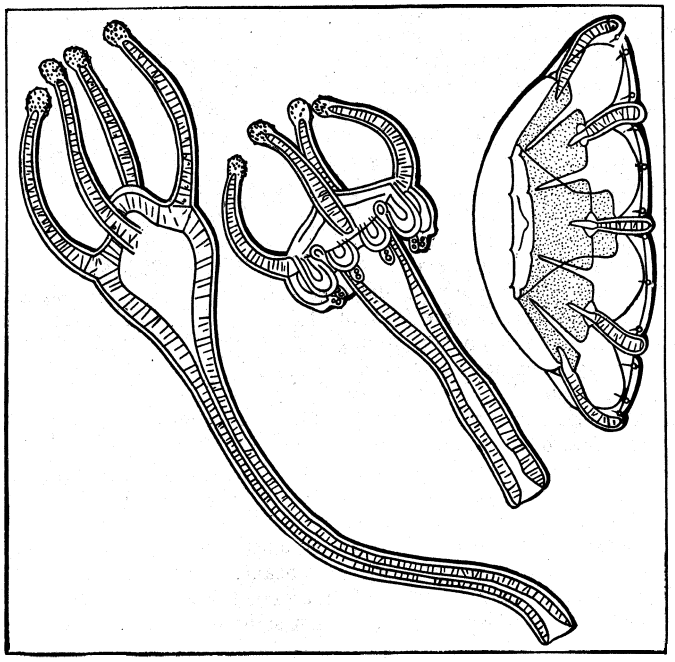


FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE" (DE GRUYTER)

FIG. 7.—PART OF A COLONY OF HYDRACTINIA (ENLARGED), SHOWING GASTROZOOIDS, DACTYLOZOOIDS, BLASTOSTYLES AND MEDUSOID BUDS, AS WELL AS FREE MEDUSAE

point of view that the roving medusa is 'an obvious gain to a fixed colony; but the facts of the case do not seem to support it. From the structure and mode of occurrence of the various grades of medusae, and from the fact that in the development of certain of the reduced forms, medusoid features appear for a time and are subsequently lost, it is judged that they are not primitive but degenerate. The precocious development of the sex-cells may be the factor which leads to the reduction of the medusae; the gain being increased fertility.

The Coelenterata are singularly free from parasitic members. Of the few that are known, one is particularly interesting. This is *Hydrichthys boycei,* a species referred to the Hydroida but which may be an unusual siphonophore. The colony is one of the mat-like kind, and the mat, instead of being affixed to a stone or weed,



FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE" (DE GRUYTER)

FIG. 8.— STAGES IN THE DEVELOPMENT OF A TRACHYLINE (MUCH ENLARGED)

The figures show the direct transformation of a polyp-like larva, with a long proboscis, into a medusa

is attached to the fins or body of a fish. The underside of it sends roots into the integuments of the fish, and under its growing edge are cells which are able to destroy the surface of the fish's skin and expose the vascular layer beneath. The polyps, which have no tentacles, bend down over the edge of the mat, apply their mouths to the wound made by the latter, and obtain blood from the vessels of the fish. Another parasite, better known than *Hydrichthys,* is *Polypodium;* this is parasitic at one stage of its life in the eggs of a sturgeon, which it destroys.

Classification. — The classification of the Hydroida is instructive, though as yet imperfect. 'The connection between medusae and polyps was at first not understood by naturalists, since it could not be deduced from observation of one of these types only, without a study of the whole life history. Even now there are polyps and medusae which have not yet been linked on to their corresponding alternative form. Consequently a double classification has grown up, dealing with the two sets independently, and the two systems can be correlated with each other so far as the inter-connections are known.

The polyps are divided into: —

1. Gymnoblastea. Here the polyps are not enclosed in cups of perisarc (hydrothecae), nor are the blastostyles enclosed in gonothecae.
2. Calyptoblastea. Here the polyps possess hydrothecae and the blastostyles gonothecae.

The medusae are classified as follows: —

1. Anthomedusae. Medusae in which there are no statocysts (though there are usually ocelli) and in which the gonads develop on the manubrium. These are the medusae belonging to the Gymnoblastic polyp-generation.
2. Leptomedusae. Medusae in which there are typically statocysts and sometimes ocelli, and in which the gonads are arranged on the radial canals. These medusae belong to the Calyptoblastic polyp-generation.

In the above scheme *Hydra* and its relatives would be considered Gyrnnoblasts by some authors, by others they would be placed in an independent group, the *Hydrida.*

ORDER II. TRACHYLINA

The Trachylina are an assemblage of Hydrozoa which differ sufficiently from any of the Hydroida or Siphonophora to warrant their inclusion in a separate group.

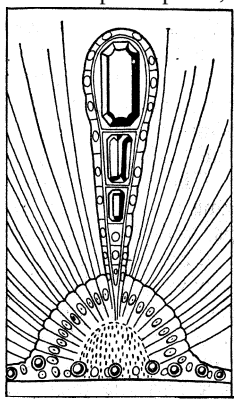
Among the Trachylina the medusa is the dominant form, and many reach a considerable size (*e.g.*, 10 x 3cm.). In accordance with this fact the Trachylina are mostly oceanic forms, pelagic throughout life; whilst the Hydroida are tethered, so far as their polyp-generation is concerned, to the bottom or to sea-weed, and include many characteristic shore-forms. The cleavage of the fertilized egg of the Trachylina typically produces a planula (see COELENTERATA), which develops into a more or less distinctly polyp-like larva; the latter is transformed directly into a medusa (fig. 8). In certain forms (Cuninidae) the polyp-larva is parasitic within medusae of its own or other kinds. In such cases it reproduces by budding, and both the parent and daughter polyps become transformed into medusae; or, the larva may form a stolon from which medusae are budded.

Beyond the facts thus outlined the Trachylina contribute little of general interest to the study of the Coelenterata, although their structure and life-histories are in themselves extremely interesting. For this reason they are dealt with very briefly here, and the only part of their structure calling for further mention is that of the sense organs. Ocelli (eye-spots) are rare amongst them, but all possess organs containing statoliths. These are of a different grade from those of the Hydroida, in that they exhibit the structure, not of ectodermal pits or sacs containing statoliths, but of small tentacles containing an endodermal core in which lie one or more statoliths, and covered by ectoderm. These modified tentacles are known as tentaculocysts (fig. g), and they may, like tentacles, project freely at the surface, or may themselves become embedded in a pit or sac formed by the surrounding tissues.

ORDER III. SIPHONOPHORA

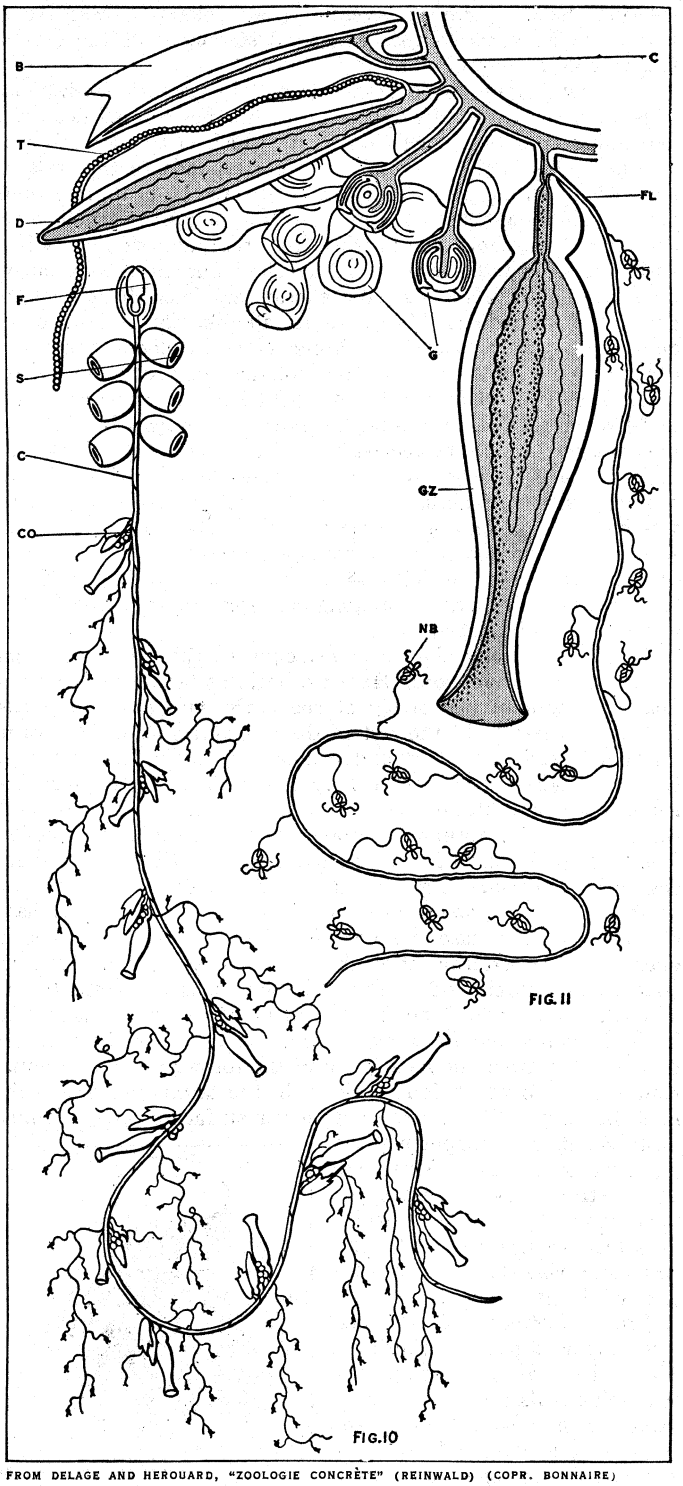
The Siphonophora constitute one of the most interesting groups of the animal kingdom, since they illustrate the lengths to which an organism may go in the direction of stringing together a number of different kinds of individuals in a single chain. In scientific terminology they exhibit at its height the phenomenon of polymorphism.

The Siphonophora, unlike the Hydroida, are essentially pelagic animals: they are exclusively marine, and most characteristic of warm seas. They one and all form colonies, but the colony is unattached and either floats or swims. It produces sexual medusae comparable to those of a hydroid, and these may or may not be set free from the colony; consequently there may be an alternation of generations, both pelagic, or the medusa-generation may never gain independent existence. There is however this difference from the state of affairs among the Hydroida, that a medusa which is set free as such is an exception, and that it has never the full structure of a Hydroid medusa, possessing no mouth or sense-organs. Most siphonophore medusae remain attached to the colony or to a segment of it, and many of them exhibit grades of reduction in structure. These are known as gonophores, but they are never as degenerate as a Hydroid sporosac. From the eggs produced by the medusae or gonophores a planula larva of a curious type develops, and this by budding produces a colony. The siphonophore contrasts with a trachyline in that it is here the colony, and not the sexual medusa, which is the dominant form; and in addition to this a new factor is introduced which is not found either in the Trachylina or in the Hydroida. This is the production by the colony not only of more than one kind of polyp (as in *Hydractinia*) but also of more than one kind of medusa. In addition to the sexual medusae corresponding to the sole medusa-form in the other groups, there are found here medusae of modified structure which neither feed nor produce gonads, but which act as swimming-bells for the whole colony; and other structures which are also probably modified medusae. Of these latter one is a medusa transformed into a gas-containing float.



FROM PARKER AND HASWELL, "TEXT-BOOK OF ZOOLOGY" (MACMILLAN & CO LTD.)

FIG. 9.—ENLARGED VIEW OF A TENTACULOCYST In the endodermal core of this organ statoliths are visible. The tentaculocyst is mounted on a prominence from which rise long sensory hairs



FROM DELAGE AND HEROUARD, "ZOOLOGIE CONCRÈTE" (REINWALD) (COPR. BONNAIRE)

FIG. 10.—THE STRUCTURE OF A STRING-LIKE SIPHONOPHORE COLONY.
FIG. 11.—TYPES OF INDIVIDUALS TO BE FOUND IN A TYPICAL SIPHONOPHORE CLUSTER

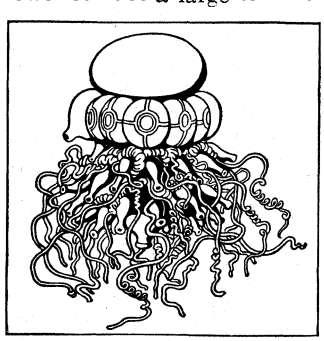
B, bract; C, coenosarc; CO, cormidium; D, dactylozooid; F, float; FL, tentacle of gastrozooid; G, bunch of gonophores; GZ, gastrozooid; NB, battery of sting cells; S, swimming-bell; T, tentacle of dactylozooid

Structure of Colonies. — It will be impossible to understand or to visualize the siphonophore organization, without first con-

sidering the structure of several typical colonies; these are so diverse in constitution that a general statement at the present stage would be unprofitable.

The first colony to be described will be that of *Halistemma* (figs. 10 and 11). At the upper end of this lies a small float, and depending from it a long thin string which is tubular and contractile. This is the *coenosarc* and corresponds to the stalk of an *Obelia.* Arranged on the string just below the float are a number of swimming-bells; each of these is a medusa attached to the coenosarc by a short stem arising from the outer side of its bell, and possessing radial canals and a velum but no manubrium or mouth. At intervals along the coenosarc are found little knots or clusters of individuals. These are not all alike, larger and smaller ones alternating regularly. Each cluster *(cormidium)* contains a certain number of individuals, but not the same selection in each case. The types of individuals comprised in the whole series are leaf-like protective structures, the *bracts,* together with digestive polyps *(gastrozooids)* each with a mouth and with a single tentacle which is attached to it at the base; other polyps *(dactylozooids)* with no mouths, each with a single tentacle at its base, which act as feelers and stingers; and lastly *blastostyles* upon which male and female gonophores are produced. The tentacles of the gastrozooids, which act as fishing-lines, are branched, the branches bearing terminal stinging-batteries; those of the dactyloeooids are unbranched

A type of colony similar in principle to that of *Halistemma* is formed by *Physophora.* Here we begin as before with a small float bearing a tubular string of coenosarc with swimming-bells. But below these bells, the rest of the coenosarc, instead of forming a long string, is short and compact, with the result that all the other individuals of the colony (which include dactylozooids, gastrozooids and blastostyles) are concentrated into a group with the dactylozooids forming a protective circlet round the outside. The same principle is further exemplified in a still more modified degree by *Stephalia* (fig. 12), in which the same essentials are present but the proportions and shapes of all the parts have changed. In this case the float is large and prominent and it opens to the exterior through a special spout-like structure (*aurophore*) at one side. The swimming-bells are restricted to a single circle below the float, instead of being strung out as in *Halistemma* and *Physophora,* and the coenosarc bearing the cormidia is neither the long string of the former nor the insignificant vesicle to which it is reduced in the latter, but is a bulky mass bearing in the middle of its lower surface a large terminal gastrozooid, and supporting the cormidia on its sides. This mass is penetrated by a number of tubes lined by endoderm, which run into each other and communicate with the digestive cavities of the gastrozooids.

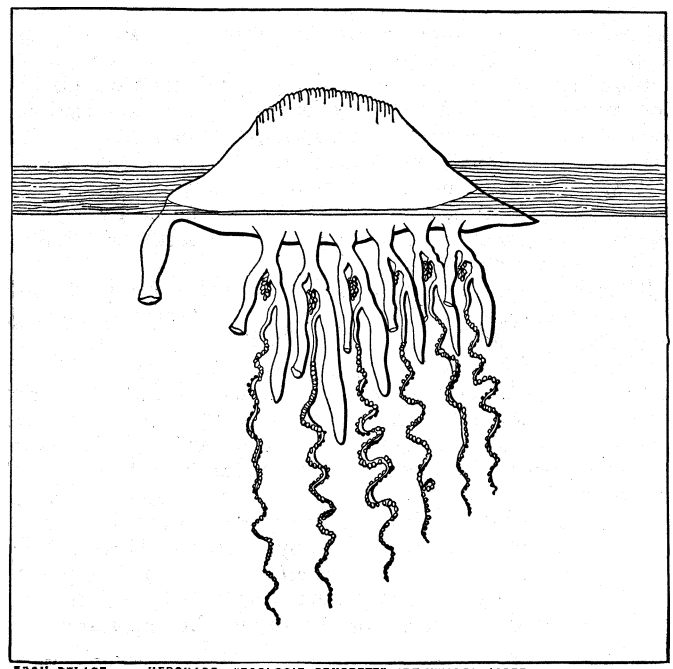


FROM E. RAY LANKESTER, "TREATISE ON ZOOLOGY," BY PERMISSION A & C BLACK

FIG. 12.—COLONY OF STEPHALIA
The swimming-bells are restricted to a single circle and not strung out as in *Halistemma* and *Physophora*

From *Stephalia* to *Physalia* (fig. 13) is a natural transition. Here there are no longer any swimming-bells, but there is a large crested float opening to the outside by a pore, and bearing a gastrozooid at one end. In a young *Physalia* the underside of the float bears directly half a dozen cormidia, each containing a gastrozooid without a tentacle, a dactylozooid with a long unbranched fishing-line, and a branching blastostyle bearing small dactylozooids upon it, and also male and female gonophores. As the colony increases in size new individuals are added somewhat irregularly upon the stalks of the old, and the simple early arrangement is lost. The colours of *Physalia* (blue, orange, etc.) are of great brilliance, and it is a well-known denizen of the Atlantic, Pacific and Indian Oceans, often occurring in fleets, and commonly known as "Portuguese Man-of-War." One of its fishing-lines reaches a greater length than all the others, attaining more than a yard; and the stinging powers of these lines are extremely powerful, producing serious conditions after contact with them even in man. The colony is not bound to float at the surface; it can deflate the float and sink, reforming the gas within it and so rising once more, within a quarter of an hour.

A colony quite unlike any so far described is formed by *Velella.* Here the whole organism has the aspect at first sight of a single flat medusa bearing a sail on its upper side and tentacles round its margin (fig. 14). On closer examination it is found, however, that the apparent tentacles are really a circle of long dactylozooids, and that the underside of the disc-like colony is covered by a number of curious blastostyles which, unlike an average blastostyle, possess mouths. In the centre of these is a single large gastrozooid, the only one which the colony possesses. The disc-like portion of the animal to which all these polyps are attached is complex in structure. It is thick and contains below the skin-layers of its upper side an internal horny float, below which is a mass of soft tissue, a concentrated coenosarc. The float is itself flattened in shape, is subdivided into chambers, bears a vertical extension in the centre stiffening the "sail," and is prolonged into the soft tissues as fine *air-tubes.* The coenosarc contains a ramifying system of endodermal tubules, in communication with the cavities of the various polyps, which is probably both absorptive and excretory in function. The coenosarc also contains a massive concentration of nematocysts, doubtless a nursery whence they migrate when sufficiently developed into the parts where they can function. Very similar to *Velella* but without a sail, is *Porpita.* In these creatures we have reached a stage in which the colony has become so compact and the parts so markedly subordinated to the whole that their interrelation resembles rather that of organs than that of independent beings; but free medusae are liberated by the colony.



FROM DELAGE AND HEROUARD, "ZOOLOGIE CONCRETE" (REINWALD) (COPR BONNAIRE)

FIG. 13.— DIAGRAM OF A YOUNG COLONY OF PHYSALIA
From the crested float depend several cormidia. At the left end of the colony is a single large gastrozooid

Finally it may be mentioned that there are a number of siphonophore colonies which differ from any so far mentioned in that they possess swimming-bells but no float.

We may now summarize the state of affairs in this very curious group of animals. In the course of the above descriptions mention has been made of a number of structures — gastrozooids, blastostyles, dactylozooids; swimming-bells, floats, bracts; and sexual medusae (fig. 11). It remains to comment on the status of these various entities. Continuing the view which is taken throughout the articles on Coelenterata in this Encyclopædia, most or all of these structures represent individuals, modifications

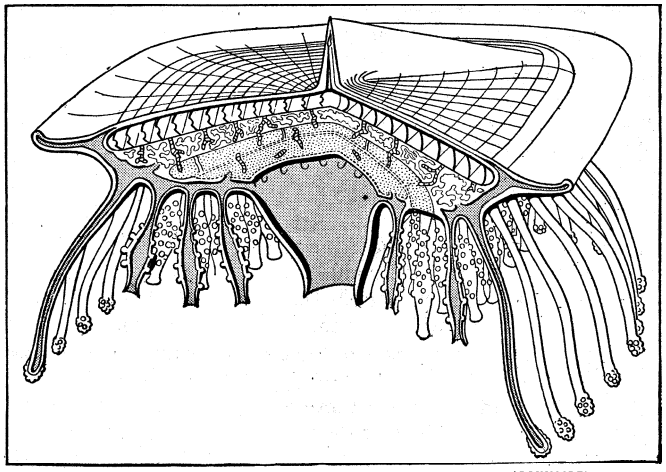
of either the polyp or the medusa form of body, or independently developed entities of equivalent standing. The gastrozooids and dactylozooids are varieties of polyp, the sexual medusae, the swimming-bells and probably the bracts are modifications of medusae. The float is sometimes regarded as the invaginated upper end of the stem of coenosarc and sometimes as a modification of a medusa. The status of the blastostyles is uncertain; they represent polyps in *I'elella,* in other cases they are perhaps the present day substitute for bygone polyps.

It should be mentioned in conclusion that the Siphonophore is regarded by Moser not as a colony of individuals but as an individual animal with division of labour between organs and "on the way to alternation of generations and to colony-formation"; and that the medusae of *Velella* are regarded by this author as free-swimming gonophores leading up to true sexual medusae. The work of Moser has thrown considerable light on the morphology and the development of the Siphonophora and has made clearer than formerly the homologies of parts throughout the group, especially that of the float, which may fairly be regarded as equivalent to the apical adult bell of the forms with no float. This work also forms a valuable contribution to the question of evolution within the Siphonophora, but in the view of the present writer it hardly establishes the claim that a siphonophore is an individual animal *(see* also the following section on Polymorphism).

POLYMORPHISM

In the articles COELENTERATA and ANTHOZOA, and in the accounts of the groups of Hydrozoa already dealt with in the present article, references will be found to the phenomena known as *polymorphism* and *alternation of generations (metagenesis).* Since these phenomena are aspects of one and the same thing and are of general interest and importance, a summary of the subject is indicated. In the following remarks it is taken for granted that the articles above mentioned are familiar to the reader.

Firstly it must be made clear that alternation of generations as found in *Obelia* is simply an example of polymorphism, which may be defined as the ability of a single species of animal to exist



FROM PELAGE AND HEROUARD, "ZOOLOGIE CONCRETE" (REINWALD) (BONNAIRE)

FIG. 14.— DIAGRAM ILLUSTRATING THE STRUCTURE OF VELELLA

A sector of the disc-shaped coenosarc has been cut away so as to reveal the internal structure

under more than one form—in this instance as polyp and medusa. In a clear-cut case of alternation of generations one of these forms is sexual and *succeeds* the alternative non-sexual form, the two co-existing on a single colony only for the period during which the medusae are developing from buds. It may be noted that some writers no longer regard the polyp and medusa as alternate ('generations," but the polyp as a persistent larva and the medusa as the adult. This view has its difficulties, however, and for purposes of the present argument the older terminology is retained. In any case the polyp phase is very persistent and has the general status of an adult organism.

The other type of polymorphism is that which is exhibited by such colonies as *Hydractinia* and in far higher degree by the Siphonophora, and in which there is not only the distinction of individuals into sexual and nonsexual forms, but the nonsexual polyps are themselves divided into kinds (gastrozooids, dactylozooids, etc.). This is exemplified even in *Obelia* by the distinction of the polyps into hydranths and blastostyles. In the Siphonophora there is the additional development that here there exist nonsexual as well as sexual medusae, and probably more than one kind of these (swimming bells, bracts and float).

In other words there exists: *(a)* a differentiation into sexual and nonsexual forms and *(b)* a division of labour between the nonsexual forms by virtue of which they become, for practical purposes, reduced to the condition of organs.

It must be noted, however, that the sexual forms tend to lose their independence; and the separate free-swimming generation so obvious in *Obelia* and similar forms becomes at the other end of the series a degenerate sporosac attached to the colony as permanently as any nonsexual individual. In fact it has become a sex-organ or gonad, and "alternation of generations" has been transformed into "division of labour."

Interesting divergences from the ordinary kinds of polymorphism typical of the Hydroida and Siphonophora are found among the Trachylina, Scyphozoa and in forms such as *Millepora.* In *Millepora* a polyp, be it a gastrozooid or a dactylozooid, becomes directly transformed under the influence of the immigrating sex cells into a medusa, instead of the medusa being formed from an independent bud. The polyp is a changeling. In the Trachylina the same process takes place, but in this case it is a pelagic or parasitic larval polyp which turns into a jellyfish, not an adult member of a colony. Among the Scyphozoa a unique condition exists; here the alternation of generations is very marked, and the medusa arises from the polyp direct; but in this case the polyp divides itself transversely into a series of superimposed saucer-like sections, which separate from it one by one, each becoming a medusa. A single polyp has therefore produced not one but several medusae. This is partly paralleled by a blastostyle; for if the latter be a polyp, it produces by *budding,* several medusae; but the scyphozoan polyp achieves the same end quite differently.

The Anthozoa are the least interesting of the Coelenterata from the point of view of polymorphism. They possess no medusoid form and among their polyps little polymorphic variation in form occurs. In, certain colonial forms ordinary polyps and siphonozooids co-exist, and there is also a distinction in some colonies between an original axial polyp and those subsequently formed. In the coral *Fungia* part of the life cycle in some respects resembles the strobilization of the Scyphozoa.

Polymorphism is chiefly interesting as an example of the extraordinary ability of animals to produce an almost infinite number of variations upon a given theme. It has also been much employed as a subject for argument, however. The argument frequently adopted has been that a siphonophore or a compound Hydroid is a *colony* and that its parts represent, morphologically speaking, *individuals* connected by a common intermediate tissue. the coenosarc. This view may appear to be far-fetched when one contemplates a sporosac, which is in effect a gonad, since it involves the claim that this structure represents not an organ but an animal. It is also true that in some cases, such as those of meandrine corals, it is difficult to decide whether a polyp with a dozen mouths represents one polyp or twelve. But taking the whole story, as presented to us throughout the Coelenterate series, as a unity, the interpretation of the systems encountered as colonies of individuals appears to be the soundest working hypothesis. The alternative view, that everything which results from the development of a single egg is an individual animal, however much it may subdivide asexually, and that gastrozooids, bracts and the rest are nothing more than the organs of this animal, seems relatively satisfactory when applied to such a form as the adult *I'elella.* But when one applies it to a free-swimming medusa it becomes reduced to an absurdity—is a jellyfish, an organism provided with mouth and stomach, canals, velum, tentacles and sense organs. simply a moving *organ* and not an animal at all? Further one may meet on many shores hosts of sea anemones. none of which have developed from eggs—each is an independent organism. not

part of a colony, and each has been produced asexually by fission. Are these anemones then "organs"? To reduce the term "organ" to such a level is to remove its actual meaning. Moser combines the two theories by regarding the Coelenterata other than Siphonophora as colonies of individuals, but the Siphonophora themselves as relatively primitive organisms, individuals comprising organs and the forerunners of true colonies.

In this connection it should however be noted that in the above paragraphs the term "individual" has been used in a purely morphological sense—*i.e.*, the individuals of a Siphonophore represent morphological individuals which have suffered a loss of independence similar to that of the component cells of any multicellular animal, which latter may be regarded as having been derived originally from a colony of individual single-celled animals (protozoa). In a physiological sense on the other hand the Siphonophore colony is a unity and may be regarded as an individual system. The status of such a system in relation to the wide general question of individuality is discussed in INDIVIDUALITY, BIOLOGICAL.

BIBLIOGRAPHY.—See bibliography **to** article COELENTERATA; see also Kükenthal's Handbuch der Zoologie, vol. i (1923–25); F. Payne, "A Study of the Freshwater Medusa, Craspedacusta Ryderi," J. *Morph.*, vol. xxxviii, p. 387 (1924); E. Haeckel, *"Challenger" Reports,* Zool., vol. xxviii (1888); G. J. Allman, *Gymnoblastic* or *Tubularian Hydroids,* Ray Society (1871). (T. A. S.)

HYENA, the name applied to members of the family Hyaenidae, a group of Carnivora (see CARNIVORE) distinguished by the four toes on each foot, the comparative length of the forelegs, the nonretractile claws, and the enormous strength of the jaws and teeth, enabling them to crush hard bones. Three species are known; two belong to the genus Hyaena, while the other is Crocuta.

The striped hyena (H. striata) has the widest distribution, being found in India, Persia, Asia Minor, North and East Africa. About the size of a wolf, the animal is grayish-brown in colour, marked with indistinct longitudinal stripes of a darker hue. There is a mane along the neck and back. The animal is nocturnal in habits and has an unearthly cry, aptly compared to demoniac laughter. It feeds mainly on carrion, but occasionally carries off sheep, goats and dogs. It is a solitary and cowardly animal.

The brown hyena (H. *brunnea*) is South African, and about the size of the striped species. It is ashy brown in colour, with a lighter collar, chest and belly. The spotted form (C. crocuta) ranges from Abyssinia to the Cape, and is yellowish-brown, with darker spots. Both spotted and striped hyenas have been found fossilized in the Pliocene of Europe.

HYÈRES, a town in the *département* of the Var in S.E. France, 11 mi. by rail E. of Toulon. Pop. (1954) 15,649. The town of Hyères was founded in the 10th century, as a place of defense against pirates, and takes its name from the *aires* (hierbo in the Provencal dialect), or threshing-floors for corn, which then occupied its site. It passed from the possession of the viscounts of Marseille to Charles of Anjou, count of Provence. The château on the summit of the hill was dismantled by Henri IV, but the town resisted in 1707 an attack made by the duke of Savoy. Hyères is celebrated (as is also its fashionable suburb, Costebelle, nearer the seashore) as a winter health resort. The town is situated about 23 mi. from the seashore on the sheltered southwestern slope of a steep hill (669 ft. of the Maurettes chain) but is exposed to the Mistral. To the southwest, across a narrow valley, is the suburb of Costebelle. The older portion of the town is surrounded, on the north and east, by remnants of its mediaeval walls, and has steep and dirty streets. The more modern quarter has broad boulevards and villas, with gardens, filled with semitropical plants. The parish church of St. Louis was built originally in the 13th century by Franciscan friars, and restored in the 19th century. The plain between the new town and the sea has large nurseries, an excellent *jardin* d'acclimatation and many market gardens, which supply Paris and London with early fruits and vegetables, especially artichokes and roses in winter.

HYGIEIA, in Greek mythology, the goddess of health. The oldest traces of her cult, so far as is known at present, are to be **found** at Titane in the territory of Sicyon, where she was **worshipped** together with Asclepius, to whom she appears completely assimilated, not an independent personality.

Her cult was not introduced at Epidaurus until a late date, and therefore, when in 420 B.C. the worship of Asclepius was introduced at Athens coupled with that of Hygieia, it is not to be inferred that she accompanied him from Epidaurus, or that she is a Peloponnesian importation at all, but rather a new invention, an offshoot of the already existing worship of Athena Hygieia. At first no special relationship existed between Asclepius and Hygieia, but gradually she came to be regarded as his daughter, the place of his wife being already secured by Epione. Later Orphic hymns, however, and Herodas, iv, 1–9, make her the wife of Asclepius. The cult of Hygieia then spread concurrently with that of Asclepius, and was introduced at Rome from Epidaurus in 293, when she was gradually identified with Salus (*q.v.*). While in classical time Asclepius and Hygieia are simply the god and goddess of health, in the declining years of paganism they are protecting divinities.

VOTIVE RELIEF FOR AN AESCULAPIUM, OR TEMPLE OF AESCULAPIUS; GREEK SCHOOL. EARLY 4TH CENTURY, B.C.; ORIGINAL IN NATIONAL MUSEUM AT ATHENS

See H. Lechat in Daremberg and Saglio's *Dictionnaire* des *antiquités,* and E. Thramer in Roscher's *Lexikon* der Mythologie.

HYGIENE, the science of preserving health. The subject embraces all agencies affecting the physical and mental well-being of man, and requires acquaintance with physics, chemistry, geology, engineering, architecture, meteorology, epidemiology, bacteriology and statistics.

On the personal side it involves consideration of food, water and other beverages; clothing; work, exercise and sleep; personal cleanliness, special habits, such as the use of tobacco, narcotics, etc.; and control of sexual and other passions. In its public aspect it deals with climate; soil; character, materials and arrangement of dwellings; heating and ventilation; removal of waste matters; medical knowledge on incidence and prevention of disease; and disposal of the dead.

These topics are treated in such articles as BACTERIOLOGY; CREMATION; DIET AND DIETETICS; FOOD PRESERVATION; HEALTH AND SAFETY LAWS; HEATING AND VENTILATION; HOUSING; INDUSTRIAL MEDICINE; MATERNAL AND CHILD HEALTH; PSYCHIATRY; SEWER CONSTRUCTION; SOCIAL HYGIENE; WATER; etc. See also PREVENTIVE MEDICINE; PUBLIC HEALTH.

HYGINUS, SAINT (d. c. 140), eighth pope after Peter. It was during his pontificate (c. 136–140) that the gnostic heresies (see GNOSTICISM) began to appear in Rome.

HYGINUS, GAIUS JULIUS (fl. c. 25 B.C.), Latin author and scholar who, according to Suetonius (De Grammaticis, 20), was appointed by Augustus superintendent of the Palatine library. He went to Rome from Spain or Alexandria as a slave or perhaps a prisoner of war and was freed by Augustus.

He was a pupil of the learned Cornelius Alexander Polyhistor and a friend of Ovid. Of his numerous works, including topographical and biographical treatises, commentaries on Helvius Cinna and the poems of Virgil, and disquisitions on agriculture and beekeeping, nothing has survived.

Two works incorrectly attributed to Hyginus, however, are extant: (1) Fabulae or Genealogiae (ed. by H. J. Rose, with commentary, 1934), about 300 mythological legends and celestial genealogies, valuable for the use made by the author of the works of Greek tragedians since lost; (2) De Astronornia, usually called *Poetica* Astronomica (ed. by B. Bunte, 1875), an elementary treatise on astronomy and the myths connected with the stars, derived chiefly from Eratosthenes (*q.v.*). Although the Fabulae are in an abridged form with later accretions, there is some evidence that both works are by the same hand, but the style and the elementary mistakes (especially in the rendering of the Greek originals) are held to prove that they cannot have been the work of so distinguished a scholar as Hyginus; nor can they have been by another Hyginus of Trajan's time, who wrote only on land tenure and kindred subjects. Both probably belong to the 2nd century A.D.

See H. J. Rose, ***A Handbook of Latin Literature, (1936).***

HYGROMETER, an instrument for determining the humidity of the atmosphere (Gr. hygros, "wet"; metron, "a measure"). These instruments can be classed according to the method employed for detecting moisture, namely: (1) evaporation, the most common instrument consisting of two thermometers mounted together, one of which has a wet cloth sleeve over its bulb. The less humid the air, the greater the evaporation from the wet bulb and the greater the difference in reading between it and the standard (dry-bulb) thermometer; (2) dew point apparatus, making use of cooling devices to cause the water vapour to condense from the air and measuring the temperature at which the condensation occurs; (3) hair or strips of goldbeater's skin (ox gut), making use of the principle that these organic substances will increase in length as the relative humidity is increased; (4) chemical absorption, making use of chemical drying agents which extract the moisture from the air, and the increased weight of the dryer noted; (5) electrical. making use of the principle that changes in the electrical resistance of a chemically treated coil of wire can be related to changes of relative humidity. See HUMIDITY, ATMOSPHERIC.

(B. G. H.)

HYKSOS or "SHEPHERD KINGS," the name of the earliest invaders of Egypt. Josephus (c. *Apion.* i, 14), who identifies the Hyksos with the Israelites, preserves an account of them from bk. ii of Manetho. According to it, in the days of King Timaeus, Egypt was invaded from the east by a destructive band who elected a king named Salatis. He made all Egypt tributary and established garrisons and fortresses in various parts of the country. His successors Beon, Apachnas, Apophis, Jannas and Asses reigned c. 199 years, and all aimed at extirpating the Egyptians. Their race was named Hyksos; *i.e.*, "shepherd kings," and some say they were Arabs (another explanation found by Josephus is "captive shepherds"). When their successors had held Egypt for 511 years, a rebellion began at Thebes. Misphragmuthosis confined the "Shepherds" in Avaris; and his son Thutmosis, failing to capture the stronghold, allowed them to depart; uhereupon they established themselves, 240,000 in number, in Judea and built Jerusalem. In Manetho's list of kings, the six above named form the 15th dynasty and are called "six foreign Phoenician kings." The 16th dynasty is made up of 32 "Hellenic shepherd kings." the 17th is of "shepherds and Theban kings" (reigning simultaneously). The lists vary greatly in different versions, but the above seems the most reasonable selection of readings. For "Hellenic" see below. In 1847 E. de Rougé proved from a papyrus of the British museum that Apopi was one of the latest of the Hyksos kings, corresponding to Aphobis; he was king of the "pest" and suppressed the worship of the Egyptian gods in favour of his god Setekh or Seti. In 1850 a record of the capture of Hawari (Avaris) from the Hyksos by Ahmosi, founder of the 18th dynasty, was discovered by the same scholar. A large class of monuments was afterwards attributed to the Hyksos. Some statues, found in 1861 by Mariette at Tanis, had peculiar "un-Egyptian" features. One of these bore the name of Apopi engraved lightly on the shoulder, and on other grounds it was concluded that the features were those of the Hyksos. In 1893 Golenischeff produced an inferior example bearing its original name, which showed that it represented Amenemhe III. In consequence it is now generally believed that they all belong to the 12th dynasty. Meanwhile a headless statue of a king named Khyan, found at Bubastis, was attributed to the Hyksos, the soundest arguments being his foreign name and the boastful un-Egyptian epithet "beloved of his ka." His name was afterwards recognized on a lion found in Baghdad. Flinders Petrie then pointed out a group of kings named on scarabs of peculiar type, which, including Khyan, he attributed to the period between the Old Kingdom and the New, while others were in favour of assigning them all to the Hyksos, whose appellation seemed to be recognizable in the title Hek-khos, "ruler of the barbarians," borne by Khyan.

HYLAS, in Greek legend, son of Theiodamas, king of the Dryopians in Thessaly, the favourite of Hercules and his companion on the Argonautic expedition. Having gone ashore at Kios in Mysia to fetch water, he was carried off by the nymphs of the spring in which he dipped his pitcher. Hercules sought him in vain; and ever afterwards, in memory of the threat of Hercules to ravage the land if Hylas were not found, the inhabitants of Kios every year on a stated day roamed the mountains, shouting aloud for Hylas (so Apollonius Rhodius I, 1207 et seq., and later authors). But, although the legend is first told in Alexandrian times, the "cry of Hylas" occurs long before as the "Mysian cry" in Aeschylus (Persae, 1054); and in Aristophanes (Plutus, 1127) "to cry Hylas" is used proverbially of seeking something in vain.

HYLOZOISM, in philosophy, a term applied to any system which explains all life, whether physical or mental, as ultimately derived from matter (Gr. hyle, "matter"; zoe, "life"). Such a view of existence has been common throughout the history of thought and especially among physical scientists. Thus the early Greek thinkers of the so-called Ionian school of philosophy sought for the beginning of all things in various material substances, water, air, fire, which were regarded as being in some sense alive and taking some active part in the development of being. This primitive hylozoism reappeared in modified forms in medieval and Renaissance thought. For later developments see MATERIALISM.

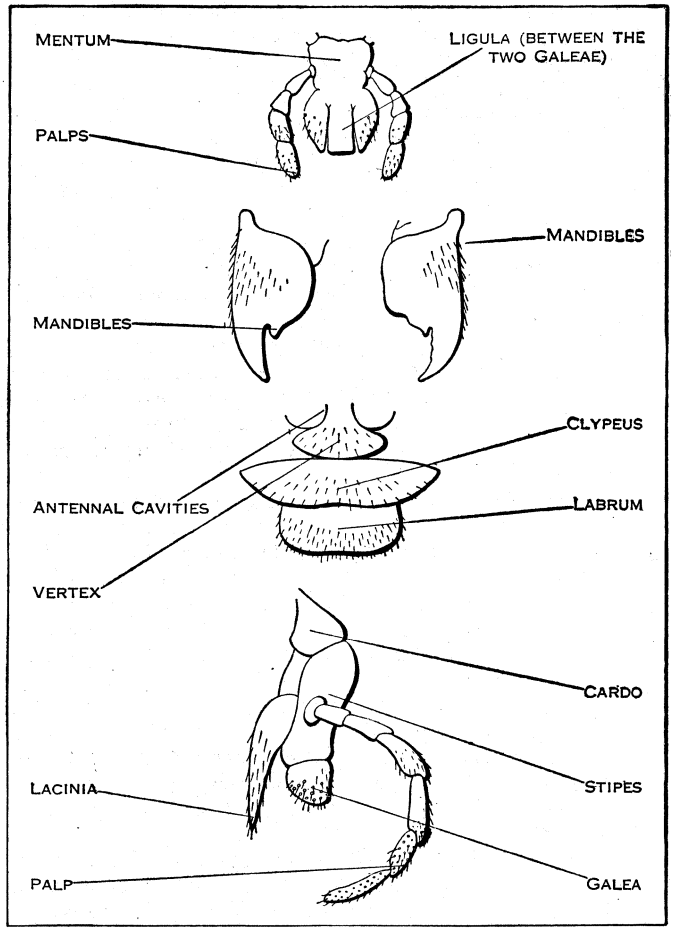
HYMANS, PAUL (1865–1941), Belgian statesman, was born at Ixelles, Brussels, on March 23, 1865. He became a barrister in 1885, and from 1898 to 1914 was professor of comparative parliamentary history at Brussels university. From 1900 he was deputy for Brussels and soon became the Liberal leader. After a mission to President Wilson in Aug. 1914 he was plenipotentiary in London, 1915–17, when he became head of the ministry of economic affairs. From 1918–20 and 1924–25 he was minister for foreign affairs. In Nov. 1918 he attended the Inter-Allied council at Versailles; he also represented Belgium at the peace conference in 1919 and on her behalf signed the peace treaty. In the same capacity he attended the conferences at San Remo, Boulogne, Brussels and Spa. He played a leading part in the settlement of the Ruhr question, the Dawes plan, the Security pact and the economic union of Luxembourg with Belgium. In Jan. 1920 he was appointed Belgian representative on the League of Nations and in the same year was made president of the first assembly at Geneva. He was again minister for foreign affairs, 1927–34 and 1934–35, and member of the council of ministers, 1935–36. A member of the Académie Royale de Belgique, Hymans continued *L'histoire parlementaire* de la Belgique (1875, etc.) and wrote *Frere-Orban* (1905, etc.), Portraits, *essais et discours*

(1914), and *Pages libérales* (1936).

HYMEN or HYMENAEUS, originally the refrain of the song sung at marriages among the Greeks. As usual, the name gradually produced the idea of an actual person whose adventures gave rise to the custom of this song. He occurs often in association with Linus and Ialemus, who represent similar personifications, and is generally called a son of Apollo and a muse. As the son of Dionysus and Aphrodite, he was regarded as a god of fruitfulness. In Attic legend he was a beautiful youth who, being in love with a girl, followed her in a procession to Eleusis, disguised as a woman, and saved the whole band from pirates. As reward he obtained the girl in marriage, and his happy married life caused him ever afterwards to be invoked in marriage songs (Servius on Virgil. *Aen.* i. 651).

See J. A. Hild in Daremberg and Saglio's *Dictionnaire* des *antiquités.*

HYMENOPTERA, the term used in zoological classification for that order of insects comprising ants, bees, wasps, and their allies the sawflies, gall wasps and ichneumon flies. These insects all exhibit the following characters: (1) The presence of two pairs of stiff membranous wings often with the venation reduced



FROM MARLATT, "ENTOMOLOGICAL BULLETIN," U.S. DEPT. OF AGRIC.

FIG. 1.— HYMENOPTERA: MOUTH PARTS OF SAWFLY (PACHYNEMATUS)

These are used principally for feeding, but in the bee the ligula is modified for sucking nectar

or almost absent: the hind wings are smaller than the fore pair and are interlocked with them by tiny hooklets. (2) The mouth parts have biting jaws, but the labium is usually modified into a kind of tongue for lapping or sucking. (3) The abdomen is generally constricted at the base to form a waist and its first segment forms a part of the thorax: an ovipositor is present and used for sawing, piercing or stinging. (4) Metamorphosis is complete and the larvae are either caterpillars or more often vermiform: the pupae may be in cocoons; their appendages are free.

Hymenoptera form one of the largest and most highly developed orders of insects and are of great interest, not only on account of the perfection of their structure but also with regard to the remarkable development of their instincts. In the latter respect they stand at the head of all invertebrate animals and their behaviour has been the subject of studies by many famous naturalists. About 80,000 species were known by 1945, but many thousands more still awaited discovery, and even in the British Isles it is only the ants, bees and wasps that have been adequately collected

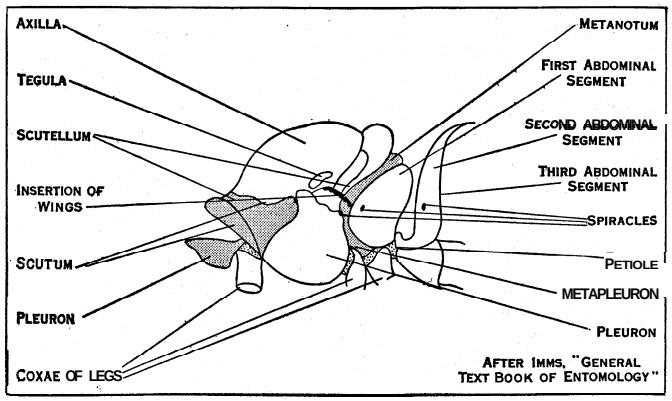
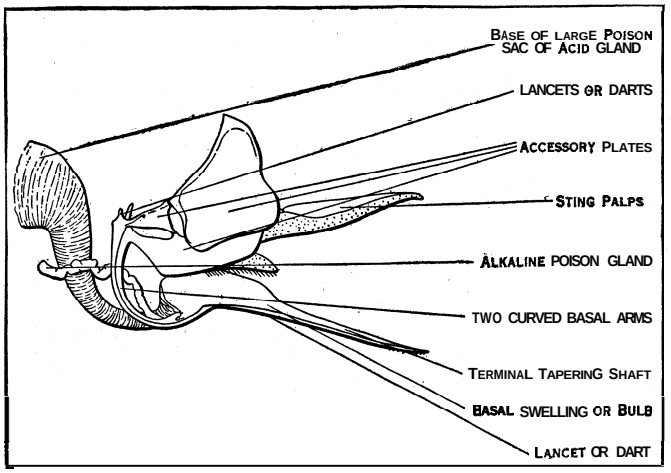


FIG. —.— LATERAL VIEW OF THE THORAX AND BASE OF ABDOMEN OF HONEYBEE

The thorax is chiefly characterized by its fusion with the first segment of the abdomen. The parts of the pre- and metathorax are shaded; mesothorax and abdomen are plain

and studied. Although the vast number of species are solitary like other insects, individuals of some species have acquired the habit of living together in great societies as is the case in ants and certain bees and wasps: their social life and behaviour is fully discussed in the article SOCIAL **INSECTS.** Hymenoptera are also remarkable for the highly evolved condition parasitism has reached in the order: tens of thousands of species betray this habit, and although they confer immense benefit to man as agents destroying other forms of insect life, they have been little collected, and in many parts of the world are very slightly known.

General Structure.— Hymenoptera have acute vision; the compound eyes are consequently large and there are usually three ocelli or simple eyes. The antennae are sometimes dimorphic in



FROM SNODGRASS, "ANATOMY OF THE HONEY BEE," U.S. DEPT. OF AGRIC.

FIG. 3.— SEMI-DIAGRAMMATIC VIEW OF LEFT SIDE OF STING OF WORKER HONEYBEE

the two sexes and in the bees and wasps they are generally composed of 13 joints in the males and 12 joints in the females. The mouth parts exhibit their simplest form in sawflies (fig. 1) where they depart but little from the generalized biting type. In most other Hymenoptera the mandibles are used for what may be termed industrial purposes more than for feeding, and the ligula is modified into an organ for lapping or sucking nectar. In the higher types of bees this organ is elongated into a kind of tongue which, in some cases, exceeds in length that of the entire insect. In these instances the labial palpi and maxillae are also correspondingly lengthened and form, with the ligula, a definite proboscis

(fig. 1). The thorax (fig. 2) is chiefly characterized by the fusion of its last segment with the *propodeum* or first segment of the abdomen. In the sawflies this union is not complete, but in all other Hymenoptera it is a pronounced feature and the second abdominal segment (or first apparent segment) is constricted to form a waist or *petiole*. The wings have departed very widely from the primitive type of venation and almost every transition can be found from the well developed condition seen in sawflies to some of the parasitic forms where there is only a single vein to the fore wings or even no vein at all. At the bases of the fore wings are small scalelike plates or *tegulae*, which afford important characters used in classification. Most members of the order fly with the wings of a side interlocked by a row of hooklets. In the female the abdomen bears an elaborate ovipositor, typically composed of three pairs of valves. The first pair arises from the eighth segment and forms the lancets, while the other pairs arise from the ninth segment and form the lancet sheath and the so-called sting palps respectively (fig. 3). In addition to functioning as an egg-laying instrument the ovipositor is used in sawflies for sawing niches in plants into which the eggs are lodged: in ichneumon flies and their allies it is often employed in stabbing their insect hosts preparatory to laying their eggs within the bodies of the latter: in bees, wasps and some ants it is used for stinging, a habit which is found in no other insects.

Classification. — Hymenoptera are grouped into two main suborders and these, along with their chief subdivisions, are enumerated below.

SUBORDER I. CHALASTOGASTRA

Abdomen with no definite basal constriction or waist: trochanters 2-jointed. Larvae generally caterpillars with a variable number of Legs.

Superfamily Tenthredinoidea. Included in this division are all the more primitive members of the order: they do not exhibit the specialized habits and instincts of the Clistogastra and their larvae are almost exclusively plant feeders. The best known family is the Tenthredinidae or sawflies (*q.v.*) which are distinguished by two large spines or spurs to each fore tibia. Their larvae are caterpillars which feed upon the leaves of plants, and those of a number of species are injurious to cultivated plants and forest trees. The ovipositor is usually elaborately toothed,

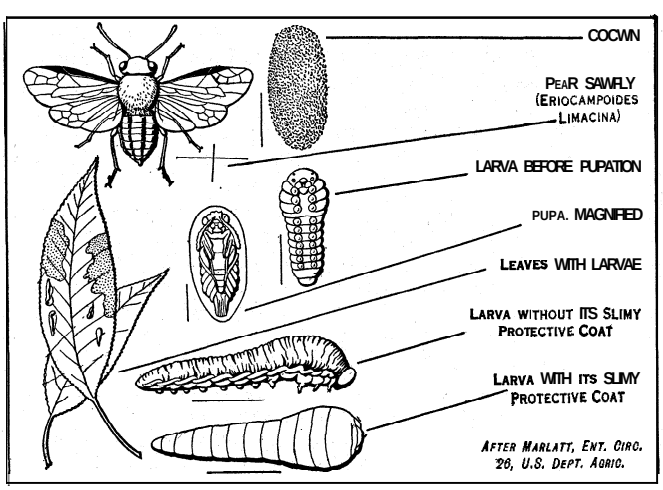


FIG. 4.—LIFE HISTORY OF PEAR SAWFLY (ERIOCAMPOIDES LIMACINA)
The larvae are plant feeders, those feeding openly on leaves being caterpillars. often with six or more pairs of feet

and is used for sawing notches to enable the eggs to be laid in plant tissues. The Cephidae or stem sawflies are a small group whose larvae feed in the stems of various plants, while those of the Siricidae or wood wasps bore into the wood of trees.

SUBORDER II. CLISTOGASTRA

Abdomen with a basal constriction or waist: trochanters 1- or 2-jointed. Larvae embryonic or vermiform without legs.

The great group is divisible into the *Parasitica* which generally have 2-jointed trochanters and the *Aculeata* or stinging forms in which the trochanters are single-jointed. The *Parasitica* include the following superfamilies.

The Ichneumonoidea have the pronotum extending back to the tegulae, the antennae are not elbowed and the fore wings have a

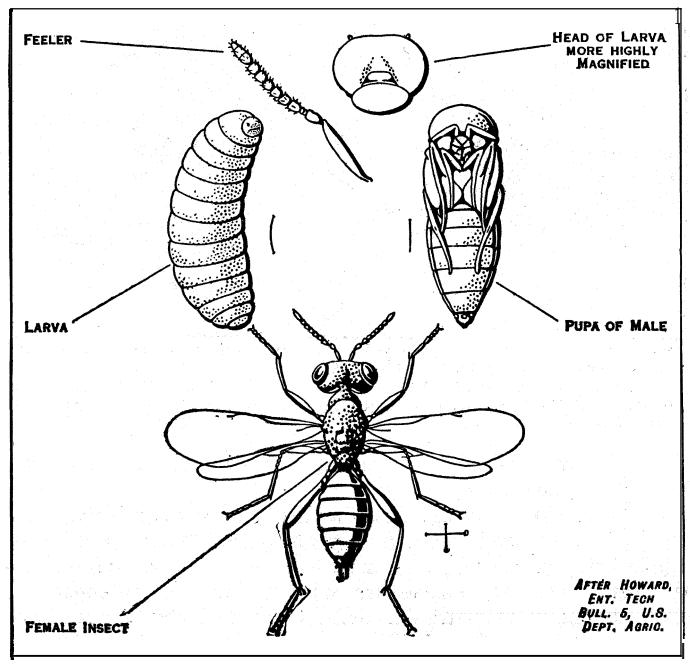


FIG. 8. — LIFE HISTORY OF CHALCID (DIBRACHYS CAVUS)
The suborder Clistogastra is chiefly characterized by the narrowly constrioted waist of the adult and by the legless condition of the larvae

dark mark or stigma (fig. 7). The larvae of all members of this group are parasites preying upon some stage in the life cycle of other insects or spiders and are consequently of great economic importance. (*See* ICHNEUMON FLY.)

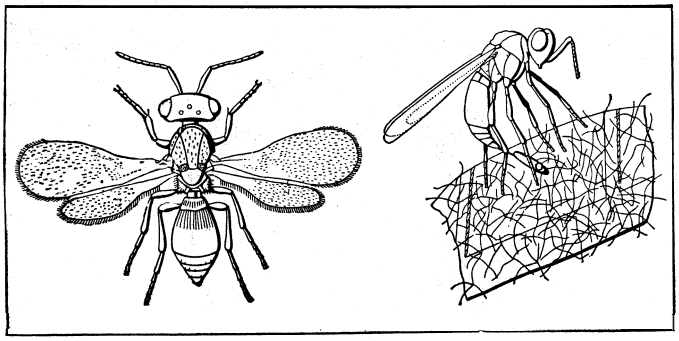
The Cynipoidea include the gall wasps or gallflies which differ from the ichneumons in the absence of a stigma to the fore wings and in the usually single-jointed trochanters, unlike most other Parasitica. In the family Cynipidae many of the species lay their eggs in various plant tissues which react in such a way that galls are produced wherein their development is completed. These galls are of characteristic form for each species. the oak apple and bedeguar of the rose being familiar examples. Other members of the family are inquilines, living within the galls and bearing a close resemblance to the true makers of the latter. The Figitidae are parasites, usually attacking fly larvae and aphides.

The Chalcidoidea or chalcid wasps (fig. 5) are very small insects with elbowed antennae and with the pronotum not extending back to the tegulae. The group includes more than 16 families, most of the members of which are either parasites of the eggs, larvae or pupae of other insects, or are hyperparasites. A small number are plant feeders living in seeds, in figs, cr forming galls on cereals and grasses. The fig insects are very numerous; certain of these are important agents in the pollination of the flowers, and have been introduced for economic purposes into lands where they were absent. The parasitic forms are of great practical value, in that they destroy vast numbers of injurious insects: certain of these exhibit the phenomenon of polyembryony, which is dealt with in the article INSECTS. Chalcids often exhibit beautiful metallic coloration, and can be recognized by the wing veins being reduced to a single stem.

The Serphoidea resemble the Aculeates in that the ovipositor issues from the apex of the abdomen, but the trochanters are usually 2-jointed. This character, together with the fact that the pronotum reaches back to the tegulae, separates them from the chalcids (fig. 5). They are all very small or minute insects with greatly reduced venation, and many are wingless. They live as parasites of other insects. or of spiders, and frequently in the eggs, which they destroy in large numbers. The largest of the

eight chief families are the Platygastridae which mainly parasitize gall midges, their larvae often living in the brain or stomach of their hosts. Like the chalcids, the Serphoidea are beneficial.

The succeeding superfamilies form the series Aculeata or stinging Hymenoptera and in these the ovipositor issues from the apex



FROM SYLVESTRI, "PLANGASTER DRYOMIAE" IN "BOLLETTINO DEL LABORATORIO DI ZOOLOGIA" (SCUOLA SUPERIORE D'AGRICOLTURA IN PORTICI)

FIG. 6.—A FEMALE PROCTOTRYPID (PLATYGASTER DRYOMIAE) On the right the female is seen in the act of oviposition in an egg (O), of a gall midge, on a leaf

of the abdomen, whereas in the Parasitica it issues some distance in front of the extremity.

The Formicoidea or ants form a very natural assemblage which are easily recognized by the greatly constricted "waist" and by the petiole being marked by one or two nodes: the pronotum extends backward, but the tegulae are uanting and the antennae are elbowed. The females are differentiated into winged "queens" and wingless workers of varied forms; each species of ant leads a complex social life which presents many phases of surpassing interest. (See ANT and SOCIAL INSECTS.)

The Sphecoidea or digging wasps (fig. 8) are marked off from the Vespoidea by the fact that the pronotum forms a collar and does not reach back to the tegulae. For the most part they are to be regarded as beneficial insects from the fact that they are predators seizing other insects, which they carry off to their cells as food for their larvae. All are solitary insects which construct cells for their brood either below ground or in dry wood or stems. There are 12 families, the largest being the Sphecidae.

The Vespoidea include a large number of other digging wasps together with the social wasps. The pronotum generally reaches back to the tegulae but there are exceptions. Among the solitary species, some Mutillidae are parasites in bumblebees' nests and their females are wingless. The Pompilidae provision their cells with spiders: they are often large insects with slender bodies and elongate hind legs. The Scoliidae are robust, hairy wasps which often deposit their eggs in chafer larvae and chiefly inhabit warm countries. The Chrysididae or ruby-tailed wasps are beautiful metallic green or green and blue or ruby insects, which lay their eggs in the nests of bees and wasps where their larvae either prey upon those of their hosts or devour their food. In this family only three or four abdominal segments are visible, the remainder forming a retractile tube containing the ovipositor. The true wasps have their wings folded length ise in repose and the fore legs are of normal build—not specialized for digging as in the fossorial groups. The Vespidae or social wasps have "queens" and "workers" as in ants, but both forms are winged, while the Eumenidae or solitary true wasps have no such differentiation into castes. (For the habits of these two families see WASP and SOCIAL INSECTS.)

The Apoidea include the solitary and social bees which agree with the Sphecoidea in the pronotum not extending back to the tegulae but differ from them in having the hind tarsi dilated, while the hairs of the head and thorax are feathery or plumose. The glossa or tongue is well developed and often exceedingly long and the food consists of nectar and pollen. The larvae are fed upon a similar diet. except that the nectar is regurgitated as honey before being served to them. These substances are stored in the cells and the latter are never provisioned with animal food. Most bees are solitary in habit, but those of the families Bombidae, Meliponidae and Apidae are social insects resembling ants and wasps in the occurrence of a worker caste. (See BEE and SOCIAL INSECTS.)

Reproduction and Development. — One of the most interesting facts with regard to reproduction in Hymenoptera is the wide occurrence of parthenogenesis which obtains among members of all the great groups. The best known instance is in the honeybee, in which the unfertilized eggs produce males (drones) : in the gall wasps or Cynipidae both sexes may be produced from unfertilized eggs and the generations which arise in this way alternate with those produced by the usual sexual method. In other of the gall wasps males are unknown: parthenogenesis is also very frequent in sawflies and chalcid wasps.

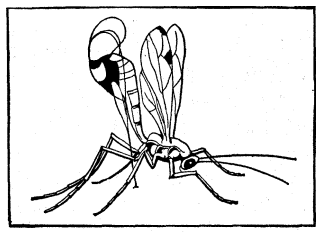
The larvae of the Chalastogastra are plant feeders: those which feed openly on leaves are caterpillars, often with six or more pairs of abdominal feet (fig. 4), but in the stem and wood borers these appendages are absent and the thoracic limbs are reduced to mere tubercles. Among the Clistogastra the larvae are usually hatched in immediate contact with an abundance of food: they are in consequence degenerate creatures devoid of limbs and of almost all traces of organs of special sense (fig. 5). In the parasitic groups hypermetamorphosis (see INSECTS) is very frequent, the larvae being hatched in forms very different from that assumed in the final instar. In a few cases the eggs are laid away from the hosts and the larvae upon hatching are active creatures of the type termed a planidium. The planidium seeks out its host, and having found it, assumes the legless maggot-like form common to all Clistogastra. Some of the parasitic species live externally on their hosts and feed by piercing the integument with their mouth parts, but the largest number are endoparasites. In the latter case the female parent drives her ovipositor into the host and lays one or more eggs wherever the larvae will find abundant food. Many of the minute Chalcidoidea and Serphoidea complete their development within the eggs of other insects: others parasitize the larvae or pupae or, more rarely, adult insects, and death of the host finally supervenes. The digging or fossorial wasps feed their brood with captured insects, which are stored away in cells along with a single egg: the wasp larva, upon hatching, thus finds its life's food supply immediately at hand. The true wasps feed their brood with animal food including many insects, from time to time, very much as a bird does her fledglings, while bees entirely resort to honey and pollen. Thus, we find throughout the order a degree of care for the offspring, not attained in other insects, which has led to the development of social life in certain groups. When fully fed most Hymenoptera pupate in cocoons formed of silk secreted for this purpose; and among the ichneumon flies and their allies, these cocoons are often elaborate and beautiful objects.

Geographical Distribution. — Hymenoptera are found in all except the most inhospitable regions of the globe, but the order, as a whole, has not penetrated to such remote parts as have the Apterygota and Coleoptera. Bees, for example, are dependent upon the existence of flowering plants and are not found outside their range: some, such as the giant *Xylocopa* or carpenter bees are mainly tropical or subtropical, while bumblebees are essentially creatures of temperate climates and are generally confined to the mountains in the tropics; they are absent from almost the whole of Africa, the plains of India and none are indigenous to Australia or New Zealand. The honeybee (*Apis mellifica*) has been introduced into most countries of the world, and some of the injurious sawflies enjoy a very wide distribution, mainly through the agency of commerce. Among the chalcid wasps the family Agaonidae, or fig insects, occurs wherever trees of the fig kind flourish, but are not found outside that limit: certain other chalcids (Eucharidae) are mainly tropical and are confined to where their particular ant hosts flourish. Perhaps the most interesting fact concerning the distribution of Hymenoptera is the great paucity of forms found in New Zealand, where they are represented by little more than 300 species, as compared with more than 6,000 found in Australia.

Geological Distribution. — The first members of the order to appear in geological history are wood wasps of the genus *Pseudosirex* from the Upper Jurassic of Bavaria. Certain parasitic Hymenoptera appeared soon afterward and some very highly specialized types occur in the Cretaceous of Canada. In Baltic

amber of Oligocene age many species have been described. In Tertiary times the order is represented by ants, bees and other forms which differ relatively little from those found living today.

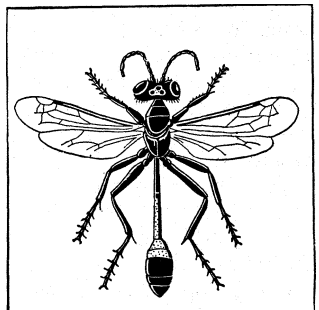
Natural History.— Hymenoptera are mostly of small or moderate size: only a few members of the order are very large insects, like the carpenter bees and spider wasps of the family Pompilidae. On the other hand, many of the parasitic forms are among the smallest of all insects, notably those which live as egg parasites; certain chalcid wasps of family Mymaridae or "fairy flies" measure only .21 mm. in length.



FROM RILEY AND HOWARD, "INSECT LIFE" U.S DEPT. OF AGRICULTURE

FIG. 7.—ICHNEUMON FLY (RHYSSA PERSUASORIA) OVIPOSITING

Hymenoptera are essentially terrestrial and aerial in habit. The only exceptions are those which parasitize the larvae or eggs of aquatic insects: the "fairy fly" *Polynema natans* swims readily beneath the water by means of its wings and seeks out the eggs of the water boatmen (Notonecta) as the host for its larvae. In number of species the parasitic groups greatly exceed the remainder of the order. No order of terrestrial insects escapes their attacks, and even larvae deep in the soil or boring in the solid wood of trees are by no means immune. As a rule the length of the ovipositor is greatest in those parasites such as Megarhyssa and Rhyssa which have to force this organ through a depth of wood, in order to reach their hosts (fig. 7). One of the most remarkable cases of parasitism is found in a proctotrypid, *Rilea* manticida which, according to L. Chopard, passes its development in the eggs of the praying mantis. The adult parasites, upon emergence, make their way to a mantis, upon whose body they settle down: in this situation they cast off their wings and live ectoparasitically. If the mantis be a female which has commenced egg laying, the *Rilea* migrates to the extremity of the body, in order to lay its eggs in the viscid mass of the mantis' egg capsule as it is being formed. Parasites which settle upon male mantids are probably short-lived and perish. The digging wasps store their cells with other insects or spiders and as a rule they sting their prey first and reduce it to a condition of immobility without actually killing it: in other cases the prey is killed, but since it retains its fresh condition up to several weeks, it is presumed that the injected venom exercises an antiseptic influence. Jean Henri Fabre's observations upon the Sphex (*Ammophila*), which stings its caterpillar prey in successive segments of its body, have often been quoted. The French observer maintained that this insect (fig. 8) had a sort of intuitive knowledge of the inner anatomy of its victim, the stings being administered in the ganglionic nerve centres, thereby inducing paralysis, a conclusion which is scarcely warranted by the facts at his disposal. The number of times a prey is stung appears to vary from once up to about a dozen: in addition to being stung the victim is vigorously pinched by the jaws of the *Sphex*, particularly when it has been stung only a few times and subsequent paralysis occurs in each case. The nature of the prey of digging wasps is often very constant for particular species. Thus *Philanthus triangulum* stores its nest with honey bees, while species of *Bembix* prey upon large Diptera, and the large species of the *Pepsis* store burrows with great tarantula spiders.



FROM IMMS, TEXT-BOOK OF ENTOMOLOGY" (METHUEN & CO.)

FIG. 8.—FEMALE SPHEX (AMMOPHILA SABULOSA) (TWICE ACTUAL SIZE)

The genus sphex includes digging wasps, which store their cells with caterpillars and other insects. The prey is paralyzed by stinging and remains fresh during the time the sphex devours it

Among bees, wasps and some ants, the capacity for stinging is employed for defensive purposes, and the usual glands which are found at the base of the ovipositor are especially large in these insects. Their secretions have irritating properties to which the sting is due, the venom containing formic acid.

The nest-building habit is another feature of Hymenoptera. Digging wasps make simple burrows in the ground, and many burrowing bees make branched tunnels. Other bees excavate wood or make their brood chambers in hollow stems, while the true wasps work up chewed fragments of wood with saliva to form a sort of paper with which they construct the cells of their nest. The social bees secrete wax from their own bodies with which they build up the combs of their nest. There are numerous Hymenoptera that are inquilines — insects which construct no nests of their own and utilize, instead, those of other species: in some cases their larvae consume the food provided by the rightful owners for their own brood, and in others, they devour the larvae of the host, thus becoming true parasites. The most interesting of all features associated with Hymenoptera is their social life, which forms the subject of a separate article. (See SOCIAL INSECTS.)

Economic Importance. — The chief injurious members of the order belong to the Chalastogastra and the larvae of many sawflies are exceedingly destructive. Thus, the turnip sawfly *Athalia spinarum* destroys the foliage of the turnip crop in Britain and many parts of Europe: the pear slug sawfly (*Eriocampoides limacina*) skeletonizes the leaves of pears in Europe, North America, Australia and New Zealand and Lygaeonematus *erichsonii* is destructive to larch on both sides of the Atlantic. The gooseberry sawfly (*Nematus* ribesii) is a well known pest of gooseberries in gardens in many parts of Europe, as well as in North America, and the larvae of various species of *Lophyrus* are destructive to pines. Wood wasps (Siricidae) bore into timber in many parts of the world and the stem borers (Cephidae), are especially injurious to cereals. The Clistogastra are almost wholly beneficial insects, the honeybee yields beeswax and honey, while the important role played by the parasitic forms in destroying injurious insects, has already been dilated upon. The introduction of the chalcid wasp *Aphelinus mali* into New Zealand is an example of the practical utilization of parasitic Hymenoptera, and the species in question has now largely controlled the woolly aphis of the apple in that territory. Among other chalcids the presence of certain fig insects (*Blastophaga*) is needed to pollinate the flowers of the fig; they have been previously mentioned. On the other hand, a small number of chalcids are injurious, notably those whose larvae live in seeds such as species of *Megastigmus* which attack those of conifers, while larvae of *Harmolita* form stem galls on grasses.

BIBLIOGRAPHY.—In an order so extensive and diverse as Hymenoptera the reader will find very few comprehensive works, the literature mainly dealing with individual groups. The European species are monographed by E. and E. André, *Species* des *Hyménoptères d'Europe* et *d'Algérie* (1879–1913), and the world's species are catalogued by C. G. de Dalla Torre, *Catalogus Hymenopterorum* (Leipzig, 1892–1902). A useful guide to the North American forms is provided by H. L. Viereck and collaborators in The Hymenoptera or *Wasp*-like Insects *of* Connecticut (Bull. 22 State Geol. and *Nat. Hist.* Survey: Hartford, Conn., 1916). One for Europe is Schmiedeknecht, Hymenopteren Mitteleuropas (Jena, 1930). For the sawflies and gallflies the accounts given in C. Schroder's Insekten *Mitteleuropas*, vol. iii (Stuttgart, 1914) are concise and well illustrated, while the British species are described by P. Cameron, British Phytophagous *Hymenoptera* (London, Roy. Soc., 1882–92), which is provided with accurate coloured plates. A useful popular account of the galls produced by Cynipidae is E. T. Connold, *British* Plant Galls (1909). For the North American galls *see* E. P. Felt, Plant Galls and the Insects *That Produce* Them (1940), and A. Cosens, A Contribution to the Morphology and Biology of Insect Galls (Trans. *Canad. Inst.* vol. ix, 1912). For parasitism and the forms exhibiting this habit the following works are important: W. H. Ashmead, Classification of the Chalcid Flips (Mem. *Carnegie Mus.* 1, 1904) and the same author's *Monograph* of the *North American Proctotrypidae* (Bull. 45, U.S. Nat. Mus. 1893); L. O. Howard, The Biology of the *Hymenopterous* Insects of the *family* Chalcididae (Proc. US. Nat. Mus., xiv, 1891); L. O. Howard and W. F. Fiske, *The* Importation into the United States of the Parasites of the *Gipsy* Moth, etc. (U.S. Dept. Agric.. Entom. Bull. 91: 1911); other references are given in the article ICHNEUMON-FLY.

The Aculeata have a very extensive literature and among the more important works are: E. Saunders, *Hymenoptera* Aculeata of the British Islands (1896); H. St. J. Donisthorpe, British Ants (1927); W. M. Wheeler, Ants (1910); P. and N. Rau, Wasp Studies Afield (Princeton, 1918); G. W. and E. G. Peckham, Wasps, Social and

Solitary (1905); for other references see SOCIAL INSECTS.

In addition to the foregoing numerous observations on the habits and behaviour of Hymenoptera are given in J. H. Fabre, *Souvenirs Entomologiques* (1879–1905), many of which are translated into English. (A. D. I.)

HYMETTUS, a mountain in Attica, bounding the Athenian plain on the south-east (3,370 ft.), has always been famous for its honey. The spring mentioned by Ovid (*Ars Amat.* iii. 687) is probably near the monastery of Syriani or Kaesariani on the western slope and identical with that known as Κύλλον Πήρα said to be a remedy for childlessness. The marble of Hymettus, which often has a bluish tinge, was used for building in ancient Athens, and even for sculpture; although the white marble of Pentelicon was preferred for both purposes.

See E. Dodwell, *Classical* and *Topographical* ***Tour*** (1819), i. 483.

HYMNS. The word "hymn" (ὕμνος) was employed by the ancient Greeks to signify a song or poem composed in honour of gods, heroes or famous men, or to be recited on some joyful, mournful or solemn occasion. But hymns are actually much older than any Greece can show; the ancient Chinese "hymned" the Ruler of Heaven; Assyria, Egypt and India have all left us records of early hymns. The Athenian dramatists (Euripides most frequently) use the word and its cognate verbs of odes in praise of conquerors at the public games; they also describe by them metrical oracles and apophthegms, martial, festal and hymeneal songs, dirges and lamentations or incantations of woe.

Hellenic hymns, according to this conception of them, have come down to us, some from a very early and others from a late period of Greek classical literature.

The Romans did not adopt the word "hymn"; nor have we many Latin poems of the classical age to which it can properly be applied. There are, however, a few—such as the simple and graceful "Dianae sumus in fide" ("Dian's votaries are we") of Catullus, and "Dianam tenerae dicite virgines" ("Sing to Dian, gentle maidens") of Horace—which approach much more nearly than anything Hellenic to the form and character of modern hymnody.

Hebrew Hymnody.—For the origin and idea of Christian hymnody we must look, not to Gentile, but to Hebrew sources. St. Augustine's definition of a hymn, generally accepted by Christian antiquity, may be summed up in the words, "praise to God with song" ("cum cantico"); Bede understood the "canticum" as properly requiring metre; though he thought that what in its original language was a true hymn might retain that character in an unmetrical translation. Modern use has enlarged the definition; Roman Catholic writers extend it to the praises of saints; and the word now comprehends rhythmical prose as well as verse, and prayer and spiritual meditation as well as praise.

The modern distinction between psalms and hymns is arbitrary (see PSALMS).

In the New Testament we find our Lord and His apostles singing a hymn (ὑμνήσαντες ἐξῆλθον), after the institution of the Lord's Supper; St. Paul and Silas doing the same (ὕμνουν τὸν θεόν) in their prison at Philippi; St. James recommending psalm-singing (ψαλλέτω) and St. Paul "psalms and hymns and spiritual songs (ψαλμοῖς καὶ ὕμνοις καὶ ὠδαῖς πνευματικαῖς) St. Paul also, in the 14th chapter of the first epistle to the Corinthians, speaks of singing (ψαλῶ) and of every man's psalm (ἕκαστος ὑμῶν ψαλμὸν ἔχει), in a context which plainly has reference to the assemblies of the Corinthian Christians for common worship. All the words thus used were applied by the LXX. to the Davidical psalms; it is therefore possible that these only may be intended, in the different places to which we have referred. But there are in St. Paul's epistles several passages (Eph. v. 14; 1 Tim. iii. 16; 1 Tim. vi. 15, 16; 2 Tim. ii. 11, 12) which have so much of the form and character of later Oriental hymnody as to have been supposed by Michaelis and others to be extracts from original hymns of the Apostolic age.

Eastern Church Hymnody.—The hymn of our Lord, the precepts of the apostles, the angelic song at the nativity, and "Benedicite omnia opera" are referred to in a curious metrical prologue to the hymnary of the Mozarabic Breviary as precedents for the practice of the Western Church. Philo describes the Therapeutae (*q.v.*) of the neighbourhood of Alexandria as composers of original hymns which were sung at their great religious festivals.

The practice, not only of singing hymns, but of singing them antiphonally, appears, from the well-known letter of Pliny to Trajan, to have been established in the Bithynian churches at the beginning of the 2nd century. This agrees well, in point of time, with the tradition recorded by the historian Socrates, that Ignatius (who suffered martyrdom about A.D. 107) was led by a vision or dream of angels singing hymns in that manner to the Holy Trinity to introduce antiphonal singing into the church of Antioch, from which it quickly spread to other churches.

The Greek hymnody contemporary with Ephraem followed, with some licence, classical models. One of its favourite metres was the Anacreontic; but it also made use of the short anapaestic, Ionic, iambic and other lyrical measures, as well as the hexametet and pentameter. Its principal authors were Methodius, bishop of Olympus, who died about A.D. 311, Synesius, who became bishop of Ptolemais in Cyrenaica in 410, and Gregory Nazianzen, for a short time (380–381) patriarch of Constantinople. They have found an able English translator in the Rev. Allen Chatfield (Songs and Hymns of Earliest *Greek Christian* Poets, 1876). Among the most striking of their works are μνήμεο Χριστέ ("Lord Jesus, think of me"), by Synesius; σὲ τὸν ἄφθιτον μονάρχην ("O Thou, the One Supreme") and τί σοι θέλεις γενέσθαι ("O soul of mine, repining"), by Gregory; also ἄνωθεν παρθένοι ("The Bridegroom cometh"), by Methodius. There continued to be Greek metrical hymn-writers, in a similar style, till a much later date. Sophronius, patriarch of Jerusalem in the 7th century, wrote seven Anacreontic hymns; and St. John Damascene, one of the most copious of the second school of "Melodists," was also the author of some long compositions in iambic trimeters.

Period of Arian Controversy.—An important development of hymnody at Constantinople arose out of the Arian controversy. Early in the 4th century Athanasius had rebuked, not only the doctrine of Arius, but the light character of certain hymns by which he endeavoured to make that doctrine popular. When, towards the close of that century (398), St. John Chrysostom was raised to the metropolitan see, the Arians, who were still numerous at Constantinople, had no places of worship within the walls; but they were in the habit of coming into the city at sunset on Saturdays, Sundays and the greater festivals, and congregating in the porticoes and other places of public resort, where they sang, all night through, antiphonal songs, with "acroteleutia" (closing strains, or refrains), expressive of Arian doctrine, often accompanied by taunts and insults to the orthodox. Chrysostom was apprehensive that this music might draw some of the simpler church people to the Arian side; he therefore organized, in opposition to it, under the patronage and at the cost of Eudoxia, the empress of Arcadius (then his friend), a system of nightly processional hymn-singing, with silver crosses, wax-lights and other circumstances of ceremonial pomp. Riots followed, with bloodshed on both sides. This led to the suppression, by an imperial edict, of all public Arian singing.

Melodists.—The controversies and persecutions of the 8th and succeeding centuries turned the thoughts of the "melodists" of the great monasteries of the Studium at Constantinople and St. Saba in Palestine and their followers, and those of the adherents of the Greek rite in Sicily and South Italy (who suffered much from the Saracens and the Normans), into a less picturesque but more strictly theological course; and the influence of those controversies, in which the final success of the cause of "Icons" was largely due to the hymns, as well as to the courage and sufferings, of these confessors, was probably the cause of their supplanting, as they did, the works of the older school.

Among the "melodists" of this latter Greek school there were many saints of the Greek church, several patriarchs and two emperors—Leo the Philosopher, and Constantine Porphyrogenitus, his son. Their greatest poets were Theodore and Joseph of the Studium, and Cosmas and John (called Damascene) of St. Saba. Neale translated into English verse several selected portions, or centoes, from the works of these and others, together with four

selections from earlier works by Anatolius. Some of his translations — particularly "The day is past and over," from Anatolius, and "Christian, dost thou see them," from Andrew of Crete — have been adopted into hymn-books used in many English churches; and the hymn "Art thou weary," which is rather founded upon than translated from one by Stephen the Sabaite, has obtained still more general popularity.

Western Church Hymnody. — It was not till the 4th century that Greek Hymnody was imitated in the West, where its introduction was due to two great lights of the Latin Church — St. Hilary of Poitiers and St. Ambrose of Milan.

Hilary was banished from his see of Poitiers in 356, and was absent from it for about four years, which he spent in Asia Minor, taking part during that time in one of the councils of the Eastern Church. He thus had full opportunity of becoming acquainted with the Greek church music of that day; and he wrote (as St. Jerome, who was thirty years old when Hilary died, and who was well acquainted with his acts and writings, and spent some time in or near his diocese, informs us) a "book of hymns," to one of which Jerome particularly refers, in the preface to the second book of his own commentary on the epistle to the Galatians. Isidore, archbishop of Seville, who presided over the fourth council of Toledo, in his book on the offices of the church, speaks of Hilary as the first Latin hymn-writer; that council itself, in its 13th canon, and the prologue to the Mozarabic hymnary (which is little more than a versification of the canon), associate his name, in this respect, with that of Ambrose.

Of the part taken by Ambrose, not long after Hilary's death, in bringing the use of hymns into the church of Milan, we have a contemporary account from his convert, St. Augustine. Justina, mother of the emperor Valentinian, favoured the Arians, and desired to remove Ambrose from his see. The "devout people," of whom Augustine's mother, Monica, was one, combined to protect him, and kept guard in the church. "Then," says Augustine, "it was first appointed that, after the manner of the Eastern churches, hymns and psalms should be sung, lest the people should grow weary and faint through sorrow; which custom has ever since been retained, and has been followed by almost all congregations in other parts of the world." He describes himself as moved to tears by the sweetness of these "hymns and canticles."

It is not, however, to be assumed that the hymnody thus introduced by Ambrose was from the first used according to the precise order and method of the later Western ritual. To bring it into (substantially) that order and method appears to have been the work of St. Benedict. Walafrid Strabo, the earliest ecclesiastical writer on this subject (who lived at the beginning of the 9th century), says that Benedict, on the constitution of the religious order known by his name (about 530), appointed the Ambrosian hymns to be regularly sung in his offices for the canonical hours. Hence, probably originated the practice of the Italian churches, and of others which followed their example, to sing certain hymns (Ambrosian, or by the early successors of the Ambrosian school) daily throughout the week, at "Vespers," "Lauds" and "Nocturns," and on some days at "Compline" also — varying them with the different ecclesiastical seasons and festivals, commemorations of saints and martyrs and other special offices. The national rituals were probably the "Ambrosian" and the "Mozarabic" (of Spain).

The hymns of which the use was thus established and authorized were those which entered into the daily and other offices of the church, afterwards collected in the "Breviaries"; in which the hymns "proper" for "the week," and for "the season," continued for many centuries, with very few exceptions, to be derived from the earliest epoch of Latin Church poetry — reckoning that epoch as extending from Hilary and Ambrose to the end of the pontificate of Gregory the Great. The "Ambrosian" music, to which those hymns were generally sung down to the time of Gregory, was more popular and congregational than the "Gregorian," which then came into use, and afterwards prevailed.

In the 5th and early in the 6th century the priest Sedulius, whose reputation perhaps exceeded his merit; Elpis, a noble Roman lady (considered, by an erroneous tradition, to have been the wife of the philosophic statesman Boetius); Pope Gelasius I.; and Ennodius, bishop of Pavia, were hymn-writers. Sedulius and Elpis wrote very little from which hymns could be extracted; but the small number taken from their compositions obtained wide popularity, and have since held their ground. Gelasius was of no great account as a hymn-writer; and the works of Ennodius appear to have been known only in Italy and Spain. The latter part of the 6th century produced Pope Gregory the Great and Venantius Fortunatus, an Italian poet, the friend of Gregory, and the favourite of Radegunda, queen of the Franks, who died (609) bishop of Poitiers. Eleven hymns of Gregory, and twelve or thirteen (mostly taken from longer poems) by Fortunatus, came into general use in the Italian, Gallican and British churches, Eleven metrical hymns are attributed to Bede and there are also in one of Bede's works (Collectanea et *flores*) two rhythmical hymns of considerable length on the Day of Judgment, with the refrains "In tremendo die" and "Attende homo," both irregularly rhymed, and, in parts, not unworthy of comparison with the "Dies Irae." Paulinus, patriarch of Aquileia, contemporary with Paul, wrote rhythmical trimeter iambics in a manner peculiar to himself. Theodulph, bishop of Orleans (793–835), author of the famous processional hymn for Palm Sunday in hexameters and pentameters, "Gloria, laus, et honor tibi sit, Rex Christe Redemptor" ("Glory and honour and praise be to Thee, King Christ the Redeemer"), and Hrabanus Maurus, archbishop of Mainz, the pupil of Alcuin, and the most learned theologian of his day, enriched the church with some excellent works.

Sequences. — The invention of "sequences" by Notker (d. 912), may be regarded as the beginning of the later mediaeval epoch of Latin hymnody. In the eucharistic service, in which (as has been stated) hymns were not generally used, it had been the practice, except at certain seasons, to sing "laud," or "Alleluia," between the epistle and the gospel, and to fill up what would otherwise have been a long pause, by extending the cadence upon the two final vowels of the "Alleluia" into a protracted strain of music. It occurred to Notker that, while preserving the spirit of that part of the service, the monotony of the interval might be relieved by introducing at that point a chant of praise specially composed for the purpose. With that view he produced the peculiar species of rhythmical composition which obtained the name of "sequentia" (probably from following after the close of the "Alleluia"), and also that of "prosa," because its structure was originally irregular and unmetrical, resembling in this respect the Greek "troparia," and the "Te Deum," "Benedicite" and canticles. That it was in some measure suggested by the forms of the later Greek hymnody seems probable, both from the intercourse (at that time frequent) between the Eastern and Western churches, and from the application by Ekkehard, in his biography and elsewhere (*e.g.*, in Lyndwood's *Provinciale*), of some technical terms, borrowed from the Greek terminology, to works of Notker and his school and to books containing them.

The "Golden Sequence," "Veni, sancte Spiritus" ("Holy Spirit, Lord of Light"). is an early example of the transition of sequences from a simply rhythmical to a metrical form. Archbishop Trench, who esteemed it "the loveliest of all the hymns in the whole circle of Latin sacred poetry," inclined to give credit to a tradition which ascribes its authorship to Robert II., king of France, son of Hugh Capet. Others have assigned to it a later date — some attributing it to Pope Innocent III., and some to Stephen Langton, archbishop of Canterbury.

Dies Irae and **Stabat** Mater. — But the two most widely celebrated of all this class of compositions — works which have exercised the talents of the greatest musical composers, and of innumerable translators in almost all languages — are the Dies Irae ("That day of wrath, that dreadful day"), by Thomas of Celano, the companion and biographer of St. Francis of Assisi, and the *Stabat Mater* dolorosa ("By the cross sad vigil keeping") of Jacopone, or Jacobus de Benedictus, a Franciscan humorist and reformer, who was persecuted by Pope Boniface VIII. for his satires on the prelacy of the time, and died in 1306. Besides these, the 13th century produced the famous sequence Lauda Sion salvatorem ("Sion lift thy voice and sing"), and the four other

well-known sacramental hymns of St. Thomas Aquinas, viz. *Pange lingua gloriosi corporis mysterium* ("Sing, my tongue, the Saviour's glory"), *Verbum supernum prodiens* ("The Word, descending from above"—not to be confounded with the Ambrosian hymn from which it borrowed the first line), *Sacris solemniis juncta sint gaudia* ("Let us with hearts renewed our grateful homage pay"), and *Adoro Te devote, latens Deitas* ("O Godhead hid, devoutly I adore Thee")—a group of remarkable compositions, written by him for the then new festival of Corpus Christi, of which he induced Pope Urban IV. (1261–1265) to decree the observance.

Before the time of the Reformation, the multiplication of sequences (often as unedifying in matter as unpoetical in style) had done much to degrade the common conception of hymnody. In some parts of France, Portugal, Sardinia and Bohemia, their use in the vernacular language had been allowed. In Germany also there were vernacular sequences as early as the 12th century, specimens of which may be seen in the third chapter of C. Winkworth's *Christian Singers of Germany*. Scoffing parodies upon sequences are said to have been among the means used in Scotland to discredit the old church services. After the 15th century they were discouraged at Rome. They retained for a time some of their old popularity among German Protestants, and were only gradually relinquished in France. A new "prose," in honour of St. Maxentia, is among the compositions of Jean Baptiste Santeul; and Dr. Daniel's second volume closes with one written in 1855 upon the dogma of the Immaculate Conception.

German Hymnody.—Luther was a proficient in and a lover of music. He desired (as he says in the preface to his hymn-book of 1545) that this "beautiful ornament" might "in a right manner serve the great Creator and His Christian people." The persecuted Bohemian or Hussite Church, then settled on the borders of Moravia under the name of "United Brethren," had sent to him, on a mission in 1522, Michael Weiss, who not long afterwards published a number of German translations from old Bohemian hymns (known as those of the "Bohemian Brethren"), with some of his own. These Luther highly approved and recommended. He himself, in 1522, published a small volume of eight hymns, which was enlarged to 63 in 1527, and to 125 in 1545. He had formed what he called a "house choir" of musical friends, to select such old and popular tunes (whether secular or ecclesiastical) as might be found suitable, and to compose new melodies, for church use. His fellow labourers in this field (besides Weiss) were Justus Jonas, his own especial colleague; Paul Eber, the disciple and friend of Melanchthon; John Walther, choirmaster successively to several German princes, and professor of arts, etc., at Wittenberg; Nicholas Decius, who from a monk became a Protestant teacher in Brunswick, and translated the *Gloria in Excelsis*, etc.; and Paul Speratus, chaplain to Duke Albert of Prussia in 1525. Some of their works are still popular in Germany. Weiss's "Funeral Hymn," *Nun lasst uns den Leib begraben* ("Now lay we calmly in the grave"); Eber's *Herr Jesu Christ, wahr Mensch und Gott* ("Lord Jesus Christ, true Man and God"), and *Wenn wir in hochsten Nöthen sein* ("When in the hour of utmost need"); Walther's "New Heavens and new Earth" ("Now fain my joyous heart would sing"); Decius's "To God on high be thanks and praise"; and Speratus's "Salvation now has come for all," are among those which at the time produced the greatest effect, and are still best remembered.

Followers of Luther.—The principal hymn-writers of the Lutheran school, in the latter part of the 16th century, were Nikolaus Selnecker, Herman and Hans Sachs, the shoemaker of Nuremberg, also known in other branches of literature. They were succeeded by men of another sort, to whom F. A. Cunz gives the name of "master-singers," as having raised both the poetical and the musical standard of German hymnody:—Bartholomäus Ringwaldt, Ludwig Helmbold, Johannes Pappus, Martin Schalling, Rutilius and Sigismund Weingartner. The well-known English hymn, "Great God, what do I see ana hear," is founded upon one by Ringwaldt. Of a quite different character were two of great beauty and universal popularity, composed by Philip Nicolai, a Westphalian pastor, dunng a pestilence in 1597, and published by him, with fine chorales, two years afterwards. One of these (the "Sleepers wake! a voice is calling," of Mendelssohn's oratorio, *St. Paul)* belongs to the family of Advent or New Jerusalem hymns. The other, a "Song of the believing soul concerning the Heavenly Bridegroom" *(Wie schon leucht't uns der Morgenstern* —"O morning Star, how fair and bright"), became the favourite marriage hymn of Germany.

The hymns produced during the Thirty Years' War are characteristic of that unhappy time. In point of refinement and graces of style, the hymn-writers of this period excelled their predecessors. Their taste was chiefly formed by the influence of Martin Opitz, the founder of what has been called the "first Silesian school" of German poetry, who died comparatively young in 1639, and who, though not of any great original genius, exercised much power as a critic. Some of the best of these works were by men who wrote little. In the famous battle-song of Gustavus Adolphus, published (1631) after the victory of Breitenfeld, for the use of his army, *Verzage nicht du Häuflein klein* ("Fear not, O little flock, the foe"), we have almost certainly a composition of the hero-king himself, the versification corrected by his chaplain Jakob Fabricius (1593–1654) and the music composed by Michael Altenburg, whose name has been given to the hymn. This, with Luther's paraphrase of the 67th Psalm, was sung by Gustavus and his soldiers before the battle of Lützen in 1632. Two very fine hymns, one of prayer for deliverance and peace, the other of trust in God under calamities, were written about the same time by Matthäus Lowenstern, a saddler's son, poet, musician and statesman, who was ennobled after the peace by the emperor Ferdinand III. Martin Rinckhart, in 1636, wrote the "Chorus of God's faithful children" *(Nun danket alle Gott*—*"Now* thank we all our God"), introduced by Mendelssohn in his *Lobgesang,* which has been called the *Te Deum* of Germany, being usually sung on occasions of public thanksgiving. Weissel, in 1635, composed a beautiful Advent hymn ("Lift up your heads, ye mighty gates"), and J. M. Meyfart, professor of theology at Erfurt, in 1642, a fine adaptation of the ancient *Urbs beata Hierusalem.*

The most copious, and in their day most esteemed, hymn-writers of the first half of the 17th century, were Johann Heermann and Johann Rist. Heermann, a pastor in Silesia, the theatre (in a peculiar degree) of war and persecution, experienced in his own person a very large share of the miseries of the time, and several times narrowly escaped a violent death. His *Devoti musica cordis,* published in 1630, reflects the feelings natural under such circumstances. Next to Heermann and Rist in fertility of production, and above them in poetical genius, was Simon Dach, professor of poetry at Konigsberg, who died in 1659.

Gerhardt.—The fame of all these writers was eclipsed in the latter part of the same century by three of the greatest hymnographers whom Germany has produced—Paul Gerhardt (1607–1676), Johann Franck (1618–1677) and Johann Scheffler (1624–1677), the founder of the "second Silesian school," who assumed the name of "Angelus Silesius." Gerhardt is by universal consent the prince of Lutheran poets. One of his hymns is well known and highly appreciated in English through Wesley's translation, "Commit thou all thy ways"; and the evening and spring-tide hymns ("Now all the woods are sleeping" and "Go forth, my heart, and seek delight") show an exquisite feeling for nature; while nothing can be more tender and pathetic than Du *bist zwar mein und bleibest mein* ("Thou'rt mine, yes, still thou art mine own"), on the death of his son. Franck, who was burgomaster of Guben in Lusatia, has been considered by some second only to Gerhardt. It was after his conversion to Roman Catholicism that Scheffler adopted the name of "Angelus Silesius," and published in 1657 his hymns, under a fantastic title, and with a still more fantastic preface.

The Pietists.—Towards the end of the 17th century, a new religious school arose, to which the name of "Pietists" was given, and of which Philipp Jakob Spener was esteemed the founder. He and his pupils and successors, August Hermann Francke and Anastasius Freylinghausen, all wrote hymns. Spener's hymns are not remarkable, and Francke's are not numerous.

Joachim Neander, a schoolmaster at Diisseldorf, and a friend:

of Spener and Schütz (who died before the full development of the "Pietistic" school), was the first man of eminence in the "Reformed" or Calvinistic Church who imitated Lutheran hymnody. The Summer Hymn ("O Thou true God alone") and that on the glory of God in creation ("Lo, heaven and earth and sea and air") are instances of his best style.

With the "Pietists" may be classed Benjamin Schmolke and Dessler, representatives of the "Orthodox" division of Spener's school; Philipp Friedrich Hiller, their leading poet in South Germany; Gottfried Arnold and Gerhard Tersteegen, who were practically independent of ecclesiastical organization, though connected, one with the "Orthodox" and the other with the "Reformed" churches; and Nikolaus Ludwig, Graf von Zinzendorf. Schmolke, a pastor in Silesia, called the Silesian Rist (1672–1737), was perhaps the most voluminous of all German hymn-writers. He wrote 1,188 religious poems and hymns, a large proportion of which do not rise above mediocrity.

Gellert and **Klopstock.**—The transition from Tersteegen and Zinzendorf to Gellert and Klopstock marks strongly the reaction against Pietism which took place towards the middle of the 18th century The *Geistlichen Oden und Lieder* of Christian F. Gellert were published in 1757, and are said to have been received with an enthusiasm almost like that which "greeted Luther's hymns on their first appearance." It is a proof of the moderation both of the author and of his times that they were largely used, not only by Protestant congregations, but in those German Roman Catholic churches in which vernacular services had been established through the influence of the emperor Joseph II. They became the model which was followed by most succeeding hymn-writers, and exceeded all others in popularity till the close of the century, when a new wave of thought was generated by the movement which produced the French Revolution. Klopstock, the author of the *Messiah,* cannot be considered great as a hymn-writer, though his "Sabbath Hymn" (of which there is a version in *Hymns from the Land of Luther)* is simple and good. Generally his hymns (ten of which are translated in Sheppard's *Foreign Sacred Lyre)* are artificial and much too elaborate.

The "Romantic" School.--Of the "romantic" school, which came in with the French Revolution, the two leading writers are Friedrich Leopold von Hardenberg, called "Novalis," and Friedrich de la Motte Fouqué, the celebrated author of *Undine* and *Sintram*—*both* romance-writers, as well as poets. The genius of Novalis was early lost to the world; he died in 1801, not thirty years old. Some of his hymns are very beautiful; but even in such works as "Though all to Thee were faithless," and "If only He is mine," there is a feeling of insulation and of despondency as to good in the actual world. which was perhaps inseparable from his ecclesiastical idealism. Fouqué survived till 1843.

The later German hymn-writers of the 19th century belong, generally, to the revived "Pietistic" school. Some of the best, Johann Baptist von Albertini, Friedrich Adolf Krummacher, and especially Karl Johann Philipp Spitta (1801–59) have produced works not unworthy of the fame of their nation.

British Hymnody.—After the Reformation, the development of hymnody was retarded, in both parts of Great Britain, by the example and influence of Geneva. Archbishop Cranmer appears at one time to have been disposed to follow Luther's course, and to present to the people, in an English dress, some at least of the hymns of the ancient church. In a letter to King Henry VIII. (Oct. 7. 1544), among some new "processions" which he had himself translated into English, he mentions the Easter hymn, *Salve, festa dies, toto memorabilis aevo* ("Hail, glad day, to be joyfully kept through all generations"), of Fortunatus. In the "Primer" of 1535 (by Marshall) and the one of 1539 (by Bishop Hilsey of Rochester, published by order of the vicar-general Cromwell) there had been several rude English hymns, none of them taken from ancient sources. King Henry's "Primer" of 1545 (commanded by his injunction of May 6, 1545 to be used throughout his dominions) was formed on the model of the daily offices of the Breviary; and it contains English metrical translations from some of the best-known Ambrosian and other early hymns. But in the succeeding reign different views prevailed. A new direction had been given to the taste of the "Reformed" congregations in France and Switzerland by the French metrical translation of the Old Testament Psalms, which appeared about 1540. This was the joint work of Clément Marot, valet or groom of the chamber to Francis I., and Theodore Beza, then a mere youth, fresh from his studies at Orleans.

The translation commonly known as the "Old Version" of the Psalms, was begun by Thomas Sternhold, whose positirn in the household of Henry VIII., and afterwards of Edward VI., was similar to that of Marot with Francis I., and whose services to the former of those kings were rewarded by a substantial legacy under his will. Sternhold published versions of nineteen Psalms, with a dedication to King Edward, and died soon afterwards. A second edition appeared in 1551, with eighteen more Psalms added, of Sternhold's translating and seven others by John Hopkins, a Suffolk clergyman. The work was continued during Queen Mary's reign by British refugees at Geneva, the chief of whom were William Whittingham, afterwards dean of Durham, who succeeded John Knox as minister of the English congregation there, and William Kethe or Keith, said by Strype to have been a Scotsman. They published at Geneva in 1556 a service-book, containing fifty-one English metrical psalms, which number was increased, in later editions, to eighty-seven. On the accession of Queen Elizabeth, this Genevan Psalmody was at once brought into use in England—first (according to a letter of Bishop Jewell to Peter Martyr, dated 5th March 1560) in one London church, from which it quickly spread to others both in London and in other cities. The first edition of the completed "Old Version" appeared in 1562.

In this book, as published in 1562, and for many years afterwards, there were (besides the versified Psalms) eleven metrical versions of the *Te Deum,* canticles, Lord's Prayer (the best of which is that of the *Benedicite);* and also *Da pacem, Domine,* a hymn suitable to the times, rendered into English from Luther; two original hymns of praise, to be sung before morning and evening prayer; two penitential hymns (one of them the "humble lamentation of a sinner"); and a hymn of faith, beginning, "Lord, in Thee is all my trust." In these respects, and also in the tunes which accompanied the words (stated by Dr. Charles Burney. in his *History of Music,* to be German, and not French), there was a departure from the Genevan platform.

Scottish Psalms.—In Scotland, the General Assembly of the kirk caused to be printed at Edinburgh in 1564, and enjoined the use of, a book entitled *The Form of Prayers and Ministry of the Sacraments used in the English Church at Geneva, approved and received by the Church of Scotland; whereto, besides that was in the former books, are also added sundry other prayers, with the whole Psalms of David in English metre.* This contained, from the "Old Version," translations of forty Psalms by Sternhold, fifteen by Whittingham, twenty-six by Kethe and thirty-five by Hopkins. Of the remainder two were by John Pulleyn (one of the Genevan refugees, who became archdeacon of Colchester); six by Robert Pont, Knox's son-in-law, who was a minister of the kirk, and also a lord of session; and fourteen signed with the initials I.C., supposed to be John Craig; one was anonymous, eight were attributed to N., two to M. and one to T. N. respectively.

So matters continued in both churches until the Civil War, During, the interval, King James I. conceived the project of himself making a new version of the Psalms, and appears to have translated thirty-one of them—the correction of which, together with the translation of the rest, he entrusted to Sir William Alexander, afterwards earl of Stirling. Sir William having completed his task, King Charles I. had it examined and approved by several archbishops and bishops of England, Scotland and Ireland, and caused it to be printed in 1631 at the Oxford University Press, as the work of King James; and, by an order under the royal sign manual, recommended its use in all churches of his dominions. In 1634 he enjoined the Privy Council of Scotland not to suffer any other psalms, "of any edition whatever." to be printed in or imported into that kingdom. In 1636 it was republished, and was attached to the famous Scottish service-book, with which the troubles began in **1637.** When the Long Parliament

undertook in 1642, the task of choosing between the rival translations of the Psaims by Rouse and Barton, Rouse's version was chosen and was received in Scotland with great favour, which it has ever since retained. The "New Version" of the Psalms, by Dr. Nicholas Brady and the poet-laureate Nahum Tate (both Irishmen), appeared in 1696, under the sanction of an order in council of William III. The relative merits of the "Old" and "New" versions have been very variously estimated. Competent judges have given the old the praise, which certainly cannot be accorded to the new, of fidelity to the Hebrew.

Wither, **Cosin,** Milton and Taylor. — Conspicuous among the sacred poets of the first two Stuart reigns in England was George Wither. His *Hymnes and Songs of the Church* appeared in 1622–1623, under a patent of King James I., by which they were declared "worthy and profitable to be inserted, in convenient manner and due place, into every English Psalm-book to metre." His *Hallelujah* (in which some of the former *Hymnes and Songs* were repeated) followed in 1641. John Cosin, afterwards bishop of Durham, published in 1627 a volume of "Private Devotions," for the canonical hours and other occasions. The hymns of Milton (on the Nativity, Passion, Circumcision and "at a Solemn Music"), written about 1629, in his early manhood, were probably not intended for singing. During the Commonwealth, in 1654, Jeremy Taylor published at the end of his *Golden Grove,* twenty-one hymns.

Restoration Period. — The epoch of the Restoration produced in 1664 Samuel Crossman's *Young Man's Calling,* with a few "Divine Meditations" in verse attached to it; in 1668 John Austin's *Devotions* in *the ancient way of offices, with psalms, hymns and prayers for every day in the week and every holyday in the year;* and in 1681 Richard Baxter's *Poetical Fragments.* In these books there are altogether seven or eight hymns, the whole or parts of which are extremely good.

Dryden, Ken, Patrick and Addison. — Dryden's translation of "Veni Creator" a cold and laboured performance, is to be met with in many hymn-books. Abridgments of Ken's morning and evening hymns are in all. These, with the midnight hymn, which is not inferior to them, first appeared in 1697, appended to the third edition of the author's *Manual of Prayers for Winchester Scholars.* Bishop Patrick's hymns were chiefly translations from the Latin, most of them from Prudentius. The best is a version of *Alleluia dulce carmen.*

Of the five attributed to Addison, not more than three are adapted to public singing; one ("The spacious firmament on high") is a perfect and finished composition, taking rank among the best hymns in the English language.

From the preface to Simon Browne's hymns, published in 1720, we learn that down to the time of Dr. Watts the only hymns known to be "in common use, either in private families or in Christian assemblies," were those of Barton, Mason and Shepherd, together with "an attempt to turn some of George Herbert's poems into common metre," and a few sacramental hymns by authors now forgotten, named Joseph Boyse (1660–1728) and Joseph Stennett. Of the 1,410 authors of original British hymns enumerated in Daniel Sedgwick's catalogue, published in 1863, 1.213 are of later date than 1707; and, if any correct enumeration could be made of the total number of hymns of all kinds published in Great Britain before and after that date, the proportion subsequent to 1707 would be very much larger.

The English Independents, as represented by Dr. Isaac Watts, have a just claim to be considered the real founders of modern English hymnody. Watts was the first to understand the nature of the want, and, by the publication of his *Hymns* in 1707–1709, and *Psalms* (not translations, but hymns founded on psalms) in 1709, he led the way in providing for it. His immediate followers were Simon Browne and Philip Doddridpe. Later in the 18th century, Joseph Hart, Thomas Gibbons, Miss Anne Steele, Samuel Medley, Samuel Stennett, John Ryland, Benjamin Beddome and Joseph Swain succeeded to them.

Isaac Watts. — Among these writers, most of whom produced some hymns of merit, and several are extremely voluminous, Isaac Watts and Philip Doddridge are pre-eminent.

Of the other followers in the school of Watts, Miss Anne Steele (1717–1778) is the most popular and perhaps the best. The influence of Watts was felt in Scotland, and among the first whom it reached there was Ralph Erskine. This seems to have been after the publication of Erskine's *Gospel Sonnets* which appeared in 1732, five years before he joined his brother Ebenezer in the Secession Church. The *Gospel Sonnets* became as some have said, a "people's classic"; but there is in them very little which belongs to the category of hymnody.

Scottish Paraphrases and Methodist Hymns. — Of the contributions to the authorized "Paraphrases" (with the settlement of which committees of the General Assembly of the Church of Scotland were occupied from 1745, or earlier, till 1781), the most noteworthy, besides the two already mentioned, were those of John Morrison and those claimed for Michael Bruce. The obligations of these "Paraphrases" to English hymnody, already traced in some instances (to which may be added the adoption from Addison of three out of the five "hymns" appended to them), are perceptible in the vividness and force with which these writers, while adhering with a severe simplicity to the sense of the passages of Scripture which they undertook to render, fulfilled the conception of a good original hymn. The "Methodist" movement. which began about 1738, afterwards became divided, between those who esteemed Arminian, under John Wesley, those who adhered to the Moravians, when the original alliance between that body and the founders of Methodism was dissolved, and the Calvinists, of whom Whitfield was the leader, and Selina, countess of Huntingdon, the patroness. Each of these sections had its own hymn-writers, some of whom did, and others did not, secede from the Church of England. The Wesleyans had Charles Wesley, Robert Seagrave and Thomas Olivers; the Moravians, John Cennick, with whom, perhaps, may be classed John Byrom, who imbibed the mystical ideas of some of the German schools; the Calvinists, Augustus hfontague Toplady, John Berridge, William Williams, Martin Madan, Thomas Haweis, Rowland Hill, John Newton and William Cowper.

Among all these writers, the palm undoubtedly belongs to Charles Wesley. In the first volume of hymns published by the two brothers are several good translations from the German, believed to be by John Wesley, who, although he translated and adapted, is not supposed to have written any original hymns; and the influence of German hymnody, particularly of the works of Paul Gerhardt, Scheffler, Tersteegen and Zinzendorf, may be traced in a large proportion of Charles Wesley's works.

The Moravian Methodists produced few hymns now available for general use. The best are Cennick's "Children of the heavenly King" and Hammond's "Awake and sing the song of Moses and the Lamb," the former of which (abridged), and the latter as varied by Madan, are found in many hymn-books, and are deservedly esteemed. John Byrom, whose name we have thought it convenient to connect with these, was the author of a Christmas hymn ("Christians awake, salute the happy morn") which enjoys great popularity.

The contributions of the Calvinistic Methodists to English hymnody are of greater extent and value. Few writers of hymns had higher gifts than Toplady, author of "Rock of ages," by some esteemed the finest in the English language.

Berridge, William Williams (1717–1791) and Rowland Hill, all men remarkable for eccentricity, activity and the devotion of their lives to the special work of missionary preaching, though not the authors of many good hymns, composed, or adapted from earlier compositions, some of great merit.

Cowper and Newton. — If, however, the number as well as the quality of good hymns available for general use is to be regarded, the authors of the *Olney Hymns* are entitled to be placed at the head of all the writers of this Calvinistic school. The greater number of the *Olney Hymns* are, no doubt, homely and didactic; but to the best of them, and they are no inconsiderable proportion, the tenderness of Cowper and the manliness of John Newton (1725–1807) give the interest of contrast, as well as that of sustained reality. *The Remains of Henry Kirke White,* published by Southey in 1807, contained a series of hymns, some of which are

still in use; and a few of Bishop Heber's hymns and those of Sir Robert Grant, which, though offending rather too much against John Newton's canon, are well known and popular, appeared between 1811 and 1816, in the *Christian Observer.* In John Bowdler's *Remains,* published soon after his death in 181j, there are a few more of the same, perhaps too scholarlike, character. But the chief hymn-writers of that period were two clergymen of the Established Church—one in Ireland, Thomas Kelly, and the other in England, William Hurn—who both became Nonconformists, and the Moravian poet, James Montgomery (1771–1854), a native of Scotland.

Collections of Hymns.—During this period, the collections of miscellaneous hymns for congregational use, of which the example was set by the Wesleys, Whitfield, Toplady and Lady Huntingdon, had greatly multiplied; and with them the practice (for mhich, indeed, too many precedents existed in the history of Latin and German hymnody) of every collector altering the compositions of other men without scruple, to suit his own doctrine or taste; with the effect, too generally, of patching and disfiguring, spoiling and emasculating the works so altered, substituting neutral tints for natural colouring, and a dead for a living sense. In the Church of England the use of these collections had become frequent in churches and chapels, principally in cities and towns, where the sentiments of the clergy approximated to those of the Nonconformists.

Two publications, which appeared almost simultaneously in 1827—Bishop Heber's *Hymns,* with a few added by Dean Milman. and John Keble's *Christian* Year—introduced a new epoch, breaking down the barrier as to hymnody which had till then existed between the different theological schools of the Church of England. In this movement Richard Mant, bishop of Down, was also one of the first to co-operate. It soon received a great additional impulse from the increased attention which, about the same time, began to be paid to ancient hymnody, and from the publication in 1833 of Bunsen's *Gesangbuch.* Among its earliest fruits was the Lyra *apostolica,* containing hymns, sonnets and other devotional poems, most of them originally contributed by some of the leading authors of the *Tracts for the Times* to the *British Magazine;* the finest of mhich is the pathetic "Lead, kindly light, amid th' encircling gloom." by Cardinal Kewman—well known, and universally admired. From that time hymns and hymn-writers rapidly multiplied in the Church of England, and in Scotland also. Works, critical and historical, upon the subject of hymns, also multiplied; and collections for church use have become innumerable—several of the various religious denominations. and many of the leading ecclesiastical and religious societies, having issued hymn-books of their onn, in addition to those compiled for particular dioceses, churches and chapels, and to books (like *Hymns Ancient and Modern,* published 1861, supplemented 1889, revised edition, 1905) which have become popular uithout any sanction from authority. Among the best known American hymn-writers are John Greenleaf Whittier, Bishop Doane, Dr. W. 4. Muhlenberg and Thomas Hastings; and it is difficult to praise too highly such works as the Christmas hymn. "It came upon the midnight clear," by Edmund H. Sears: the Ascension hymn, "Thou, who didst stoop below," by Mrs. S. E. Miles; two by Dr. Ray Palmer, "My faith looks up to Thee, Thou Lamb of Calvary," and "Jesus, Thou joy of loving hearts," the latter of which is the best among several good English versions of *Jesu, dulcedo, cordium;* and "Lord of all being, throned afar." by Oliver Wendell Holmes.

The more modern "Moody and Sankey" hymns *(see* MOODY, DWIGHT LYMAN) popularized a new Evangelical type, and the Salvation Army has carried this still farther.

The object aimed at in this article has been to trace the general history of the principal schools of ancient and modern hymnody, and especially the history of its use in the Christian church. For this purpose it has not been thought necessary to give any account of the hymns of Racine, Madame Guyon and others, who can hardly be classed with any school, nor of the works of Caesar Malan of Geneva (1787–1864) and other hymn-writers of the Reformed churches in Switzerland and France.

BIBLIOGRAPHY.—I. Ancient.—George Cassander, *Hymni ecclesiastici* (1556); A. J. Rambach, *Anthologie christlicher Gesange* (1817); H. A. Daniel, *Thesaurus hymnologicus* 5 vols. (1841–56); J. M. Neale, *Hymni ecclesiae et sequentiae* (1851–52); and *Hymns of the Eastern Church* (1863). The dissertation prefixed to the second volume of the *Acta sanctorum* of the Bollandists; Cardinal J. B. Pitra, *Hynznographie de l'église grecque* (1867), *Analecta sacra* (1876); *W.* Christ and M. Paranikas, *Anthologia Graeca carminum Christianorum* (1871); F. A. March, *Latin Hymns with English Notes* (1875); R. C. Trench, *Sacred Latin Poetry* 4th ed. (1874); J. Pauly, *Hynzni breviarii Romani,* 3 vol. (1868–70); A. W. F. Fischer, *Kirchertlieder-Lexicon* (1878–79); J. Kayser, *Beiträge zur Geschichte der altesten Kirchenhyrnnen* (1881); M. Manitius, *Geschichte der christlichen lateinischen Poesie* (1891); John Julian, *Dictionary of Hymnology* (1892, new ed. 1907). For criticisms of metre, *see* also Huemer, *Untersuchungen über die altesten christlichen Rhythmen* (1879); *E.* Bouvy, *Poètes et mélodes* (1886); C. Krumbacher, *Geschichte der byzantinischen Literatur* p. 700 *seq.* (1897); and D. J. Donahoe, *Early Christian Hymns* (1909).

II. Mediaeval.—Walafrid Strabo's treatise, ch. 25, *De hymnis, etc.* Radulph of Tongres, *De psaltario observando* (14th century); Clichtavaens, *Elucidatoriunz ecclesiasticunz* (1556); Faustinus Arevalus, *Hymnodia Hispanica* (1786); *E.* du Méril, *Poésies populaires latines antérieures au XIII^e siècle* (1843); J. Stevenson, *Latin Hymns of the Anglo-Saxon Church,* Surtees Society (1851); Norman, *Hymnarium Sarisburiense* (1851); J. D. Chambers, *Psalter, etc.,* according *to* the Sarum use (1852); F. J. Mone, *Lateinische Hymnen des Mittelalters,* 3 vols. (1853–55); Ph. Wackernagel, *Das deutsche Kirchenlied von der altesten Zeit bis zum Anfang des 17. Jahrhunderts,* vol. i. (1864); E. Diimmler, *Poetae latini aevi Carolini* (1881–90); the *Hynznologische Beiträge: Quellen und Forschungen zur Geschichte der lateinischen Hymnendichtung,* ed. by C. Blume and G. M. Dreves (1897); G. C. F. Mohnike, *Hynznologische Forschungen; Das katholische deutsche Kirchenlied* (vol. i. by K. Severin Meister, 1862, vol. ii. by W. Baumker, 1883); the "Hymnodia Gotica," *Mozarabische Hymnen des altspanischen Ritus,* vol. xxvii. (1897); J. Dankó, *Vetus Hymnarium ecclesiasticae Hungariae* (1893); *J.* H. Bernard and R. Atkinson, *The Irish Liber Hymnorum,* 2 vols. (1898); C. A. J. Chevalier, *Poésie liturgique du moyen âge* (1893).

III. Modern.—J. C. Jacobi, *Psalmodia Germanica* (1722–25 and 1732, with supplement added by J. Haberkorn, 1765); F. A. Cunz, *Geschichte des deutschen Kirchenliedes* (185j); Baron von Bunsen, *Versuch eines allgemeinen Gesang- und Gebetbuches* (1833), and *Allgemeines evangelisches Gesang- und Gebetbuch* (1846); Catherine Winkworth, *Christian Singers of Germany* (1869) and *Lyra Gernzanica* (1855); Catherine *H.* Dunn, *Hymns from the German* (1857); Frances E. Cox. *Sacred Hymns from the German* (1841); Massie, *Lyra domestica* (1860); *Appendix on Scottish Psalmody* in D. Laing's edition oi Baillie's *Letters and Journals* (1841–42); J. and C. Wesley, *Collection of Psalms and Hymns* (1741); Josiah Miller, *Our Hymns, their Authors and Origin* (1866); John Gadsbp, *Memoirs of the Principal Hymn-writers* (3rd ed., 1861); L. C. Biggs, Annotations to *Hymns Ancient and Modern* (1867); Daniel Sedgwick, *Comprehensive Index of Names of Original Authors of Hymns,* 2nd ed. (1863); R. E. Prothero, *The Psalms in Human Life* (1907); *C.* J. Brandt and L. Helweg, *Den danske Psalmedigtning* (1846–47); J. N. Skaar, *Norsk Salmehistorie* (1879–80); *H.* Schiick, *Svensk Literaturhistoria* (1890); Rudoli Wolkan, *Geschichte de deutschen Literatur in Bohnzen,* 246–256, and *Das deutsche Kirchenlied der bohnz. Briider* (1891); Zahn, *Die geistlichen Lieder der Brüder in Bohmen, Mähren u. Polen* (1875); and J. Müller, "Bohemian Brethren's Hymnody," in J. Julian's *Dictionary of Hymnology.*

For account of hymn-tunes, etc., *see* W. Cowan and James Love, *Music of the Church Hynznody and the Psalter in Metre* (1901); and Dickinson, *Music in the History of the Western Church* (1902); S. Kümmerle, *Encyklopadie der evangelischen Kirchenmusik,* 4 vols. (1888–95); Chr. Palmer, *Evangelische Hynznologie* (1865); and P. Utto Kornmuller, *Lexikon der kirchlichen Tonkunst* (1891); *F.* J. Sillman, *The Story of Our Hymns* (1921); H. E. Langhorne, *Some Favourite Hymns* (1924)

HYNDMAN, HENRY MAYERS (1842–1921). founder of British socialism, was born in London on March 7, 1842. the son of a wealthy man. He was educated at Trinity college, Cambridge and traveled extensively. He was deeply influenced by the Paris Commune and in 1881 joined with several extreme radicals in forming the London Democratic federation which advocated views which were practically socialist. For its first conference (June 1881) he wrote *England for All,* the first socialist book published in England since the collapse of Owenism. In this he expounded the views of Karl Marx, which he now finally adopted. But as he omitted to make what Marx ,felt was the necessary acknowledgment of his indebtedness, Marx was offended and Engels. who disliked Hyndman, deliberately widened the breach. The chief. and indeed only exponent of Marxism in the country where Marx lived was thus not on speaking terms with his leader. This, however, did not stop the spread of Marxist socialism. The

Democratic federation in 1884 became the Social Democratic federation (S.D.F.) and nearly all the prominent socialists of the new generation, except J. Keir Hardie, were molded by Hyndman. William Morris, John Burns, Tom Mann, H. H. Champion, George Lansbury and Harry Quelch were among his colleagues and pupils. But it was significant of Hyndman's failings that of these named above only one succeeded in working with him for any long space of time. Hyndman remained always an aristocrat among the Socialists. He was proud and dominant in his manners, intellectually intolerant, and resentful of criticism or disagreement. Even when distributing leaflets announcing meetings he always wore a top hat and frock-coat, and he frequently in Trafalgar square or elsewhere, taunted his ragged audiences with being such fools as to provide the money on which such as he could dress so well. But the qualities of his defects were also present—his indomitable energy which enabled him to create a Socialist movement almost from the void, his self sacrifice and patience, and his uprightness and hatred of compromise and of loose thinking. In the late 1880s the Socialist and unemployed movement blew suddenly up to an enormous size; the riots in Trafalgar square mere succeeded by the famous dock strike (1889); and for a short while public opinion, hostile or friendly, magnified the importance of the S.D.F. and its leader, whom it credited with the control and inspiration of these occurrences. With the return of better trade in the 1890s the explosive period of Hyndman's career ended, though he incurred plenty of hostility by his denunciation of the Boer War.

Hyndman was severely critical of the policy of both the Independent Labour party and the Labour party, and till 1914 was the acknowledged chief of a small, but hard working and influential party of doctrinaire revolutionaries. But on the outbreak of World War I, to the surprise of his followers, he became a strong nationalist, and later on equally vehement anti-Bolshevik. For the first time he was unable to carry his party with him: in 1915 the British Socialist party (as it had become) ousted him and his sympathizers from control. They formed a small group known as the National Socialist party. He expounded his new views in *The* Evolution of Revolution (1920). Hyndman died on Nov. 22, 1921.

HYOGO, a former town of Japan in the prefecture of Hyogo, on the western shore of the bay of Osaka, 21 mi. W. of Osaka. Pop. (1955) 211,414. The town is now incorporated in Kobe (*q.v.*) Hyogo has several temples of interest, one of which has near it a huge bronze statue of Buddha, while by the Minatogawa, which flows into the sea between Hyogo and Kobe, a temple commemorates the spot where Kusunoki Masashige, the mirror of Japanese loyalty, met his death in battle in 1336. The temple of Ikuta was, according to tradition, erected on the site of the ancient fane built by Jingo on her return from Korea in the 3rd century.

MYOSCINE: see SCOPOLAMINE.

HYOSCYAMINE, the chief alkaloid occurring in the leaves and tops of henbane, deadly nightshade (belladonna) and Jimson weed. It is a powerful poison and the major natural source of atropine, its racemic form (see STEREOCHEMISTRY). Hyoscyamine occurs in the plant sources almost entirely as the levorotatory form l-hyoscyamine, which is converted to atropine, containing both levorotatory (l) and dextrorotatory (d) molecules, during the process of extraction or by the action of dilute alkali. The d-isomer does not exist free in nature. In its action on nerve endings, l-hyoscyamine is about twice as potent as atropine, the *d*-isomer being almost inactive; the two isomers, however, exert almost equal effects on the brain and spinal cord. Thus *l*-hyoscyamine is almost entirely responsible for the peripheral actions of atropine, but the two isomers contribute equally to the action on the central nervous system. The difference in potency between d- and l-hyoscyamine is attributed to differences in their rates of chemical breakdown in the body, as well as to differences in their ability to reach the sites in the body where they exert their effects.

See also ALKALOIDS; ATROPINE; HENBANE. (V. E.)

HYPAETHRUS, an architectural term used by Vitruvius for an opening in the roof to admit light. Alternative forms are hypaethros and hypaethrum. Many students of Greek temples, especially James Fergusson and T. J. Hittorff, basing their conclusions upon the Vitruvian reference to such a hypaethrus in the temple of Zeus Olympius at Athens, and upon coping tiles found in the temple at Aegina, have concluded that all Greek temples had some such method of admitting light. Moreover, late Greek tombs at Cyrene and Alexandria show raised copings in the centre of the roof as if for such an opening. And according to Strabo (c. 50 B.C.), the temple of Apollo Didymaeus at Miletus (second half of 4th century B.C.) had its entire vast cella open to the sky and planted with groves of laurel. Pausanias, however, states that this temple was never completed; if this is so a roof may have been planned originally.

Modern consensus is counter to the idea that the hypaethrus was a common feature. No arrangements for drainage have been found in connection with Greek temples, and the very reference of Vitruvius on which the speculations of Fergusson, Hittorff and others are based seems to point to the arrangement as exceptional enough to warrant mention, and used only in the largest buildings. Thus the ordinary temple would be lighted only by the enormous doorway; certainly light thus obtained would furnish a more beautiful and impressive illumination than any direct glare from above. (T. F. H.)

HYPATIA (d. A.D. 415), who was a typical representative of Alexandrian Neoplatonism (*q.v.*), was the daughter of Theon of Alexandria, a writer on mathematics from whom she seems to have derived an interest in the subject. She is said to have occupied the chair of Platonic philosophy at Alexandria and to have lectured on Plato, Aristotle and other philosophers. Her most notable pupil was Synesius of Cyrene, who became bishop of Ptolemaïs *c.* 411 and whose affectionate and admiring letters to her are the main source of information about her personality. This close friendship between the pagan Neoplatonist teacher and the Christian Neoplatonist pupil illustrates one aspect of the complex relationship between Christians and pagans at Alexandria under the Christian Roman empire, the close and fruitful contact, so important for later developments, of Christianity with pagan philosophy.

Hypatia's cruel murder in 415, by a Christian mob in the course of a characteristic Alexandrian riot, shows another. The notice of Hypatia in Suidas gives the titles of several of her works. all now lost. They are mathematical and astronomical commentaries: the existence of any strictly philosophical works is not known. Available information about her suggests that her philosophy was the embodiment of Alexandrian Neoplatonism, which was more scholarly and more scientific in its interests, less given to metaphysical elaboration and less intransigently pagan than the Athenian school. whose greatest philosopher was Proclus.

See F. Ueberweg, ed. by K Praechter, *Die Philosophie* des *Altertums (1926)*; also K. Praechter, "Hypatia," in Pauly-Wissowa, *Real Encyclopädie der classichen Altertumswissenschaft,* vol. ix (1914). Charles Kingsley's historical romance *Hypatia* (1853) is to be recommended rather as an illustration of the mentality of the author and his period than as a source of reliable information about Hypatia and 5th-century Alexandria. (A. H. AG.)

HYPERBOLA. This geometric. two-branched curve is a conic section (*q.v.*) obtained by the intersection of any circular cone with a plane cutting both nappes of the surface (fig. 1). It may be defined as the locus of a point whose distances from two fixed points F and *F′*, the foci, have a constant difference. This difference is equal to segment *2a* (fig. 2), which is the transverse axis cutting the hyperbola.

Let *O* be the midpoint of the focal segment FF'. The points *A*, *A′* defined by the relation:

$$OA = OA' = a$$

lie on the curve, for

$$AF' - AF = AF' - A'F' = AA' = 2a,$$

and similarly for *A′*. The points *A*, *A′*, called the vertices of the curve, lie inside the focal segment FF' = $2c$; for, if M is any point of the curve, we have in the triangle MFF':

$$2c = FF' > (MF - MF') = 2a.$$

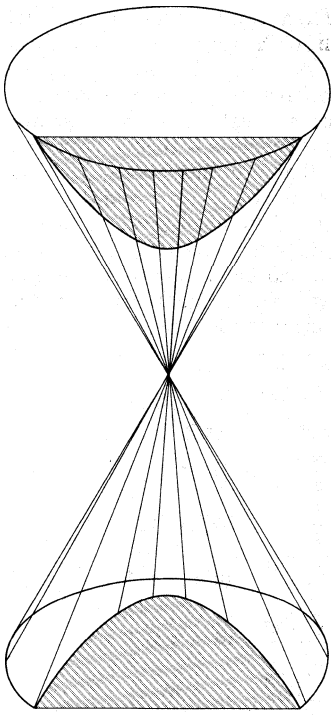


FIG 1.—THE HYPERBOLA AS A CONIC SECTION

Let L be any point on the line FF', outside the segment FF'. The two circles (F, LA), (F', LA') centred at F, F and having for radii LA, LA', respectively, intersect in two points, P, P', belonging to the curve, since

$$PF' - PF = P'F' - P'F = LA' - LA = AA' = 2a.$$

The points of intersection Q, Q' of the circles (F, LA'), (F', LA) are another pair of points of the curve From this construction by points the following properties of the hyperbola are derived: The two infinite branches have no point in common. The line FF' (fig. 2) lies on an axis of symmetry, the transverse (real) axis. The point O is a centre of symmetry and the perpendicular to FF' at O is another axis of symmetry, the conjugate axis, which does not cut the curve, since the difference of the distances of any of its points from the foci is equal to zero. More generally if a point S lies inside either of the two branches of the hyperbola, then $SF - SF' > 2a$; if S lies between the two branches, then $SF - SF' < 2a$.

If the tno axes of symmetry of the hyperbola are taken as co-ordinate axes, the co-ordinates of the foci F and F are, respectively, $(-c, 0)$ and $(c, 0)$. If $M(x, y)$ is a point on the curve, the definition of the curve given above may be translated into the equation:

$$\sqrt{(x-c)^2 + y^2} - \sqrt{(x+c)^2 + y^2} = 2a,$$

which, after simplification, becomes the standard equation of the hyperbola:

$$(1) \qquad x^2/a^2 - y^2/b^2 = 1,$$

where $b^2 = c^2 - a^2$; and, by analogy with the case of the ellipse (*q.v.*); $2b$ is taken as the length of the conjugate axis of the hyperbola.

Two tangents may be drawn from the centre O to the curve. The chord of contact of these two tangents is the line at infinity; in other words, the points of contact of these tangents recede indefinitely. and the tangents are thus the asymptotes of the curve. The equations of the asymptotes are

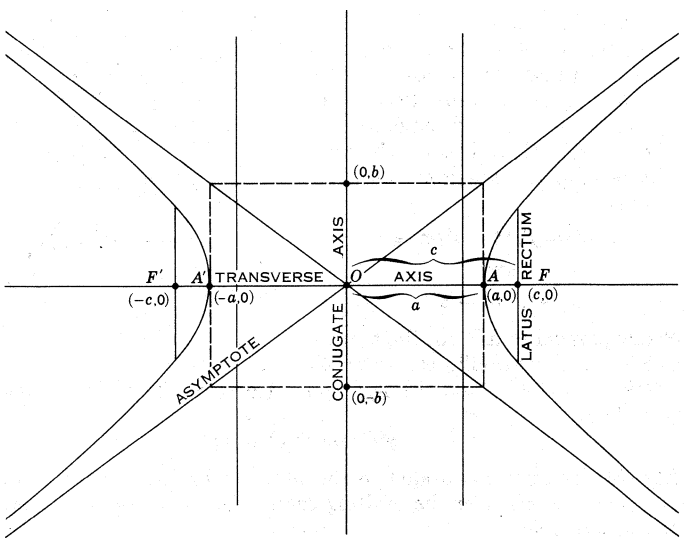


FIG. 2.—GRAPH OF THE HYPERBOLA

$$(2) \qquad ay + bx = 0; \quad ay - bx = 0.$$

The equation

$$y^2/b^2 - x^2/a^2 = 1$$

represents the *conjugate* hyperbola of the one considered, and vice versa. Conjugate hyperbolas are so related that the transverse axis of one is the conjugate axis of the other, and they have common asymptotes.

The tangent to the hyperbola at a point M is the bisector of the external angle formed by the focal radii MF, MF' of the point of contact M. The chord through a focus and perpendicular to the transverse axis is called the *latus rectum*.

The locus of the symmetric of a focus F of the hyperbola with respect to the tangents of the curve is the circle $(F', 2a)$, centred at the other focus F and having for radius the length $2a$ of the transverse axis. The asymptotes of the hyperbola are the perpendiculars dropped from the centre O upon the tangents drawn from the focus F to the circle $(F', 2a)$, or vice versa, from F' to the circle $(F, 2a)$.

The locus of points from which pairs of mutually perpendicular tangents may be drawn to the hyperbola is a circle whose centre coincides with the centre of the hyperbola and the square of whose radius is equal to $a^2 - b^2$.

In equation (1) above, if $b = a$ then that equation becomes

$$x^2 - y^2 = a^2,$$

and the hyperbola is said to be equilateral. with major and minor axes equal. The equations (2) above become $y - x = 0$, $y + x = 0$, showing that the asymptotes of an equilateral hyperbola are perpendicular to each other. If those asymptotes are taken for co-ordinate axes, the equation of the curve takes on the form $xy = k$, k being a constant. Since this equation shows that x and y are inversely proportional, the equilateral hyperbola may be said to be the graph of two inversely proportional variable quantities. *See* also CONIC SECTION; ANALYTIC GEOMETRY; ELLIPSE; PARABOLA; PROJECTIVE GEOMETRY. (N. A. CT.)

HYPERBOLE (Gr. *hyper,* "over", and *ballein,* "to throw"; hence. "in excess"), a figure of speech exaggerating the qualities or importance of a thing or person, used in satire and serious eulogy. Shakespeare's Cleopatra, lamenting Anthony's death, declares. "His legs bestrid the ocean . . ." See FIGURES OF SPEECH: *Figures of Degree of Emphasis.* (G. W. A.)

HYPERBOLIC FUNCTIONS, six functions related to the equilateral hyperbola in a manner analogous to the relation of the trigonometric functions to the circle, as explained later in this article. Two are usually defined by means of the exponential function e^x as follows:

$$\sinh x = \frac{e^x - e^{-x}}{2},$$

$$\cosh x = \frac{e^x + e^{-x}}{2}.$$

The number e is the base of natural logarithms (*2.71828 . . .*). The remaining four functions are defined in terms of sinh x (read "hyperbolic sine of x") and cosh x so that relations analogous to those for the trigonometric functions are obtained. The definitions are:

$$\tanh x = \frac{\sinh x}{\cosh x} = \frac{e^x - e^{-x}}{e^x + e^{-x}},$$

$$\operatorname{ctnh} x = \frac{1}{\tanh x} = \frac{e^x + e^{-x}}{e^x - e^{-x}} \qquad (x \neq 0);$$

$$\operatorname{sech} x = \frac{1}{\cosh x} = \frac{2}{e^x + e^{-x}};$$

$$\operatorname{csch} x = \frac{1}{\sinh x} = \frac{2}{e^x - e^{-x}} \qquad (x \neq 0).$$

The fact that ctnh x and csch x are undefined for $x = 0$ is indicated to the right of their definitions.

Of the six functions, two, cosh x and sech x, are even and the other four are odd. These properties of the functions are ex-

pressed by the equations:

$$\sinh(-x) = -\sinh x;$$
$$\cosh(-x) = \cosh x;$$
$$\tanh(-x) = -\tanh x;$$

and the three that are obtained from these when the reciprocals of the members are taken. Four of the functions have simple values when the argument is zero:

$$\sinh 0 = \tanh 0 = 0, \cosh 0 = \operatorname{sech} 0 = 1.$$

In addition to these relations there are three fundamental identities involving the squares of the functions, viz.,

$$\cosh^2 x - \sinh^2 x = 1;$$
$$1 - \tanh^2 x = \operatorname{sech}^2 x;$$
$$\operatorname{ctnh}^2 x - 1 = \operatorname{csch}^2 x;$$

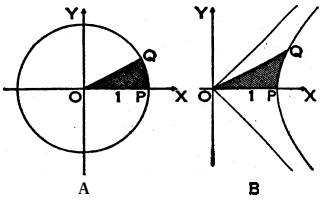
and three important addition formulas:

$$\sinh(x \pm y) = \sinh x \cosh y \pm \cosh x \sinh y;$$
$$\cosh(x \pm y) = \cosh x \cosh y \pm \sinh x \sinh y;$$
$$\tanh(x \pm y) = \frac{\tanh x \pm \tanh y}{1 \pm \tanh x \tanh y}.$$

From these basic identities many others are readily derivable. They all bear the same striking resemblance to trigonometric identities. This is a consequence of the fact that all identities in the trigonometric and hyperbolic functions are valid when the variables are complex and in the domain of complex numbers the functions are related as follows:

$$\sin ix = i \sinh x;$$
$$\cos ix = \cosh x;$$
$$\tan ix = i \tanh x;$$
$$\operatorname{ctn} ix = -i \operatorname{ctnh} x;$$
$$\sec ix = \operatorname{sech} x;$$
$$\csc ix = -i \operatorname{csch} x$$

If in any trigonometric identity the variables x, y, . . . are replaced by ix, iy, . . . , respectively, and substitutions are then made from these equations between the two sets of functions, the trigonometric identity is transformed into an identity for hyperbolic functions. In like manner a hyperbolic identity is transformed into an identity for trigonometric functions by the six relations that are obtained from the above six when sin and sinh, cos and cosh, etc., are interchanged. Corresponding formulas may have different signs in some of the terms because of the occurrence of i^2 which is -1.



ILLUSTRATIONS OF THE PARAMETRIC EQUATIONS OF THE CIRCLE (A) AND THE EQUILATERAL HYPERBOLA (B). *See* TEXT FOR FURTHER EXPLANATION

Trigonometric and hyperbolic functions of complex numbers may be evaluated by means of the addition formulas and the relations between the hyperbolic and trigonometric functions. For example:

$$\sin(a+bi) = \sin a \cosh b + i \cos a \sinh b;$$
$$\cos(a+bi) = \cos a \cosh b - i \sin a \sinh b;$$
$$\sinh(a+bi) = \sinh a \cos b + i \cosh a \sin b;$$
$$\cosh(a+bi) = \cosh a \cos b + i \sinh a \sin b.$$

The quantities in the right members are obtainable from tables for the trigonometric functions and from similar tables for the hyperbolic functions. Another interesting consequence of the relation between the two sets of functions is that, although the hyperbolic functions have no real period, they are nevertheless periodic with an imaginary period πi for tanh x and ctnh x, and $2\pi i$ for the other four functions.

The inverse hyperbolic sine of x is written $\sinh^{-1}$ x. It is defined in the usual manner as the function for which $\sinh(\sinh^{-1} x) = x$ is an identity in x. In the domain of reals, the inverse exists as a continuous, real, single-valued function for all real values of its argument. There are two continuous, real, single-valued functions for which $\cosh(\cosh^{-1} x) = x$ is an identity in x. One is positive-valued and the other negative. It is customary to denote the positive-valued inverse function by $\cosh^{-1} x$, which is defined for all real values of x greater than or equal to 1. The other inverse function is then $-\cosh^{-1}$ x. Likewise sech x has two inverses that are continuous, real and single-valued; the positive one is denoted by $\operatorname{sech}^{-1} x$ and the negative one by $-\operatorname{sech}^{-1}$ x. Both are defined on the interval $0 < x < 1$. Each of the remaining three functions has one continuous, real, single-valued inverse defined on the real domain that is indicated at the right in the equations below. These equations relate the inverse hyperbolic functions to the logarithmic function.

$$\sinh^{-1} x = \ln(x + \sqrt{x^2+1});$$
$$\cosh^{-1} x = \ln(x + \sqrt{x^2-1}) \quad (x \geqq 1);$$
$$-\cosh^{-1} x = \ln(x - \sqrt{x^2-1}) \quad (x \geqq 1);$$
$$\tanh^{-1} x = \tfrac{1}{2} \ln \frac{1+x}{1-x} \quad (|x| < 1);$$
$$\operatorname{ctnh}^{-1} x = \tfrac{1}{2} \ln \frac{x+1}{x-1} \quad (|x| > 1);$$
$$\operatorname{sech}^{-1} x = \ln \frac{1+\sqrt{1-x^2}}{x} \quad (0 < x \leqq 1);$$
$$-\operatorname{sech}^{-1} x = \ln \frac{1-\sqrt{1-x^2}}{x} \quad (0 < x \leqq 1);$$
$$\operatorname{csch}^{-1} x = \ln \frac{1+\sqrt{1+x^2}}{x} \quad (x > 0);$$
$$\operatorname{csch}^{-1} x = \ln \frac{1-\sqrt{1+x^2}}{x} \quad (x < 0).$$

For complex values of x the inverse hyperbolic functions have infinitely many complex values.

Parametric equations for the circle $x^2 + y^2 = a^2$ are $x = a \cos u$, $y = a \sin u$. Likewise, parametric equations for the equilateral hyperbola $x^2 - y^2 = a^2$ are $x = a \cosh u$, $y = a \sinh u$. When $a = 1$ the variable u has, for the circle, three possible geometric interpretations. The usual one is the angle POQ in figure **(A).**

It may also be taken as the length of the arc PQ and as twice the area of the sector POQP in the same figure. The latter is the trigonometric analogue of the geometric interpretation of u in the parametric equations for an equilateral hyperbola $x^2 - y^2 = 1$. For the hyperbola, u in $x = \cosh u$, $y = \sinh u$ is twice the area of the sector POQP, see figure (B). The formulas for the derivatives, integrals and power series expansions of the hyperbolic functions are obtainable from standard mathematical tables. See also TRIGONOMETRY: Trigonometric Functions. (R. W. BD.)

HYPERBOLOID, in geometry, either of two open centric surfaces of the second degree (conicoids, quadrics). The general equation of such centrics takes the form

$$Ax^2 + By^2 + Cz^2 = 1,$$

where A, B, C may have four orders of signs: $+\ +\ +$ (ellipsoid) and $-\ -\ -$ (a nowhere ellipsoid, with no real points); the other two, $+\ +\ -$ and $+\ -\ -$, yield hyperboloids of one sheet or two sheets. The central rectangular equations may be written

$$x^2/a^2 + y^2/b^2 - z^2/c^2 = 1$$

and

$$x^2/a^2 - y^2/b^2 - z^2/c^2 = 1.$$

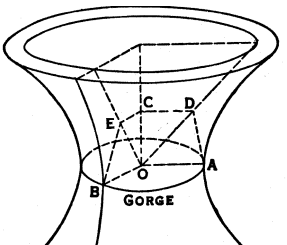


FIG. 1

Planes parallel to XY cut the hyperboloid in similar ellipses, $x^2/a^2 + y^2/b^2 = z^2/c^2 + 1$, and the hyperboloid of two sheets in similar hyperbolas

$$x^2/a^2 - y^2/b^2 = z^2/c^2 + 1;$$

likewise for sections parallel to the other co-ordinate planes. It is simplest to consider the limiting cases, when $a = b = c$. Then the hyperboloid

$$x^2 + y^2 - z^2 = a^2$$

is plainly the "revolute" of the rectangular hyperbola $x^2 - z^2 = a^2$ rotated round the Z-axis, each point (x, z) tracing a circle $x^2 + y^2 = a^2 + z^2$. For $z = 0$, $x^2 + y^2 = a^2$ becomes the minimal circle. The general surface (fig. 1) is found, as in the ellipsoid (*q.v.*), by compression (or expansion) of ally's and *z's* in the ratios b/a and c/a respectively, which yields

$$x^2/a^2 + y^2/b^2 - z^2/c^2 = 1.$$

The "revolute" has as tangent at ∞ the central cone $x^2 + y^2 - z^2 = 0$, which remains tangential in the form

$$x^2/a^2 + y^2/b^2 - z^2/c^2 = 0,$$

after the affine transformation. Rotating the same hyperbola $x^2 - z^2 = a^2$ around X yields the conoid $x^2 - y^2 - z^2 = a^2$, whose asymptotic cone is $x^2 - y^2 - z^2 = 0$. On compression (or expansion) parallel to Y or Z in the ratio b/a, c/a respectively, there results the general hyperboloid of two sheets

$$x^2/a^2 - y^2/b^2 - z^2/c^2 = 1,$$

with its asymptotic cone $x^2/a^2 - y^2/b^2 - z^2/c^2 = 0$ (fig. 2).

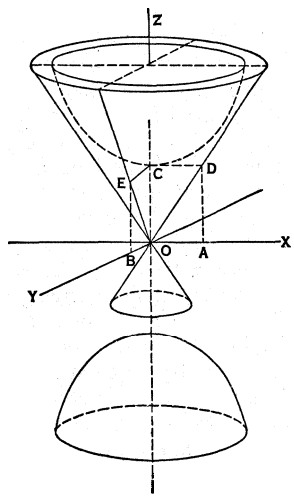


FIG. 2

Surfaces of the second degree are all ruled; *i.e.*, traceable by a right line moving in a definite way. For, combining the two equations of a line and the one of such a surface, we may eliminate two co-ordinates and obtain a resultant equation in one co-ordinate, and this equation, which is of the second degree, vanishes identically when its three coefficients reduce each to 0; and since the equations of the line have four parameters, this reduction is possible in an ∞ of ways; hence, there are ∞ many lines lying on a conicoid, like line elements forming a cone. In the ellipsoid and the hyperboloid of two sheets these lines are imaginary, but in the hyperboloid of one sheet they are real, forming two systems, each line of each system meeting all lines of the other system but none of its own (fig. 3).

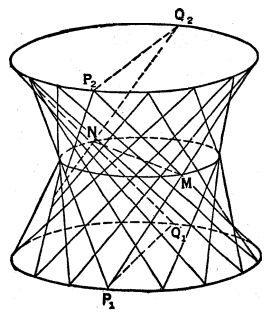


FIG. 3

See MATHEMATICAL MODELS.

HYPERBOREANS, a mythical people intimately connected with the worship of Apollo. Their names do not occur in Homer, but Herodotus (iv, 32) states that they were mentioned in Hesiod and in the Epigoni, an epic of the Theban cycle. According to Herodotus, two maidens, Opis and Arge, and later two others, Hyperoche and Laodice, escorted by five men. called by the Delians Perpherees, were sent by the Hyperboreans with certain offerings to Delos. Finding that their messengers did not return, the Hyperboreans adopted the plan of wrapping the offerings in wheat straw and requested their neighbours to hand them on to the next nation, and so on until they finally reached Delos. The likeliest explanation of their name is "those who carry over." The home of the Hyperboreans was placed in a paradisiacal region beyond the north wind. The duration of their life was 1,000 years, but if any desired to shorten it, he decked himself with garlands and threw himself from a rock into the sea. The close connection of the Hyperboreans with the cult of Apollo may be seen by comparing the Hyperborean myths, the characters of which by their names mostly recall Apollo or Artemis (Agyieus, Opis, Hecaergos, Loxo), with the ceremonial of the Apolline worship.

HYPEREIDES (*c.* 390–322 B.C.), one of the ten Attic orators, was the son of Glaucippus, of the deme of Collytus. He belonged to a wealthy family, was probably a pupil of Plato and of Isocrates and started as a forensic speech writer. His defense of the courtesan Phryne is famous. In 362 B.C. he accused the influential Aristophon of Azenia; he also prosecuted Diopeithes of Sphettos. From 346 to some time before 324 he firmly supported Demosthenes in the struggle against Macedon. In the affair of Harpalus he appeared as one of the ten public prosecutors of Demosthenes. He had probably come to consider Demosthenes too tame an opponent of Alexander. During the Lamian war Hypereides was the leader of the patriotic party and pronounced the funeral oration over the men who fell for Athens. After the defeat of Crannon (322) he fled but was captured and put to death by Antipater.

Hypereides was an ardent pursuer of "the beautiful": his temoer was easygoing and humorous. In his development of the periodic sentence he followed Isocrates, but the essential tendencies of his style are those of Lysias, whom he surpassed, however, in the richness of his vocabulary and in the variety of his powers. His diction nas plain and forcible and his composition simple.

See editions by F. G Kenyon (1906) and by F. Blass and C. Jensen (1917). G. Colin's edition (1946) is provided with a French translation. See also F Blass, *Attische Beredsamkeit,* 2nd ed, vol. iii (1898) ; R C. Jebb, *Attic Orators,* 2nd ed, vol. ii (1893). (A. D. Mo.; X.)

HYPERION, in Greek mythology, one of the Titans, son of Uranus and Ge and father of Helios, the sun-god. The name is often used as an epithet of Helios, who is himself sometimes called simply Hyperion. Its meaning may be "son of Hyperos"; *i.e.,* of him who is above (heaven).

HYPERSTHENE: see PYROXENXTE.

HYPERTROPHY AND HYPERPLASIA are descriptive terms commonly used in medical terminology with no uniformly accepted precise meaning. They are used in both noun and adjective forms to describe changes in cells, tissues, organs and structures. Hypertrophy generally implies excessive size of a cell, tissue, organ or structure, whereas hyperplasia implies an increase in number of cells, with no connotation of cell abnormality. These terms are not commonly used to describe tumours or inflammatory swellings.

The causes are varied and manifold and the resultant hypertrophy and hyperplasia may be within physiologic limits, but ordinarily some abnormal condition exists. (F. L. A.; X.)

HYPNOSIS (HYPNOTISM) is the term applied to a unique, complex form of unusual but normal behaviour which can probably be induced in all normal persons under suitable conditions and also in many persons sufiering from various types of abnormality. It is primarily a special psychological state with certain physiological attributes, resembling sleep only superficially and marked by a functioning of the individual at a level of awareness other than the ordinary conscious state; for convenience in conceptualization, this is called unconscious or subconscious awareness. Functioning at this special level of awareness is characterized by a state of receptiveness and responsiveness in which inner experiential learnings and understandings can be accorded values comparable with or even the same as those ordinarily given only to external reality stimuli.

When hypnotized, or in the hypnotic trance, the subject can think, act and behave in relationship to either ideas or reality objects as adequately as. and usually better than, he can in the ordinary state of awareness. In all probability this ability derives from intensity and restriction of attention to the task in hand, and the consequent freedom from the ordinary conscious tendency to orient constantly to distracting, even irrelevant, reality considerations.

The subject is not. as is commonly and wrongly believed, without will power, or under the power of the hypnotist. Instead, the relationship between the subject and the hypnotist is one of interpersonal co-operation based upon mutually acceptable and reasonable considerations. Hence, the subject cannot be forced, as a function of hypnosis itself, to do things against his will, as is sometimes claimed. He can be aided in achieving possible desired goals, but frequent failures in hypnotherapy attest the limitations of hypnosis in accomplishing even wanted purposes. and extensive and reliably controlled studies discredit the possibilities of antisocial use of hypnosis.

The history of hypnosis is as ancient as that of sorcery, magic and medicine, to the armamentaria of which it belonged. Its scientific history began in the latter part of the 18th century with Franz Mesmer (*q.v.*), a Viennese physician who used it in the treatment of patients. Because of his mistaken belief that it was an occult force, which he termed "animal magnetism," that flowed through the hypnotist into the subject, he was soon discredited; but mesmerism, as it was named after him, continued to interest medical men. Extensive use was made of it by a number of clinicians, without adequate recognition of its nature until the middle of the 19th century when the English physician James Braid studied its phenomena and coined the terms hypnotism and hypnosis.

Thereafter many scientifically trained men studied hypnosis, but not until after World War I was much progress made. This progress derived from the recognition of the re-educative possibilities afforded by hypnosis. World War II gave further impetus to its study, greatly extended its recognition and utilization and freed it from many of the superstitions, fears and misconceptions that had hampered its scientific acceptance and investigation. The next significant developments in the history of hypnosis occurred in the mid-1950s when both the British and American Medical associations formally approved its medical use and discountenanced its use by the laity. At that period also was organized the American Society of Clinical Hypnosis, with international scientific societies.

Hypnotic Technique.— Popular belief still ascribes significance to magical devices and rituals such as "making passes" or stroking the body, the use of "hypnotic crystals," the "eagle eye" and the "hypnotic command," all of which belong to the charlatan's stock in trade. Actually, the important consideration in inducing hypnosis is that the subject be willing, co-operative and interested in learning a new experience. To such a subject a trusted operator can progressively, persuasively and repetitiously suggest tiredness, relaxation, eye closure, loss of interest in externalities and an increasingly absorbing interest in inner experiential processes, until the subject can function with increasing adequacy at the level of unconscious awareness. The length of time required to induce a trance differs greatly with subjects and with trance situations, and the time spent should be in reasonable accord with both the importance and the specific character of the hypnotic work to be done. The charlatan boasts of his speed; the scientist considers time an important variable. Thus, the dentist might need only a few minutes to induce the trance state requisite to permit a simple tooth extraction; the psychologist might need an hour to effect those psycho-neuro-physiological responses needed for a long, involved laboratory experiment; and the hypnotherapist, because of his patient's needs, might distribute over a period of months the development of a trance state otherwise possible in a short period of time.

Another essential element in technique—for either investigative or therapeutic work—is the utilization of the subject's own patterns of learning and response, rather than an attempt to force upon him by suggestion the hypnotist's limited comprehension of what constitutes experiential validity for the subject. Failures in hypnotic experimentation and therapy often derive from treating the subject as an automaton, expected to execute commands in accord with the hypnotist's understanding, rather than as a personality with individual patterns of response and behaviour.

Hypnotic Phenomena.— Hypnotic phenomena differ from one subject to another and from one trance to another, depending upon the purposes to be served and the depth of the trance. Hypnosis is a phenomenon of degrees, ranging from light to profound trance states but with no fixed constancy. There are, however, certain basic manifestations, the extent and clarity of which vary. Foremost among these is rapport, which signifies the limitation of the subject's awareness to that which is included in the hypnotic situation. Usually the subject responds only to stimuli from the hypnotist, who may limit or direct the subject's awareness or responsiveness as is desired or needful. However, in accord with personality needs or the demands of the situation, the subject may remain in or actively establish contact with part or all of the circumstances surrounding the trance.

Catalepsy. another hypnotic manifestation, is properly tested only indirectly, since direct tests may elicit it as a responsive rather than as a spontaneous phenomenon. Catalepsy is a state of balanced muscle tonicity which permits great economy of effort, allowing the subject to maintain postures and positions for unusually long periods of time.

Suggestibility. a state of greatly enhanced receptiveness and responsiveness to suggestions and stimuli, constitutes the central phenomenon of hypnosis. It is characterized by the remarkable facility with which the subject can respond to either external stimuli or those deriving from inner experiential acquisitions. However, suggestions must be acceptable to the subject, and rejection of them can be based upon whim as easily as upon sound reasons. By acceptance of and response to suggestions. the subject can become psychologically deaf, blind, hallucinated, amnesic, anesthetic or dissociated, or he can develop various special types of behaviour regarded by him as reasonable or desirable in the given situation.

The psychological processes involved are essentially those of vivification of memories, ideas. understandings, emotions—indeed, any type of experiential acquisition—so that they are experienced subjectively as deriving from external events rather than from internal processes. This is the feature of hypnosis most often abused by the charlatan, and it is also the feature that permits the greatest accomplishments in psychology, dentistry and medicine. (See also SUGGESTION AND SUGGESTIBILITY.)

A most fascinating manifestation, also of great scientific importance, is that of posthypnotic suggestion and behaviour. By this is meant the execution, at some later time, of instructions and suggestions given in a trance and intended to become a part, either interpolated or integrated, of a later activity. For example, a pregnant patient may be instructed posthypnotically to develop, at some future time when labour begins. an obstetrical anesthesia to meet the needs of childbirth. Such use of posthypnotic phenomena offers extensive opportunities for direction and guidance of behaviour in terms of the individual's needs and patterns of response without dependency upon immediate guidance and relationships.

Amnesia of any degree of selectiveness or comprehensiveness may be developed in hypnosis, either spontaneously or by instruction. It may include all the events of the trance state or only selected items, or it may be manifested in connection with matters unrelated to the trance. Hypnotic amnesia is reversible; it may be induced. abolished, reinduced or altered by the operator or by the subject if adequate personal motivation develops. It is very useful in both experimentation and therapy and can be used in a variety of ways. For example, otherwise uncontrollable pain in malignant disease has been partially controlled by use of amnesia.

Conversely, hypermnesia, an ability to remember that transcends the everyday ability is another aspect of hypnotic behaviour that is valuable experimentally and therapeutically. For example, in the trance state, the subject, by virtue of an uncritical willingness to make the effort and a freedom from inhibitions deriving from preformed judgments, can remember vividly long-forgotten, even deeply repressed experiences, recount them in extensive detail and still maintain an amnesia for them at the ordinary level of consciousness. This remarkable ability permits the recovery of memories otherwise unavailable, makes possible extensive exploration of the experiential past, and offers opportunities for studies of basic processes underlying learning and memory.

A striking phenomenon of the profound trance is somnambulism. This is a state of deep hypnosis in which the subject can present the outward appearance and behaviour of ordinary awareness but is able to manifest readily and often spontaneously any type of hypnotic behaviour within his personal capabilities. Some subjects never achieve this state, some reach it with a minimum of effort. It is of great value in certain specialized procedures and studies. Experience and training are often required even to recognize the somnambulistic state, and even more experience is necessary to induce it readily and to utilize it adequately.

Ordinarily all trance behaviour is characterized by a simplicity,

a directness and a literalness of understanding, action and emotional response suggestive of childhood. This is the phenomenon of regression, which can be enhanced so that the subject experiences a retrogressive loss of memories, ,learnings and responses, and those belonging to an earlier age are re-established. When developed carefully, this regression is not a re-enactment or a revivification of the past in terms of current understanding, but a restoration of previous response patterns through a process of amnesic loss of subsequent learning. This manifestation permits extensive exploration of the developmental aspects of the subject's experiential past.

Dissociation. a detachment or separation of subjective from objective values, another highly complicated phenomenon, is of particular significance in effecting specialized learnings (for example, anesthesia or emotional objectivity) without arousing impeding or obstructing subjective reactions—the hypnotized subject, that is, can be made insensitive to a needle prick because the dissociation phenomenon prevents a subjective reaction (pain) from occurring.

Time distortion, first elaborated as a specific scientific concept in the mid-1940s, has proved to be useful in both hypnotic therapy and experimentation. It is essentially a function of speed of cerebration, as a result of which the passage of time is perceived subjectively in terms of inner experiential processes and events. As a consequence, time as a personal experience may be "expanded" or "condensed" with resulting alterations in subjective values and psychological and physiological functioning.

Among other interesting hypnotic manifestations are enhanced visual and auditory imagery, automatic writing, depersonalization. various types of disorientation, and acceleration or inhibition of physiological functions.

Autohypnosis.—Autohypnosis, or self-hypnosis, is both possible and feasible, but it is often a sterile procedure because of misconceptions of its nature and use. Usually the autohypnotist tries too hard to direct *consciously* the activities he wishes to take place at the hypnotic level of awareness, thus nullifying the effort.

Acceptance of autohypnotic processes, rather than attempted direction of them. leads to productive results. Usually autohypnosis is best learned through supervised instruction.

Related Questions.—Certain questions are repeatedly asked about hypnosis. Among these is the possibility of employing hypnosis to commit crimes. The better scientific studies deny this possibility and therapeutic experience discredits it, but a few experimental studies, either inadequately controlled or in protective situations. have resulted in pretended crimes. However, pretense is not reality. nor is hypnosis an essential in pretense.

Concerning harmful effects, none have been reported by earnest students of long experience. but the inexperienced and the armchair theorist are often emphatic in affirming such possibilities. Occasionally an amateur will hypnotize a person suffering from a personality disorder and mistake the evidence of that disorder for hypnotic effects. In this connection may be mentioned the harmfulness of lay hypnosis. This derives not from the hypnosis itself but from the misconceptions promulgated and from the discredit and disrepute that always attend dabbling by the uninformed in. and exploitation by the charlatan of, any field of beneficial learning.

Can hypnosis be induced without the subject's willingness or awareness? Hypnosis is based upon willingness and co-operation. but this may be concealed behind a superficial attitude of unwillingness; similarly, superficial willingness may conceal deep-seated unwillingness; with a consequent failure of trance induction. A trance state cannot be maintained without the subject's consent, actual or implied.

Then there is the question of what would happen if the subject could not be awakened, or if in some way the hypnotist were to be removed. leaving the subject in a trance state. The reply is simply that the trance state, being dependent upon an interpersonal relationship of mutual co-operation, would terminate upon the cessation of that relationship. It is possible to arrange with a subject to remain in a trance in the absence of the hypnotist. but this is merely a form of continued co-operation. Occasionally a subject may refuse through a whim to arouse immediately from a trance, but this is a problem only for the inexperienced and is not significant.

BIBLIOGRAPHY.—J. Milne Bramwell, *Hypnotism: Its History, Practice and Theory* (1903; reissued 1956); L. Chertok, *Psychosomatic Methods in Painless Childbirth: History, Theory and Practice* (1959); G H. Estabrooks, *Hypnotism* (1934; rev. ed. 1957); Lesley Kuhn and Salvatore Russo, *Modern Hypnosis* (1947); Lewis R. Wolberg, *Medical Hypnosis*, 2 vol (1948); Bernard Wolfe and Raymond Rosenthal, *Hypnotism Comes of Age* (1949).

See also the *American Journal of Clinical Hypnosis*, quarterly (July 1958 ff.). (M. H. EN.)

HYPOCAUST, in architecture, an open space below a floor to allow the passage of hot air and smoke in order to heat the room above. This type of heating was developed to a high degree by the Romans who used it not only in the warm and hot rooms of the baths (*q.v.*), but also almost universally in private houses in the northern provinces. Many examples of such hypocausts exist in villa and house foundations in Roman centres in Germany and England. The usual custom was to lead the smoke from a hypocaust into a single vertical flue through which it escaped into the open air. Where greater warmth was desired, several flues would lead up from the hypocaust in the side walls of the room; at times these wall flues consisted of hollow oblong tiles, set close together, entirely around the room. The usual construction of a hypocaust consisted of a layer of tiles, two feet square, laid continuously in a bed of concrete for the bottom surface. Piers approximately eight inches square and about two feet apart were used as the supports. A floor above was made of concrete or of large square tiles supporting a bed of concrete, on which the finished floor of marble, tesserae or mosaic was laid.

HYPOCHONDRIASIS, a medical term, given by the ancients and early physicians to derangements of the abdominal viscera. It is not now used to refer to any actual disease but to a morbid mental symptom which consists in an undue preoccupation in one's own state of health with a tendency to find evidence of disease from insignificant signs. There may arise a settled conviction that disease exists even in their absence. The idea of ill health, however, relates essentially to the internal organs and predominantly to the functioning of the heart. intestinal canal, or genital structures. Such a symptom may occur in many forms of mental illness. It is not infrequently noted in hysterical anxiety and neurasthenic neuroses; in melancholic states, especially those of later years; in dementia praecox; and in the initial stages of such organic psychoses as arteriosclerotic dementia and general paresis.

In other cases hypochondriasis seems to present itself without any other symptom. and though examination reveals no physical abnormality, the assurance of that fact has usually only a temporary effect on the false belief which may lead to self-centredness, depression and insomnia.

It is probable that the hypochondriacal type has a greater sensitivity to sensations emanating from the internal organs, is therefore more easily aware of any change that may occur therein, and so more affected by any possible alteration in their functioning.

Any treatment naturally depends on the associated disease. In its more pure manifestation some form of psychotherapy is indicated. but results are often disappointing. (C. S. R.)

HYPOTHALAMUS is the inferior part of the diencephalon, the portion of the brain that forms a bridge between brain stem and cerebral hemispheres. The pituitary body is attached to its middle portion. The hypothalamus contains nerve fibres and neurons, the latter forming nuclear groups that have elaborate and extensive fibre connections. Information on the physiology of the hypothalamus is largely based on animal experiments, but many of these findings have support from clinical observations in human beings. There is evidence that some of its neurons produce substances that theoretically regulate the secretory activities. of the anterior pituitary, as well as provide the antidiuretic and oxytocic (childbirth-hastening) hormones of the posterior pituitary. After certain specific hypothalamic lesions there may be increased appetite and obesity, while lesions in other areas of the hypothalamus reduce appetite. The hypothalamus is concerned in

regulation of blood pressure, gastrointestinal activity, dilatation of the pupils, etc., as well as other autonomic manifestations that are characteristic of emotional states. It is also concerned with bodily behaviour patterns of emotional type (*i.e.*, rage and fear), and is at the upper end of the reticular formation of the brain stem, which, together with the sensory systems, aids in maintaining the cerebral cortex at a level of activity consistent with consciousness.

Experimental work indicates further that the hypothalamus is connected with the little-known rhinencephalic systems as well as with more recently developed cerebral regions. This adds weight to theoretical concepts that this small region is involved in very extensive neural patterns concerned with the regulation of autonomic and endocrine activity as well as emotional expression.

See also BRAIN; ENDOCRINOLOGY; HORMONES; THALAMUS.

(W. R. IM.)

HYPOTHEC. It is a general principle of the law of Scotland, recognized also by the law of Rome, that a security over movables cannot be constituted without transfer of possession of the movable object from the debtor to the creditor. (The law of England is different: thus the floating charge, so well known in English law, is not recognized in Scotland, since the property covered does not change hands but remains in the possession of the debtor.)

To this general rule the law of Scotland recognizes some exceptions. and most prominent among them is the "hypothec." This may be described as a security constituted over movable property which remains in the possession of the debtor. The cases, however, in which a hypothec arises by force of law—cases of so-called legal hypothec—are limited, although it is competent for the parties covered to assent by express contract to a "conventional" or contractual hypothec. The following paragraphs relate only to legal hypothecs.

The best-known legal hypothec is that of the landlord over movables in leased premises. Similar is that of the superior for his feu-duty. A solicitor has a hypothec, for expenses incurred by him, over expenses awarded to his client by the court. His rights have been extended by statute to cover also property recovered in the action.

In maritime hypothecs a ship and its cargo may be hypothecated by bond granted by the master—a bond of bottomry over the ship and a bond of respondentia over the cargo. Hypothecs, more comtnonly called liens, also exist over a ship for seamen's wages, salvors' claims, repairs and necessaries incurred abroad, and collision damage.

See also LIEN; MORTGAGE. (A. D. G.)

HYPOTHESIS, something supposed or taken for granted, with the object of following out its consequences (Gr. *hypothesis,* "a putting under," the Latin equivalent being *suppositio*).

In planning a course of action, we may consider various alternatives. working out each in detail. Though the word hypothesis is not actually used here, our procedure is just the same as that of an investigator of crime considering various suspects or of a scientist working out various possible explanations of some set of facts. however different the methods used for deciding betneen the various alternatives may be. What is fundamental is the consideration of a supposal as if it were true, without actually accepting it as true.

One of the earliest uses of the word in this sense was in geometry. It is described by Plato in the *Meno* (86e–87a). The most important modern use is in relation to scientific investigation. A scientist is not merely concerned to accumulate such facts as he can discover by observation: he wants to discover the linkages between facts. He is guided by some problem nhich puzzles him; but he needs to have some clue as to what facts will help him to solve his problem.

His best guide is a tentative hypothesis, which fits in with the existing body of doctrine and which is so framed that with its help he can deduce that under certain factual conditions ("initial conditions") certain other facts would be found if the hypothesis were

The concepts involved in the hypothesis need not themselves refer to observable objects. But the initial conditions should be able to he observed or to be produced experimentally, and the deduced facts should be able to be observed. William Harvey's researches on the motion of the heart and blood in animals show how greatly experimental observation can be helped by a fruitful hypothesis.

While a hypothesis can be partially confirmed by showing that what is deduced from it with certain initial conditions is actually found under those conditions, it cannot be completely proved in this way. What would have to be shown is that no other hypothesis would serve.

Hence. in assessing the soundness of a hypothesis, stress is laid on the range and variety of the facts which can be brought under its scope. Again, it is important that it should be capable of being linked systematically with hypotheses which have been found fertile in other fields.

If the predictions derived from the hypothesis are not found to be true. the hypothesis may have to be given up or modified. The fault may lie, however, in some other principle forming part of the body of accepted doctrine which has been utilized in deducing consequences from the hypothesis; or it may lie in the fact that other conditions, hitherto unobserved, are present beside the initial conditions, affecting the result. Thus the hypothesis may be kept, pending further examination of facts or some remodeling of principles.

A good illustration of this is to be found in the history of the corpuscular and the undulatory hypotheses about light.

BIBLIOGRAPHY.—K. R. Popper, *Logik der Forschung* (1935); *W.* C Kneale, *Probability and Induction* (1949); Richard Bevan Braithwaite, *Scientific Explanation;* a *Study of the Function of Theory, Probability and Law in Science* (1953). (L. J R.)

HYPOXANTHINE: *see* PURINES.

HYPOXIA (also called ANOXEMIA or ANOXIA) is a general term comprising those conditions of the body under which the tissues are starved of oxygen. There are four types: (1) The hypoxemic type, in which the oxygen pressure in the blood going to the tissues is too low to saturate the hemoglobin. (2) The anemic type in which, though the hemoglobin is fully charged, there is too little of it, and hence the capacity of the blood to carry oxygen is too low. (3) The stagnant type in which the blood is or may be normal but in which the quantity of blood running through the organ is too small. (4) The histotoxic type in which—as the term suggests—the tissue cells are poisoned (for example, by cyanide) and are, therefore, unable to make proper use of the oxygen.

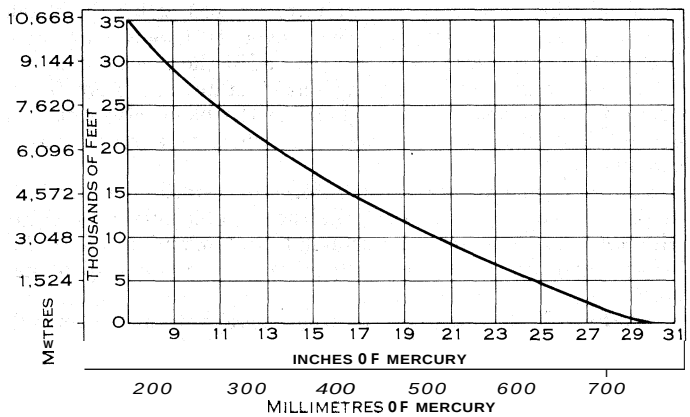
Diseases of the blood, the heart and circulation and the lungs may all produce some form of hypoxia.

Hypoxemia.—Apart from disease conditions, hypoxia is frequently encountered at high altitudes, either in airplanes or on mountains. Between the two there is this distinction—the aviator reaches the rare air suddenly, the mountain climber gradually. Moreover. the aviator reaches it without physical effort, the mountain climber usually as the result of considerable muscular effort. For these reasons the symptoms from which the two classes suffer are different.

The airman loses his faculties if he goes too high. This may amount merely to a loss of judgment or manipulative power, or it may extend to complete loss of consciousness. Because the brain symptoms are the first and most baffling, the use of some system to maintain oxygen pressure is universal in high-flying aircraft.

A person traveling to a high altitude suffers from a somewhat different series of symptoms comprising the condition known as mountain sickness or, in the Andes, *seroche.* In the case of a person traveling by train up to the mining districts about Cerro de Pasco in Peru or up Pikes Peak in Colorado (both 14,000–15,000 ft.) the symptoms usually appear a few hours after arrival, frequently during the night. They are generally a selection from the following: (1) symptoms of the brain—headache, lassitude, fatigue, sleeplessness, visual and auditory impairment and mental depression—symptoms very much like those of an acute attack of migraine; (2) cardiac symptoms—pain in the chest. palpitation, sinus arrhythmia (*i.e.*, irregularity of heart beat); (3) circulatory

symptoms—cold hands and feet, blueness, throbbing; (4) respiratory symptoms—shortness of breath on exertion, change in pattern of breathing, sighing; (j) gastrointestinal symptoms—nausea, vomiting, anorexia. After a residence of two or three days these acute symptoms usually pass off—that is, the subject becomes acclimatized—but no amount of acclimatization makes the human frame at 14,000 ft. as efficient as at sea level. Persons born and raised at this altitude approach sea-level efficiency, but visitors, no



BY COURTESY OF THE CONTROLLER OF H M STATIONERY OFFICE

FIG 1 — CHART SHOWING MEAN ATMOSPHERIC PRESSURE AT DIFFERENT ALTITUDES

The ordinate and abscissa are given both in the metric system and in feet and inches. Ordinate is altitude. Abscissa is atmospheric pressure

matter how long their stay, probably never reach the performance of which they are capable at lower altitudes.

The hurtful results of ascent to high altitudes, whether on a mountain or in an aircraft, are governed by condition of the blood. The processes of oxidation on which life and health depend take place within the tissues of the actual organs concerned—the heart, the brain, the muscles, the glands, etc. Of these, undoubtedly the most vulnerable is the brain. It not only carries out the processes of thought but governs the condition of the rest of the body; *e.g.*, the rate of the pulse, the depth of respiration, etc. Therefore the study of the conditions that produce trouble at high altitudes resolves itself into a study of the adequacy of the oxygen supply of the brain.

Oxygen is transported from the lungs to the brain by the blood. The hemoglobin or red pigment has the ability to form a loose compound with oxygen. Of each 100 g. of hemoglobin leaving the lung, the number of grams that transport oxygen depends upon the pressure of oxygen in the alveoli (air cells of the lung), nhich in turn depends upon its pressure in the air. Oxygen at any altitude is 21% of the local atmospheric pressure, hence the higher the subject ascends the lower will be the oxygen pressure in the air cells of his lungs.

At ordinary atmospheric pressures the oxygen pressure is sufficient nearly to saturate the hemoglobin.

Acclimatization.—The human body is able to make adjustments to a hypoxic condition provided it is not too severe. These adjustments are best understood in relation to hypoxemic hypoxia, most simply seen in ascent to altitude. Some of the adjustments to hypoxia begin the moment the ascent from sea level is started; others appear as the height or the duration of exposure increases. Adaptation enables the organism to withstand better the stress of the hypoxic condition. There are persons in the Chilean Andes who have their homes at 17,500 ft. altitude and who uork in the mines at 19,000 ft. In these persons the process of adaptation has gone more or less to its completion, and it can be said that they are well acclimatized to their hypoxic environment. It is possible that the Andean residents represent not only an individual adjustment but also represent the nearly complete acclimatization of a people.

In the process of acclimatization the disturbing symptoms of exposure to hypoxia disappear as the acclimatization becomes complete. The latter state is characterized by a few simple properties: a normal appetite and with it the maintenance of growth in the immature and stable body weight in the adult; a normal reproductive capacity; and finally, the general well-being common to all healthful living.

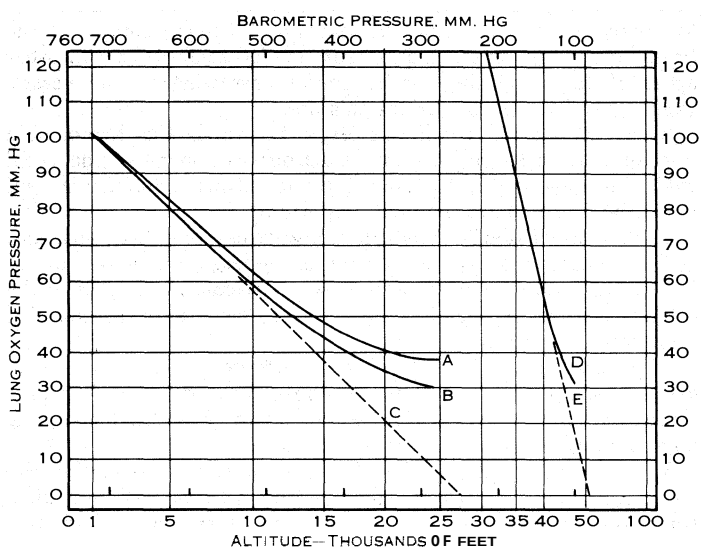
In the adjustment to hypoxia of altitude, and in those illnesses associated with hypoxia, processes are set into motion that eventually raise to more compatible levels the low oxygen pressure of the body tissues. The ventilation of the lungs in breathing becomes more effective as acclimatization develops, and this, directly or indirectly, involves the kidneys, the adrenals and the nervous system. Even before ventilation increases, the heart is required to pump more blood in order to compensate for the lower tension of oxygen in the blood. As the respiratory adaptation proceeds, the demands on the heart and circulation diminish, but whenever the demand on the body is increased, as in exercise, the circulatory system has a heightened capacity. Part of the latter apparently is due to an improved distribution of blood to the tissues consequent to either an increase in the calibre of the small vessels or an increase in their number or both.

One of the earlier adjustments to hypoxia is the increase in the oxygen-carrying compound of the blood—hemoglobin. Low oxygen tension stimulates the red bone marrow (the blood-making tissue) to heightened activity, resulting in increases in the number of circulating red blood cells with their hemoglobin. The end result is that each millilitre of blood can carry more oxygen than it did before, and therefore compensate for the deficient oxygen supply.

The average number of red blood corpuscles in each cubic millimetre of blood at various altitudes is given by Maj. R. W. G. Hingston (1924 Mt. Everest expedition) for the people living on the Pamir plateau:

Altitude (in 000 ft.)	7	8	12	15.6	18.2
Red corpuscles (in 000,000 per cu.mm. of blood)	4.5	6.0	6.8	7.8	8.3

The increased ventilation of the lungs, mentioned above as one of the early adjustments to hypoxemic hypoxia, causes the pressure of oxygen in the lungs to rise. Concomitantly the carbon dioxide in the lungs is blown off at a rate greater than normal, and as a



MODIFIED FROM SCHOOL OF AVIATION MEDICINE, U.S A.F.

FIG. 2.— EFFECTS OF THE ADJUSTMENT TO CHANGES IN ALTITUDE IN SUBJECTS BREATHING AIR OR 100% OXYGEN

(A) Acclimatized subject breathing air; (B) unacclimatized subject breathing air; (C) theoretical response in absence of adaptation of subject breathing air: (D) unacclimatized subject breathing oxygen; (E) theoretical response in absence of adaptation of subject breathing oxygen

consequence the carbon dioxide pressure in the lungs falls. This in turn reduces the carbon dioxide pressure in the arterial blood, which lowers the hydrogen ion concentration.

Since the normal stimulation to breathing is derived from normal carbon dioxide pressure and hydrogen ion concentration in the

blood, the stimulation due to the hypoxia will be less effective. However. as the duration of exposure to hypoxia continues. the kidneys secrete increased quantities of alkali in the urine, so that the hydrogen ion condition of the blood is gradually returned to normal. The hypoxic stimulation of breathing then becomes more effective, so that the lung ventilation is increased and the oxygen pressure heightened.

The above points are illustrated in fig. 2. On the left the lines trace the course of the oxygen pressure in the lungs with ascent to increasing altitude. It is apparent that for the higher altitudes, particularly, the oxygen pressure in the lungs is increased by the heightened lung ventilation in those acutely exposed (compare line B with line C). It may be seen also that for these same altitudes the acclimatized person (line **A)** has a still higher oxygen pressure. The pressure of oxygen in the arterial blood is quite dependent upon that in the lungs. The respiratory adaptation just outlined ensures that the supply of oxygen to the working tissues of the body is improved as the process progresses.

The lines on the right of fig. 2 (D and E) illustrate that ascent can be made to much higher altitudes while breathing 100% oxygen rather than air. Advantage was taken of this fact by the members of the ninth British Everest expedition in 1953—indeed it made possible the reaching of the peak.

Lines D and E also show that the altitude to which ascent can be made by the use of auxiliary oxygen is definitely limited. The lung oxygen pressure (approximately 40 mm. Hg) is about the same at 44,000 ft. breathing oxygen as it is at 17,000 ft. breathing air. In the unacclimatized person either exposure is hazardous because the alveolar oxygen tension is so low.

For airmen who must ascend to altitudes above 44,000 ft. pressurized cabins or suits must be used to provide sufficient air and oxygen pressure.

Anemic **Hypoxia.**—In this condition there is too small a quantity of functional hemoglobin in the blood to supply the oxygen needs. (1) The most obvious form is anemia in which the actual quantity is too small (see ANEMIA). In severe anemia, such as pernicious anemia, the red blood cells may be so reduced in number that the normal complement of oxygen cannot be carried. (2) After severe bleeding there may not be enough blood in the body to support its needs adequately. Under such circumstances the body makes the effort to maintain the blood supply to the brain; other organs are in a measure denied their share. In other areas of the body there is a general narrowing of the vessels (vasoconstriction) that brings this about.

Three important conditions exist in which the hemoglobin present is temporarily put out of action: carbon monoxide (coal gas) poisoning, methemoglobinemia and sulfhemoglobinemia. Of these the first two are the most important.

Carbon monoxide is found in many gases other than coal gas. It is a frequent source of danger in underground mines of all kinds. Incompletely combusted gases, particularly those from the exhaust of internal-combustion engines, have been a cause of numerous fatalities.

Most cases of accidental carbon monoxide poisoning, however, are due to poorly adjusted, unflued space heaters, which can produce fatal concentrations of carbon monoxide from the incomplete combustion of gas which contains none.

In order for a person to lose consciousness, over half of all the hemoglobin in the body must be united with carbon monoxide, thus preventing oxygen transport. A concentration of less than 0.1% of the gas in the atmosphere can bring this about. (See fig. 3, based on the observations of John Scott Haldane.) However, the absorption of an absolute volume of about 500 c.c. of carbon monoxide is required; this will take perhaps 60 minutes. The effect on different persons varies greatly, but speaking in rough terms a saturation of 30% to 40% means a headache afterward, 50% to 60% means unconsciousness and 75% saturation is probably fatal.

Carbon monoxide in the blood is gradually eliminated when air free from the gas is breathed, and is eliminated at a much greater rate when pure oxygen is inhaled. If a subject has been exposed to a dangerous concentration of carbon monoxide, but recovers consciousness, some cells in the brain may have sustained irreparable damage, and, depending upon the amount of cellular destruction, he may later experience noticeable changes in personality or suffer a grave mental disorder. *(See* also CARBON MONOXIDE POISONING.)

Methemoglobinemia is another condition in which a part of the hemoglobin is thrown out of action. The simplest form is produced by the inhalation of aniline, volatile nitrites, nitrobenzene, etc., causing a conversion of oxyhemoglobin into methemoglobin (which has no respiratory value) within the blood, with injury to the corpuscles. The conversion is only temporary if the impure air ceases to be inhaled and if the poisoning is not too severe. Some other drugs such as chlorates and bromates in addition to producing methemoglobin in the blood also cause an actual destruction of red blood cells, which is a much graver condition.

Sulfhemoglobin is still another form of hemoglobin which is inactive as an oxygen carrier. Sulfhemoglobinemia may occur with the administration of acetanilid, sulfanilamide and other benzene derivatives. Occasionally it may even occur spontaneously.

Stagnant **Hypoxia.**—This may be general or local. If general, it may result from very different causes: (1) In cases of heart disease, the heart may be unable to pump the blood around the body at the required rate. (2) In cases of impairment of venous return, the back pressure may prevent the blood from circulating as it should. (3) Following severe abdominal wounds or surgical operations that have entailed considerable exposure of the internal organs, a condition known as surgical shock may supervene. The circulation of the blood is greatly reduced, and the tissues, therefore, are not supplied with sufficient oxygen. In the conditions mentioned the difficulty lies in the fact that the blood moves so slowly (or not at all) that practically all the oxygen leaves the blood, and there is not enough freshly oxygenated blood flowing along to sustain the tissues.

Local stagnant hypoxia may be due to any condition that reduces or prevents the circulation of the blood in any area of the body. Examples of this condition are Raynaud's disease and Buerger's disease, which restrict circulation in the extremities; the application of a tourniquet to control bleeding; ergot poisoning; and exposure to cold.

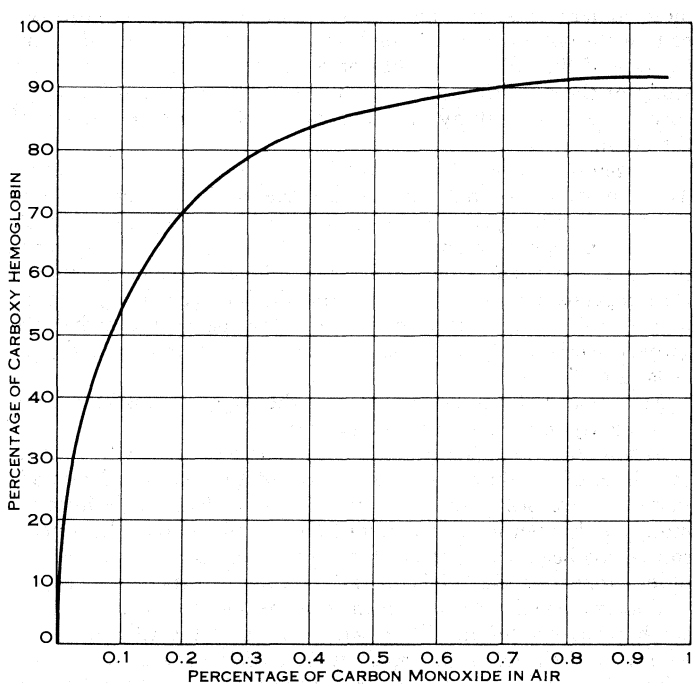


FIG. 3.—CHART SHOWING EFFECTS OF CARBON MONOXIDE SATURATION
Curve shows the percentage of carbon monoxide in the air which, if breathed indefinitely, is capable of saturating the blood to any given degree

Histotoxic **Hypoxia.**—In this case the body cells are unable

to use the oxygen, although the amount of oxygen in the blood may be quite normal and under normal tension. Although characteristically produced by cyanide, theoretically any agent that depresses cellular respiration may cause it. Some of these agents are narcotics, alcohol, formaldehyde, acetone and certain anesthetic agents. This form of hypoxia has, perhaps, somewhat less clinical significance than do the others; nevertheless, fatal poisonings by some of the above-mentioned agents are not uncommon.

BIBLIOGRAPHY.—E. J. Van Liere, *Anoxia, Its Effect on the Body* (1942); E. C. Hoff and J. F. Fulton (comps.), *Bibliography of Aviation Medicine* (1942), *Supplement* by Phoebe *M.* Hoff (1944); Alberto Hurtado, *et al.*, "Influence of Anoxemia on Hemopoietic Activity," *Arch. Int. Med.*, 75:284–323 (1945); C. Monge, *Acclimatization in the Andes* (1948); J. C. Stickney and E. J. Van Liere, "Acclimatization to Low Oxygen Tension," *Physiol. Rev.*, 33:13–34 (1953); *Handbook of Respiratory Physiology* (1954); Bryan Matthews *et al.*, "A Discussion on the Physiology of Man at High Altitude," *Proc. Roy. Soc.*, Ser. B, vol. 143 (1954).

(E. J. V. L.; X.)

HYPSOMETER, an instrument for measuring heights (Gr. *ypsos,* "height," *metron,* a "measure"), which employs the principles that the boiling point of a liquid is lowered by diminishing the pressure *(see* HEAT) and that the barometric pressure varies with the height of the point of observation. *(See* METEOROLOGY.) The instrument consists of a cylindrical vessel in which the liquid, usually water, is boiled, surmounted by a jacketed column in the outer partitions of which the vapour circulates while in the central one a thermometer is placed.

Foresters use other types of hypsometers, operating on the principles of triangulation, to determine the heights of trees.

HYRACOIDEA, a group of small hoofed mammals, including the biblical cony. The name cony or coney originally referred to the rabbit but has also ,come to be used for the related pikas, and for the present quite distinct animals. There is no unambiguous popular term for members of the Hyracoidea. They are usually called hyraxes (or hyraces). Rock rabbits, also sometimes used, is objectionable because they are not rabbits and many of them have nothing to do with rocks. In appearance the living hyraxes. with their plump, pointed heads. short necks, relatively short, slender legs, and squat. almost tailless bodies, look much more like rodents than ungulates. Nevertheless their anatomy clearly shows they are related to the hoofed mammals.

Living hyraxes are confined to Africa south and east of the Sahara and extreme southwestern Asia. They may be divided into two groups. One, the genus, *Procavia,* includes the ground-living forms, especially characteristic of deserts, hills and mountains up to about 10,000 ft., living in holes and fissures among the rocks. The other group is similar but is best separated as *Dendrohyrax.* These forms, confined to Africa, are almost entirely tree-dwelling, the only true arboreal hoofed mammals. They live in holes in trees and move readily along the trunks and branches. Both types climb easily, clinging even to almost vertical surfaces by the pads on their feet.

The hyraxes have numerous structural peculiarities which separate them sharply from any other mammals. The normal adult dental formula is $i.\frac{2}{2}$ $c.\frac{0}{0}$ $p.\frac{4}{4}$ $m.\frac{3}{3}$. The upper incisors are large, curved in a semicircle longitudinally, and grow continuously throughout life like those of rodents. Canines are absent. The premolars and molars are in pattern surprisingly like those of some of the typical ungulates, especially the rhinoceros. The dorsal and lumbar vertebrae are unusually numerous (up to 30 in *Procavia*). On both front and hind feet the three middle toes are well developed. In the forefeet the other two toes are also present, although the first is much reduced; in the hind ieet the first toe is absent, the fifth vestigial. The hoof of the inner (second) toe of the hind foot is clawlike, but on all the other toes the hooves are normal, although small. The wrist bones are arranged serially, the individual bones generally coming in contact with only one bone of the opposite row—an arrangement typical of the most primitive extinct ungulates but lost in the more specialized modern forms. The alimentary canal is unique in having a pair of large coeca opening into the large intestine some distance below the usual one at the junction of large and small intestines. There is a gland on the back marked by light hair.

The relationships of the hyraxes are doubtful. There is no question that the numerous resemblances to the rodents are all superficial and that the fundamental characters indicate affinities with the ungulates, but these affinities must be distant so far as any living forms are concerned. In addition to their many very primitive characters, the hyraxes show some special resemblance to primitive or extinct members of several groups, particularly the Proboscidea, Perissodactyla, some Condylarthra (*Meniscotherium*) and the peculiar South American fossil ungulates. This confusing series of resemblances suggests that the group is an ancient and unprogressive offshoot derived from the ungulate stem at a time when the modern groups of ungulates were not well differentiated.

Fossil Hyracoidea.—Numerous extinct hyracoids are known and they indicate that the group was formerly much more diversified than at present. Ten extinct genera are recognized, chiefly from the Oligocene of Egypt (Faiyum), Miocene of east and southwest Africa, and Pliocene of Greece (Pikermi and Samos). The earliest forms are characterized generally by having a full complement of teeth, $i.\frac{3}{3}$ $c.\frac{1}{1}$ $p.\frac{4}{4}$ $m.\frac{3}{3}$ with the last molars relatively larger than in recent forms. In some cases, for instance *Geniohyus* from Faiyum, the skull was strikingly elongated. Most of these extinct forms were larger than the recent hyraxes and some, such as species of *Megalohyrax* or *Titanohyrax* from Faiyum or *Pliohyrax* from Greece, were relatively gigantic. The largest must have been as big as a horse. *(See* UNGULATA.)

(G. G. SI.; X.)

HYRAX: *see* HYRACOIDEA.

HYRCANIA. (1) An ancient district of Asia, south of the Caspian sea, and bounded on the east by the river Oxus, called *Virkana,* or "Wolf's land," in Old Persian. It was a wide and indefinite tract. Its chief city is called Tape by Strabo, Zadracarta by Arrian. The latter is evidently the same as Carta, mentioned by Strabo as an important city. Little is known of the history of the country. Xenophon says it was subdued by the Assyrians; Curtius that 6,000 Hyrcanians were in the army of Darius III. (2) Two towns named Hyrcania are mentioned, one in Hyrcania, the other in Lydia. The latter is said to have derived its name from a colony of Hyrcanians. transported there by the Persians.

HYRCANUS (*Yrcanos*), a Greek surname, of unknown origin, borne by several Jews of the Maccabaean period.

JOHN HYRCANUS I, high priest of the Jews from 135 to 105 B.C., was the youngest son of Simon Maccabaeus. In 137 B.C. he, with his brother Judas, commanded the force which repelled the invasion of Judaea led by Cendebeus, the general of Antiochus VII Sidetes. On the assassination of his father and two elder brothers by Ptolemy, governor of Jericho, his brother-in-law, in 135, he succeeded to the high priesthood and the supreme authority in Judaea. While still engaged in the struggle with Ptolemy, he was attacked by Antiochus with a large army (134) and compelled to shut himself up in Jerusalem. Peace was secured at last on condition of a Jewish disarmament and the payment of an indemnity and an annual tribute. He confirmed the alliance which his father had made with Rome, and at the same time availed himself of the weakened state of the Syrian monarchy under Demetrius II to overrun Samaria. and also to invade Idumaea, which he completely subdued. About 109 B.C. his sons took Samaria and by his orders razed it to the ground. He died in 105 and was succeeded by Aristobulus, the eldest of his five sons. The external policy of Hyrcanus was marked by considerable energy and tact, and, aided by favouring circumstances, was so successful as to leave the Jewish nation in a position of great independence and influence.

JOHN HYRCANUS II, high priest from 78 to 40 B.C., was the eldest son of Alexander Jannaeus by his wife Alexandra, and was thus a grandson of the preceding. When his father died in 78 he was appointed high priest, and on his mother's death in 69 he claimed the succession to the supreme civil authority. After a troubled reign of three months he was compelled to abdicate both

dignities in favour of his more ambitious younger brother Aristobulus II. In 63 Pompey restored him to the high priesthood, with some semblance of supreme command. He was soon again deprived of his office by the arrangement of the proconsul Gabinius, according to which Palestine was in 57 B.C. divided into five separate circles. For services to Caesar after the battle of Pharsalia he was again rewarded with the sovereignty in 47 B.C., Antipater of Idumaea, however, being at the same time made procurator of Judaea. In 41 B.C. he was practically superseded by Antony's appointment of Herod and Phasael to be tetrarchs of Judaea; and in the following year he was taken prisoner by the Parthians, deprived of his ears that he might be permanently disqualified for priestly office, and carried to Babylon. He was permitted in 33 B.C. to return to Jerusalem, where on a charge of treasonable correspondence with Malchus, king of Arabia, he was put to death in 30 B.C.

See Josephus (Ant., xiii, 8–10 and xiv, 5–13; **Bell. Jud.**, i, 2 and i, 8–13). *See* also MACCABEES.

HYSSOP (Hyssopus *officinalis*), a garden herb belonging to the family Labiatae, formerly cultivated for use in domestic medicine. It is a small perennial plant about two feet high with slender, quadrangular, woody stems; narrowly elliptical, pointed, entire, dotted leaves, about one inch long and one-third inch wide, growing in pairs on the stem; and long terminal, erect, half-whorled, leafy spikes of small violet-blue flowers, which are in blossom from June to September. Varieties of the plant occur in gardens, with red and white flowers, also one having variegated leaves. The leaves have a warm aromatic bitter taste and owe their properties to the presence of a volatile oil.

Hyssop is a native of the south of Europe, ranging eastward to central Asia, and has become naturalized in North America from Maine to Ontario and southward and also on the Pacific coast. A strong tea made of the leaves, and sweetened with honey, was formerly used in lung and nose and throat affections, and externally on bruises.

The hedge hyssop comprises herbs of the genus Gratiola, which belong to the family Scrophulariaceae, and are native of marshy lands throughout Eurasia and North America. G. *officinalis*, of Europe, has smooth, opposite, entire leaves, but the stems are cylindrical, the leaves twice the size of the true hyssop, and the flowers solitary in the axils of the leaves and having a yellowish-red veined tube and bluish-white limb, while the capsules are oval and many seeded.

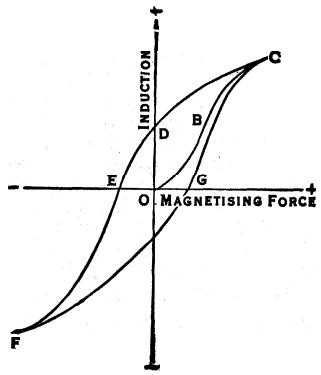
The herb has a bitter, nauseous taste, but is almost odourless. In small quantities it acts as a purgative, diuretic and emetic when taken internally. When growing in abundance, as it does in some damp pastures in Switzerland, it becomes dangerous to cattle.

The hyssop (*'ezob*) of Scriptures (Exod., xii, 22; Lev., xiv, 4, 6; Num., xix, 6, 18; 1 Kings, v, 13 [iv, 33]; Ps.. li, 9 [7] ; John xix, 29), a wall-growing plant adapted for sprinkling purposes, is not to be identified with the *Hyssopus officinalis*, which is not a native of Palestine. The most probable opinion would seem to be that it was a species of caper (Capparis *spinosa*), but it may have been Satureia thymus, a plant of very frequent occurrence in Syria and Palestine, with which *Thymus serpyllum*, or wild thyme, and Satureia thymbra are closely allied. Its smell, taste and medicinal properties are similar to those of H. *officinalis*.

HYSTASPES (the Greek form of the Persian Vishtaspa). (1) A semilegendary king (kava), praised by Zoroaster as his protector and a true believer, son of Aurvataspa (Lohrasp). The later tradition and the *Shahname* of Firdousi make him (in the modern form Kai Gushtasp) king of Iran. As Zoroaster probably preached his religion in eastern Iran, Vishtaspa must have been a dynast in Bactria or Sogdiana. The Zoroastrian religion was already dominant in Media in the time of the Assyrian king Sargon (c. 715 B.C.), and had been propagated probably in much earlier times (cf. PERSIA) ; the time of Zoroaster and Vishtaspa therefore may be put at c. 1000 B.C. (2) A Persian, father of Darius I. under whose reign he was governor of Parthia, as Darius himself mentions in the Behistun inscription (*2*, 65). By Ammianus Marcellinus (xxiii, 6, 32) and by many modern authors he has been identified with the protector of Zoroaster, which is impossible for chronological and historical reasons and from the evidence of the development of Zoroastrianism itself.

(See PERSIA: History).

HYSTERESIS. If an unmagnetized iron bar be subjected to a gradually increasing magnetizing force, and the corresponding values of the magnetic induction (flux density) in the iron be determined, then on plotting the magnetizing force against the induction a curve OBC is obtained. If now the magnetizing force is gradually decreased to zero and the values of the magnetic induction determined, it will be found that the curve obtained does not coincide with OBC but takes the form CD. If now the direction of the magnetizing force is reversed, D E F is obtained, and decreasing the magnetizing force again to zero, reversing, and increasing will give the curve FGC. It will be seen from a study of the complete curve that the magnetic induction (flux density) lags *behind* the magnetizing force. It was to this property of magnetic materials that Ewing gave the name Hysteresis. See ELECTROMAGNET ; GENERATOR, ELECTRIC; MAGNETISM ; etc.



HYSTERESIS CURVE

HYSTERIA is a term applied to a type of psychiatric disorder in which a wide variety of sensory, motor or psychic disturbances may occur. It is classified as a psychoneurosis, and is not dependent upon any known organic or structural pathology. The term is derived from the Greek hystera, meaning "uterus," and reflects the ancient notion that the disorder was the result of disturbances in uterine functions. Actually, hysterical symp, toms may develop in either sex and may occur in children and elderly people, although they are observed most commonly in early adult life.

Hysteria, in pure form, seems to occur more often among the psychologically nai've than among sophisticated persons. Studies have indicated that hysterias tend to be commoner in persons in the lower ranges of intelligence than among those in the higher ranges. There is reason to believe that the incidence of hysteria has been diminishing over the years in England and America, probably due to cultural factors which include increasing psychological sophistication, diminishing sexual prudery and inhibition and a less authoritarian family structure. Cases of classical hysteria, like those so often described by 19th-century clinicians, have become rare. Most psychoneuroses in actual clinical practice are apt to be "mixed" forms in which hysterical symptoms may be found interspersed with other varieties of neurotic disturbances. Isolated hysterical symptoms may occur in psychotic disorders also.

Manifestations. — The sensory and motor manifestations of hysteria take many forms and are designated as conversion reactions, in line with the theory that in such instances the underlying anxiety has been "converted" into a physical symptom. Sensory disturbances may range from paresthesias ("peculiar" sensations) to hyperesthesias (hypersensitivity), to complete anesthesias (loss of sensation). They may involve the total skin area or any fraction of it. In medieval times, and as late as the end of the 17th century, the finding of small discrete areas of anesthesia on the body of a person was considered to he definite proof that the person was a witch. Hysterical sensory disturbances generally do not follow any anatomic distribution of the nervous system. Thus, in "glove" or "stocking" anesthesias, the patient feels no sensation in the parts of the limbs corresponding to those covered by gloves or stockings, but such sensory loss does not follow the distribution of specific nerve pathways. Similarly, in hysterical hemianesthesia (loss of sensation over half the body). the nonfeeling area stops abruptly at the midline, while in organic hemianesthesias the transition from anesthetic to normal sensation is gradual and does not terminate at the midline. Other hysterical

sensory disturbances may encompass the special senses of vision, hearing, taste or smell; or may involve the experiencing of severe pain for which no organic cause can be determined.

Motor symptoms vary from complete paralysis to tremors, tics, contractures or convulsions (hystero-epilepsy). In each instance neurological examination of the affected part of the body reveals an intact neuromuscular apparatus with normal reflexes and normal responses to electrical stimulation. In hystero-epilepsy the electroencephalogram reveals essentially normal electrical activity of the brain, even at the height of the convulsion. Other motor disturbances which are at times hysterical in origin are loss of speech (aphonia), coughing, nausea, vomiting or hiccoughing.

Psychic symptoms may be equally varied, and are usually classified under the broad heading of dissociative reactions. Attacks of amnesia, in which the person is unable to remember who he is or anything about himself, are among the more striking of these. Occasionally the amnesia may last for weeks, months or even years, during which time the person may begin an entirely new life pattern; such protracted reactions are called fugue states. Sleepwalking (somnambulism) is also considered to be a hysterical dissociative reaction, as are also the occasional dramatic cases of multiple personality.

Causation. — Numerous theories have been advanced to account for hysteria. Prior to the work of Pierre Janet (*q.v.*), most clinicians believed it to be an essentially physiological disturbance. Janet, however, considered it to be a mental malady which he attributed to an inherent weakness in the capacity of the personality to synthesize or integrate experiences. As a result of this, he believed, certain ideas became split off from the personality. and in this "dissociated" state produced the hysterical symptoms. Janet's theory failed to explain, however, why a patient develops a particular symptom in preference to any other. The most fruitful explanation for hysterical phenomena came from Sigmund Freud (*q.v.*), the founder of psychoanalysis. Both the method and theory of psychoanalysis were derived largely from Freud's study and treatment of hysterical patients. Freud advanced the theory that all psychoneuroses are the result of conflict between unconscious wishes and prohibiting forces within the personality. The unconscious wishes are generally concerned with sexual impulses (Freud's concept of sexuality embraced all impulses concerned with biological pleasure) or aggressive ones. The forbidding or repressing forces are the result of internalizations (introjections) of parental or surrogate parental attitudes, which make the person experience anxiety in the presence of the forbidden impulse. In anxiety states this anxiety is felt by the person but he is not aware of its origin. In anxiety hysteria (phobia) the anxiety is "displaced" from its original, unconscious source to some other object, which then becomes the apparent source of the anxiety. In conversion hysteria, according to Freud, the anxiety is "converted" into a somatic symptom. This would explain the apparent lack of anxiety, *la belle indifference*, which characterizes many hysterical patients. The exact mechanism by which this conversion takes place is uncertain. The specific form taken by the hysterical symptom was attributed by Freud to the particular nature of the unconscious conflict situation. The symptom may express in disguised form either the repressed impulse, the repressing counterforce or a compromise between the two. Thus, a hysterical convulsion might be a symbolic expression of a forbidden sexual wish, a hysterical paralysis the manifestation of self-punishment for a hidden aggressive impulse, or a hysterical contracture the fusion of the wish to carry out some forbidden act with the counter-impulse which is prohibiting it.

In general it may be said that the symptoms of hysteria represent reactions to stress. They are apt to appear during life situations involving stress, and sometimes disappear spontaneously after the stress subsides. With his symptom the person is often expressing in "body language" his reaction to an intolerable life situation Thus hysterical vomiting may be saying, "I cannot stomach this any longer"; hysterical blindness, "I cannot bear to see what is going on"; hysterical false pregnancy (pseudocyesis), "I wish to have a baby," etc. Often the hysterical symptom may serve the person as a justification for avoiding certain responsibilities or for controlling and manipulating the people in his life. This is sometimes referred to as the secondary gain of the illness.

The question of why a person develops one type of neurosis rather than another is one of the major unsolved problems of psychiatry. It is probable that multiple factors. including constitutional ones, are involved. Freud believed that hysterical disorders originated in conflicts which developed in the so-called Oedipal period of personality development (ages three to five), and were due to failure adequately to resolve the Oedipus complex (based on love for the parent of the opposite sex and rivalry with the parent of the same sex). Although it is undoubtedly true that such factors can be found to be present in most hysterics in our culture, subsequent studies have indicated that this formulation is probably too narrowly based. There is reason to believe that, in many hysterics, the first roots of the personality disturbance date back to an even earlier period, the pre-Oedipal, when the basic security system of the young infant is taking form within the matrix of the primal parent-child interrelationship. Given a certain kind of constitutional predisposition, it would appear that some children, feeling unloved or insecure in their early environments, gradually develop the kind of personality structure that later, under conditions of stress, may incline them to hysterical symptom formation. This personality structure is characterized by emotional immaturity, apprehensiveness, suggestibility, feelings of inadequacy, passivity, a strong dependency on the approval of others for self-esteem, a compulsive need to be loved and admired, and an inability to express hostile or aggressive feelings directly.

Treatment. — In the treatment of hysteria a distinction must be made between the management of the hysterical symptom and that of the underlying personality disorder. The symptom is much more easily treated than is the personality disorder. Because of the suggestibility of the hysterical patient, the hysterical symptom is often responsive to any technique involving suggestion. The dramatic manipulations and theatrical equipment of medical charlatans have their greatest success with hysterical patients, as do various forms of faith healing and hypnosis. If the underlying hysterical character structure is not altered, however, there is a strong likelihood that the symptom will sooner or later return, either in its original form or in some substitutive expression. Rational therapy of the underlying personality problem requires a form of psychotherapy which is aimed at uncovering the underlying conflicts and adaptive patterns of the patient, and which, by bringing these to his awareness, will enable him gradually to learn more effective techniques of coping with his life problems and interpersonal relationships. Psychoanalysis (*q.v.*) is generally regarded as one of the most effective psychotherapeutic approaches for this purpose.

BIBLIOGRAPHY. — A. P. Noyes and L. C. Kolb, *Modern Clinical Psychiatry*, 5th ed. (1958); P. Janet, *Major Symptoms of Hysteria*, 2nd ed. (1920); J. Breuer and S. Freud, *Studies in Hysteria*, authorized trans. with introd. by A. A. Brill (1958). (J. MR.)

HYTHE, a market town and seaside resort, one of the Cinque Ports (*q.v.*) and a municipal borough of Kent, England, 65 mi. E.S.E. of London by road. Pop. (1951) 9,220. Area 4.7 sq. mi. It lies on the coast at the east end of Romney marsh and on either side of the Royal Military canal, built as a defensive moat when Napoleon threatened invasion. Modern Hythe extends from the canal to the coast; the old town climbs the hill inland from the canal. The church of St. Leonard is partly Late Norman, with an Early English chancel and a tower rebuilt about 1750. In a vaulted processional path under the ambulatory are hundreds of human skulls and bones believed to have been transferred from the churchyard during the 14th and 15th centuries. Lionel Lukin (1742–1834), inventor of the lifeboat, is buried in the churchyard. The guildhall was founded 1794. St. Bartholomew's hospital was founded by Hamo, bishop of Rocliester, in 1336; that of St. John (rebuilt 1802), even older, was founded for reception of lepers.

As a port Hythe owes its origin to the silting-up of the Roman *Portus Lemanis*, where Lympne (pronounced lim) and West

Hythe now stand about 2 mi. west of the town. Here is the end of the Roman Stone street from Canterbury; on the hillside substantial remains of the Roman fortress adjoin the castellated mansion known as Studfall castle. The church at Lympne is Early English and has a Norman tower with Roman material in its walls. There is an airfield at Lympne. A short distance east is Shipway or Shepway Cross, where important assemblies relating to the Cinque Ports were held. A mile north from Hythe is Saltwood castle, rebuilt in the 14th century. It was granted to the see of Canterbury in 1026 and there the murder of Thomas Becket is said to have been planned. It remained a residence of the archbishops of Canterbury until the time of Henry VIII, and was restored as a residence in 1882.

About 2 mi. north of Saltwood are remains of the fortified 14th century manor house of Westenhanger, quadrangular and surrounded by a moat.

Hythe (landing place), a port in Saxon times, was granted by a Saxon thegn to Christ church, Canterbury. In the Domesday survey the borough is entered among the archbishop's lands as appurtenant to his manor of Saltwood, and the bailiff of the town was appointed by the archbishop. King John in 1205 confirmed the liberties which the townsmen of Hythe had under Edward the Confessor. The liberties of the Cinque Ports were confirmed in 1278 by Edward I in a general charter which was confirmed, often with additions. by subsequent kings down to James II. These charters were granted to the Cinque Ports in return for the 57 ships which they supplied for the royal service (the Ports were thus "the germ of the Royal Navy"). The Cinque Ports were first represented in the parliament of 1265, to which they each sent four members. Hythe, with Folkestone, was a parliamentary borough returning one member until 1949, since when it has formed part of the Folkestone and Hythe division of the county of Kent. Hythe mas incorporated by Elizabeth I in 1575, when a fair for the sale of fish etc. was granted. With the silting-up of its harbour, Hythe lost its importance as a port. A marine parade more than four miles long links Hythe with Folkestone.

West of the town is the School of Small Arms. A miniature railway (15″ gauge) runs from Hythe to Dymchurch and New Romney.

HYTHE, CONFERENCE OF, a meeting (May 15 to 17, 1920) between the British and French prime ministers, together with the chancellor of the exchequer and the French minister of finance, in preparation for the Conference of Spa. A French proposal that France should be granted priority in reparation payments seems to have been put forward but not pressed, and the linking up of the reparation problem with the question of inter-Allied debts was proposed publicly for the first time in the official communiqué.

I THIS letter corresponds to Semitic *(yod)*, which may derive from an early symbol for hand, and to the Greek I *(iota,* whence Eng "jot"). Early Greek forms from the island of Thera were and which obviously more closely resemble the Semitic than the later single vertical stroke. In Attic inscriptions also the form appears, while in early Corinthian inscriptions the forms are found The Chalcidic alphabet had the form , and this was the form in all the Italic alphabets, including the Etruscan. The Lydian alphabet besides the form also shows a form (written from right to left).

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1.200	
CRETAN	1.100-900	
THERAEAN	700-600	
ARCHAIC LATIN	700-500	
ATTIC	600	
CORINTHIAN	600	
CHALCIDIAN	600	
IONIC	403	
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	
URBAN ROMAN		
FALISCAN		
OSCAN		
UMBRIAN		
CLASSICAL LATIN AND ONWARDS		

THE DEVELOPMENT OF THE LETTER "I" FROM THE PHOENICIAN THROUGH THE CLASSICAL LATIN TO THE PRESENT FORM

The minuscule letter is merely a shortened form of the majuscule. The dot first appears in manuscripts of about the 11th century and was used to distinguish the letter and assist reading in words in which it was in close proximity to letters such as *n* or *m* *(inimicis,* for example). The dot frequently took the form of a dash, *e.g.*, . It became the custom in medieval manuscripts to distinguish an initial or otherwise prominent *i* by continuing it below the line, and it was from this habit that the differentiation of the letters *i* and j arose. The initial letter, nearly always lengthened, had most frequently a consonantal force, and this led to *j* representing the consonant, i the vowel. The two letters were not considered as separate until the 17th century.

In Semitic the letter represented a sound akin to the English y. In Greek, Latin and the Romance languages it has represented a high front vowel similar to English long *e*, as in "be." In Latin short *i* represented a considerably more open sound than long i, as is evidenced by the fact that in late Latin it ran together with long *e*. In modern English the sound of short *i* is almost identical with what it was in Latin; *e.g.,* in the word "pit." Long *i* has become a diphthong *(ai, e.g.,* in the words "ice," "hire"), its former sound as a high front vowel having been assumed by long *e* as its position shifted forward and upward. (B. F. C. A.)

In words such as "fir" the letter represents the neutral vowel, while in certain foreign words it retains its continental sound, identical with that which it represented in Middle English and previously; *e.g.,* in the words "pique," "emir." The combinations *ei* and *ie,* as in "receive," "believe," have in the great majority of cases the sound of the long *e* in "precede," although the long *i* sound of "tide" is found in many local and personal names of German origin and in a few other foreign borrowings; *e.g.,* "eider." The vowel sound in "either" is optional.

In chemistry, **I** is the symbol for iodine.

(B.F.C.A.;J.W.P.)

IAMBIC, a verse or succession of verses composed wholly or principally of the foot called an iamb or iambus (⏑ –). It is generally described by a compound name consisting of a Greek numeral and the word *metron,* signifying a group of two iambi; as, iambic dimeter, a line consisting of two *metra* or four iambi: "perunxit hoc Iasonem," or "John Gil|pin was | a cit|izen." The commonest form, and one of the most popular of Greek metres, especially in drama, is the trimeter (three *metra,* or six iambi). When "pure," *i.e.,* containing no other feet, this runs "suis et ipsa Roma viribus ruit." Classical poets, however, permitted various substitutions of other metrical feet according to well-established rules. Since the 14th century, beginning with Chaucer, iambic metre has been the principal one used in English poetry. *(See* ELEGY.) In English verse, too, substitutions have usually been permitted. One of the most common is the anapaest, which, being also a rising rhythm (from unstress to stress), blends easily with iambs. For example, in John Greenleaf Whittier's "John Underhill":

He shook/ from his feet/ as he rode/ away
The dust/ of the Mass/achu/setts Bay . . .

(John Greenleaf Whittier, "John Underhill," lines 13–14, *The Complete Poetical Works of John Greenleaf Whittier,* Boston and New York, Houghton Mifflin Co., 1904, p. 155.) In the blank verse of William Cullen Bryant's "Thanatopsis," the pyrrhic (⏑ ⏑) and the spondee (– –) are frequently substituted for the iamb:

Of the/ great tomb/ of man./ The gol/den sun, . . .

Other common substitutions are a trochee (– ⏑) in any position, but especially in the first foot, and an extra syllable at the caesura or at the end of the line. In his later dramas Shakespeare used this extra syllable frequently. Shelley in "To a Skylark" mixed

trochaic and iambic rhythms:

Hail to/ thee, blithe/ spirit!
Bird thou/ never/ wert, . . .
And sing/ing still/ doth soar,/ and soar/ing ev/er singest

See also METRE; VERSE. (G. W. A.)

IAMBLICHUS (*c.* 250–*c.* 330), founder of the Syrian school of Neoplatonism (q.v.), was born at Chalcis in Coele-Syria. He studied under Porphyry and afterward established his own school in Syria. He died at some time during the reign of the emperor Constantine the Great (306–337), before the brief court career and execution at Constantinople of his pupil Sopater. Those works of his which survive (*see* below) are of minor philosophical importance; his major metaphysical works are lost. But a fairly good idea of the main lines of his philosophy can be formed from the references to his teaching in Proclus together with the fragments preserved by Stobaeus and such philosophical ideas as can be discovered in the theurgic treatise *On the Egyptian Mysteries.* So far as can be discovered, it was Iamblichus who did more than any other single philosopher to transform the Neoplatonism of Plotinus into the stiff and complicated (though often subtle and profound) pagan scholasticism known best from the works of Proclus. He began the attempt to build up on a Neoplatonic basis a complete and coherent theology encompassing all the rites, myths and divinities of later syncretistic paganism. It was with him that theurgy, the magical conjuration of the gods, began first to play an important part in Neoplatonic religion and to push into the background the purely spiritual and intellectual mysticism of Plotinus. It was Iamblichus, moreover, who not only began but carried a very long way that process of splitting up and subdividing the great realities of the spiritual world of Plotinus and inserting intermediaries between them which produced the late Neoplatonic view of reality as a many-storied structure of complex orders of beings mirroring each other on different levels. It seems to have been Iamblichus who devised the structural principles according to which this splitting up of the spiritual world was carried out. (1) the "law of mean terms," according to which two doubly unlike realities must always be connected by an intermediate term resembling one in one respect and the other in another (AB must be connected to not-*A*-not-*B* either by *A*-not-*B* or by *B*-not-*A*), which forms a triad with them and without which they cannot be directly related; and (2) the triadic order of "remaining," "procession" and "return," according to which effects proceed from their cause and return to it again. Beyond "the one" of Plotinus which is Identical with "the good," he introduced a higher "one" which is absolutely ineffable and beyond all qualifications. He split the intelligible world of Plotinus into tao spheres of complex construction, the intelligible and the intellectual; and he introduced similar complications into his account of the sphere of soul.

In ethics Iamblichus took over Porphyry's classification (based on Plotinus) of virtues into "political," "purifying" and "exemplary" but inserted a fourth category. the "contemplative," between the last two and placed above all four the "priestly" or "unifying" virtues by which we are united in ecstasy to "the one."

Five genuine works of Iamblichus, parts of a sort of encyclopaedia or comprehensive treatise on Pythagoreanism. are extant. On *the Pythagorean Life,* ed by *L.* Deubner (1937); *The Exhortation to Philosophy* or *Protrepticus,* ed. by *H.* Pistelli (1888); *On the General Science of Mathematics,* ed. by N. Festa (1891); *On* the *Arithmetic of Nicomachus,* ed. by *H.* Pistelli (1894); and *Theologzcal Principles of Arithmetic,* ed. by V. de Falco (1922) *The Reply of Abammon to Porphyry's Letter to Anebo,* commonly knonn as the *De Mysteriis* (*On the Egyptian Mysteries*), is also accepted as a genuine work of Iamblichus. text ed. by G. Parthey (1857), Eng. trans. by T. E. Taylor (1821; new ed., 1926), Ger. trans and commentary by T. Hopfner (1922).

BIBLIOGRAPHY.—F Ueberweg, *Die Philosophie des Altertums* (1926); *G* Mau and W Kroll, "Iamblichus," in Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft,* vol ix (1914); E R Dodds, introduction to *Proclus: the Elements of Theology (193;); T* Whittaker, *The Neo-Platonists,* and ed (1918) (A. H. Ag.)

IAPETUS, in Greek mythology, son of Uranus and Ge, one of the Titans, father of Atlas, Prometheus, Epimetheus and Menoetius. As a punishment for having revolted against Zeus, he was imprisoned in Tartarus (according to the *Iliad)* or underneath the island of Inarime off the coast of Campania (according to Silius Italicus).

Hyginus makes him the son of Tartarus and Ge, and one of the giants. The etymology of the name is doubtful, and it may be connected with the Hebrew Japhet.

IATROCHEMISTRY (coined from Gr. *iatros,* "physician"), a stage in the history of chemistry during which the object of this science was held to be "not to make gold but to prepare medicines." This doctrine dominated chemical thought during the 16th century, its foremost supporters being Paracelsus, J. B. van Helmont and Franciscus Sylvius. But it gave way to the new definition formulated by Boyle. viz., that the proper domain of chemistry was "to determine the composition of substances."

See CHEMISTRY: *Emergence of Alchemy.*

IAZYGES, Sarmatian tribe on the Maeotis, allies of Mithradates the Great (*q.v.*). Moving westward across Scythia, they were on the lower Danube by the time of Ovid, and about A.D. 50 occupied the plains east of the Theiss. There, under the general name of Sarmatae, they were a perpetual trouble to Dacia (*q.v.*), the Roman province.

The Iazyges were divided into freemen and serfs, the latter of whom were probably an older settled population enslaved by nomad masters. They rose against their masters in A.D. 344 but were repressed.

Nothing is heard of Iazyges or Sarmatae after the Hunnish invasions.

IBADAN, a town in Ibadan province, in the Western Region of the Federation of Nigeria. 70 mi N.E. of Lagos by rail. Ibadan is the largest native city in Africa, having an African urban population of 499,000 (1957). It is the headquarters of the western regional government and the seat of the University college for Nigeria, opened in 1952. In conjunction with the medical faculty of the University college, a teaching hospital was planned. Although most of the people are Moslems, the influence of Christian missions is considerable, particularly on education. The town is surrounded by low hills and in the 19th century was a large warrior camp enclosed by mud walls. The prowess of the soldiers in intertribal wars led to a rapid growth in population, both from refugees and from captured slaves. The continued expansion of Ibadan arises from its position as the commercial centre for the Nigerian cocoa industry, a considerable proportion of Nigeria's cocoa crop being grown within a 20-mi. radius. Oil palms and citrus are also cultivated, as well as maize, cassava and yams.

The majority of the people are farmers or traders and live in single-storied, mud-built houses plastered with cement and roofed with corrugated iron sheets. After World War II the traditional type of dwellings were rapidly replaced by double-storied houses built of cement blocks. Local administration is in the hands of a council of 39 popularly elected councilors and 12 traditional chiefs. The traditional chiefs include the head chief of the town, the *olzrbadan,* and the leader of the women, the *iyalode.* (B. K. C.)

IBAGUÉ (SAN BONIFACIO DE IBAGUÉ), capital of the department of Tolima. Colombia. about 60 mi. W. of Bogotá and 18 mi. N.W. of the Nevado del Tolima. Pop. (1961 est.) 143.590. Ibagué is built on a plain between the Chipalo and Combeima, small affluents of the Coello, a western tributdry of the Magdalena. Its elevation, 4.300 ft. above the sea. gives it a mild, subtropical climate. The plain and the neighbouring valleys produce cacao. tobacco. rice and sugar cane. It is an important commercial centre, being on the road which crosses the Quindio pass, or *paramo,* into the Cauca valley.

Ibagué nas founded in 1550 by Andrés López de Galarza on the site of an Indian village and was moved to its present location because of Indian attacks. It aas the capital of the republic for a short time in 1854. The rapid expansion of coffee planting on the slopes above the city contributed to its growth, especially after 1890. It is the seat of the Colegio San Simon. (Js. J. P.)

IBAN (SEA DAYAKS), a proto-Malay people of southwest Borneo. The name Sea Dayak (though still in official use) is a misnomer, for the Iban are primarily a riverine and hill people. The local name Iban was introduced to anthropological literature by A. C. Haddon in 1901. Haddon classified the Iban as Oceanic Mongols. They are brachycephalic (average cephalic index. 83), of short stature (average height, 5 ft. 2½ in.), with dark eyes, broad noses, full lips, black, lank hair and cinnamon-coloured skin. The Iban of Sarawak (pop., 1961, approximately 235,000; about one-third of the mixed population) are scattered throughout the undeveloped, interior zone of the colony, major areas of settlement being the Lupar, Saribas and Rajang rivers. Other Iban tribes live in the headwaters of the Kapuas river in Kalimantan, or Indonesian Borneo.

The Iban are an agricultural people; their subsistence economy is based on shifting cultivation, dry rice being grown on hillside clearings in the tropical rain forest. By the second half of the 20th century, rubber had been widely adopted as a cash crop. Settlements are scattered (average density of population about ten per square mile) and almost invariably built on the banks of rivers navigable by dugout canoes. Many of these canoes are nowadays equipped with outboard engines. The Iban live in long houses, each consisting of from under 10 to as many as 50 or more privately owned one-family apartments joined together. Each family (containing an average of six persons) is an independent unit, owning land and property. Iban society is classless and egalitarian, and its members marked individualists; their kinship system is cognatic. There is general equality between the sexes.

The Iban language is closely akin to Malay. Although the majority of the Iban people are still preliterate, education services have been greatly extended during the past ten years: schools have been established, an Iban newspaper, *Pembrita,* is published monthly by the government of Saramak and Radio Sarawak broadcasts daily programs in Iban. The highly developed and complex indigenous religion of the Iban is still widely practised. There is an extensive pantheon of named, anthropomorphic gods and goddesses who are invoked in poetic language and concerning whom there is a rich "oral literature." Elaborate rituals, which confer social prestige, are a main activity. However, following mission activity, many Iban have become Christians.

Formerly the Iban were the most inveterate head-hunters in Borneo; martial virtues are still prized, and many young Iban men have served with British Commonwealth forces in Malaya. The traditional Iban are a virile, spirited, self-confident people, immensely proud of their own distinctive culture. The necessary but difficult transition from their traditional culture to the modern world, by which the Iban are taking their proper place with Chinese. Malays and others in the "plural" society emerging in Sarawak, mas still in process at the beginning of the 1960s. *See* also BORNEO: *Anthropology;* DAYAK.

See E. H. Gomes, *Seventeen Years Among the Sea Dayaks of Borneo* (1911); J. *D.* Freeman, *Iban Agriculture* (1955). (J. D. FE.)

IBÁÑEZ, VICENTE BLASCO: *see* BLASCO IBÁÑEZ, VICENTE.

IBÁÑEZ DEL CAMPO, CARLOS (1877–1960), Chilean politician and soldier, commonly referred to as Chile's "Man-on-Horseback," was born at Linares, Chile, on Nov. 3, 1877. After a military career, which he began in 1894, he became involved in politics in 1924. In September of that year he participated in a revolt against the government of Arturo Alessandri Palma and four months later led a coup that ousted a conservative military junta. In 1927 he became minister of interior and vice-president, from which posts he forced the resignation of Pres. Emiliano Figueroa Larrain and had himself elected president, a position he held until 1931. His regime was directed to material development, financed by heavy borrowing from abroad. Discontent with his authoritarianism and the economic depression led to his overthrow and exile. He returned from exile in May 1937 and with Chilean-Nazi support attempted a coup against the government. He was involved in numerous plots and failed as a presidential candidate (1942) before he was elected to the Chilean senate in 1949. He ran successfully for the presidency in 1952 under the slogan "Larger Loaves of Bread," an appeal directed to the depressed urban elements and the emergent rural workers.

He attracted foreign capital in an effort to create a viable economy, but this objective failed and at the end of his regime (Nov. 1, 1958) Chile was in desperate straits. Ibáñez died at Santiago on April 28, 1960.

See also CHILE: *History.* (J. J. J.)

IBARAKI, a prefecture *(ken)* in the northwest of the Kanto district, central Honshu, Japan. Area 2,351 sq.mi.; pop. (1960) 2,047,024. The prefecture is basically agricultural, the chief products being cereals, potatoes and tobacco. Mechanization of agriculture is advancing rapidly.

Coal is produced at the Ibaraki mines in the Jôban coal field, and copper at the Hitachi mines.

Many of the cities were castle towns. Mito, the prefectural capital, was developed under the Mito branch of the Tokugawa family; its Kairaku-en is one of the most celebrated gardens in Japan. (R. B. H.)

IBARA SAIKAKU: *see* IHARA (IBARA) SAIKAKU.

IBERIANS, an ancient people inhabiting parts of the Spanish peninsula. The name was applied by the earlier Greek navigators to the peoples who inhabited the eastern coast of Spain; originally those who dwelt by the river Iberus (mod. *Ebro).* The river's name itself may represent the Basque phrase *ibay-erri,* "the country of the river." In older Greek usage the term Iberia embraced the country as far east as the Rhone and by the time of Strabo it was the common Greek name for the Spanish peninsula. Iberians thus meant sometimes the population of the peninsula in general and sometimes one element in that population. In Spain, when this element first became known to the Greeks and Romans, there existed many separate and variously civilized tribes connected by at least apparent identity of race, and by similarity (but not identity) of language, and sufficiently distinguished by their general characteristics from Phoenicians, Romans and Celts.

1. Numismatic.— Knowledge of ancient Iberian language and history is mainly derived from a variety of coins, found widely distributed in the peninsula, and also in the neighbourhood of Narbonne. (For the prehistoric civilization of the peninsula as a whole ***see*** SPAIN.) They are inscribed in an alphabet which has many points of similarity with the western Greek alphabets, and some with the Punic alphabet, but retains a few characters from an older script. The same Iberian alphabet is found also rarely in inscriptions. The coinage began before the Roman conquest was completed; the monetary system resembles that of the Roman republic, with values analogous to *denarii* and *quinnrii.* The coin inscriptions usually give only the name of the town; *e.g., Plplis* (Bilbilis), *Klaqriqs* (Calagurris), *Seqbrics* (Segobriga), *Tmaniav* (Dumania). The types show late Greek and perhaps also late Punic influence, but approximate later to Roman models. The commonest reverse type, a charging horseman, reappears on the Roman coins of Bilbilis, Osca, Segobriga and other places. Another common type is one man leading two horses or brandishing a sword or a bow. The obverse has usually a male head, sometimes inscribed with what appears to be a native name.

2. Linguistic.— The survival of the Basque language (*q.v.*) around the west Pyrenees suggested the attempt to interpret by its means a large class of similar-sounding place names of ancient Spain, some of which are authenticated by their occurrence on the inscribed coins, and to link it with other traces of non-Aryan speech round the shores of the western Mediterranean and on the Atlantic seaboard of Europe. K. W. von Humboldt contended that there existed once a single great Iberian people, speaking a distinct language of their own; that an essentially "Iberian" population was to be found in Sicily, Sardinia and Corsica, in southern France, and even in the British Isles; and that the Basques of the present day were remnants of this race, which had elsewhere been expelled or absorbed. He adduced explanations of a vast number of the ancient topographical names of Spain, and of other asserted Iberian districts, by the forms and significations of Basque.

3. Anthropological.— This "Iberian theory" depended partly on the widespread similarity of physical type among the popula-

tion of southwestern Europe. Anthropological researches have proved the existence in Europe, from Neolithic times, of a race, small of stature, with long or oval skulls, who buried their dead in tombs. Their remains have been found in Belgium and France, in Britain, Germany and Denmark, as well as in Spain; and they bear a close resemblance to a type common among the Basques and all over the Iberian peninsula. This Neolithic race has consequently been nicknamed "Iberians," and the racial characteristics of "Iberians" have been identified in the "small swarthy Welshman," the "small dark Highlander" and the "Black Celts to the west of the Shannon," as well as in the typical inhabitants of Aquitania and Brittany. Thus a race with fairly uniform characteristics was at one time in possession of the south of France (or at least of Aquitania), the whole of Spain from the Pyrenees to the straits, the Canary Islands (the Guanches), a part of northern Africa and Corsica. Whether this type is more conveniently designated by the word "Iberian" or by some other name ("Eur-African," "Mediterranean," etc.) is a matter of comparative indifference, provided that there is no misunderstanding as to the steps by which the term "Iberian" attained its meaning in modern anthropology.

IBERO-AMERICAN ARCHITECTURE. In Spanish America the high quality as well as the great quantity of colonial architecture establish it as a major contribution of the new world to civilization. The zeal and power of the Spanish church were abetted by the wealth of the colonies in the construction of sumptuous ecclesiastical buildings. Skilled Indian labour also contributed to the early development of large-scale programs in both religious and domestic architecture. Types of buildings and styles were Spanish in origin, although local conditions produced modifications. In centres of European culture, such as Santo Domingo, Mexico City, Quito, Lima and Cuzco, architectural styles were contemporary with those in Spain. Medieval traditions survived, however, especially in monastic structures; even in the 17th century, late Gothic ribs persisted in the vaults of churches.

Spanish-Moorish elements (Mudejar), such as wooden ceilings in geometric patterns, coloured tiles, the rectangular frame of an arch (*alfiz*), and the trefoil arch, were popular throughout Spanish-American architecture.

Spanish America.—16th Century.—In Santo Domingo, site of the first Spanish settlement, is preserved the earliest cathedral (1514–40), which has a superb Spanish Renaissance façade and a Gothic interior. In Mexico large building campaigns (c. 1550–1600) were carried out by Franciscan, Augustinian and Dominican friars. Their monasteries generally have a huge vaulted church, cloister and monastic buildings, based upon Spanish prototypes. The large atrium yard and the "open chapel" for outdoor religious services are special features developed in America to accommodate crowds of Indians, as at Acolman, Cuernavaca and Huejotzingo. Portals display a wide variety of styles, including medieval and Renaissance elements and occasional Indian influences. The largest Mexican cathedrals, those of Mexico city (1563–1813) and Puebla (1575–1690). have the rectangular basilican plan and other features of the Andalusian Renaissance.

Important early monuments of Peru were destroyed by earthquakes; the surviving structures, of modest character, are found in Ayacucho, on the shores of Lake Titicaca and in Sucre, Bol. Vaulted churches were virtually unknown in South America until the 17th century. In Quito, Ecuador, the Franciscan and Dominican monasteries are notable for their cloisters and Mudejar ceilings, and the cathedral (1562–72) is an example of Andalusian Gothic-Mudejar construction.

17th *Century*.—The architecture of the first half of the 17th century preserves the late classical style of the Spanish architect of the Escorial, Juan de Herrera. Austerity characterizes San Agustin and Santo Domingo in Puebla, as well as the faqade of the cathedral.

Most awesome is the cathedral (1598–1654) of Cuzco, Peru, rectangular in plan, and Herreresque in its sobriety except for the early baroque portal. The Jesuit church in Cuzco, whose handsome faqade was designed in 1664 by Diego Martinez de Oviedo, constituted the first late baroque architecture in the Americas. The city abounds in handsome churches and palaces, built of Andean stone in the second half of the 17th century, and it is in many respects unrivaled in America. At Lima, Peru, the rebuilding of the monastery of San Francisco (1657–73) brought a new wave of Hispano-Mauresque (Mudejar) influence in the geometric designs of the plasterwork. The main portal (1674) of the church inaugurated in that city the late baroque type of faqade, closely resembling a carved altarpiece.

In Bolivia the chief architectural centre was Sucre, where Gothic vaults persisted, but otherwise both religious and domestic buildings adhered to simple classical designs. The Jesuit church in Bogotá, Colombia, owes its Italianate classicism to the Italian architect Father Coluccini. The greatest masterpiece of Jesuit architecture in America is, however, the church in Quito. There the Mudejar patterns, which stand out in gold against a red background, make the interior (1605–89) of the church unforgettably sumptuous. More provincial though extremely colourful Mudejar interiors are characteristic of the monastic churches of Tunja, Colombia. Due to the splendid designs of its monastic buildings, Quito stands with Cuzco as one of the major schools of architecture in South America.

18th *Century*.—The first stage of baroque architecture in Spanish America is generally distinguished by richly sculptured façades, whereas the interiors often remain sober settings for resplendently carved and gilded altarpieces. The late baroque altar of spiral columns was imported from Spain about 1650–60. Its translation into stone on the faqade of a church first occurred (1697–1704) in South America in La Merced at Lima, to be followed by San Agustin there and three churches in Cajamarca, Peru.

In this period appeared in southern Peru and Bolivia a school of architectural decoration characterized by native Indian contributions in the primitive manner of carving and in the introduction of non-European ornament. The crossbred style is known as mestizo, because it, like the people, is compounded of European and native Indian stock. Evidences of Indian contribution are also found in Mexico throughout the colonial period, and there exist parallel phenomena in Central America. The first examples of the independent Peruvian-Bolivian style are preserved in Arequipa, Peru, where the faqade (1698) of the Jesuit church is carved like a tapestry in stone. Other famous examples are Santiago at Pomata, Peru (c. 1690–1722), San Lorenzo (1728–44) and the Jesuit church (1700–07) at Potosi, Bol., and San Francisco (1753–72) at La Paz, Bol.

Argentina lay in the outer periphery of the Spanish colonies, and its early architecture consisted of provincial chapels of rubble and adobe, with the exception of the Jesuit monastery (1654–79) at Córdoba. In the 18th century two Italian Jesuit architects, Blanco and Primoli, established the spacious style of the Italian baroque in the Jesuit estates of Alta Gracia and Santa Catalina near Cordoba and in El Pilar at Buenos Aires.

Baroque architecture reached its climax in Mexico with lavishly carved faqades in which the tapering pilaster (*estipite*) was a distinguishing feature. Introduced in the capital in the Sagrario faqade (1749–68) under the architect Lorenzo Rodriguez, it spread rapidly and appeared in La Santisima, in the Jesuit seminary at Tepotzotlán, in the churches of Guanajuato, and elsewhere. The school of Puebla maintained independence in producing an extraordinary array of brilliantly coloured exteriors of glazed tiles, both in churches and in countless palaces. Mixtilinear contours in doorways, windows and roof levels created highly picturesque effects in Mexican buildings of this period.

Throughout Spanish America, cities were built on a gridiron plan, with a rectangular plaza in the centre and covered sidewalks (portales) of Mediterranean tradition. Houses, large or small, were arranged about a central patio. Handsome domestic buildings exist throughout the continent; special mention should be made of those in Mexico city, Puebla, Tunja, Potosi and Cuzco. Most remarkable civil edifices, such as the customhouse and viceregal palace, survive in Mexico city, whereas elsewhere only the royal mint at Potosi (1753–73) and the government palace (1764) in Antigua, Guat., are comparable in importance. Spanish colonial

architecture came to an abrupt end with the triumph of neoclassicism (1800).

Brazilian architecture. — The Colonial Period (*1530–1822*). — The architecture, language and culture of Portugal were transplanted to Brazil, which was the only major area of non-Spanish origin throughout Latin America. The first cities were built upon hills in medieval style, unlike the unified Spanish settlements. Little of importance survives from the 16th century, when buildings were mostly of wattle and palm thatch.

The Jesuits brought to Brazil the first significant ecclesiastical style, a severe and undecorated architecture, in which the rectangular façade with angle pilasters has a pedimental gable and windows in the second story (Olinda, 1592). This type with variations persisted in Brazil until 1750. Plans are rectangular with square sanctuary and sacristy directly behind, and basilican structures are few. Long lateral chapels parallel with the nave are an unusual feature, derived from Portugal. Vaults and domes are rare, and decoration is limited to the occasional use of imported blue glazed tiles.

Salvador, the viceregal capital until 1763, had the closest ties with Lisbon, and its architecture reflected contemporary Portuguese models. The former Jesuit church, now the cathedral of Salvador (1657–72), has a late Mannerist façade of stone in two principal stories, decorated with Doric pilasters and topped by a large attic story. The prominent windows in the second story are typical of Portuguese and Brazilian ecclesiastical and domestic design.

The more exotic church façades began in the 18th century; great volutes over the centres between square towers created extraordinarily ingenious effects. This development can be traced at Salvador, Deodoro, Penedo, Olinda, João Pessoa, and elsewhere, in a series of Franciscan churches with arched open narthex, three windows in the second story, and fantastic volutes crowning the top.

In the last period of Brazilian colonial architecture (1750–1822) the court style of Lisbon took hold in Belém and the new viceregal capital (1763) at Rio de Janeiro. The neo-Palladian church of the Candelaria (177j) there is the most important monument in the early neoclassical style. The late rococo was, however. still well entrenched, and in the mining country of Minas Gerais it found its most original expression after 1750. Here the great sanctuary of the Bom Jesús at Congonhas do Campo is approached by terraces, a provincial version of the shrines at Braga and Lamego in Portugal.

The oval and octagonal plans, which had been earlier introduced at Rio and Recife, reached a new development in São Pedro dos Clérigos at Mariana and in the double oval plan of the Rosario at Ouro Preto (1785), where they are combined with round towers and curving facades. Curving exteriors in various forms in the Franciscan churches at Ouro Preto (1766) and São João del Rei by Aleijadinho and in other monuments established the keynote of this late period.

Extreme decorative luxuriance characterized the altars and church furnishings in the 18th century, and often the walls of chapels and churches were overlaid with carved ornament. Rio, Salvador and Minas Gerais became the chief centres of interiors in which gilding, spiral columns, late baroque ornament, and illusionistic painting combined to create extraordinary decorative ensembles. An equal flowering of late rococo ornament distinguished portals, windows and profiles of both ecclesiastical and domestic buildings. With the arrival of the French commission in 1816 to establish an academy of fine arts the neoclassical style was definitively implanted in Brazil, and French taste prevailed thereafter.

Ibero-America.—*20th* Century. — Revivals of traditional historical styles of building held sway throughout the 19th century in Ibero-America and well into the early years of the 20th century. In the 1930s North American skyscrapers and modern functionalism in homes and apartment buildings were introduced at Buenos Aires. However, the great development of modern architecture in Ibero-America occurred in Brazil in the same period. The Swiss architect Le Corbusier was invited to Rio de Janeiro in 1936, and under his direction the Brazilian architects Lúcio Costa and Oscar Niemeyer worked upon plans for the ministry of education (1937–43). A great rectangular structure raised upon exposed cylindrical piers in pure Le Corbusier style, it established the new Brazilian school. The invention of adjustable blinds to counteract the intensity of the sun was a feature which was also widely adopted subsequently. The rapid expansion of the cities of Rio and São Paulo as well as smaller centres, such as Belo Horizonte was one of the great phenomena of the first half of the 20th century. Office buildings and apartment houses in the form of skyscrapers abound. Private houses, schools, hospitals and airports all followed the traditions of the international style of Le Corbusier, with Brazilian variations in the extensive use of tiles and stucco exteriors and in a propensity to curving plans.

Brasilia (*q.v.*), on a vast remote plateau 600 mi. N.W. of Rio, was an epoch-making event of contemporary architecture. The city plan, shaped like two great wings, with complicated levels, terraces and approaches, was conceived by Lucio Costa; and construction began in 1957 under the direction of Oscar Niemeyer, who designed the presidential palace and the government buildings, which were largely completed in 1960.

After World War II, numerous tall buildings were built everywhere in Ibero-America, notably in Caracas, Venez., and Mexico City. In the expansion of the former alone was a uniform city plan followed. Remarkable new university cities were built at Santiago de Chile, Rio de Janeiro, Caracas and Mexico City. The last (1950–52) was designed by a group of artists collaborating on the vast complex of buildings, including the Olympic stadium. The use of mosaics on exteriors and the adoption of pre-Columbian architectural traditions, especially in the stadium, gave the Mexican style a high degree of individuality within the general conventions of the modern international style of glass and concrete. Domestic architecture of the luxurious region of Pedregal also incorporated similar native elements.

BIBLIOGRAPHY.—*Handbook of* Latin Anzerican Studies, vol. 2–21 (1938–59); R. C. Smith and E. Wilder, Guide to the Art of Latin America (1948); M. J. Buschiazzo, Bibliografia de arte colonial *argentino* (1947); Angulo, Marco Dorta and Buschiazzo, *Historia* del ***arte hispanoamericano,*** vol. i–iii (1945, 1950, 1956); Germain Bazin, *L'architecture religieuse* baroque au *Bresil* (1956); Henry R. Hitchcock, Latin Anzerican *Architecture* Since *1945* (1955); P. Kelemen, Baroque and Rococo in Latin America (1951); G. Rubler, Mexican Architecture of the Sixteenth Century (1948); Kubler and Soria, Art and Architecture in Spain, Portugal, *and* Their *American Dominions* (1959); H. E. Mindlin, Modern Architecture in Brazil (1956); Robert C. Smith, "Baroque Architecture," Portugal and Brazil, ed. by H. V. Livermore, pp. 349–384 (1953); M. Toussaint, Arte colonial en *México* (1948); H. E. Wethey, Colonial Architecture and Sculpture in Peru (1949).

(H. E. W.)

IBERO-AMERICAN LITERATURE. With the discovery of new lands beyond the ocean sea, Iberian Spain and Portugal embarked on a Christian crusade three centuries long that was to stamp its colonial seal on vast sprawling areas of the Americas. This bold adventure mas chronicled fully from the very day Christopher Columbus set sail out of Palos, Spain. His letters to King Ferdinand and Queen Isabella marked the beginnings of a rich body of colonial writings. Conquerors of the sword and cross alike spelled out the story of the discovery and the conquest, of natural wonders and ancient civilizations, in countless letters, chronicles, histories, polemic tracts, dictionaries, grammars, religious pieces and epic poems that comprise this "literature of the conquest." The most fascinating and the most vital of these writings are those vibrant still with the high hopes and lusty spirit of the men who participated actively in the great crusade for church and crown.

This article is divided into the following sections:

I. The Colonial Years (1492–1826)
  A. Literature of the Conquest (1492–1600)
  B. The Flowering of Colonial Letters (1600–1808)
  C. Literature of Rebellion (1808–1826)
II. The Formative Years (1826–1910)
  A. The Romanticists (1826–1870)
  B. The Realists and the Naturalists (1855–1900)
  C. The Modernists (1888–1910)
III. The Mature Years (1910–)

A. Vanguard Literature (1918–1930)
B. Literature of Social Protest (1930–)

Biographies of many Ibero-American writers mentioned below may be found in articles under their names.

I. THE COLONIAL YEARS (1492–1826)

A. Literature of the Conquest (1492–1600).—For the thrill of first contacts, of epic adventure and of new vision there are the five dispatches, or *Cartas de relactdn,* sent by Hernán Cortés (1485–1547), the courageous, calculating conqueror of the Aztecs, to his emperor Charles V; the inimitable and disarming account of the indignant and doughty Bernal Diaz del Castillo (1492–1584), who spoke for the common soldier in his *Verdadera historia de la conquista de la Nueva España;* the incredible odyssey of the first white man to cross America on foot from Florida to the Mexican Pacific as told by Alvar Núñez Cabeza de Vaca *(c.* 1490–1564) in his *Naufragios* y *comentarios;* the impassioned pages of that impetuous "apostle of the Indies" the Dominican friar Bartolomé de las Casas (1474–1566), whose *Brevísima relación de la destruicidn de las Indias* (1552) became the cornerstone of the "black legend" of colonial Spain; and finally, the nostalgic reminiscences of a mestizo born of an Inca princess and a Spanish conqueror, (Inca) Garcilaso de la Vega (1540?–1616), embodied in his imaginative and exciting history, *Los comentarios reales que tratan del origen de los Incas* (1609–17).

The conquerors were not content. however, with chronicling their deeds in prose alone. Fired by the heroic fervour of their age and by the example of Ariosto, Tasso and the Latin masters, they sang in epic measures the nhole story of adventure that lured them from distant Antarctica to the upper reaches of the Rio Grande. *La araucana* (1569–89), the first of these epic poems and the best of the many written in the closing years of the 16th century, and sporadically throughout the later colonial period, mas begun on scraps of paper and bark by the young captain and courtier Alonso de Ercilla y Zúñiga (*q.v ;* 1533–94) while with the Spanish armies pitted against the indomitable Araucanians of Chile. Tremendously popular in its time, this national epic inspired other participants elsewhere to do for northern South America what Ercilla had done for Chile: Juan de Castellanos (1522–1607?), *Elegías de varones ilustres de Indias* (1588); for the Plate river region, Martin del Barco Centenera *(c.* 1535–1605), *La argentina;* and even for the northern outposts of New Spain, Gaspar Pérez de Villagrá *(c.* 1; 55–1620), *Conquista de la Nuevo México* (1610). These later poems pale in poetic import as they gain in documentary significance. Only the *Arauco domado* (1596) of Pedro de Oña (1570–1643), Chile's first outstanding native poet, approaches the Ercilla epic in artistic achievement. In *La cristiada* (1611), written in Lima (Peru) by the Dominican Diego de Ojeda (1571–1615), America was also to produce the best sacred epic in the Spanish language. And finally there is the brilliant and ambitious Bernardo de Balbuena (1562–1627) whose work best represents the rich and varied literary expression of the dawning Baroque age. His vast epic, *Bernardo, o victoria de Roncesvalles* (1624), and his eclogues are overshadowed by his *La grandeza mexicana* (1604), an effusive paean that placed him among the best descriptive poets of colonial America.

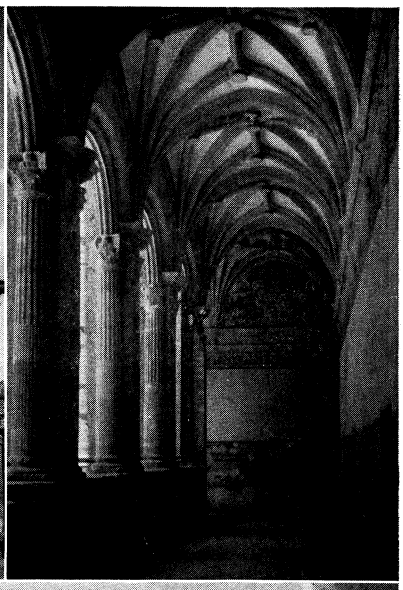
The discovery and conquest of the tropical heartland of America did not produce a like rich body of Brazilian counterparts to the spirited epics in prose and verse of the Spanish conquerors. The Portuguese found no centuries-old native civilizations upon nhich to build a new society. Indians were few. Rather than resist, they retreated into the interior, leaving the invaders to settle at nidely scattered points along the extended narrow coastal plain. There was, then. no epic clash of nhich to sing. But there was the beautiful and bountiful land and nature's children of coast and forest. and these, beginning nith the very day of discovery, nere described and extolled by the Portuguese explorers and missionaries and by others of many lands. Brazil's "literary baptism." like that of colonial Spain. is to be found in the letter of discovery sent to Dom Manuel I of Portugal by the scribe Pero Vaz de Caminha nho accompanied the explorer Pedro Álvares Cabral in 1500 The missionary labours nere largely in the hands of the Jesuits. and to one of their number, José de Anchieta (1534?–97), linguist. historian, poet, dramatist and educator. befell the distinction of being hailed as the father of Brazilian literature. For the period, however, there is only one epic, and this, except for some descriptive passages that give voice to *brasilidade,* or love for the new land of Brazil. sings of Portuguese exploits against the Moors in feeble imitation of Luis Vaz de Camões. The epic *Prosopopéa* (1601). by Bento Teixeira Pinto *(c.* 1540–1618), is commonly regarded as the first book by a Brazilian-born writer.

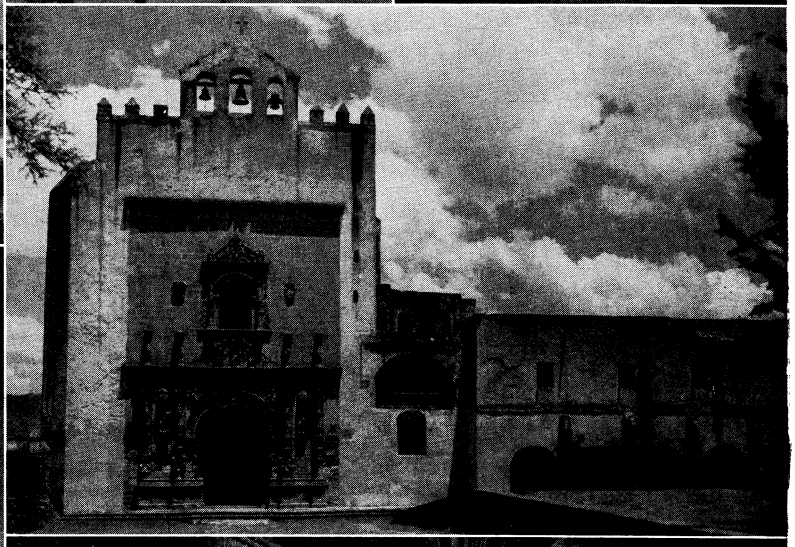
B. The Flowering of Colonial Letters (1600–1808).—By 1600 the day of the conqueror was past and the new world began to adjust to a less spectacular development for two more long centuries under Spanish-Portuguese dominion. Institutions and manners evolved and flourished under patterns already set in the latter half of the 16th century. The first printing press in the Americas was established in Mexico City about 1539, to be followed by another in Lima in 1584, and both cities were granted university charters as early as 1551. Such, however, was not the case in Brazil where not a single university was founded during colonial years and where printing was not permitted until the close of the period. But everywhere in the Americas a growing leisure class could devote more time to intellectual and artistic pursuits, and close ties maintained with the homeland through men and books encouraged the development of parallel literary patterns. In convent and court, life and letters became a pallid reflection of trends across the Atlantic, and there was little in these two centuries that could lay claim to originality or to distinction as the product of a genuine American art.

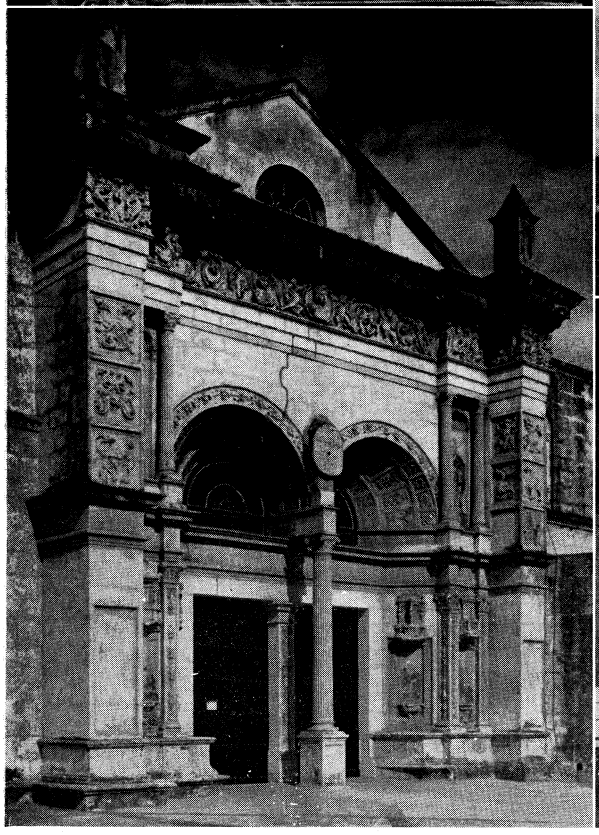
The theatre, barely emerging from its medieval forms at the time of the conquest, served largely during the 16th century as a missionary medium in the Indian tongues for the conversion of the native masses. But for the creoles and the growing mestizo class the dramatic repertoire was mainly Spanish and Portuguese, and even those plays that were written in America, but rarely published, were patterned after the flourishing drama of the Golden Age. The plays of the greatest of these native dramatists, the Mexican Juan Ruiz de Alarcón (1580?–1639), more properly belong to Spain.

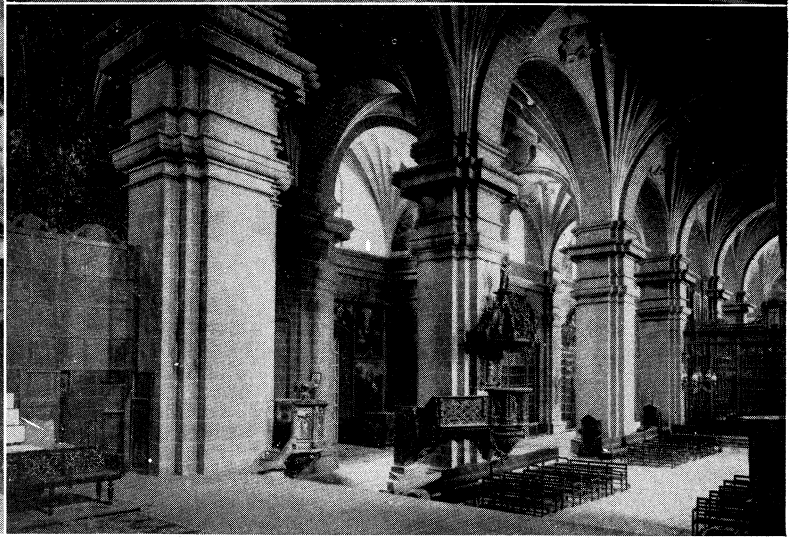
No true novel was written during the entire colonial period. Prose fiction as such continued to yield to works of historical and biographical import. One of the most readable of these pieces is the entertaining travelogue, *El lazarillo de ciegos caminantes,* written sometime about 1773, by the still unidentified Calixto Bustamente Carlos Inga, of Peru, better known under his pseudonym Concolorcorvo.

That poetry was the most popular form may be inferred from a contest held in Mexico in 1585 in which more than 300 versifiers took part. But these rhymesters did little more than produce a flood of mediocre poetry as indifferent disciples of the cult of the Cordovan genius Luis de Góngora y Argote (1561–1627). Most of their work remains mercifully buried and almost forgotten. Samplings of their blighted art may be found in the curious and entertaining anthology, *Ramillete de varias flores poéticas* (1675), gathered by Jacinto de Evia (b. 1636) of Ecuador. One name alone stands out above them all, that of the famed Mexican nun and "tenth muse," Sor Juana Inés de la Cruz (*q.v.;* 1651–95). Thirsting after knowledge, she had at 16 sought refuge in a convent where she hoped to be able to dedicate her talents entirely to meditation and writing. But her admirers all over the western world kept her in the intellectual and social limelight, where she added further to her stature as Mexico's first feminist. Her fame was enhanced not a little through her critique of one of the sermons of the most eloquent Jesuit missionaries of the day. Antônio Vieira (1608–97). Vieira's vigorous writings in defense of the Indian and Negro and against the exploitation of Brazil by Portugal attest to the fact, that protest as he did against current literary licence, he too like Sor Juana and others could not free himself entirely of the fateful attraction of Góngora. Sor Juana's plays, religious tracts. a revealing autobiographical piece (the product of her contact with Vieira). but above all her sacred and profane lyrics of simple beauty and emotional appeal, amazingly free of









ALL PHOTOS BY COURTESY OF HAROLD E. WETHEY; PHOTOGRAPHS (BOTTOM LEFT) ROBERT C. SMITH, (BOTTOM RIGHT) GONZALEZ, CUZCO, PERU. (OTHERS) HAROLD E. WETHEY

16TH- AND 17TH-CENTURY RELIGIOUS ARCHITECTURE

Top left: Fapade of Augustinian church (*c.* 1570), Cuitzeo, Mex. Renaissance style

Top centre: Façade *of* the Jesuit church at Cuzco, Peru. Baroque style (1664)

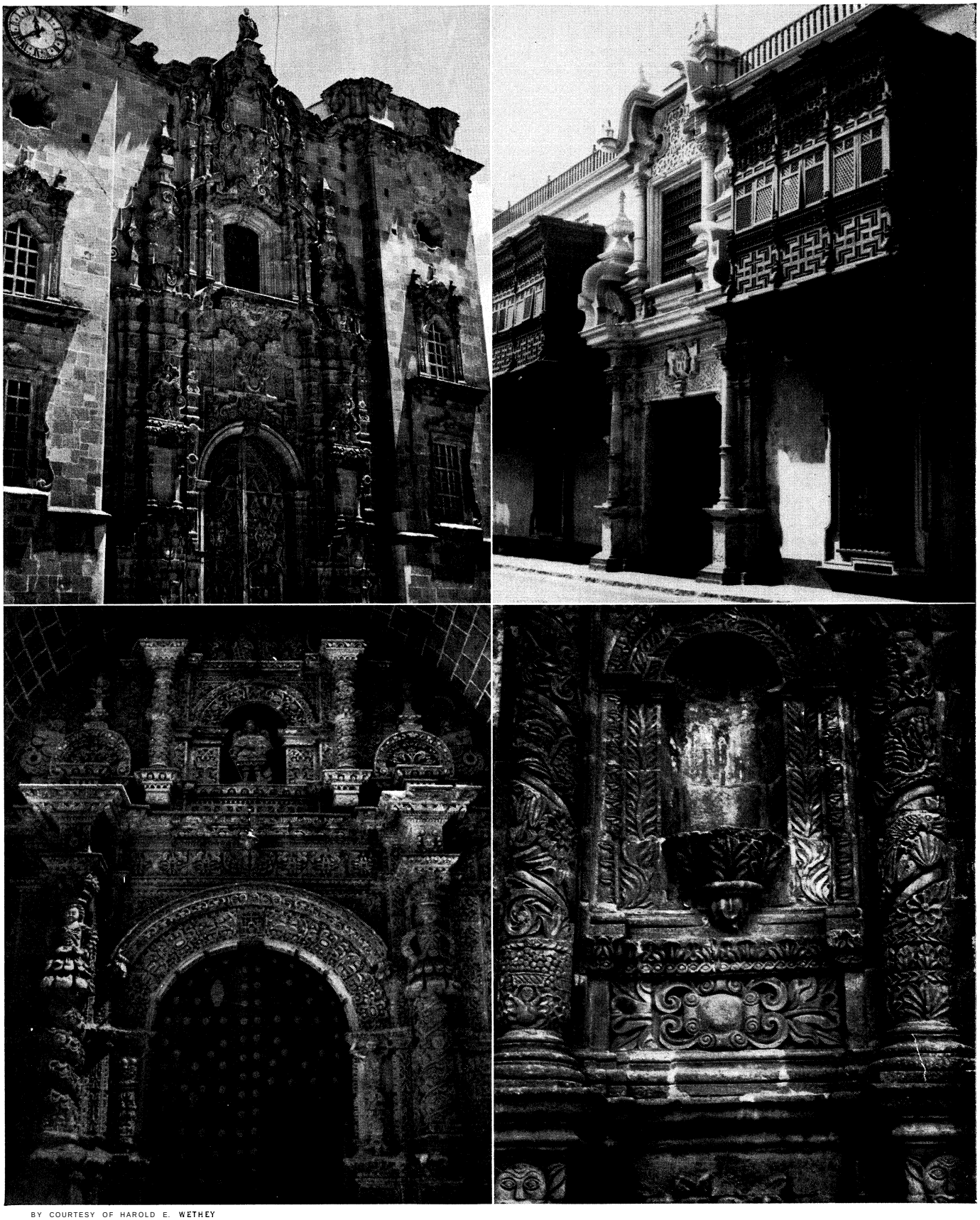
Top right: Cloister with Renaissance piers and Gothic vaults, Augustinian monastery (*c.* 1560), Yuriria, Mex.

Centre right: Exterior (1560) of Augustinian monastery at Acolman, Mex.

Bottom left: Façade of cathedral of Santo Domingo, Ciudad Trujillo, Dominican Republic. Spanish Renaissance (1514–40)

Bottom right: Interior of Cuzco, Peru, cathedral (1598–1654). Spanish Herreresque with Tuscan piers and Gothic vaults

IBERO-AMERICAN ARCHITECTURE



BY COURTESY OF HAROLD E. WETHEY

17TH- AND 18TH-CENTURY ARCHITECTURE

Top left: Facade of La Valenciana (1765–88), Guanajuato, Mex. Late Baroque (Mexican) with tapering pilasters

Top right: Torre Tagle palace, Lima, Peru (1735). Barosue portal and closed wooden balconies of near eastern tradition

Bottom left: Façade of San Lorenzo church (1728–44), Potosi, Bolivia. Style intermingled formalized patterns of both European and Indian themes

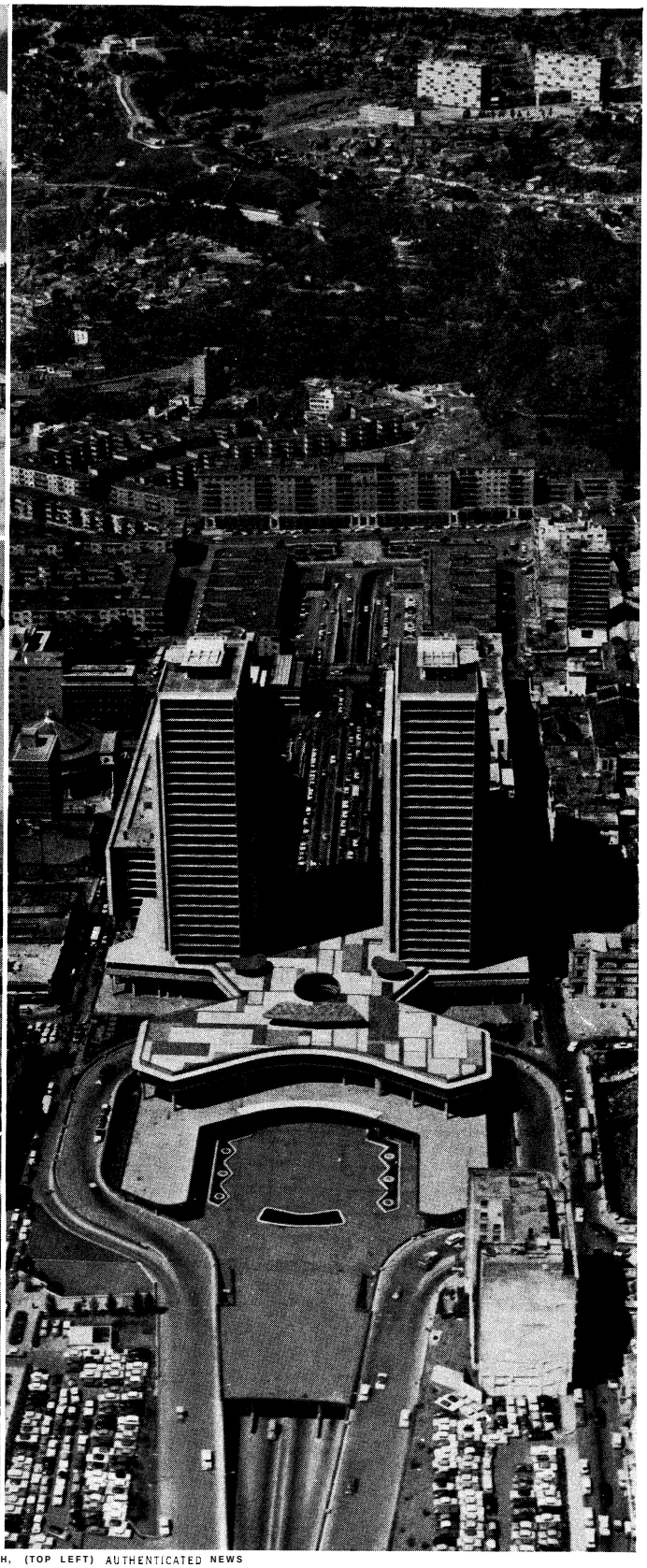
Bottom right: Church of Santiago, Pomata, Peru. Detail of lateral portal (*c.* 1720); mestizo style showing Indian influence

BY COURTESY OF (TOP LEFT, BOTTOM LEFT, BOTTOM RIGHT) LIBRARY OF CONGRESS; PHOTOGRAPH, (TOP RIGHT) WAYNE ANDREWS

RELIGIOUS ARCHITECTURE OF BRAZIL AND MEXICO

Top *left:* Facade of São Francisco, São João del Rei, Brazil; about 1770
Top right: San Francisco Xavier, Tepotzotlán, Mexico; 1582–1760
Bottom left: Interior of São Francisco, Salvador, Brazil; middle of the 18th century
Bottom right: Cathedral, Salvador, Brazil: 1657–72

IBERO-AMERICAN ARCHITECTURE



BY COURTESY OF (RIGHT) HAMILTON WRIGHT, (BOTTOM LEFT) BRANIFF AIRWAYS; PHOTOGRAPH, (TOP LEFT) AUTHENTICATED NEWS

SECULAR ARCHITECTURE

Top *left:* Government palace, Antigua, Guatemala; 1764
Right: Simón Bolivar centre, Caracas, Venezuela; the focal point of the 20th-century redevelopment of the city. In the background are modern housing units

Centre left: Jai alai courts of University city, Mexico: 1950–52
Bottom left: Palace of the Dawn, residence of the president, Brasilia, Brazil. Oscar Niemeyer, architect; 1959

Góngorist excesses, constitute one of the greatest single colonial literary legacies of Ibero-America.

As the colonial period ended only an occasional voice protested against the artificiality and decadence of viceregal life and letters. Among the earliest of these were the mordant Peruvian wit Juan del Valle y Caviedes (*c.* 1652–92) and his contemporary Gregório de Mattos Guerra (1633–96), the epigrammatic "devil's mouthpiece" of Brazil. Both stemmed directly from the Quevedo tradition in Spain and both were extremely popular, their verse circulating widely from manuscript to manuscript, not to be collected and published until long after their deaths.

C. Literature of Rebellion (1808–1826).—Protest and general political unrest began to spread as the 18th 'century advanced and French letters and ideas broke through the relaxed controls indifferently held by Spain and Portugal over new world thought and expression. Early stirrings became more purposeful when French revolutionary doctrines were put to the test by the bold action of Britain's colonies to the north. Printing presses and periodicals sprang up everywhere to convey the new ideas and ideals quickened in the flourishing literary societies founded by Ibero-America's young liberals returning from fruitful contacts abroad.

One of the earliest, most immediate fruits of these contacts with foreign thought was the abortive Brazilian *Inconfidência Mineira* of 1789, a "conspiracy of poets," headed by Joaquim José da Silva Xavier, called Tiradentes (the "toothpuller"), and supported by a number of exceptional writers who were members of the *escola mineira.* This "Minas school" of epic and Arcadian (neoclassic) poets had no equal in the Spanish colonies of that day. Inspired by Camões and Ercilla, José Basilio da Gama (1740–95), author of *O Uruguay* (1769), and Friar José de Santa Rita Durão (*c.* 1720–84), author of *Caramurú* (1781), composed two great native epics of Brazil. Love of country and the appearance of the Indian as a literary character stamped both works as forerunners of Brazilian intellectual independence. The outstanding lyrist, Tomás Antônio Gonzaga (*q.v.;* 1744–1807), author of the delicate love songs to *Marília de Dirceu* (1792), is still the most popular love poet in the Portuguese language. Gonzaga was to die in exile in far-off Mozambique and a somewhat similar fate awaited most of the conspirators of that ill-starred revolt. When, after a bloodless victory in 1822, Brazil finally emerged as an empire under Dom Pedro I (1822–31) and Dom Pedro II (1840–89) only one literary figure, José Bonifbcio de Andrada e Silva (1763?–1838), stood out as the patriarch of Brazil's struggle for independence. As the author of such vigorous, passionate verse as *Poesias,* published in Bordeaux (1825), he clearly reveals his affinity to Byron; he is also acclaimed Brazil's first romantic poet.

The pioneer Venezuelan Francisco de Miranda (*q.v.;* 1750–1816) left a remarkable journal that reveals how he profited from firsthand contacts in the United States with the "great American experiment." His compatriot. the liberator Simón Bolivar (1783–1830), was later christened "the thinker of the Revolution." Through his prophetic analyses of the sociopolitical scene filtered some of the best and most applicable of French thought. particularly that of Montesquieu and Rousseau. Bolivar's dream of a confederation of Ibero-American states received ardent support from the fiery Argentine pamphleteer Bernardo de Monteagudo (1785–1825). onetime secretary of his country's national hero, José de San Martin.

But brilliant and decisive as was their contribution to the cause, the Mexican propagandist and journalist José Joaquin Fernandez de Lizardi (1776–1827), referred to as *el pensador mexicano* (the Mexican thinker) after the revolutionary journal founded by him in 1812, was the only one of that patriotic band of "liberators" to be remembered as a man of letters. His present fame rests largely on the picaresque tale *El Periquillo Sarniento* (1816). generally conceded to be the first authentic Ibero-American novel.

The revolution found its most popular form of expression in balladry and heroic verse. Only an occasional national anthem, such as that of Argentina written in 1813 by Vicente López y Planes (1784–1856), remains as a symbolic reminder of that time. The more enduring patriotic poetry came with the flush of victory and represents but a phase of the total output of three outstanding poets whose significance transcends the brief violent period of the struggle for independence. Only the work of the Ecuadorean José Joaquin de Olmedo (*q.v.;* 1780–1847) was limited almost exclusively to the themes and spirit of revolutionary years. His best-known poem, "La victoria de Junin, Canto a Bolivar" (1825; London and Paris, 1826), composed at Bolivar's request, is generally considered to be the finest example of heroic poetry in the classical style written in America. In his Virgilian "Silva a la agricultura de la zona tórrida" (1826), worthy companion piece to Olmedo's battle-inspired ode, the serene and encyclopedic poet and scholar Andrés Bello (*q.v.;* 1781–1865) of Venezuela, exhorted his fellow Ibero-Americans to turn their swords into ploughshares and live the good and abundant life that rich tropical America held out to all free men. In his later years Bello was to distinguish himself as a grammarian, literary critic, translator, lawgiver and educator and as the revered father of Chile's own first intellectual generation.

José Maria de Heredia (1803–39), Ibero-America's first great lyric poet and romanticist, lived most of his life in exile (Venezuela, New York, Mexico) where nature in its grander moods inspired the rebellious nostalgic poet of enslaved Cuba to write his widely acclaimed poems "En el teocalli de Cholula" (1820) and "Niágara" (1824). In Mexico, as was the case with Bello in Chile, Heredia was to participate actively in the new literary movement of romanticism with which the young Ibero-American nations were born to political independence.

II. THE FORMATIVE YEARS (1826–1910)

A. The Romanticists (1826–1870).—Victory brought immediate political independence from Spain and Portugal (except for the island countries of the Caribbean) but not freedom from the despotism of political anarchy that beset the young nations in their early formative years. Economic and political stability would not be realized for most of the new nations until the closing years of the century. American themes had fired the imagination of the "liberators," but neoclassic forms were still too sacred to be violated even by the tempestuous romantic Heredia. European romanticism was to show the political liberals the way to cultural independence also, even though that way lay largely along the route marked out by France (Chateaubriand, Lamartine and Hugo). England (Scott and Byron), and Spain (Espronceda and Zorilla). Neoclassic form and restraint yielded to the romantic tenets of freedom, individualism and emotional intensity, tenets ideally suited to fit Ibero-American temperaments and conditions.

The most illustrious group of early romanticists was that of the Argentine political refugees who fled from the tyranny of Juan Manuel Kosas (1793–1877). Their leader was Esteban Echeverria (1805–51), who shortly after his return from a four-year stay in France (1826–30) when romanticism was at its height, indicated the way by writing "La cautiva" (1837), his best poem and the earliest example of the wedding of native themes and scenes to new and more appropriate verse forms. The pampa had been discovered. It remained for Domingo Faustino Sarmiento (*q.v.;* 1811–88), who rose from rural schoolmaster to be his country's first civilian president, to present in *Facundo* (1845), written in Chile in passionate denunciation of Rosas, the first serious study of the pampa and of gaucho lore. It was this emphasis on the national scene that gave birth to an indigenous literary genre without European prototype, the so-called gaucho literature of Argentina and Uruguay. The gaucho had long been the subject of folk tale and ballad. He then became the subject of some of the best verse of the century, his romantic story finding, in part, its highest artistic expression in Rafael Obligado's (1851–1920) three poems (1887) on the legendary minstrel Santos Vega. He was acutely portrayed in the humorous gem *Fausto* (1866) by Estanislao del Campo (1834–80). And, finally, he aroused the national conscience and received epic treatment in the classic *Martín Fierro* (1872–79) by José Hernández (1834–86).

These "primitive" poems written in imitation of the gaucho minstrel's ballads and speech are one of two of Ibero-America's original contributions to western letters. The other springs from

the romanticist's interest in the search of national roots: the past of the "noble savage" of Utopian pre-Colombian days and of the victim of Spanish colonial tyranny, the past of a hardy epoch of discovery and of clash of conqueror and conquered, the past of the romance and intrigue of later viceregal days and finally the past of the glorious epic of the struggle for self-determination and self-expression. Echeverria was one of the first to exploit this past in *La cautiva,* the poetic narrative of the legend of the ill-starred lovers of the pampa. This romantic evocation mothered a growing brood of poems and plays that reached its poetic climax in the elegiac *Tabard* (1886) in which the Uruguayan Juan Zorrilla de San Martin (1855–1931) sings of the sad fate of the aboriginal Charrúas forever vanquished by the Spanish invaders. In prose this past produced the *tradicidn,* the other unique Ibero-American genre patterned after the historical anecdote and perfected by the Peruvian Ricardo Palma (1833–1919), one of the greatest Ibero-American masters of piquant, humorous prose. Palma's *Tradiciones peruanas* (1872–1910) have been imitated by many, but no one has yet succeeded in matching his entertaining and artistic re-creation of the past, especially of colonial years.

The Brazilian romantics had no great Indian past and a relatively uneventful colonial era. They therefore continued to extol the beauties of their tropical homeland and to exalt the simple living of the idealized Indian, always with languid nostalgia, or *saudades,* and not infrequently with marked religious fervour. Domingos José Gonçalves de Magalhães (1811–82) is generally credited with having launched the romantic movement in 1836 with the publication of the patriotic and deeply religious poems, *Suspiros poéticos e saudades.* The earlier phases of the movement found their best and most representative expression, however, in the inspired and richly variegated writings of Antônio Gonçalvez Dias (1823–64), one of Ibero-America's truly outstanding poets of the romantic period. Later phases of romanticism are best exemplified in the poetry of doubt and despair of the would-be Byronic, soul-sick, short-lived Manuel Antônio Alvares de Xzevedo (1831–52) of the so-called "Satanic school" and author of *Uma noite na taverna (c.* 1851) and in the Hugoesque sociopolitical verse of the abolitionist and intensely Brazilian Antônio de Castro Alves (1847–71), author of *Os escravos* (1876).

B. The Realists and the Naturalists (1855–1900).—The romanticist's interest in the picturesque and unusual helped him discover types and customs in the living present that gave evidence of a budding national way of life. The sketch of contemporary manners, or *cuadro de costumbres,* closely modeled after those of the Spanish *costumbristas*—*Larra,* Estébanez Calderón, Mesonero Romanos—developed into the realistic novel of manners shortly after mid-century. From that date on, the novel began to assume a more commanding role in Ibero-American letters. Contrary to its development elsewhere. homever, it appeared almost concurrently in the several types representative of successive literary trends in Europe whose masters (Scott. Dumas, Balzac, Pereda, Galdós, Eça de Queiroz) provided the molds in which were poured Ibero-American themes. José Mármol (1817–71), the most virulent anti-Rosas poet of the Argentine exiles, is remembered for *Amalia* (1851–55), a highly romantic novel of contemporary political events that afforded the outside world a dramatic depiction of life in Argentina under the tyranny of Rosas. Across the Andes the realist Alberto Blest Gana (1830–1920) began producing a series of *cosfumbrista* novels on Chilean life of which *Martin Rivas* (1862) is generally considered his best. At about the same time, the Colombian Jorge Isaacs (1837–95) gave Ibero-America its most popular and most representative novel of the 19th century in the tragic idyll of *Maria* (1867), while Juan León Mera (1832–94) of Ecuador contributed *Cumandd* (1871) to the growing number of highly romantic fictional portrayals of idealized Indian life.

Except for a scattering of prose pieces of dubious novelistic stamp, the true novel did not put in an appearance in Brazil until 1844, the date of publication of the perennially popular and romantically sentimental A *moreninha* by Joaquim Manuel de Macedo (1820–82). From that time on, however. the form enjoyed a more orderly and more continuously progressive growth than in the other sister republics. Still one of the most widely read of his country's novelists, José Martiniano de Alencar (1829–77) initiated the vogue of the Brazilian *Indianista* novel by contributing two of the most popular works to the genre, *O Guarany* (1857) and *Iracema* (1865). But these romantic tales of love between Indian and white represent only one aspect of Alencar's varied literary activity. In attempting to novelize the whole of his country's past, he turned to the *sertão* (hinterland) to depict the life and customs of Brazil's backlands. His *O gaúcho* (1870) and *O sertanejo* (1876), although still markedly romantic in spirit, were among the forerunners of a flourishing regional genre that set the stage for the flowering of a truly national novel. Two exceptional contributors to this transitional genre were Alfredo d'Escragnolle Taunay (1843–99), whose *Inôcencia* (1872), an unusual love idyll set in the backlands of Mato Grosso. became a universal favourite. and Bernardo Guimarães (1827–84), whose frankly abolitionist *A escrava Isaura* (1875) was a decisive step forward in the direction of the novel of social protest.

True realism—with a definite leaning toward naturalism—had made an early and isolated bow in the long-overlooked *Memórias de um sargento de milícias* (1854–55), a Balzacian novel of early 19th-century types and customs by Manuel Antônio de Almeida (1831–61). But it was not until the mid-1870s that the novel began to cut deeply under the surface of rural and urban national life to expose the cankers of social and psychological maladjustments to a rapidly changing economic scene. Aluizio de Azevedo (1857–1913) was to become the forerunner of the 20th-century novelist of social protest by virtue of such favourites as *O mulato* (1881) and *O cortiço* (1890). Less concerned with the external aspects of Brazilian life, Joaquim Maria Machado de Assis (1839–1908) pried with piercing irony and refined humour into the psychological complex of the Brazilian soul to distinguish himself as a master craftsman and as his country's most original and gifted writer. His trilogy: *Braz Cubas* (1881), *Quincas Borba* (1890) and *Dom Casmurro* (1900) is a landmark in Ibero-American letters. A *carne* by Júlio Ribeiro (1845–90) and *O ateneu* by Raúl de Avila Pompéia (1863–95), both published in 1888, revealed two additional writers of note who helped set the Brazilian novel on a Course not to be similarly charted by novelists of the other Americas until almost a generation later.

The struggle against the old tyrannies that survived political separation from Spain and Portugal gave birth to a mass of polemical writing notable more for its passion and invective than for profundity of thought or style. After mid-century, homever, several of these late romantic "liberators" distinguished themselves in the manner and content of their writing, significantly distinctive in the essay form. Juan Montalvo (1832–89) became the symbol of uncompromising opposition to political tyranny. He is best remembered as the stylist and essayist of the philosophical *Siete tratados* (1882). Eugenio Maria de Hostos (1839–1903) of Puerto Rico. inspired teacher and essayist, led the way for social reform and independence for Caribbean lands. The abolitionist Joaquim Nabuco (1849–1910) and the cosmopolitan statesman Ruy Barbosa (1849–1923) were the two civic-minded intellectual giants of Brazil in mid-passage from empire and slavery to republicanism and the new way of life. It was, however, relentless attacks against all forces of repression that marked Peru's most dynamic and colourful essayist, Manuel González Prada (1844–1918), as the intellectual leader of successive generations of zealous youthful reformers. His ironic experimental verse, too, paved the way for the full-flowering of the "new" poetry that came into being with the younger rebels who sought to break once and for all with the aesthetic shackles that held them captive to old world writing.

C. The Modernists (1888–1910).—Political stability and a measure of economic security vouchsafed the emergence of a growing leisure class dedicated to cultural pursuits and to a cosmopolitan awareness of life and letters. This new attitude found its best expression in the revolt against the sentimental strains of romantic versifiers whose clichés began to fill the bulging pages of national anthologies. The romanticist's striving for national expression was largely responsible for the development of a sterile,

cloying product in which the potential of a rich new world and a complex social scene degenerated into a meaningless mass of banal lines. Ibero-American writers were suffocating in the stagnant confines of excessive nationalism. The revolt began when young writers, independently of one another over the Americas, withdrew temporarily from the local whirlpool to immerse themselves in the mainstream of world thought and writing. These new horizons broadened their perspective and afforded them a revitalized vision of how to achieve the cultural independence they had so long sought. At first, then, there were the young despondents and pessimists, those who attempted to shut themselves out from their immediate environment in artificial worlds of their own making. They were the transition group, or precursors, disparagingly labeled *modernistas* (modernists) by the older generation. They experimented in metres and in language. They wrote on themes exotic and rare—the ancient past, the distant orient, lands of childhood fancy and opiate creation. Beauty was their goddess and "art for art's sake" their creed, a creed nurtured largely in the French Parnassian and symbolist schools but one that derived strength and richness from sources representing the range of western poetics.

Foremost among the modernists of early transition years were the Mexican Manuel Gutiérrez Nájera (1859–95), whose elegiac verse and restrained rhythmical prose sketches and tales best represent the trend from romanticism to modernism; the Colombian José Asunción Silva (1865–96), whose metrical experimentation and romantic reminiscences left a small but influential body of poems that were widely imitated and even parodied; the morbid Julián del Casal (1863–93), probably the first full-fledged modernist, and his compatriot José Martí (1853–95), martyr and symbol of Cuba's struggle for freedom from Spain, whose inspired prose style and deceptively simple, sincere verse set his work above and apart from all schools and movements. Martí's life and writings have a special meaning for all Americans for all time.

But these modernists all died too young to witness the full-flowering of the movement under the leadership of Rubén Dario (*q.v.;* 1867–1916) of Nicaragua, whose collection of verse and prose, *Azul,* published in Chile in 1888, is the cornerstone of Ibero-American modernism. Dario's next significant work, *Prosas profanas* (1896), represents the high point of the escapist, cosmopolitan, "precious" phase of the movement. When Spain's empire crumbled completely in 1898 and mutual understanding and sympathy swept away much of the centuries-old distrust and antipathy between the mother country and her former colonies, Dario abandoned the ivory tower to sing new songs of life and hope for Spanish-speaking peoples everywhere. His *Cantos de vida y esperanza* (1905) are the fruit of a process of blending the best of modernist form with the more enduring and more universal themes of Hispanic lands. Dario's influence was far reaching, his imitators legion. The imitators, particularly those who exploited his early experimental escapist phase, were responsible for the emergence of a cult that bore his name, *rubendarismo,* a phenomenon that had its classic counterpart in the cult to which Góngora had given unwitting birth. But many of Dario's contemporaries stood out as individual artists of exceptional merit. The titles alone of their best-known and most appreciated individual pieces or collections often suggest the content and tone of their major contributions to the movement. This is especially so in the case of Mexico's Amado Nervo (1870–1919), whose mystic serenity is reflected in *Serenidad* (1914) and *Elevacidn* (1916); of Peru's José Santos Chocano (1875–1934), whose exalted Americanism gave birth to *Alma Amkrica* (1906); of Bolivia's Ricardo Jaimes Freyre (1872–1933), who drew upon Scandinavian mythology for the exotic measures and themes of his *Castalia bdrbara* (1899); of Colombia's Guillermo Valencia (1873–1943), whose classic bent is manifest in *Ritos* (1898); and of Uruguay's philosopher and essayist José Enrique Rod6 (1872–1917), whose overly polished appeal in *Ariel* (1900) for the cultural integrity of Hispanic lands but lately humiliated by the northern colossus, the United States, distinguished him as the leading critic and exponent of modernist ideals.

Long after Dario's death several of his contemporaries continued to contribute to the evolving trends of postmodernist years, including Leopoldo Lugones (1874–1938) of Argentina. whose philosophy and aesthetics kept pace with the vanguard of thought and expression to maintain him in a position of national leadership from early modernist days to the later phases of an arbitrarily pronounced nationalism; Enrique González Martinez (1871–1952), whose call to wring the neck of the modernist swan signaled his emergence as a serious and sensitive pace setter of later poetic trends in his native Mexico; and finally, the poet's poet, Julio Herrera y Reissig (1875–1910) of Uruguay, the outstanding symbolist of modernism, whose daring imagery paved the way for the neo-Gongorist cult of the 1920s. But such poets as Lugones and Gonzblez Martinez, who adjusted or gave direction to the trends away from modernism after 1910, were the exception. The vast majority of Spanish-American modernists, and their younger satellites, continued to be spellbound by the verbal magic and brilliance of the Dario of *Prosas profanas.*

In Brazil the reaction against romantic verse set in somewhat earlier than in the rest of Ibero-America, but it never produced the richly variegated mosaic of Spanish-American modernism. The Brazilian Parnassians owed as much to their Portuguese colleagues as they did to the French masters. They remained, then, essentially Brazilian, and though the more formal aspects of their poetry were challenged by a number of poets attracted to French symbolism, a symbolist movement as such never materialized in Brazil. Parnassianism as epitomized in the poetry of Raimundo Corréia (1860–1911). Alberto de Oliveira (1857–1937) and Olavo Bilac (1865–1918) reached its high point in the mid-1880s, and continued to dominate the stage, virtually supreme and relatively unchanged, until the "stirring 1920s" of Brazilian modernism. But the ivory tower of the escapists and the formalists was soon to topple under the pressure of world-shaking events already in the offing as the period drew to a close.

III. THE MATURE YEARS (1910-)

A. Vanguard Literature (1918-1930).—The Mexican Revolution of 1910, World Wars I and II and the Spanish Civil War served to confirm the conviction of thinking men everywhere in Ibero-America that drifting and dreaming on the roseate waters of the modernist swan would not help them to meet the multiple challenges arising out of local and international conflicts that shook their tottering social, political and economic structure to its very foundations. The horror and bloodshed of the Mexican Revolution shocked a complacent intellectual minority into a realization of the sad plight of their country's submerged masses. The Indian and the mestizo everywhere found able champions of their cause. Ardent youthful liberals broke away sharply from modernist tenets and from the wordy descriptions of local scenes and types, largely imitative of European realist and naturalist techniques, to create a body of writing that in theme, form, spirit and even language was unequivocal testimony to the fact that Ibero-American literature had at last come of age. The Spanish Civil War and World Wars I and II gave continental and international perspective to America's attempt to define her lot, place and mission among the nations of the world. World-wide depression and dollar diplomacy encouraged the emergence of radical economic philosophies that seemed to offer hope of deliverance from the bondage of imperialism. From this ferment of self-discovery and self-assertion, Ibero-America produced a literary portrait that in composition. colour and complexity was a remarkable tribute to the land and to the men whose dramatic story was told therein.

Shortly after 1900 the modernist leaders (Dario, Nervo, Lugones) turned away from the more formal and exotic aspects of the movement to initiate a return to traditional forms and to sincerity and simplicity of expression. Their followers, however, never wholly rejected the blessings of modernist experimentation —enriched versification and language and the revelation of countless new thematic sources. Of these postmodernists one group stands out sharply, an extraordinary band of women whose lyrics were more widely read and enjoyed than that of the majority of male poets in the first half of the 20th century. Love in all of

its impassioned and transcendental manifestations, maternal longing and social protest are the themes of Delmira Agustini (1886–1914), Alfonsina Storni (1892–1938), Juana de Ibarbourou (1895–) and Gabriela Mistral (1889–1957). Their contribution was recognized in the honour accorded Gabriela Mistral, winner of the Nobel prize in poetry for 1945.

Stemming directly from the modernist tradition and representative of a number of more pronounced trends are the unpretentious lyrics of Enrique Banchs (1888–); the deceptively experimental verse of the deeply subjective Mexican Ramon López Velarde (1888–1921); the wholesomely mystical expression of the Guatemalan Rafael Arévalo Martinez (1884–); the brilliant sonnet sequence of the tropical scene in *Tierra de promisión* (1921) by the Colombian José Eustasio Rivera (1889–1928); and the intensely racial rhythms of Cuba's "nativist" mulatto poet Nicolás Guillén (1904–).

While the postmodernists signaled a return to a poetic expression less markedly divorced from traditional forms and themes, other groups, caught up by the nihilistic waves of post-World War I "isms," sought to wrench poetry loose from its age-old moorings. Free verse and daring imagery that more often than not defied objective analysis and gave the mistaken impression of a coldly intellectual mood were the salient features of Ibero-American vanguard experimentation. Not a few *ultraístas,* as members of these vanguard coteries were collectively labeled, wrote with sociopolitical overtones.

Under the banners of *creacionismo,* Vicente Huidobro (1893–1948) of Chile launched one of these ephemeral movements in Spain in 1918. His continued denial of the entire poetic past was offset somewhat by the classical leanings and love of the national past that rendered the novel imagery of Argentina's Jorge Luis Borges (1900–) less vulnerable to the charges of obscurity usually leveled at all vanguard groups, including those who joined the *ultraísta* movement launched by Borges in Buenos Aires in 1921. César Vallejo (1895–1938) of Peru best represents the shift from modernism to the later Marxist emphasis of the *ultraístas* of the 1930s. It was, however, upon the intensely subjective Pablo Neruda (1904–) of Chile that the mantle of Ibero-America's most gifted living poet fell. His influence upon his contemporaries bids fair to equal that of Dario and of Gongora in their time.

Upon the auspicious occasion of the *Semana de Arte Moderna* (Modern Art week) held in São Paulo in 1922, the vanguard revolt in Brazil. usually referred to as modernism, careened off to a noisy destructive break with academicism and colonial cultural bondage until the world depression of 1929 and the new political order (1930) under Getulio Vargas (1883–1954) sobered their aggressive flaunting of all convention. Although incited by European iconoclasts, the Brazilian modernists were primarily bent on bringing national thought and life abreast of modern times. It was a high-pitched, often theatrical, self-searching period of aesthetic re-evaluation and of analysis of the immediate Brazilian present. However, as in the case of the Spanish vanguard movements, there was little of enduring value that came of it. But it did serve as a sorely needed purge and produced a number of men whose names became fixed in Brazilian literary history, such as the movement's high priest, the gifted and many faceted poet and musicologist Mario de Andrade (1893–1945); his lieutenant, the genial and unpredictable Oswaldo de Andrade (1890–1954); the perceptive critic and Whitmanesque bard Ronald de Carvalho (1893–1935); and the nation's greatest living poet Manuel Bandeira (1886–). Certain modernist techniques, a highly sensitive preoccupation with social and metaphysical problems. but above all an imperative urge for untrammeled self-expression characterize the poetry of such outstanding modernist contemporaries or followers as Jorge de Lima (1893–1953). Cecilia Meirelles (1901–) and Augusto Frederico Schmidt (1906–).

B. Literature of Social Protest (1930–).—The Spanish-American modernists, and later the Brazilian modernists as well, made their best contribution in verse and in poetic prose pieces. Contrary to its exceptional development in Brazil, the Spanish-American novel had been left largely to the unwieldy pens of uninspired realists. among them some who aspired to apprenticeship under Emile Zola and his naturalist followers. Federico Gamboa (1864–1939) of Mexico and Baldomero Lillo (1867–1923) of Chile gave both strength and a measure of artistic balance to the vehement protests of their fiction of social reform. The later novelists, essayists and short-story writers who took up the battle shortly after the turn of the 20th century developed new and more effective techniques from the modernists and from such more revolutionary stylists of other lands as Joyce. Proust, Romains. Steinbeck and Kafka. As this literature of protest moved forward from 1910 to mid-century it gained in profundity, strength, clarity and form as it continued to probe into the causes that make for injustice and inequality.

Martí and Gonzalez Prada had advanced the essay to a prominent place in the realm of ideas and effective expression. And both came to be hailed as the intellectual and literary progenitors of succeeding generations of men acutely aware of their responsibilities as leaders in the move to interpret and to guide America in a rapidly changing world. Rufino Blanco Fombona (1874–1944) of Venezuela, more widely known for his prose fiction in which he assailed his country's tyrants with more passion than poise as in *El hombre de hierro* (1907) and *El hombre de oro* (1916). became the ardent spokesman for dynamic pan-Hispanism. He was also among the first to attack "Yankee imperialism," a role in which he was abetted by the militant Argentine. Manuel Ugarte (1878–1951) whose *El porvenir de América latina* (1911) and *El destino de un continente* (1923), together with *Les démocraties latines de l'Amérique* (1912) and *La creación de un continente* (1913) by the Peruvian Francisco Garcia Calderón (1883–1953), envisioned Ibero-America as the future guardian of the Latin tradition. Ricardo Rojas (1882–1957), outstanding literary critic and historian of Argentine letters, and José Vasconcelos (1882–1959), controversial philosopher and educator of Mexico, were more concerned with racial and cultural aspects of national development within the American family of nations. Under the classic touch of Alfonso Reyes (1889–1959), poet, scholar and literary critic of Mexico, the essay has become a vital intimate force, engaging in form and universal in appeal. One of America's most representative humanists, Reyes is generally recognized as the dean of a younger generation of writers—Jorge Luis Borges (1900–) of Argentina, Germán Arciniegas (1900–) of Colombia, Mariano Picón-Salas (1901–) of Venezuela—for whom the essay gives every promise of a rich fulfillment.

It was in both the short story and the novel, however, that the panoramic grandeur of the American scene and the human conflict in all of its dramatic interest were best to be described and interpreted.

The disheartening years that followed the abolition of slavery in Brazil in 1888 and the establishment of a republic in 1889 posed a number of agonizing questions to which serious-minded Brazilians at the turn of the century sought answers through an analysis of their troubled homeland as the raw product of an extraordinary amalgam of man, land and climate. It remained for an army engineer and journalist, Euclides da Cunha (1866–1909), to lay bare the very bedrock of Brazilian life, to create in the unclassifiable epic. *Os sertdes* (1902), a work that has been called the "bible of Brazilian nationality." The author and his work became a cult. It was the first written protest in behalf of Brazil's forgotten man—the cornerstone of all later efforts, no matter what the form—to probe the nation's weaknesses and strength. Da Cunha focused *Os sertdes* on the emerging Brazilian of the backlands. In a novel of ideas, *Canaan,* also appearing in 1902, José Pereira da Graça Aranha (1868–1931) focused on the problem of the effects of recent European immigration upon this evolving Brazilian type. Somewhat later, in 1918, the publication of a remarkable collection of short stories, *Urupês,* by José Bento Monteiro Lobato (1883–1948), made it apparent that talented intellectuals were continuing to probe for native types and traits in a search that gave direction and impetus to the modernist outburst of the 1920s and birth to a new cultural regionalism that

achieved full flowering after 1930 in the fiction of Brazil's northeastern backlands. The region produced a remarkably gifted and dedicated group of prose writers. A number of them, such as Gilberto Freyre (1900–), uhose *Casa grande e senzala* (1933) is fundamental to an understanding of the region. have distinguished themselves as sociologists Two of the more prominent novelists of this "Northeastern school" are José Lins do Rego (1901–57), who in a highly personal evocative style depicted the clash of the old and new way of life in his classic "sugar cane" cycle (1932–34) and in such other novels as *Pedra Bonita* (1938) and the symbolic *Fogo morto* (1943), and Jorge Amado (1912–), whose convincing manipulation of mass minds and movements gave Brazil some of America's best "proletarian" literature in such novels as *Cacau* (1933), *Jubiabá* (1935) and *Terras do sem fim* (1943). *Angústia* (1936) by Graciliano Ramos (1892–1953) attests to the fact that the individual inner struggle has also been adroitly plumbed by these new "regionalists." Constantly experimenting in technique and ever abreast of themes that reveal deep preoccupation with the individual in time and in a changing social structure, Erico Verissimo (1905–) ranks high as one of Ibero-America's few cosmopolitan nriters of distinction. hfuch of his work is now available in English and in other languages: *Caminhos cruzados* (1935), Eng. trans., *Crossroads* (1943); *Olhai os lírios do campo* (1938), Eng. trans., *Consider the Lilies of the Field* (1947); *O resto é silêncio* (1943), Eng. trans.. *The Rest Is Silence* (1946) ; and *O tempo e o vento* (1950), Eng. trans., **Time** and *the Wind* (1951).

Mexico's bitter bloody rebellion of the masses gave birth to memoirs, chronicles, sketches, short stories and novels—kaleidoscopic. journalistic, staccato pitched—of nhich the earliest and the most widely acclaimed was *Los de abajo,* a novel conceived in 1915 over the campfire and on forced marches by Mariano Azuela (1873–1952), an army doctor of one of Villa's bands. Azuela alone chronicled almost every aspect of the revolution from its preliminary rumblings to its later social implications. From the late 1920s on, Martín Luis Guzmán (1887–) in *El águila* y *la serpiente* (1928). Gregorio López y Fuentes (189j–) in El *indio* (1935) and José Rubén Romero (1890–1952) in *La vida inútil de Pito Pérez* (1938) took up the challenge to give breadth and scope to Azuela's treatment.

The Mexican Revolution focused attention on the sad plight of the Indian. This 20th-century Indian was not the uncompromising hero of the epic *La araucana,* nor yet the symbol of colonial revolt against tyrannical Spain, and much less the "noble savage" of America's untamed romantic nilderness. More discerning minds came to realize that he was the victim of centuries-old political and economic forces that kept the masses in abject bondage to colonial institutions that would not disappear nith political panaceas alone. This new *Indianista* literature. in which the Indian is presented as a pressing social problem. had already found favour in fiction in the novel *Aves sin nido* (1889) by the Peruvian Clorinda Matto de Turner (1854–1909). And the Indian's cause had been advanced by González Prada. the spiritual precursor of the militant pro-Indian, social-reform party Apra (Alianza Popular Revolucionaria Americana) that from its founding in 1923 became a vital political and intellectual force in Andean America. Out of the early sociological novels. *Pueblo enfermo* (1909) and *Raza de bronce* (1919), by the Bolivian Alcides Argüedas (1879–1946) came the sombre short stories *Cuentos andinos* (1920) by Enrique López Albujar (1872–) of Peru; the prize-ninning novel of Indian life in the Peruvian highlands. *El mundo es ancho y ajeno* (1941) by Ciro Alegria (1909–); and the brutally realistic pages of an entire school of Ecuadorean nriters nhose internationally heralded spokesman. Jorge Icaza (1902–), skirted dangerously close to aesthetic suicide in his mass-minded. vernacular-ridden novels, *Huasipungo* (1934) and *En las calles* (193j national award).

The long struggle between man and nature became more critical as more powerful economic forces brought the primitive nay of life ınto sharper conflict with the demands of modern civilization. The clash between the forces of "barbarism" and "civilization." the pampa and the city, described by Sarmiento in his classic account, *Facundo,* had by no means receded into history with the passing of 19th-century *caudillos* (local chiefs). Subtler and less tangible international forces changed the colour and pace of the aging colonial system. Land and nature's gifts were more zealously sought after and fought over than ever before: cattle on the pampas and the llanos. tin and copper and nitrates in the mountain fastnesses and desert wastes, oil in areas long neglected by modern man. rubber and bananas in the "green hell" of the tropics. Nature resisted man's inroads into its romantically conceived domain. And the struggle between the two became more violent as man fought against man, selfishly, to possess nature alone. These same forces were at work too in the growing urban centres where modern industrial economy exerted an even more insidious control over the destiny of the masses and where the traditional way of life and man's attitude toward man and toward himself were subjected to ever increasing pressures of all kinds.

The clash between the old and the new on the pampas of Argentina and Uruguay created a rich literature that runs the gamut from the sombre descriptive pages of Uruguay's early outstanding short-story nriter Javier de Viana (1872–1926) and the keen psychological portrayal of rural types in *El terruño* (1916) by Carlos Reyles (1868–1938), also of Uruguay, to the simple humorous narrative of gaucho life so engagingly depicted in *El inglés de los güesos* (1924) by Argentina's Benito Lynch (1885–1951) and the image-studded. evocative prose epic of the gaucho, *Don Segundo Sombra* (1926), by the Argentine Ricardo Guiraldes (1886–1927), a classic and perfect example of the application of modern technique to the treatment of a regional theme. In *Doña Bdrbara* (1929) Romulo Gallegos (1884–), one of Ibero-America's masters of plot technique. gave a dramatic and poetic depiction of similar forces at work on the Venezuelan llanos.

For the tropics appeared two artists who spoke for a growing number of younger writers who discovered the *selva,* or jungle, where cotton and bananas and oil have outdistanced rubber in pitting man against nature and man ever more sharply against man: Horacio Quiroga (1878–1937) of Uruguay. consummate short-story artist and worthy disciple of Poe and Kipling, who excelled in his dramatic descriptions of the Chaco and the jungle of Misiones (Arg); and the Colombian poet, José Eustasio Rivera (1889–1928). whose sole prose work, *La vorágine* (1924)—probably the best novel on the American tropics yet written—is a powerful denunciation of the type of exploitation that marred the lives of the rubber gatherers in the upper Amazon during the boom days of the early 1900s.

Man's conflict with man in urban society has been the subject of a growing body of novels since the turn of the century when Gamboa exposed the social ills of his time. His popular *Santa* (1903), a melodramatic picture of prostitution in his homeland, is the Mexican counterpart of Zola's *Nana.* In *Nacha Regules* (1919) Manuel Gálvez (1882–), distinguished Argentine novelist of a varied and rich production, did for metropolitan Buenos Aires nhat Gamboa had done for Mexico City. And in *La maestra normal* (1914) Gálvez has captured forever the universal pettiness and monotony of life in the smaller provincial centres before the quickening pace of modern mechanized manners shattered the old colonial nays Urban Santiago and Chile's underprivileged everynhere have two powerful champions in the novelist Joaquin Ednards Bello (1888–) and in Manuel Rojas (1896–). one of Ibero-America's truly gifted short-story writers. Man's struggle nith the deeper forces within and beyond himself has found commendable expression in the psychological novels of the Chilean Eduardo Barrios (1884–) and in the existentialist approach of the Argentine Eduardo Mallea (1903–).

In their soul-searching for a key to individual and collective existence in the Americas nriters have continued to turn to a record of the past as well. La *gloria* de *Don Ramiro* (1908) by the accomplished stylist Enrique Rodriguez Larreta (1875–1961) of Argentina is generally considered the best historical novel yet nritten in the Spanish language.

Ever since colonial times the Ibero-American theatre has shown a decided preference for peninsular productions and for plays borrowed from other tongues. Only one native dramatist,

Florencio Sánchez (1875–1910) of Uruguay, succeeded in obtaining minor prominence on the international stage, and his relative success was due largely to the *criollo* (creole) content of his plays rather than to anything indicative of an emerging new world dramatic technique. The favourable reception which the outside world accorded Deus *lhe pague* (c. 1938) by Brazil's Joracy de Camargo '(1898–) only served to accentuate the fact that in spite of a rapidly swelling native repertoire and of the heartening and continued efforts of experimental groups everywhere, Ibero-America had not yet produced a dramatist who could claim the universal recognition bestowed on a growing number of her distinguished sons in the fields of poetry and prose fiction.

BIBLIOGRAPHY.—Isaac Goldberg, *Brazilian Literature* (1922); Alfred Coester, *The Literary History of Spanish America* (1928); Hispanic Foundation of the Library of Congress, *Handbook of Latin American Studies* (1935 *et seq.*); Alice Stone Blackwell (tr.), *Some Spanish-American Poets,* 2nd ed. (1937); Angol Flores and Dudley Poore (eds.), *Fiesta in November: Stories From Latin America* (1942); Willis Knapp Jones, *Latin American Writers in English Translation* (1944); German Arciniegas (ed.), *The Green Continent,* trans. by Harriet de Onís *et al.* (1944); Dudley Fitts (ed.), *Anthology of Contemporary Latin-American Poetry,* rev. and enlarged ed. (1947); H. de Onís (ed. and tr.), *The Golden Land: an Anthology of Latin American Folklore in Literature* (1948); E. H. Hespelt (ed.), *An Outline History of Spanish American Literature,* 2nd ed. (1947), *An Anthology of Spanish American Literature* (1946); A. Torres Rioseco, *The Epic of Latin American Literature* (1942); J. R. Spell, *Contemporary Spanish-American Fiction* (1944); P. Henriquez Ureiia, *Literary Currents in Hispanic America* (1945); E. Verissimo, *Brazilian Literature* (1945); S. Putnam, *Marvelous Journey: a Survey of Four Centuries of Brazilian Writing* (1948).

(J. E. EK.)

IBERT, JACQUES FRANÇOIS ANTOINE (1890–1962), French composer known for his skilled orchestration, was born on Aug. 15, 1890, in Paris. He was a pupil of Gabriel Fauré and Paul Vidal at the Conservatoire, and won the Prix de Rome in 1919. Among his best-known orchestral works are Escales, La Ballade de la *geôle* de Reading, based on Oscar Wilde's poem, the flute concerto, the concerto for cello and wind instruments and the suite *Paris.* "Le Petit âne blanc" from the suite *Histoires* became his most popular piano work. Ibert was director of the French Academy in Rome, 1937–61. He died in Paris on Feb. 5, 1962.

See J. Feschotte, *Jacques Ibert* (1958).

IBERVILLE, PIERRE LE MOYNE, SIEUR D' (1661–1706), French-Canadian soldier and colonizer of Louisiana, was born in Montreal on July 16, 1661. At the age of 14 D'Iberville was appointed midshipman in the French navy and sent to France. After four years' service on French ships he returned to Canada. In 1686 he led a detachment on the overland expedition under De Troyes against the English forts on Hudson bay and aided in the reduction of forts Monsipi, Rupert and Kitchichouame (later Ft. Albany), also capturing two English vessels. He was left in command of the forts, 1686–89, and in 1688 succeeded in taking two more English ships. In 1690 he was a leader of the French expedition against Schenectady, but before the end of the year returned to Hudson bay to recapture Ft. Albany, which had relapsed into English control. In 1694 he led a land expedition which captured Ft. Nelson on Hudson bay.

During the winter of 1696–97, D'Iberville captured Ft. Pemaquid and ravaged the English settlements on the coast of Ne foundland. In 1697, in command of a frigate, he again entered Hudson bay and defeated three superior English vessels in a desperate engagement. Afterward he again took Ft. Nelson, which the English had recaptured. After the peace of Ryswick D'Iberville was called to France and commissioned by the marine minister, Pontchartrain, to found a settlement at the mouth of the Mississippi. He left Brest in Oct. 1698 with four vessels and 200 colonists and reached Mobile bay in Jan. 1699. There the colonists were left while D'Iberville and a number of men searched the coast for the Mississippi, which was entered at the delta and ascended probably to the mouth of the Red river. No favourable site for a colony was found along the river, and, it being late, D'Iberville built Ft. Maurepas on the present site of Biloxi, Miss. This was the first permanent French settlement on the Gulf coast.

Returning the next year, D'Iberville built a post on the Mississippi river near New Orleans and explored much of the lower valleys of the Red and Mississippi rivers. Returning a third time in 1701, he found his colony badly reduced by disease and transferred most of the colonists to Mobile. He returned for additional colonists, but France was again at war, and D'Iberville was retained for naval service. He was given command of the West Indian fleet, and in 1706 invaded the islands of Nevis and St. Christopher, forcing them to surrender. While at Havana, D'Iberville fell ill with fever and died July 9, 1706.

IBEX, the Alpine wild goat, *Capra* ibex. Formerly common in the Alps, the ibex is now confined to the Gran Paradiso range in the neighbourhood of Cogne, Italy, and to the Swiss National park in the Engadine. It measures about 43 ft. in length and stands about 36 in. at the shoulder. In summer the short fur is ashy gray, but in winter this is concealed by long, yellowish-brown hairs. The horns are long, curved backward and ridged on the front surface. The forelegs are somewhat shorter than the hind limbs. The agility of the ibex on its native mountains is astounding. It inhabits the line of perpetual snow, descending at night to graze in the highest woods. The ibex is gregarious, living in small herds, but the old males are usually solitary. The female, after a period of gestation of 90 days, produces a single young one, which is at once able to follow her. The flesh resembles mutton, but with a flavour of game.

BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

ALPINE IBEX (CAPRA IBEX)

The name ibex has been extended to include allied species, of which the Asiatic ibex (*C. sibirica*), ranging over central Asia, is the finest and may possess horns 60 in. long. Other species, differing in the thickness of and ridges on the horns, occur in Arabia, Ethiopia, the Caucasus and the Pyrenees, and the name is wrongly applied to the short-horned Indian *Hemitragus hylocrius* from the Nilgiris, really more closely related to the chamois.

IBIS, any one of 25 species of medium-large birds, kin to storks (*q.v.*) but with a slender, down-curving, curlewlike bill, comprising the subfamily Threskiornithinae in the order Ciconiiformes. Six warm continents and many islands in or near the tropics have ibis. They wade in shallow lagoons, lakes, bays and marshes, feeding on small fishes and soft mollusks. They fly with neck and legs extended, alternately flapping and sailing. Ibis often nest in vast colonies, building compact stick nests low in bushes or trees and laying three to five eggs, usually dull white mottled with brown. Oldest known and emblem of Osiris' secretary, the sacred ibis (Threskiornis *aethiopica*) of Africa, 25 in. long, white with black in its wings, has a bare black head and neck. Glossy ibis (Plegadis *falcinellus*), a rich chestnut colour, range the world, the white-faced race (P. f. guarauna) from Oregon to Argentina. The scarlet ibis (Guara rubra) lives in tropical America, white ibis (*G. alba*) north to Gulf coast lowlands.

ALLAN D. CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY

GLOSSY IBIS (PLEGADIS FALCINELLUS) ON NEST

(G. F. Ss.)

IBLIS, in Islamic religion the personal name of the devil. In the Koran he is mentioned by name 11 times as an angel who rebelled against God when man was created; his punishment was postponed until the Judgment Day, and meantime he is allowed to tempt men to evil. He is the counterpart of the Jewish and Christian Satan; in Arabic this Hebrew word has become the generic term for devil. Iblis is identified with "the devil" (references to whom occur 68 times in the Koran), but "devils" in general are also freely mentioned. See also DEVIL.

See Koran, vii, 11 ff., and s.v. "Iblis" in the indexes; "Iblis" and "Shaitan" in *Shorter Encyclopaedia of Islam* (1953), with bibliography. (W. C. Sx.)

IBN ʿABD RABBIHI (ABU ʿUMAR AHMAD IBN MOHAMMED IBN ʿABD RABBIHI) (860–940), Arab poet, celebrated for his anthology of Arabic literature, *ʿIqd al-Farid* ("The Precious Necklace"; edited by Ahmad Amin *et al.,* 1940), which resembles the *'Uyun al-Akhbar* of Ibn Qutaybah (*q.v.*), from which it borrows largely. He was born at Cordoba in Spain in 860, and won a great reputation for learning and eloquence. Selections of his own poems are included in the *Yatimat al-Dahr,* vol. i, (1887).

IBN ABI-USAYBIAH (MUWAFFAQ-AL-DIN ABU-AL-'ABBAS AHMAD IBN ABI-USAYBIAH) (1203–1270), Arab physician, was born at Damascus, the son of an oculist, and studied medicine at Damascus and Cairo. In 1236 he was appointed by Saladin physician to a new hospital in Cairo, but resigned in 1237 to serve the amir of Damascus in Salkhad. There he lived and died. His great work, *'Uyun al-Anba* ("Lives of the Physicians"), contains biographies of over 400 physicians and scientists and is probably the most important source for the history of Islamic medicine.

IBN AL-ATHIR (IBN ATHIR), the family name of three brothers, all famous in Arabic literature, who were born at Jazirat ibn Omar in Kurdistan.

The eldest, MAJD-AL-DIN IBN AL-ATHIR (1149–1210), made a special study of the Koran, the tradition and Arabic grammar. His *Kitab al-Nihaya* ("Book of the Utmost Effort," pub. 1904) is a dictionary explaining obscure terms in the traditions. He also wrote a dictionary of family names *Kitab al-Murassa* (ed. by *C.* F. Seybold. 1896). Having long been in the service of the amir of Mosul he died at Mosul in 1210.

ABU AL-HASAN IZZ-AL-DIN IBN AL-ATHIR (1160–1234), the most distinguished of the brothers, was a historian whose chief work is *al-Kamil fi-al Ta'rikh* ("The Complete in History"; ed. by C. J. Tornberg, *Ibn al-Athiri Chronicon,* 14 vol., 1851–76). It extends to 1231, the first part, up to 923, being an abbreviation of the work of Tabari (*q.v.*) with additions. He also wrote a history of the atabegs of Mosul (pub. by the Académie des Inscriptions in *Recueil des historiens des croisades,* vol. ii. 1906); an account of 7,500 companions of Mohammed, *Usud al-Ghaba* ("The Lions of the Forest"; pub. in 5 vol., 1869–71); and a compendium of Sam'ani's *Kitab-al-Ansab* ("Book of Genealogies") entitled *al-Lubab* (pub. 1938–49; *cf.* F. Wiistenfeld, *Specimen el-Lobabi,* 1835). He died at Mosul in 1234, having also been in the service of the amir.

The youngest brother DIYA' AL-DIN IBN AL-ATHIR (1163–1239) was outstanding as a literary critic and was author of a book on rhetoric, *Kitab al-Mathal* ("The Bock of Example," pub. 1939; *cf.* I. Goldhizer, *Abhandlungen zur arabischen philologie,* vol. i, 1896). He entered the service of Saladin and later became vizier to his son al-Malik al-Afdal. He died at Baghdad in 1239.

IBN AL-FARADI (ABU-AL-WALID ʿABDULLAH IBN AL-FARADI) (962–1013), Arab historian; best known for his history of Andalusian scholars, *Ta'rikh Ulama' al-Andalus* (edited by F. Codera, 1891). He was born at Cordoba, Spain, Dec. 22, 962, and studied law and the prophetic tradition. In 992 he made the pilgrimage to Mecca and thereafter lived in Egypt and Tunis. After his return to Spain (1009) he became *qadi* (judge) in Valencia, and was killed in Cordoba. April 20, 1013, when the Berbers sacked the city. He also wrote a history of the poets of Andalusia.

IBN AL-FARID (SHARAF AL-DIN ABU HAFS 'UMAR) (1182–1235), Arab poet and mystic, whose verse is accounted the finest expression of mystical aspiration in Arabic, was born at Cairo, Egy., son of a public notary. Intended for a legal career, he abandoned his studies for the religious life and wandered about the Muqattam hills overlooking Cairo. For some years he lived in Mecca, and it was there that he met the famous Baghdadi mystic Shihab al-Din al-Suhrawardi. He spent the last years of his life in Cairo, and is buried in a mausoleum in the Muqattam hills.

The *diwan* of his poems, collected after his death, consists mainly of formal odes cast in the form of a lover's yearning for reunion with his beloved, said to reside in Arabia; their esoteric meaning is the mystic's desire to be assimilated into the pre-eternal spirit of Mohammed, the first projection of the Godhead. This idea is developed at great length and with profound metaphysical subtlety in the famous *Ta'iya,* a veritable epic in 761 couplets all rhyming in *ati.* Numerous commentaries were written on this poem and on the *diwan* as a whole, the most valuable being those of al-Farghani (d. *c.* 1300), al-Kashani (d. 1334), al-Burini (d. 1615) and 'Abd al-Ghani al-Nabulusi (d. 1730). Several Arabic editions of the *diwan* have been printed; an edition in Roman transcription, based upon the oldest extant manuscript, was published in 1952 by A. J. Arberry, who also translated and annotated *The Mystical Poems* of Ibn al-Farid (1952). Ibn al-Farid's style is highly mannered and exhibits all the rhetorical embellishments of the *badi'* school of poetry *(see* ARABIC LITERATURE); nevertheless his poems contain many passages of striking beauty and deep religious emotion.

BIBLIOGRAPHY.—C. Brockelmann, *Geschichte der arabischen Litteratur,* vol. i (1898) and suppl. i (1937); R. A. Nicholson, *Studies in Islamic Mysticism* (1921); Muhammad Mustafa Hilmi, *Ibn al-Farid wa'l-hubb al-ilahi* (1942). (A. J. AY.)

IBN ʿARABI (ABU BAKR MOHAMMED IBN ʿALI MUHYI AL-DIN AL-HATIMI AL-QAI AL-ANDALUSI IBN AL-'ARABI) (1165–1240), Moslem theologian and mystic, was born in Murcia, Spain, on July 28, 1165, and educated in Seville. He traveled in Egypt, Arabia, Baghdad, Mosul and Asia Minor, and then settled in Damascus. where he lived for the rest of his life. He died in Oct. 1240.

In law Ibn 'Arabi was a Zahirite, in theology a mystic of the extreme order, though professing orthodox Ash'arite theology and combating in many points the Indo-Persian mysticism (pantheism). He claims to have had conversations with all the prophets past and future, and reports conversations with God himself. Of his numerous works about 150 still exist. The most extensive is the 12-volume *al-Futuhat al-Makkiya* ("Meccan Revelations"; 1274, 1329), a general encyclopaedia of Sufistic beliefs and doctrines.

See C. Brockelmann, *Geschichte der arabischen Litteratur,* vol. i, pp. 441–448 (1898); R. A. Nicholson, *A Literary History of the Arabs,* pp. 399–404 (1907).

IBN BATUTAH (or BATTUTAH; Arabic, ABU ABDALLAH MOHAMMED) (1304–1368), the greatest of Moslem travelers, nhose journeys extended from the Niger basin to China from 1325 to 1355, and was born at Tangier in 1304.

He set out from his native town in 1325 to make the pilgrimage to Mecca, traveling by caravan to Alexandria and Cairo. As the Red sea crossing from Aidhab to Jidda was blocked, he returned to Cairo, journeyed to Damascus and thence to Medina and Mecca. The lure of travel had already begun to beckon him, and before the next pilgrimage he toured southern Persia and Iraq. His next journey took him to Yemen, and from Aden down the east coast of Africa to Mombasa, Kilwa and Mogadishu (Mogadiscio), received everywhere by the local sultans as an honoured guest. He sailed back to Dhofar, and thence to Oman and Hormuz (on the new island site to which it had been transferred from the mainland about 1315) and back through the pearl fisheries and Qatif to Mecca for another pilgrimage.

His ambition was now set on going to India, of the generosity of whose sultan, Mohammed Tughluq, to newcomers fabulous tales were told. But no ship was available, and for some reason he recrossed the Red sea and made through Egypt and Syria to Asia Minor, then partitioned between numerous Turkish baronies. His eyewitness account of these, including the infant Ottoman state, is of outstanding value Crossing the Black sea to the Genoese port of Kaffa (his first experience of a Christian city, in which he was at first perturbed by the church bells), he traveled to the court of the Mongol khan of the Golden Horde, Mohammed Uzbeg, in the Caucasus. At this point he inserts two detours the veracity of which has been challenged: one to the city of Bulghar, on the middle Volga, the other to Constantinople in the company of a Greek princess married to the khan. The latter is a vivid narrative, especially in describing his interviews with the emperor Andronicus III and the ex-emperor Andronicus II, but is difficult to reconcile nith his chronology. After returning to the khan's capital at New Sarai on the Volga, he crossed the steppes to Khwarizm and Bukhara, and made an extensive tour in Khurasan

before crossing the Hindu Kush into Afghanistan, whence he reached the Indus in Sept. 1333.

Sojourn in the East.—The immensity: variety and wealth of India made an indelible impression on Ibn Batutah's mind. Everything aroused his curiosity, and about one quarter of his book is devoted to descriptions of its (to him) strange customs and institution;, the diversity and abundance of its products and the manners of its rulers and peoples. On arrival at Delhi. he was in due course presented to Sultan Mohammed and appointed to the sinecure of *qadi* ("a judge in a Mohammedan court") of the Malikis. He has much to relate of the mixture of tyrannical cruelty and extravagant generosity in the sultan's character, and when he himself eventually fell under suspicion he feared for his life, with just cause. In the meantime he had made several journeys in the north, but mentions them only incidentally. In 1342 he was restored to favour and ordered to accompany an embassy to the Mongol emperor of China. The party traveled to Cambay and then by ship down the Malabar coast to the great port of Calicut, where they were to embark in junks for China; but he was accidentally hindered from embarking, and the junks were wrecked. Left destitute, he spent many months on the Malabar coast, taking part in various adventures, including the capture of Sandabur (Goa), and finally sailed to the Maldive Islands, where he again became *qadi* and a personage of importance. A year later, probably in 1345, he left for Ceylon, where he climbed Adam's peak to visit the venerated "footprint of Adam."

After a short visit to the Coromandel coast and revisiting Malabar and the Maldives, Ibn Batutah sailed to Bengal, visited a Moslem saint in Sylhet and embarked near Dacca for Sumatra. whence he sailed to the trading port of Zayton in China. He visited also Canton and claims to have been in Kinsai (Hangchow) and Cambaluc (Peking).

His Return and Later Journeys.—On his may home Ibn Batutah saw the great bird *rukh* (evidently from his description, an island lifted by refraction), passed rapidly through Sumatra, Malabar, Dhofar, Oman and southern Persia to Baghdad, where he learned of his father's death 15 years before. He gives a gruesome account of the ravages of the Black Death of 1348 in Syria and Egypt, through which he traveled to Mecca for his last pilgrimage. Back in Cairo, he decided to return to Morocco, sailed to Tunisia and then by Catalan ship to Mostaganem, calling at Sardinia on the way, and reached Fès in Nov. 1349. Then, after a brief stay in Tangier, he crossed to Gibraltar to take part in the holy war against Castile, but only visited Granada and its dependencies and returned to Marrakech. In 1352 he set out from Tafilelt in southern Morocco on his last and probably most adventurous journey across the Sahara to the Moslem Negrolands in the Niger basin. Here again his narrative'is the fullest (indeed, almost the only) first-hand account of the Mandingo kingdom of Malli and the Songhai capital at Gogo. On orders from the sultan of Morocco he returned from Gogo through the Tuareg country of Ahaggar mountains and Tuat to Tafilelt and Fès, so ending 75,000 mi. of travel. His narrative was dictated to a royal secretary, Ibn Juzayy, at Fès, and his remaining years were spent as a *qadi* in Morocco.

An English translation of later abridgments of his narrative was published by S. Lee in 1829 for the Oriental Translations fund. The complete text with French translation was issued by C. Defremery and B. Sanguinetti in 1853–59. Mahdi Husain has published an annotated translation of the travels in India and Ceylon (1953). The first volume of a complete translation by H. A. R. Gibb, published by the Hakluyt society, was issued in 1958.

See H. F. Janssens, *Ibn Batouta, "le voyageur de l'Islam,"* (1948).

(H. A. R. G.)

IBN DURAID (ABU-BAKR MOHAMMED IBN AL-HASAN IBN DURAID) (837–934), Arab philologist, was the author of a large-scale dictionary, the *Jamhara fi 'l-lugha.* He was born at Basra of south Arabian stock, but fled to Oman in 871, during the revolt of the *Zanj* or Negroes. In 883 he went to Persia, and remained there until he settled in Baghdad in 920. In his dictionary (published in Hyderabad, India, 4 vol., 1926–30) the author retained the anagrammatical arrangement of Khalil (*q.v.*) though using the normal alphabetical order of the letters. The work is, however, marred by the addition of many chapters on rare word forms, which include a large number of words listed in no particular order. Another work, the *Kitab al-ishtiqaq* ("Book of Etymology," edited by F. Wüstenfeld, 1854), deals with the etymology of Arab tribal names.

See F. Krenkow, "The Beginnings of Arabic Lexicography, Till the Time of al-Jauhari, With Special Reference to the Work of Ibn Duraid," *Journal of the Royal Asiatic Society,* centenary supplement, p. 255 (1924); Carl Brockelmann, *Geschichte der arabischen Litteratur,* vol. i, p. iii (1898), suppl. vol. i, p. 172 (1937).

(J. A. HD.)

IBN FALAQUERA (SHEMTOB BEN JOSEPH IBN FALAQUERA or PALQUERA) (*c.* 1222–*C.* 1295), Spanish-born Jewish philosopher and translator. propagated a reconciliation between Jewish orthodoxy and philosophy and defended Maimonides' *Guide of the Perplexed* against the attacks of the traditionalists. His numerous works include a *Dialogue Bet-ween a Philosopher and a Man of Piety;* an ethical treatise, *The Balnt of Sorrow;* an introduction to the study of the sciences entitled *Reshit Hokhmah* ("The Beginning of Wisdom"), which reproduces al-Farabi's *The Aims of the Philosophy of Plato and Aristotle* and was translated into Latin at the end of the 15th century; the *Sefer ha-Ma'alot* ("The Book of Degrees"), which advocates the Neoplatonic ideal of the contemplative life; a commentary on Maimonides' *Guide* under the title *Moreh ha-Moreh;* and an abstract of Ibn Gabirol's *Fons Vitae,* in Hebrew.

BIBLIOGRAPHY.—L. Venetianer, *Das Buch der Grade* (1894); M. David, *Schemtob ibn Falaqueras Rrschit Choknzah* (1902); R. Klibansky, *The Continuity of the Platonic Tradition,* p. 39 (1939); and *Alfarabius: De Platonis Philosophia,* ed. by F. Rosenthal and R. Walzer (1943), being vol. ii of *Plato Arabus.* (A. AN.)

IBN GABIROL (SOLOMON BEN JUDAH IBN GABIROL; in medieval Latin and Romance languages AVENCEBROL or AVICEBRON) (*c.* 1020–*c.* 1050 or 1070), Jewish poet and philosopher, was born at Málaga. Spain. His early years were spent at Saragossa. where he enjoyed the patronage of the statesman, scholar and poet Samuel ha-Nagid. At the age of 16 he began writing Hebrew poetry, using various Arabic metres and following both Spanish and Palestinian Hebrew tradition. Developing a style of his own, he wrote some of the finest pieces of medieval Hebrew poetry. They include the *'Anaq,* a poem on grammar, partially extant; about 400 lyric poems. religious and secular; and the *Azharot,* liturgical compositions for the festival of *Shebhu'ot.* His *Keter Malkhut* ("The Royal Crown"), a didactic poem on the nature of God, the universe and man's destiny, concluding with a confession of sin, has been adopted into the Jewish liturgy for the Day of Atonement.

Ibn Gabirol's chief philosophical work was written in Arabic and is preserved only in a Latin translation by Johannes Hispanus and Dominicus Gundisalvi entitled *Fons Vitae.* It exercised *a* considerable influence on the schoolmen but was less fortunate among Jewish medieval philosophers. It was not translated into Hebrew except for an abstract made by Ibn Falaquera (*q.v.*). The only traces left by it are found in Abraham ibn Daud's strictures upon its metaphysical doctrine and in quotations from it in Ibn Falaquera's *Moreh ha-:Wore11* and Moses ibn Ezra's *'Arugat ha-Bosem.* Isaac Abrabanel (d. 1508) and his son Judah (Leone Ebreo) knew Ibn Gabirol as the author of the *Fons Vitae,* but so much had the work fallen into oblivion that the 17th-century Joseph Solomon Delmedigo shared the schoolmen's view that its author was an Arab. This view prevailed until S. Munk discovered a manuscript of Ibn Falaquera's Hebrew abstract in 1846 and proved that Xvicebron, the author of the *Fons Vitae,* was identical with Ibn Gabirol.

Ibn Gabirol's metaphysical system is Neoplatonic but has features which according to Ibn Falaquera derive from pseudo-Empedoclean writings but would seem to be much nearer the (lost) pseudo-Aristotelian source on which Isaac Israeli and the longer (Arabic) version of the so-called *Theology of Aristotle* drew. It depicts the universe as a hierarchy of substances in the following order: universal (spiritual) matter emanates from the essence of God, and universal form from His will or word; then follow intellect (the Plotinian *nous*), soul and nature, which represent the

three spiritual or simple substances, and finally the lower world of corporeal or composite substances. Ibn Gabirol assigns to the will of God a much more dynamic role (similar to that which Philo attributes to the *Logos)* than it possesses in the literary sources before him. Another novel feature of his system is the doctrine that all beings, spiritual and corporeal, are composed of matter and form. The attribution of matter to spiritual beings such as the angels became a point of conflict between Franciscans and Dominicans and was opposed, on the Jewish side, by Abraham ibn Daud.

Texts include: the *Fons Vitae* in Latin, edited by C. Bäumker (1895), on which the Hebrew translation by J. Bluvstein and A. Zifroni (1926) and the Spanish translation by F. de Castro y Fernández (1902) are based; Ibn Falaquera's abstract, *Liqqutim,* edited by S. Munk in his *Mélanges de philosophie juive et arabe* (1859); an ethical treatise, *Kitab Islah-al-Aklzlag,* edited by *S.* S. Wise (1902); a collection of moral maxims translated from Arabic into Hebrew by Judah ibn Tibbon under the title *Mibhar ha-Peninim* and edited aith English translation by B. H. Ascher (1859); and the poems, edited by H. N. Bialik and J. H. Rawnitzki, 3 vol. (1924–29). *See* also the selected religious poems edited by I. Davidson and I. Zangwill in Hebrew and English (1923).

BIBLIOGRAPHY—J. Guttmann, *Die Philosophie des Salomon ibn Gabirol* (1889); David Kaufmann, *Studien uber Salomon Ibn Gabirol* (1899); A. Borisov, "Sur le point de depart de la philosophie volontariste de Salomon ibn Gabirol," *Bulletin de l'Academie des Sciences de l'U.R.S.S., Sciences Sociales,* no, 10, pp. 755–768, in Russian (1933); French abstract by G. Vajda, *Revue des Études Juives,* vol. 98, pp. 102–103 (1934); J M. Millas Vallicrosa, *Šĕlomó Ibn Gabirol como poeta y filósofo* (1945). (A. AN.)

IBN HAZM (ABU MOHAMMED 'ALI IEN AHMAD IBN SAID IBN HAZM) (994–1064), Moslem theologian, was born in a suburb of Córdova, Spain, on Nov. 7, 994. He studied history, law and theology and became a vizier as his father had been before him, but was deposed for heresy. and spent the rest of his life quietly in the country. Little is known of his later life. In legal matters Ibn Hazm belonged first to the Shafi'ite school, but came to adopt the views of the Zahirites, who admitted only the external sense of the Koran and tradition, disallowing the use of analogy and appeal to the authority of an imam, and objecting altogether to the use of individual opinion. Ibn Hazm extended the application of these principles from the study of law to that of dogmatic theology. His chief work is the *Kztab al-fasl fi al-milal wa al-ahwa wa al-nihal,* or "Book of Sects," in which he particularly attached the Ash'arites.

IBN HISHAM (ABU MOHAMMED 'ABD-AL-MALIK IBN AYYUB AL-HIMYARI) (d. 834), Arab grammarian, whose recension of *Kitab Sirat Rasul Allah* (edited by F. Wustenfeld, 1858–1860; Eng. trans. by A. Guillaume. *The Life of Muhammad,* 1955), the chief source for the life of Mohammed, written by Ibn Ishaq (*q.v.*), is the only version extant. Ibn Hisham was born at Basra, studied in Kufa and later lived in Fostat (old Cairo), where he gained a name as a grammarian and student of language and history.

IBN ISHAQ (MOHAMMED IBN ISHAQ) (d. *c.* 768), Arab historian, author of *Kitab Sirat Rasul Allah,* the most important source for the biography of the prophet Mohammed. He lived in Medina, nhere he interested himself to such an extent in the details of the Prophet's life that he was accused of scepticism. He consequently left Medina in 733, and went to Alexandria, then to Kufa and Hira, and finally to Baghdad, where he wrote *Kitab Sirat Rasul Allah,* which is now lost in its original form and is known only in the recension of Ibn Hisham (*q.v.*). The work has been attacked by Arab writers (as in the *Fihrist* of Er-Nedim) as untrustworthy.

IBN JUBAIR (Abu Husain Mahommed ibn Ahmad ibn Jubair) (1145–1217), Arab geographer, was born in Valencia, Spain. At Granada he studied the Koran, tradition, law and literature, and later became secretary to the Mohad governor of that city. During this time he composed many poems. In 1183 he left the court and traveled to Alexandria, Jerusalem, Medina, Mecca, Damascus, Mosul and Baghdad, returning in 1185 by way of Sicily.

The *Travels of Ibn Jubair* were edited by W. Wright (1852), and a new edition of that text, revised by M. J. de Goeje, was published by the Gibb Trustees (1907).

IBN KHALDUN ('ABD-AL-RAHMAN IBN KHALDUN) (1332–1406), Arab historian and sociologist, is celebrated as a pioneer in the philosophy of history. He was born on May 27, 1332, at Tunis, the descendant of a Seville family which claimed to have come originally from the Hadramaut. In 1352 he entered the service of the sultan of Fez, but in 1356, his integrity having been suspected, he was imprisoned for two years. Later he emigrated to Granada, but returned to Africa (1364) and entered the service of the sultan of Tlemcen. After various vicissitudes, including further imprisonment and a period of residence in a monastery, he obtained employment with the sultan of Tunis. Subsequently, while on a pilgrimage to Mecca, he was persuaded by the sultan of Cairo to remain in that city and was appointed grand *qadi* (1384). He was removed from and re-installed in this office no fewer than five times. In 1400 he was taken to Damascus with the Egyptian army which vainly attempted to oppose Timur and had several interviews with him. He died in Cairo on March 19, 1406.

His *Kitab al-'Ibar,* a universal history (pub. 1867), is prefaced by one volume, the *Muqaddimah* (ed. by E. Quatremère, 1858; crit. ed. by Ali Abdel Wahid Wafi, 1957; Eng. trans. by F. Rosenthal, 3 vol., 1958). This is followed by four volumes of general Islamic history, and two of the history of the Berbers (ed. by M'G. de Slane with French trans., *Histoire des Berbères* . . . , 3 vol., 2nd ed. 1925–1934). Included in the history is an autobiography (French trans. by M'G. de Slane in his *Prolégomènes historiques d'Ibn Khaldoun,* 1862–1865). The *Muqaddimah* is more important than the history itself. In it Ibn Khaldun, with great insight and originality, tries to explain the pattern of history. Taking a scientific view of the rise and decay of human societies he argues that such phenomena obey certain laws which can be discovered empirically. According to his analysis the basis of society is group-feeling and many of his conclusions have a remarkable relevance to modern problems.

An Arab Philosophy of History (1950) consists of selections from the Prolegomena (*i.e.,* the *Muqaddimah*), translated and arranged by Charles Issawi.

BIBLIOGRAPHY.—G. Sarton, *Introduction to the History of Science,* vol. iii, pp. 1769–1779 (1948); A J. Toynbee, *A Study of History,* vol. iii, pp. 321–328, 473–476 (1934); Muhsin Mahdi, *Ibn Khaldûn's Philosophy of History* (1957). (E. S. AH.)

IBN KHALLIKAN (SHAMS-AL-DIN AHMAD IBN MOHAMMED IBN KHALLIKAN) (1211–1282), Arab author of a famous biographical dictionary, was born in Arbela, Mesopotamia, on Sept. 23, 1211. After studying jurisprudence he went to Cairo, where he became deputy chief *qadi* ("judge"). In 1261 he became chief *qadi* of Damascus and, except for one interval (1271–78) when he taught jurisprudence in Cairo, he held this appointment until his death on Oct. 21, 1282. His *Wafayat al-a'yan* (first pub. by F. Wiistenfeld, 1835–43; incomplete edition by Ahmed Farid Rifa'i, 6 vol., 1936 *et seq.;* English translation with introduction by M'G. de Slane, 4 vol., 1842–71) is a brilliant alphabetical biographical dictionary, dealing with all types of men famous in Islamic history. Mohammed, his companions and their followers and the caliphs, were excluded, since adequate literature concerning them already existed. The work deftly sketches the characters of its subjects by interesting anecdotes.

See E. V. Lucas, *A Boswell of Baghdad* (1917). (J. A. HD.)

IBN QUTAYBAH (IBN KUTAIBA; Arabic, ABU MUHAMMAD 'ABDALLAH IBN MUSLIM IBN QUTAYBAH) (828–899); Arab writer of Khurasani stock, born in Kufa, Iraq, specialized in theology, philology and literature and spent his later years teaching these subjects in Baghdad. In philology, he is said to have drawn on both Basran and Kufan ideas *(see* ARABIC LITERATURE: *Technical and Scientific Literature: Philology)*; but his grammatical writings have been lost. His *Adab al-Katib* ("Secretary's Guide," edited by M. Grdnert, 1900) is a compendium of Arabic usage and vocabulary, classified under word patterns and subject-headings. He opposed the pro-Persian *shu'ubiya* movement, and wrote the *Kitab al-'Arab* to show the pre-eminence of the Arabs. His theo-

logical works have not been printed; but he was orthodox and old-fashioned. He disliked the subtleties of professional theologians and philosophers, and thought that the traditions (*hadith*) were the only authoritative source for Islamic jurisprudence. In his *Kitab al-shi'r wa' l-Shu'ara* ("Poetry and Poets") he laid down canons of criticism. The important introduction has been printed with French translation by M. Gaudefroy-Demombynes, *Ibn Qotaiba—Introduction au livre de la poésie et des poètes* (1947). His *'Uyun al-Akhbar* (edited by Carl Brockelmann, 1900–03) deals with such subjects as war, nobility, character, eloquence and friendship. Its chief value lies in its illustrations from history, poetry and proverb. The *Kztab al-Ma'arif* ("Book of Knowledge," edited by F. Wiistenfeld, 1850) deals with history.

See Ishaq Musa Huseini, ***The Life*** *and Works of Ibn Qutayba* (1050). (J. A HD.)

IBN SA'D (ABU ABDALLAH MOHAMMED IBN SA'D IBN MANI' AL-ZUHRI) (d. 845), Arab biographer, often called Katib al-Waqidi, "Secretary of Waqidi," after one of his instructors in the Prophetic tradition, was the author of *Kitab al-Tabaqat al-Kabir* ("The Great Book of the Classes," edited by E. Sachau *et al.*, 1904–1921). This work in eight volumes contains the life stories of Mohammed, his companions and successors down to Ibn Sa'd's own day. He lived chiefly in Baghdad.

See O. Loth, *Das Classenbuch* des *Ibn Sa'd (1869).*

IBN SA'UD, 'ABD UL-'AZĪZ IBN 'ABD UR-RAHMĀN IBN FAISAL (*c.* 1880–1953), was born at Riyadh, capital of Nejd. His father, 'Abd ur-Rahmān (d. 1928), was the youngest of four sons of the amir Faisal, sultan of Nejd from 1834 to 1867. The latter's death had plunged central Arabia into a state of anarchy and civil war owing to the contest of his two elder sons, 'Abdullah and Sa'ud, for the throne he had vacated. In 1875 the Turks occupied Hasa, while the rival dynasty of Ibn Rashīd in northern Nejd gradually extended southward until in 1891 the great amir Mohammed put an end to the Wahhabi state by the occupation of Riyadh itself. 'Abd ur-Rahmān went into exile with his family and, after a period of residence at Bahrein, arrived at Kuwait. Here he was influenced by Sheikh Mubarak ibn Sawah; and to this Ibn Sa'ud owed much of his future greatness and his friendship for Great Britain. From his father he inherited steady purposefulness.

Though 'Abd ur-Rahmān was the cadet of the Wahhabi dynasty, it was he who made the first effort to recover his father's throne in 1900. His defeat at Sarif was followed by the formal abdication of his rights and obligations in favour of his eldest son, 'Abd ul-'Azīz, who in 1901 launched into the desert with a force of only 200 men. At some distance from the capital he selected 15 of these, including his cousin 'Abdullah ibn Jiluwi (afterward governor of Hasa), for the final venture; entering Riyadh by night with his following he forced an entry into a house opposite the great fort where the Rashidian governor was lodged. A desperate struggle left Ibn Sa'ud the master of Riyadh, where he was at once proclaimed ruler of Nejd.

During the next few years Ibn Sa'ud consolidated the outlying provinces and resisted the Turks in their support of Ibn Rashīd. A Wahhabi victory at Bukairiya (1904) was followed by Ibn Rashīd's death (1906) and left Ibn Sa'ud master in the house of his ancestors with no danger of interference from the north.

Free now to show his capacity for administration Ibn Sa'ud proceeded to lay the foundations of his future greatness in a scheme remarkable both for boldness and ingenuity. He boldly seized upon the latent fanaticism of his countrymen as an instrument for the creation of a nontribal or pan-tribal element out of tribal material to leaven the mass into the semblance of a homogeneous nation. The first *Ikhwan* colony in 1912 was the first step of a deliberate program aiming at the abrogation of the patriarchal system in Arabia in favour of nationalism. At the time such an ambition was beyond the bounds of practical politics, but circumstances combined to bring it within the focus of Ibn Sa'ud's clear vision.

Al-Artāwīya, a flourishing town of 10,000 inhabitants, rapidly became the prototype of a hundred colonies which sprang up in various parts of Nejd during the next 15 years. Agriculture displaced pastoral activities as the binding force of the new organization, while the *shar'* or religious law took the place of the customary law of Bedouin society. Each colony constituted a contingent of the new Wahhabi standing army, for which circumstances have provided ample work at home and abroad. It was first put to the test in 1913 when Ibn Sa'ud turned his attention to the Turks who had been in Hasa since 1875. With a mere handful of men he suddenly appeared before Hufuf, whose astonished garrison surrendered without a blow. The garrisons at 'Uqair and Qatif followed suit and the Turks left eastern Arabia.

At the end of 1914 Captain W. H. I. Shakespear was deputed by Sir Percy Cox to visit Ibn Sa'ud with a view to enlisting his active assistance against the Turks, with whom his dynastic rival, Ibn Rashīd, had thrown in his lot. Ibn Sa'ud immediately undertook military operations; and in Jan. 1915 a battle took place at Jarrāb. The result was indecisive, but Captain Shakespear was killed and the British authorities were discouraged from further activity in Arabia. In December Ibn Sa'ud concluded a treaty of friendship with Great Britain but remained quiescent though he grew increasingly anxious as he saw King Husain ibn 'Ali in the Hejaz building up a strong position for himself with the help of T. E. Lawrence. In 1917 the Philby mission visited him at Riyadh to take stock of the situation and in the autumn of 1918 Ibn Sa'ud resumed activities against Ibn Rashīd. He reached the walls of Ha'il without being able to press home the attack, and the sudden termination of World War I found him still within the same frontiers as at its outbreak and with two powerful enemies to reckon with, Ibn Rashīd and King Husain. Relations with the latter were already strained to the breaking point. In March 1919 Lord Curzon on behalf of the British government decided in favour of King Husain and authorized him to occupy Khurma, which Ibn Sa'ud was warned to relinquish. The latter disregarded the warning; and two months later the Wahhabi army surprised and annihilated the Hashimite forces at Turaba. Having vindicated his rights by might Ibn Sa'ud retired to Riyadh. In 1920 a Wahhabi expedition added the highland districts of 'Asir to Ibn Sa'ud's dominions and in August of the following year the capture of Ha'il placed all central Arabia under a single rule. Meanwhile Bisha and Tathlith in the south were occupied, as also Khaibar and Taima northward, while in 1922 Jauf came within the Wahhabi sphere.

The British government made a belated effort to mediate at the conference of Kuwait, convened in Nov. 1923. The discussions ended without result in April 1924; and in September the Wahhabi invasion of the Hejaz began with the sudden capture of Ta'if and a massacre of its inhabitants. King Husain was forced to abdicate in favour of his eldest son, 'Ali, who evacuated Mecca. Mecca was quietly occupied by the Wahhabis in October, and the outlying districts of the Hejaz were rapidly overrun. Only Jidda and Medina remained in the hands of the Hashimites, both being subjected to a desultory siege. Ibn Sa'ud entered Mecca for the first time in Dec. 1924. In Nov. 1925 he and Sir Gilbert Clayton concluded the treaties of Bahra and Hadda which satisfactorily disposed of certain questions relating to Iraq and Transjordan. The following month Medina surrendered, while Jidda followed suit a fortnight later. On Jan. 8, 1926, Ibn Sa'ud was proclaimed king of the Hejaz in the great mosque of Mecca; and a year later his title of sultan of Nejd and its dependencies was converted to king.

Relations with Great Britain were brought up to date by a new treaty of Jidda negotiated with Sir Gilbert Clayton in May 1927; but a frontier dispute with Iraq broke out in November of the same year. In 1932 the kingdom and its dependencies was renamed "the kingdom of Saudi Arabia." In 1936 and 1939 Ibn Sa'ud granted oil concessions to a U.S. company; and the royalties derived from these concessions greatly increased the state revenues, though they caused the life of the royal entourage to degenerate considerably from its former Wahhabi austerity. Ibn Sa'ud's confidence in the survival of Britain, even in the darkest days of World War II, exercised an important influence on other Arab governments.

For political and other reasons the Wahhabi king took the fullest advantage of Islamic law in the matter of marriage and divorce

and was reputed to have been married about 150 times in the course of his career. The jubilee of Ibn Sa'ud's accession to his father's rights was celebrated in 1950. Ibn Sa'ud died Nov. 9. 1953, near hlecca; his eldest surviving son Sa'd ibn 'Abd ul-'Aziz al-Sa'ud (b. 1905), was proclaimed king. His second son, the amir Faisal, (b. 1906) minister for foreign affairs who had acted as viceroy of Hejaz in his father's absence, became heir to the throne.

BIBLIOGRAPHY.—Harold Armstrong, *Lord of Arabia* (1934); K. S. Twitchell, *Saudi Arabia* (1947); H. St. J. Philby, *Arabian Days* (1948).
(H. ST. J. B. P.; G. E. K.)

IBN TUFAIL (ABU-BAKR MOHAMMED IBN 'ABD-AL-MALIK IBN TUFAIL; Lat. ABUBACER) (d. 1185/86), Moorish philosopher and medical writer, was born at Guadix, Spain, in the first decade of the 12th century. He became court physician and general adviser of the Almohade ruler Abu Ya'kub Yusuf (1163–84), to whom he introduced his younger friend Xverroes (*q.v.*). Ibn Tufail died at Marrakech in 1185/86.

Ibn Tufail wrote a number of medical works in Arabic, both in prose and in verse; but his reputation rests on the *Risalat Hayy ibn Yakzan* ("The Treatise on Hayy ibn Yakzan"), a kind of philosophical novel in which he describes the self-education and gradual philosophical development of a man who passes the first 50 pears of his life in complete isolation on an uninhabited island. The author does not follow the emanationist Neoplatonic astronomy which al-Farabi and Avicenna had introduced into their otherwise Aristotelian description of the world above the moon and which Avempace and Averroës accepted without criticism. He rather inclines toward Islamic theology in this respect and does not establish any "secondary causes" as the powers ruling the different celestial spheres. God, the highest being, is the only efficient cause. Philosophy is by no means the highest aim in life. Mystic contemplation is superior to it, and the hero of the novel succeeds eventually in staying in an almost uninterrupted mystical union with God.

Moses of Narbonne in the 14th century translated the *Risalat Hayy ibn Yakzan* into Hebrew and provided a Hebrew commentary, and Pico della hlirandola in the 15th century had a Latin version made from this translation. From the Arabic, E. Pococke made a Latin translation, *Philosophus autodidactus* (1671), and Simon Ockley an English translation, *The Improvement of Human Reason* (1708), new edition, *The History of Hayy ibn Yaqzan* (1929). For the text with French translation *see* Léon Gauthier (ed.), *Hayy ben Yaqdhân, roman philosophique d'Ibn Thofaïl*, 2nd ed. (1936).
(R. R. WR.)

IBO. A southern Nigerian tribe composing 33 subtribes, inhabiting the provinces of Benin, Ogoja, Onitsha, Owerri and Warri, whose language is related to Ibibio. The Ibo on the west of the Niger were long subject to the Edo: the rest lived in independent towns or villages under a paramount chief and a chief for each quarter. The extended family groups lived together in the same quarter. Marriage rules vary: marriage is usually prohibited between members of the same extended family and between near relations. Marriage by exchange is frequent. Descent is patrilineal. Age classes and secret societies flourish.

IBRAHIM (d. 1536), grand vizier of Turkey, was the son of a sailor at Parga, was sold into slavery and was bought by the sultan Soliman I who made him his grand vizier and married him to his own sister. Ibrahim, says a Venetian record, was "the heart and breath of the Padishah, who does nothing without consulting him; he is learned, fond of reading. and knows his law well." He was made commander in chief of the army for the invasion of Hungary, and in 1526 took Peterwardein. But his main functions were diplomatic. With the Venetian Gritti he conducted the negotiations for peace between the sultan and the emperor Ferdinand in 1533 In the autumn of that year he took command in Asia against the Persians. He occupied Tabriz on July 13; he nas then joined by Soliman, and marched against Baghdad. In both cases he prevented plunder. They returned to Constantinople on Jan. 8. 1536. He had for 14 years been the sultan's constant companion, even sharing his sleeping apartments. They retired as usual on March 30, and in the morning Ibrahim was found strangled by the sultan's orders.

IBRAHIM PASHA (1789–1848), Egyptian general, son, or adopted son of Mohammed Ali, pasha of Egypt. was born at Kavala in Thrace. During his father's struggle to establish himself in Egypt, Ibrahim, then 16 years of age, was sent as a hostage to the Ottoman capitan pasha (admiral), but when hlohammed Ali was recognized as pasha, he was allowed to return to Egypt. When Mohammed Ali went to Arabia to fight against the Wahhabis in 1813. Ibrahim was left in command in Upper Egypt. He continued the war with the broken power of the hfamelukes, whom he suppressed. In 1816 he succeeded his brother Tusun in command of the Egyptian forces in Arabia. Mohammed Ali had already begun to introduce European discipline into his army, and Ibrahim had probably received some training, but his first campaign was conducted more in the old Asiatic style than his later operations. The campaign lasted two years, and the political power of the Wahhabis was destroyed. Ibrahim landed at Yembo, the port of Medina, on Sept. 30, 1816. The holy cities had been recovered from the Wahhabis, and Ibrahim's task was to follow them into the desert of Nejd and destroy their fortresses. Such training as the Egyptian troops had received, and their artillery, gave them a marked superiority in the open field. But the difficulty of crossing the desert to the Wahhabi stronghold of Deraiya, some 400 mi. east of Medina. and the courage of their opponents, made the conquest a very arduous one. Ibrahim displayed great energy and tenacity, sharing all the hardships of his army, and never allowing himself to be discouraged by failure. By the end of Sept. 1818 he had forced the R'ahhabi leader to surrender, and had taken Deraiya, which he ruined. On Dec. 11, 1819, he made a triumphal entry into Cairo. After his return he supported the Frenchman. Colonel Sève (Suleiman Pasha), who was employed to drill the army on the European model. Ibrahim set an example by submitting to be drilled as a recruit.

When in 1824 Mohammed Ali mas appointed governor of the Morea by the sultan. who desired his help against the insurgent Greeks, he sent Ibrahim with a squadron and an army of 17,000 men. The expedition sailed on July 10, 1824. but Ibrahim was not able to land at Modon until Feb. 26. 1825. Ibrahim easily defeated the Greeks in the open field. and though the siege of Missolonghi proved costly he captured the place on April 24, 1826. The Greek guerrilla bands harassed his army, and in revenge he desolated the country and sent thousands of the inhabitants into slavery in Egypt. These measures led first to the intervention of the English. French and Russian squadrons (*see* NAVARINO, BATTLE OF), and then to the landing of a French expeditionary force. By the terms of the capitulation of Oct. 1, 1828, Ibrahim evacuated the country. In 1831 Ibrahim was sent to conquer Syria. He took Acre after a severe siege on May 27, 1832, occupied Damascus, defeated a Turkish army at Homs on July 8, defeated another Turkish army at Beilan on July 29, invaded Asia Minor, and finally routed the grand vizier at Ronia on Dec. 21. The convention of Kutaiah on May 6 left Syria for a time in the hands of Mohammed Ali.

After the campaign of 1832 and 1833 Ibrahim remained as governor in Syria. The exactions he was compelled to enforce by his father soon provoked revolts. In 1838 the Porte felt strong enough to renew the struggle, and war broke out once more. Ibrahim won his last victory for his father at Nezib on June 24, 1839. But Great Britain and Austria intervened on behalf of Turkey. Their squadrons cut his communications by sea with Egypt. a general revolt isolated him in Syria. and he was finally compelled to evacuate the country in Feb. 1841. In 1846 Ibrahim paid a visit to western Europe. When his father became imbecile in 1848, he held the regency till his own death on Nov 10, 1848

IBSEN, HENRIK JOHAN (1828–1906) Norwegian poet and dramatist. nas born at Skien on March 20, 1828. His father, Rnud Henriksen Ibsen, a merchant. was of mixed Danish. German and Scotch blood; his mother. hfaria Cornelia Xltenburg was a Norwegian, of German descent When Ibsen was eight vears old, his fdther failed in business. and recollections of the penury which followed can be found in Peer *Gynt*.

Early **Life** and Works.—At the age of 1j Ibsen was apprenticed to an apothecary in Grimstad. a small town of 800 inhabitants; it was a business he detested, and he began to express himself and relieve his misery by writing poetry in 1847.

He read widely and deeply, especially in poetry and theology, and in 1850 he went to Christiania as a student; this year also saw the publication of his first play, a blank-verse tragedy, *Cataline,* which was followed, not many months after, by *The Viking's Barrow,* which was performed at the Christiania theatre, but not published. For a few months he co-operated in the production of a weekly satirical newspaper; but in November 1851, when in September the paper's brief life of nine months had ended, he was appointed as "theatre-poet" to the new theatre at Bergen, established for the encouragement of Norwegian drama, by the violinist Ole Bull. This position Ibsen held until the summer of 1857, and this intimate connection with the theatre — he combined the duties of producer, manager, adviser and designer with that of a poet — confirmed him in his nascent desire to be a dramatist. The plays which he wrote for this theatre were *St. John's Night* (1853), *Lady Inger of Ostrat* (1855), *The Feast of Sollzaug* (1856) *and Olaf Liljekrans* (1857). He left Bergen for Christiania in 1857; and his next two plays reflect the influence of his engagement and marriage to Susanna Thoresen; *The Vikings of Helgeland* (1858) and *Love's Comedy* (1862) are the first plays — earlier signs may be found in the lyric poems — in which the unmistakable voice of Ibsen is heard clearly. Both plays were misunderstood; and the fierce anti-romantic, idealistic satire of *Love's Comedy* caused a storm of indignation in Denmark and Norway: it is Ibsen's earliest protest on behalf of the inalienable rights of the individual, his first stroke in the life-long battle against the stupidity, the weight of the majority. There is in it not a little of the spirit which we find in the satiric poetry of Arthur Hugh Clough whose lines "O let me love my love unto myself alone And know my knowledge to the world unknown," might well have been Henrik Ibsen's motto. He had accepted the position of manager of a new theatre in Christiania; but he could not get *The Vikings* produced there, and it was not acted until 1861. The next year his theatre failed, and Ibsen became adviser in aesthetics at the opposition house. In spite of his disappointment and the disgust he felt at the reception of *Love's Comedy* he wrote for this theatre *The Pretenders* (1864), the best drama of his saga period. It was a popular success; but the managers of the Christiania theatre were shy of its strangeness, and it was not until Ibsen's reputation was secure — after the publication of *Brand* and *Peer* Gynt — that it took its place as one of the masterpieces of the new theatre.

Ibsen had applied to the Storthing for a poet's pension, which had been recently given to Bjornson; but it was refused and in indignation he went into exile; for his departure to Italy in 1864 was not an ordinary tour to the sun and the south. It was undertaken with a deep sense of injustice, which was partly responsible for the two magnificent poetic dramas — Brand (1866) and *Peer Gynt* (1867). After the issue of *Brand* he was granted a poet's pension and Ibsen had no longer to fear actual penury.

Plays. — In 1869 he wrote the earliest of his modern prose dramas *The League of Youth,* a political satire that roused as much animosity as did *Love's Comedy;* he was now settled in Dresden, but he returned to Norway for a short time after the publication of one of the most ambitious dramas ever composed — the huge double play *Emperor and Galilean* (1873), an elaborate historical study of the character of Julian the Apostate, which shows wide reading and a remarkable power of re-creating familiar figures of history. It is of great interest as one of the first attempts to free the study of Greek history from that smooth, neo-classical veneer by which it was falsified; it is far nearer in spirit to the Greece of Gilbert Murray and Jane Harrison than the Hellas of Winckelmann or Shelley. These years also mark the end of Ibsen's work as a poet; his collected lyrics were published in 1871, and the occasionally exalted prose of *Emperor and Galilean* does not again reappear in his work, except in brief snatches in some of the later prose dramas. His deep interest in politics was made intenser by the growing power of Germany, and when the days of the Commune came in Paris he felt strong in him something of the hopes that had awakened in 1848, when there was promise of revolution in Europe. His only persistent political principle, to be found in every play from *The Pretenders* to *When We Dead Awaken,* was the necessity of a society which should give the amplest possible opportunity for the free growth of the individual, and he was naturally and inevitably disappointed with all movements of reform — liberal, radical, socialist — as conducted. He found that they all tended in time to subordinate the individual to the state — and to Ibsen the state, the great compact majority, was always the enemy. In 1877 he published *The Pillars of Society* — *a* title which might be taken to cover all the social dramas which succeeded that play.

Later Life. — Ibsen's life presents few points of interest except the steady production of his plays; he never had the inclination nor the necessary social exuberance for such public and political appearances as were enjoyed by his rival and contemporary Bjornson. From 1868 to 1891 his permanent home was Germany, first in Dresden, later in Munich; in 1891 he settled in Christiania where he lived till his death on May 28th, 1906; for the four years previously he had suffered from an almost complete physical and mental collapse, and was unaware of the world without. Of his marriage (1858) there was one son, Sigurd, to whose education Ibsen devoted no little care and thought. When he left his home in 1850, he ceased to communicate with any of his family except his sister Hedvig; and although he had friends in journalism and in the theatre there is little evidence that any one had any real or permanent influence on the development of his character and his genius; he was grateful to Bjornson, he was grateful to Brandes, for the support each gave him at different periods of his career, but he never showed the slightest inclination to accommodate his own thought to their ideas. No other dramatist of so immensely creative a genius has ever been so lonely: he did not need long or continuous intercourse with society. A chance word, a chance meeting, a sudden memory were enough to fertilize that powerful imagination which then, feeding on itself and nourishing the germ, gave birth, every two years, to a play which brought into the world entirely new characters, owing only an infinitesimal part of their life to any power outside the mind and spirit of the dramatist. Ibsen was first and last a great poet, and a great mystic — one of the greatest poets and the greatest mystics who ever devoted himself to the drama; the "lyrical Pegasus" may as Brandes said, "have been killed under him," but his poetic inspiration burned all the more fiercely because of the severe limits which Ibsen forced on its expression, limits which are unfortunately very much exaggerated in the best-known English versions of his social dramas. His interest in his characters, real as they are, intense as it is, is always dependent on his poetic vision of life; his vision of life is never dependent, as was Bjornson's, Strindberg's or even Goethe's, on circumstances either of his own choosing or of chance. Ibsen was never afraid that facts, however obstinate, or persons, however powerful, could detract from the truth and his grasp of it In this he showed signs of affinity to the theological outlook on the world. He knew, mystically, that his conception of life and of mankind could explain and express all the facts with which he came in contact; and if ever he met apparent contradictions, he was ready to dismiss them as irrelevant or worthless. His consummate skill as a dramatist, his influence in the making of a new European theatre must not allow us to forget that he was never of the movement which he caused, and of which he was acclaimed the leader. He was always in advance and always detached.

Main Ideas. — There are two main ideas in Ibsen's work, implicit even in the early dramas, and explicit, in different degrees of emphasis, in his theatre from *Brand* to *When We Dead Awaken.* Of this continuity in his work he was himself fully conscious, and resented the tendency to separate his work into periods, and find any contradiction — except a purely formal one — between the laughing, rapid poetry of *Peer* Gynt and the close, compact prose of the social dramas. The two ideas are these. First, the supreme importance of individual character, of personality: in the development and enrichment of the individual he saw the only hope of a really cultured and enlightened society. Second, comes the belief that the only tragedy that can be suffered, the only final wrong that can be committed, is the

denial of love. The former idea was easily grasped, and was proclaimed by most Ibsenites — Brandes, Archer, and Shaw — as the key to Ibsen's drama; the latter idea was excused in the poetic plays as a relic from an imaginary romantic phase of Ibsen's life, and ignored when it appeared again in the social dramas, especially the later ones. Archer indeed was so disturbed at its very evident intrusion in *When We Dead Awaken*, that he suggested that the dramatist's mind was already failing; while he followed Shaw in his description of the climax of *Peer Gynt* as a "crowningly unreal self-realization." The reason for this obtuseness — shared by nearly all early critics of Ibsen except Sir Arthur Quiller-Couch — is to be found in the fact that it was the lot of Ibsen, a Christian mystic with no definite allegiance to any religious body, to be interpreted to the world by men who were mostly sentimental rationalists, who noticed, what was fully obvious, that the dramatist waged an unceasing war against conventional Christianity, but failed to observe that he did so, not under the banner of rationalism, but in the name of an intenser Christianity.

The same mistake was made, and is still made occasionally, by interpreters of William Blake, in whose thought may be found not a little which would have won Ibsen's sympathy and understanding. In *Brand* Ibsen preached his first and most defiant proclamation of the need of whole-heartedness in the personality; the prophet-priest of the play with his cry of "All or nothing," is a projection of Ibsen's own character, with its stern refusal to be diverted from his work. Balancing that play is *Peer Gynt*, the richest, the most imaginative and fantastic of Ibsen's works: as Brand stands for singleness of purpose, *Peer Gynt* is the embodiment of distraction and dreaming — a parody in some sense of Ibsen's own gospel that facts do not matter, anticipating the bitterer parody of *The Wild Duck*.

In *A Doll's House* (1879) we have the first emphatic statement of Ibsen's individualistic creed. It is not a feminist play. Ibsen was at the moment pre-occupied with the struggle between society and the individual, and he chose a woman as his protagonist because he knew that, on the whole, women were more likely to take a personal view of life than men. There are two dramas in the play — one consists in Nora's discovery that she has lived for years with a strange man; but this depends on the more essential drama that for Torvald a crime against society is more important than a sin against love. The same motive inspired, in a more terrible form, *Ghosts* (1881); and when *Ghosts* roused fury throughout Europe, Ibsen retorted on his critics with *An Enemy of the People* (1882) in which he attacks the stupid majority who prefer disease to the confession of their disgrace. One of the loveliest of his plays, one in which the poet breaks out again, is *The Wild Duck* (1884). It has a tenderness and a lyrical beauty which stand out all the more strongly beside the fierce satire against those who have misinterpreted him. This play, with its quiet charm, its ironic humour and its devastating satire, is the record of Ibsen's discovery that it takes two people to tell the truth, one to speak and one to understand what is spoken — the last lesson to be learned by all prophets.

Later Works. — *Rosmersholm* (1886) written after a journey to Norway is a powerful study in ineffective idealism — and in the contrast of Rebecca West and Rosmer Ibsen reached his greatest heights in pure tragedy. *The Lady from the Sea* (1888) is the happiest of the prose dramas; it is rather weak in construction, but its characterization has a cheerful, relenting quality, and Dr. Wangel is one of the few men who can be put on a level with Ibsen's women. Of all modern plays Ibsen's come nearest, in form and sense of necessity, to the theatre of Athens; and of all his plays *Hedda Gabler* (1890) is, with the possible exception of *Ghosts*, the nearest to the Greek. If Hedda had been called Medea, her egotistic ferocity would not perhaps have so distressed those critics who pitifully complained that Ibsen's women were not womanly. *The Master Builder* (1892) is a return to the poetic, symbolic manner; and the conflict between two generations, Solness and Hilda, has become a classic statement of an age-long problem. *Little Eyolf* (1894) and *John Gabriel Borkman* (1896) are variations on his old theme, the conflict between love and the claims of other desirable things. In *Little Eyolf* love is threatened by the lust of the woman and by the vanity and incompetence of the man; the solution comes only through disaster; in *John Gabriel Borkman* love has been killed by ambition, and with love dead, there is nothing else; and the end of the play is the dramatist's consummate disclosure of the truth that Borkman, Ella and Gunhild were dead before the play opened, and that none of the other characters, except the old clerk Foldal (one of Ibsen's most exquisite minor characters) has ever been alive. Yet there is hope *When We Dead Awaken* (1900). This great final statement of the poet's invincible creed has disappointed those who had misunderstood his earlier plays, and attached too much importance to the incidental social teaching that can be extracted from them, and to their amazing stagecraft. Its form is less perfect, its external action fantastic; but in the reunion of Rubek and Irene Ibsen writes out of his very soul, repeating once more his persistent cry that, whether the world be well lost for love or no, at least that which a man thinks to gain by the sacrifice of love is not held at all.

The intense reality of Ibsen's characters, while evident at a first reading or a first hearing of any play, can only be properly appreciated by continuous study of his complete theatre. It was his habit to make more or less complete histories of the lives of his people up to the moment of the opening of the first act; and in the drafts and first version of many plays (available in the volume called *Ibsen's Workshop*) can be seen the care with which he worked, the fierceness with which he sacrificed anything, however entertaining, that was not essential, and his amazing power of getting the utmost out of a character or a situation. He made his people work for him; and there is no dramatist in whose work it would be so hard to find a single speech out of character. He could not bear either to discuss, or to disclose, the idea of a new play until it was completed. He retired into his own world with his own people, and agonized until they became and did exactly what he knew was right. When, as in *The Lady from the Sea*, he relaxes a little, the change in atmosphere is startling. This severity might be lamented as a defect did we not know from *Peer Gynt* that it was a deliberate sacrifice. The author of that supremely diverting and supremely mobile play cannot be accused of any incapacity for exuberance.

Ibsen's later abstinence from humour, from divagations and those extravagances which charm us in *Peer Gynt* was the abstinence not of impotence but a deliberately self-imposed control. It may be that he sometimes regretted his choice, for in 1900 he wrote to Count Prozor (after the publication of *When We Dead Awaken)* that, if he comes back to the old battlefields, "it will be with new weapons and in new armour"; there was, however, to be no reappearance, and it would indeed be ungracious for the world to complain of any lack of variety in the drama of the man who left us *Brand, Peer Gynt, Emperor and Galilean, A Doll's House, The Wild Duck, The Master Builder* and *When We Dead Awaken*.

BIBLIOGRAPHY.—*Samlede Vaerker* (Copenhagen, 1898–1902). *Efterladte Skrifter* (Copenhagen, 1909). *Ibsen's Liv of Vaerker;* by Gerard Gran (Copenhagen, 1919). *Collected Works* ed. and trans. by Wm. Archer, F. Archer, C. H Herford, E. Gosse and others (1906–12). *Early Plays* translated by A. Orbeck (1921). *Lyrics* and *Brand* trs. by F. E. Garrett (1912). *Peer Gynt,* trs. by R. Ellis Roberts (1912). Various Plays in Everyman's Library trs. by R. F. Sharp (London; n d.). *See* also P. H. Wicksteed, *Henrik Ibsen* (1892); G. Brandes, *Ibsen and Björnson* (1899); E. Gosse, *Henrik Ibsen* (1907); R. Ellis Roberts, *Hennk Ibsen* (1912); G. Bernard Shaw, *The Qwntessence of Ibsenism* (1891); A. E. Zuckw, *Ibsen the Master Builder* (1929).

(R. E. R.)

IBYCUS, of Rhegium in Italy, Greek lyric poet, contemporary of Anacreon, flourished in the 6th century B.C. He lived a wandering life, and spent a considerable time at the court of Polycrates, tyrant of Samos. Plutarch *(De Garrulifate,* xiv.) preserves the legend of his death. Attacked by robbers, he called on a flock of cranes to avenge him. Later, one of the robbers, in the theatre at Corinth, saw the cranes, and said "Behold the avengers of Ibycus," thus betraying himself. The "cranes of Ibycus" became proverbial. Ibycus wrote seven books of lyrics, partly mythical, but mainly erotic (Cicero, *Tusc. Disp.* iv. *33).*

The best editions of the fragments are by F. W. Schneidewin (1833) and Bergk, *Poetae lyrici* Graeci.

ICA, a department in southern Peru, bounded on the west by the Pacific ocean. on the north by the department of Lima, on the east by Huancavelica and Ayacucho, and on the south by Arequipa. Area 8,205 sq.mi. Pop. (1940) 144,547; (1958 est.) 199,795. The capital is the city of Ica (*q.v.*).

The department comprises the western slope of the Andes, the arid coast and the north end of the coastal range. Included in the department are the Viejas and Chincha Islands (*q.v.*), famous as sources of guano.

Ica is thinly inhabited except in four separate river valleys. from north to south the Rio Chincha, Rio Pisco, Rio Ica and Rio Grande. where irrigation is practised. The largest irrigated areas are in the Chincha "and Ica valleys. Cotton occupies the largest acreage, and the Pisco valley was where Fermin Tanguis originated the indigenous white long-stapled Tanguis cotton that proved to be highly productive in the irrigated lands of the Peruvian coast. In addition to cotton, fruitgrowing and viticulture are important, the latter especially in the Ica valley. Although the grapes produce an inferior wine, this is distilled into a famous brandy, which takes its name from the port of Pisco, through which it is exported. The department also includes the iron ores at Marcona, which are brought to the port of San Juan for shipment to the new steel plant at Chimbote. There is some gold mined at Nazca, and fishing is important at Pisco and San Andrés. (P. E. J.)

ICA, a city near the coast of Peru and capital of Ica department, located 160 mi. S.E. of Lima, with which it is connected by an all-weather highway. Pop. (1940) 21,437; (1958 est.) 34,230. It is the commercial centre of the department and has numerous small industries. Its chief outlet is by rail to the port of Pisco. 46 mi. N.W. Ica is in the midst of an irrigated area about 1,300 ft. above sea level, where the chief products are grapes and cotton. The famous Pisco brandy, well known along the Pacific coast of both North and South America, is produced in Ica. The city was founded in 1563 and was twice destroyed by earthquakes. (P. E. J.)

ICE is the solid form of H_2O, the substance of water. Although practically colourless, ice often appears white as a result of included air bubbles, and in large masses—*e.g.,* glaciers—it takes on a blue or blue-green colour.

Ice in its several forms (snow, lake ice, sea ice, glaciers) occurs abundantly. Of the estimated 22,000,000 cu.km. of ice occurring on earth, 87% lies on the antarctic continent and 12% on Greenland, with only 1% elsewhere. If all this ice melted, the sea level would rise about 50 m. and change the face of the earth. This could happen if the climate of the polar regions should get much warmer. Yet melting would be slow because ice has a very high heat of fusion, equal to 79.8 cal. per gram. This is the amount of heat necessary to change ice at 0° C. to water at the same temperature. (The zero point temperature of the Celsius or centigrade scale is defined as the temperature of a mixture of water and ice exposed to ordinary air at a pressure of one atmosphere.)

Ice has a density of 0.917 g. per cubic centimetre and will float on water with about 10% of its volume above the surface. However, ice containing air or brine may have a lower or higher density and will sink to different depths. As water cools it passes through a maximum density at 4° C. before any of it will freeze, for above this temperature convection currents carry the heavier cooled water to the bottom. Ice can form on the surface only after all of the water has reached 4° C. This is the reason why shallow lakes freeze over before deeper ones.

Another unusual characteristic of ice is that its melting temperature decreases when it is subjected to pressure. Under a pressure of 134 atm. ice melts at — 1° C. The low friction of most materials on ice can be accounted for, in part, by this phenomenon, for even moderately loaded surfaces will be under high pressures in the neighbourhood of edges and irregularities. Near 0° C. melting will occur at the points of high pressure, and the water formed can provide a lubricating film. At lower temperatures

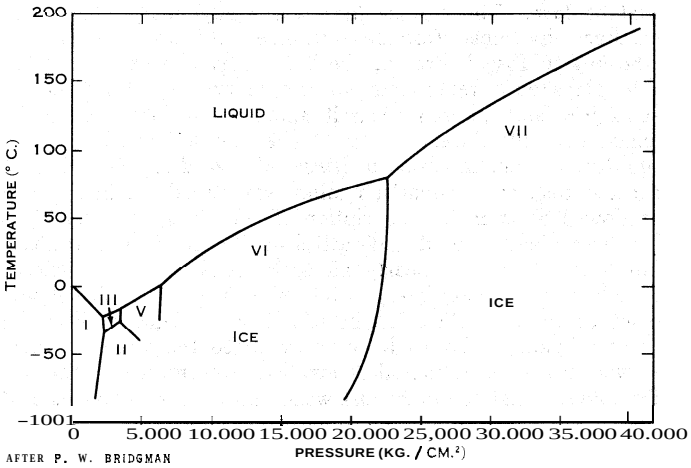


FIG. 1.— PHASE DIAGRAM FOR WATER AND ICE
Five high-pressure modifications of ice are shown along with ordinary ice (ice I). The existence of several unstable modifications, including ice IV, remains unconfirmed

ease of sliding may be due mainly to local melting by frictional heating.

The flow of ice under stress, as in glaciers, has often been explained in terms of regelation. In this process, pressure is relieved by the flow of water formed by the lowering of the freezing point. Thus, an object can pass through ice by progressive melting ahead and refreezing behind. This type of flon can occur only near to 0° C.; at lower temperatures a visco-plastic flow takes place. in which ice crystals are deformed without breaking.

Modifications. — There are several modifications of ice, one of which may be amorphous. Five different crystalline modifications were made in the laboratory of P. W. Bridgman (fig. 1); they are stable only at pressures in excess of 2,000 atm., and all have densities higher than one gram per cubic centimetre. Only one modification occurs in nature — ordinary ice — which crystallizes in a hexagonal structure; but ice crystals rarely exhibit symmetrical shape unless grown from the vapour.

Crystal Structure. — Masses of ice are aggregates of single crystalline grains. In quickly frozen ice these may be only a few millimetres to a few centimetres in size. Under slower rates of growth, as occur in temperate glaciers, single crystals are often found having dimensions of several decimetres. Although lake ice crystals may grow as large, they are less perfect. In neither case is the symmetry shown in exterior form.

Crystals, several centimetres in size and displaying the hexagonal habit, often grow from the vapour on ceilings and walls of unheated buildings in the arctic. The beautiful and varied patterns of snow crystals manifest the symmetry of ice grown from the vapour.

Boundaries between neighbouring crystals in polycrystalline ice are usually irregular and can be observed under crossed polaroids or by etching. Etching can be accomplished by evaporation of the surface or by melting with radiant heat. When the surface water is removed the grain boundaries become visible. Orientation of the individual ice crystals can be determined by X-ray crystallography. Because ice is doubly refracting, optical methods can locate the position of the C-axis (hexagonal axis), but they do not distinguish between directions in the plane normal to it. A convenient method for determining the orientation of ice is by observing the vapour (Tyndall) figures produced in the body of the

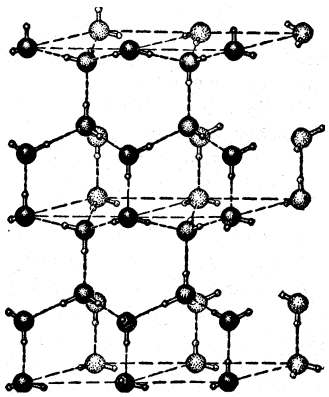


FIG 2.— CRYSTAL STRUCTURE OF ICE
Large spheres represent oxygen atoms; small spheres, hydrogen atoms

crystal by radiant heating. These flat hollow figures have the shape of snowflakes displaying hexagonal symmetry, and their axes of symmetry are parallel to those in the host crystal.

The oxygen atoms, being considerably larger than the hydrogen atoms. determine the basic structure of ice. Each oxygen atom is surrounded tetrahedrally by four others at a distance of 2.76 Å (fig. 2). The two hydrogen atoms can occupy any of the four tetrahedral directions with the limitation that only oqe can be between any pair of oxygen atoms. Because of the uncertainty concerning the position of the hydrogen atoms. the symmetry class of ice is not known. Both polar and nonpolar symmetries have been proposed.

For the manufacture of ice see REFRIGERATION AND ITS APPLICATION.

See N. E. Dorsey, *Properties of Ordinary Water-Substance in All Its Phases* (1940); P. G. Owston and K. Lonsdale, "The Crystalline Structure of Ice," *Journal of Glaciology,* vol. i (March, 1948).

(HI. B.; J. K. LR.)

ICE AGE: see PLEISTOCENE EPOCH.

ICEBERG, a floating mass of ice broken from the end of a glacier or a polar ice sheet. Icebergs drift according to the direction of the sea currents, frequently from the polar regions to navigable waters, and they are therefore occasionally encountered far beyond the polar regions. When a glacier descends to the sea and is pushed outward into water of greater depth than the thickness of the ice, the ends are broken off and the detached masses float away as icebergs. Only one-ninth of the mass of ice is seen above water. Many bergs are overturned, or at least tilted, as they set sail, as the result of the wave cutting and melting which disturb their equilibrium. The disintegration of an arctic ice sheet is a simpler matter, as the ice is already floating. The ice sheet cracks at the end, and masses break off, owing to the upward pressure of the water upon the lighter ice. This is accomplished with considerable violence. Icebergs, especially those of glacier origin, carry a load of debris which they gradually strew upon the sea floor; glacial material found in dredgings shons that icebergs occasionally transport their load for a considerable distance.

ICEBOATING: see ICE YACHTING.

ICEBREAKERS, powerfully built vessels specially designed and equipped to clear a path through ice in harbours. rivers or other navigable waters. Since late in the 19th century many maritime nations have used icebreakers to keep their ports and shipping lanes open. More recently, icebreakers have also proved valuable to exploring parties in the polar regions.

Ice encountered in the navigable waters of North America and Europe is of the annual type, which forms in sheets varying in thickness up to about 36 in. on the Great Lakes. Under the action of wind and seas such sheet ice often breaks and forms into windrows which attain great thicknesses, occasionally extending to the bottom of the lake.

Polar ice is composed of glacial ice, floes and annual ice, and is often too thick to break. Icebreakers follow open leads in navigating polar ice or force openings between floes. Modern icebreakers successfully use radar and helicopters for locating leads in the ice pack.

The design of icebreakers generally has followed the practice of developing vessels for particular areas of operation, such as the Baltic sea, Great Lakes or the Arctic. Dutch ice plows, so named because they turn ice up and out on the surrounding unbroken ice, were developed for the shallow harbours and rivers of the Netherlands.

A number of icebreakers have been fitted with bow propellers in addition to stern propellers. The action of the bow propeller creates turbulence in the water, which assists the breaking action of the bow and also moves broken ice out of the way. Bow propellers are particularly successful in breaking annual ice.

Design Characteristics. — The designs of icebreakers built during and since World War II have incorporated most of the following major characteristics.

High Beam-to-Length Ratio. — This is an important element because a short vessel performs better when forcing tortuous leads in the ice pack. Such a vessel can turn better and does not risk becoming wedged in a narrow lead as would a long vessel. The large beam is required to cut as wide a channel as possible for conventionally built merchant ships to follow. A narrow beam would require the icebreaker to make a second pass at the ice to cut a channel wide enough for a following ship.

High *Horsepower-Displacement* Ratio. — Modern icebreakers have ratios of 1.75 to 2.4 shaft horsepower per ton of ship's weight. These high ratios permit a vessel to make sustained progress in ice of varying thicknesses without the need for continually stopping, backing and ramming.

The Russian nuclear-powered icebreaker "Lenin," launched in 1957, was designed with a ratio of 2.75 shaft horsepower per ton, higher than all other icebreakers then in service. It was estimated that the "Lenin" would be able to make sustained progress in unbroken ice fields up to 6½ ft. thick and to cruise for a year nithout entering port.

Flared Hull Shape. — The use of flare-shaped transverse sections has been widely adopted in icebreaker design. The flare of the sections permits the ship to lift rather than be crushed when under ice pressure during the forcing of leads or when operating between floes. The angle of flare at midships is betneen 10° and 20°. This design feature also adds to the ship's icebreaking capability, because the sloping sides at the bow create a downward force on the ice. This characteristic, in combination with the common feature of cutaway bow or forefoot, produces a bending action on the ice. This action occurs not only as the forefoot meets the ice, but also as the hull moves along and the sloping sides of the bow and forward part of the hull meet areas of unbroken ice.

The hull shape resulting from the use of flared sections makes the icebreaker a heavy roller in open water. The absence of bilge (rolling) keels on most icebreakers. due to their vulnerability to ice. contributes to the rolling. Angles of 40° to 50° in heavy seas are not uncommon. The Canadian icebreaker "Labrador" is fitted nith retractable stabilizing bow fins to dampen the roll.

Electric *Propulsion.*—An icebreaker must be able to develop its maximum power from a standing start. This characteristic requires machinery capable of providing approximately full power at reduced propeller shaft revolutions. Electric drive has this ability and is the most common type of propulsion for icebreakers, using diesel or steam turbines to drive generators that supply the direct-current propulsion motors. Ships of the U.S. coast guard "Northwind" class (see fig. 1) and the "Mackinaw" were constructed with two stern propellers and a bow propeller. The diesel-electric propulsion plant was designed to transmit all the power developed either to the stern propellers or to divide the power betneen the stern and bow propellers. When icebreakers designed with bow propellers operate in polar regions the bow propeller is usually removed.

BY COURTESY OF U.S. COAST GUARD

FIG. 1.—THE "NORTHWIND," U.S. COAST GUARD ICEBREAKER

Rugged Hull Structure. — Heavy plating of the underwater body, with rugged framing to resist the crushing effects of icebreaking, are basic characteristics of icebreakers. Frames are spaced as close together as considerations of access for construction and maintenance permit, and by means of web frames and systems of longitudinal girders the ice loads are transferred from the frames to the decks or the bulkheads of the ship. Over-all weight considerations favour using the decks and deck beams as the major strength factors.

Shell plating, often steel of high tensile strength, usually is heaviest at the water-line areas, with a gradual reduction in thickness to the keel.

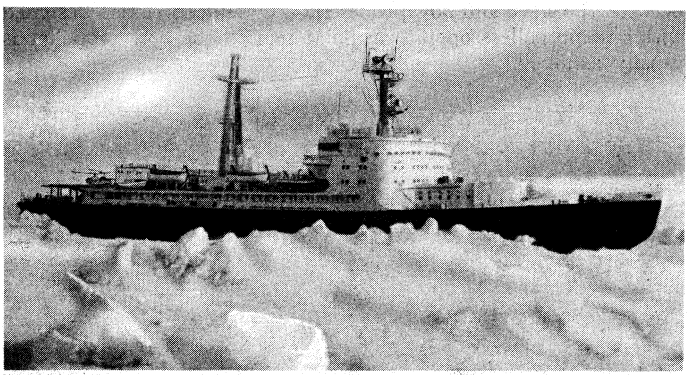
Miscellaneous Characteristics. — The rolling tendencies of icebreakers are used to advantage in connection with special heeling and trimming systems installed to induce rolling and change in fore and aft trim (the ship's position in relation to a horizontal plane). Ability to cause the ship to roll and change trim is an asset in breaking ice and in helping the ship free itself should it become stuck and be unable to move by using its propellers. Rolling and trimming are performed by using large pumps to transfer large quantities of water rapidly between the ship's tanks.

Particular attention is paid to providing rugged appendages, such as the rudder and propellers. In heavy ice the need to back off and charge the ice field requires particularly strong rudder construction, and the propellers have heavy blade sections for maximum strength. In addition to cast steels, a number of alloy steels and bronzes have been used for propeller materials to achieve the desired strength. Propellers are located as far inboard and as deep in the water as conditions permit, to give them the maximum protection.

Automatic tensioning towing machines and notched sterns to take the bow of a convoyed vessel are features included in numerous icebreakers.

A major requirement for an icebreaker designed for polar duty is large fuel capacity. The polar icebreaker operates in remote areas, where refueling facilities are deficient or do not exist at all, and the possibility is always present that the ship may get stuck in the ice and have to "winter in" until the ice conditions improve. When an icebreaker is doing its hardest work in clearing a path through heavy ice, its fuel consumption is enormous.

In the 1950s this fuel problem gave impetus to proposals to use nuclear power. A number of countries studied the feasibility of constructing nuclear-powered icebreakers, but the U.S.S.R. was the first country to build one. The keel of the atomic icebreaker



SOVFOTO

FIG. 2.— THE "LENIN," ATOMIC-POWERED ICEBREAKER OF THE U.S.S.R.

"Lenin" was laid in 1956, and the vessel was launched in Dec. 1957. (See fig. 2.) It had the following characteristics:

Length	440 ft. 0 in.
Depth of hull	52 ft. 10 in.
Maximum beam	90 ft. 6 in.
Draft	30 ft. 3 in.
Displacement	16,000 tons
Reactors	3 pressurized water reactors (1 spare) using enriched uranium fuel
Propelling machinery	Turboelectric (direct current) triple screw, 44,000 shaft horsepower

(AT. L. S.)

ICE CREAM. Water ices were known in the Roman empire, and Marco Polo is supposed to have brought a recipe for milk ices from the far east. Centuries later, chefs for the courts of Europe experimented with ice-cream recipes and tried, unsuccessfully, to keep the secret for nobility. Its commercial production became successful after the discovery that salt mixed with ice produce a lower temperature than ice alone. In the late 19th century, also, the introduction of mechanical refrigeration greatly assisted the growth of the ice-cream industry.

Ingredients. — The liquid mix, or unfrozen ice cream, for representative, good-quality vanilla ice cream contains about 80% by weight of cream and milk products and 15% sweeteners. Almost 70% of the milk or its equivalent used in ice-cream manufacture in the United States is bought during the spring and early summer months when milk production is at its peak and prices are lowest. Because this milk may be stored as frozen or concentrated milk products for use in later periods of lower milk production on farms and consequent high prices, ice cream has been called the "balance wheel" of the dairy industry.

Cream, milk, nonfat milk solids, sugar and sometimes eggs form the basis of all ice cream. Less than 0.5% of a stabilizer, of which there are several types, is generally included.

The food values of ice cream vary as compared to its ingredients. One-third pint of vanilla ice cream is about equal to one-half cup of whole milk in calcium, protein and vitamin B, and to a little more than one cup in vitamin A and calories.

The ingredients of ice cream are combined in varying proportions, but always in a way to make the solids about 38% of its weight. Milkfat in ice cream may range from 8% to 14%; nonfat milk solids from 8% to 12%, the use of the latter being limited by the amount of lactose, or milk sugar. since excessive lactose may crystallize and cause a "sandy" ice cream. In the second half of the 20th century the trend was toward the higher content of nonfat milk solids. Each U.S. state and many cities set minimum legal requirements for ice cream.

Manufacturing. — Pasteurizationin the manufacturing process and homogenization and automatically controlled freezing contribute to the quality of ice cream. Homogenization blends the fat globules with the nonfat milk solids to help form a stable emulsion and aids development of a smoother texture by retarding churning of the fat globules in the freezer. Automatic control of the whipping process produces ice cream of uniform consistency, the whipping, which incorporates air, being necessary to produce a palatable product, ice cream without whipping being like bread that has not risen.

The mix for ice cream contains all the ingredients except the fruits, nuts or other special flavouring. In a modern plant the mix is pasteurized and homogenized and then cooled rapidly to below 40° F.

At least half the ice cream made in the second half of the 20th century was frozen in the continuous type freezer, a refrigerated tube with revolving blades, or beaters, surrounded by a refrigerant. The mix moves through the freezer without stopping and comes out in less than 60 seconds as partially frozen ice cream. Fruits, nuts and similar flavourings are added at this time. Liquid flavourings are added to the mix just before freezing, except for chocolate, which is added as the mix is made.

The partially frozen ice cream is drawn off into containers, which are immediately covered, and is sent on conveyors to a hardening room with a temperature of from 0° F. to −20° F. Containers ranging from cup size to large cans of several gallons are used. The ice cream is then delivered in refrigerated trucks to dealers, who place it in refrigerated cabinets, where it is kept frozen until sold.

The ice-cream mix and the frozen ice cream are tested routinely for the amount of butterfat, total solids and bacteria. The ice cream is produced and packaged through sterilized pipes and by automatic machinery, frequent checks being made by the manufac-

turer and health authorities. Samples on the market are retested to assure quality.

Varieties. — Ice Cream. — This is a cream and milk product, variously flavoured; more than 100 flavours of ice cream have been made.

Mousses, Parfaits. — Mousse is a frozen dessert of sweetened and flavoured whipped cream or thin cream and gelatin. Parfait is a frozen dessert of whipped cream, eggs cooked with syrup, and flavouring. Both mousses and parfaits are frozen without stirring.

Fruit Sherbets. — Sherbets are made of milk, sweeteners and fruit flavouring, in many varieties.

Fruit Ices. — Fruit, fruit juices, water and sweeteners are used in water ices, and many of the flavourings used for sherbets are added. (EH. G. B.)

ICE HOCKEY. One school of thought holds that ice hockey is a development of field hockey (see HOCKEY), and another that it is a development of the old Irish game of hurling (*q.v.*). Some experts believe that the game of bandy, played with a ball and bent sticks by two teams, is a forerunner of ice hockey, while there is evidence that the Indians played some such game in Canada centuries ago.

Canada is regarded as the mother of the modern sport and was the first country to organize the game on a nationwide basis (see below), with a codified form of playing rules that has been accepted throughout the world. For long the sport was confined to natural ice, but with the advent of ice rinks its popularity spread rapidly.

INTERNATIONAL

This article will consider first the international aspects of the game, then hockey in the United States and Canada, technique and finally the game in Europe. In 1908 the International Ice Hockey federation was formed, with Great Britain, France, Belgium, Switzerland and Bohemia as founder members. In the second half of the 20th century there were 25 member nations. The international body organizes the world and European championships each year with both titles at stake although only one series of games is played. The winning team, if European, takes both titles and if non-European only the world title, in which case the European trophy is awarded to the European team gaining the most points. At one time the world championships could not be competed for unless a non-European team competed. For the winter Olympics the same system is adopted, the winner of the world title also taking the Olympic honours.

The international rules are applicable to most affiliated countries and govern the world and European championships. The governing bodies in Canada, the United States and Great Britain have, however, slight variations in the rules and slightly different interpretations for the game as played in their respective countries.

The rules of the game are comparatively easy to follow, with the possible exception of the defensive tactic known as body checking, whereby the defending player is permitted to hit with his body an attacking player in possession of the puck. Confusion also arises from the application of the offside rule (bringing the puck forward illegally) and the penalty rule. A breach of certain rules results in the offending player's being sent off the ice for a number of minutes during which his team has to play shorthanded.

Under the international rules, the number of players per team permitted on the ice at any one time is six: goalkeeper, two defense men and three forwards. In addition, the international rules allow eight others, one of whom must be a goalkeeper, to be at the disposal of the team's coach. Apart from the second goalkeeper the coach is permitted to change players as and when he chooses, provided that not more than six players are on the ice at the same time.

Before the change to six-man hockey, teams were made up of seven men, and the positions were goal tender, point, cover-point, rover, left wing, centre and right wing.

Players are permitted to wear protective equipment the specifications of which are covered by the rules. This equipment is essential because of the inherent hazards of the sport.

The puck — the term applied to the disklike object with which the game is played — is made of vulcanized rubber, or other approved material, is 1 in. thick and 3 in. in diameter and weighs $5\frac{1}{2}$ to 6 oz.

The sticks are of hardwood and must not exceed 53 in. from the heel to the end of the shaft and $14\frac{3}{4}$ in. from the heel to the end of the blade. The blade must not exceed 3 in. in width. The goalkeeper is permitted to use a special stick.

The game consists of three periods of 20 minutes each of actual playing time. The playing surface is divided into three areas, known as the defending zone, neutral zone and attacking zone. The neutral zone is again divided by the centre line. These lines govern the off sides. (J. F. AE.)

UNITED STATES AND CANADA

History. — Despite the introduction of international play in Europe, Canada took the lead in establishing the sport firmly through organization. In 1887 the Amateur Hockey Association of Canada was formed and this body soon came to be recognized. Under its guidance, hockey flourished throughout the entire dominion.

The game was not played in the United States until the winter of 1894–95. In that year a group of U.S. students visited Canada, saw some games and participated in others. On their return home, their enthusiasm prompted them to organize hockey clubs. According to the *Official* Hockey Guide of the Amateur Hockey Association of the United States,

The first official league or association ice hockey game on record in the United States was played by the St. Nicholas Skating Club and the Brooklyn Skating Club in New York's St Nicholas Rink on December 1 j, 1896, and was won by St Nick's 1 j to o The other teams in this four club circuit were the New York Athletic Club, winner of the Amateur Hockey League title for 1896–97, and the Crescent Athletic Club of Brooklyn.

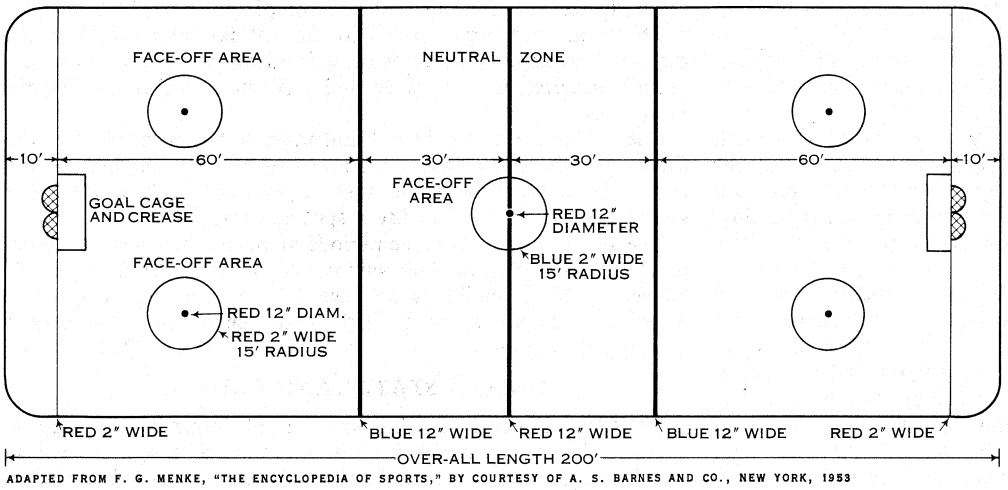
In a short time many colleges were attracted to the sport with the result that it soon became an important winter game. Not long after the colleges had accepted the game, club teams were formed, and eventually hockey was organized for professional play. A number of leagues employing paid athletes were formed, the strongest of which, the National Hockey league, came into being on Nov. 22, 1917, as an outgrowth of the National Hockey association founded in Montreal, Que., Dec. 2, 1909. This league in the beginning embraced only four teams, the Toronto Arenas, Montreal Wanderers, Montreal Canadiens and Ottawa Senators. It was successful from the start and in 1924 it expanded to include teams in the United States.

At one time ten teams, representing cities in Canada and the United States, were in the circuit. In 1942 the "loop" was reduced to six — the Toronto Maple Leafs, the Montreal Canadiens, the New York Rangers, the Boston Bruins, the Chicago Black Hawks and the Detroit Red Wings. Players are purchased by the teams, with the prices running from $5,000 to $30,000. The National league season of 70 games, exclusive of the play-off games, runs from mid-October to April.

Nature of the Game. — Hockey since its inception has been an onside game, that is, a game in which forward passing is discouraged. Early in its existence all forward passing was prohibited, but this rule, despite the fact that it required the player to be more deft, tended to retard the action to some degree. To correct this shortcoming three zones were established in which the puck could be passed forward. The puck may be passed forward or, for that matter, in any direction, within zones, and can also be moved ahead from zone to zone with certain limitations described below.

In the Gnited States all schools play according to the National Collegiate Athletic association rules, which permit forward passing within the three zones and forward passing to a teammate from the defensive zone up to the attacking zone blue line. *i.e.*, a two-zone forward pass is allowed; however, no attacking player can penetrate the attacking zone ahead of the puck; if he does he is off side.

Canada and several club leagues in the United States play according to the National Hockey league rules that permit forward



ADAPTED FROM F. G. MENKE, "THE ENCYCLOPEDIA OF SPORTS," BY COURTESY OF A. S. BARNES AND CO., NEW YORK, 1953

DIAGRAM OF AN ICE HOCKEY RINK

passing within the three zones and forward passing to a teammate from his defensive zone up to the red line which halves the neutral zone. No attacking player can penetrate the attacking zone ahead of the puck. The object of the game is for one team to shoot the puck into its opponent's goal in the face of the opposing team's efforts to prevent such an occurrence.

Each goal counts one point. The player scoring the goal is credited one point. and the players assisting in the scoring of the goal are credited one point for each assist, but no more than two assists are credited with each goal. The last two assists prior to the actual scoring are the ones considered for credit.

Positions. — The positions on a six-man hockey team are goal tender (more commonly called goalies in the United States and goaler in Canada), left defense, right defense, centre, left wing and right wing. The wings and the centre constitute the forward positions, and they operate most frequently as an offensive unit, although there is nothing in the rules to prevent a defense man from engaging in aggressive offensive play. In fact, since the advent of the forward passing style of play, defense men play a very important part in the offensive phase of the game, in addition to their primary duty of defending their defensive zone and goal tender. Many defense men, amateur and professional, outscore their team's forwards.

The Rink. — The game is played on a surface called a rink which should measure, as nearly as possible, 200 ft. in length and 85 ft. in width. The rink sideboards and endboards should be at least 3 ft. 4 in. high and no higher than 4 ft.

A goal cage stands at each end of the rink, at least 10 ft. and not more than 1j ft. from the endboards and equidistant from the sideboards; it should be firmly fixed to the ice. The goal is 4 ft. in height, with an opening of 6 ft. facing the centre of the playing area. An area *8* ft. wide and 4 ft. deep in front of the goal is called the crease. In this area the goalie has certain privileges the other players do not. The three zones are marked on the playing surface by lines drawn across the ice, 60 ft. from the goal line.

Sticks. — Except for the goalie, each player plays with a stick terminating in a blade approximately 4j° from the shaft. The degree of the stick-blade angle to the shaft varies with the lie. Stick lies range from 3 to 10 and the players' preference for lie depends on the position in which they like to "carry the puck" in front of them. A player who likes to carry the puck in close to his skates prefers a high lie of 7, *8* or g. A player who likes to carry the puck way out in front of his skates prefers a low lie of 3 or 4. The average or normal lie used by most players is a 5 or 6.

Sticks are lefts, rights and neutrals according to the side the player shoots from. The neutral is preferred by shooters who get too much "rise" in their shot. The sticks are of standard measurements and must be made of wood.

The shafts are $1\frac{1}{4}$ in. by $\frac{3}{4}$ in. square but the blade increases in width to $2\frac{1}{2}$ in. and must not exceed 3 in. The stick used by the goalie is of different dimensions. The blade of the goalie's stick must not exceed 34 in., except at the heel, where it must not exceed $4\frac{1}{2}$ in. The widened portion of the goalie's stick extending up the shaft from the blade must not exceed more than 24 in. from the heel and must not exceed $3\frac{1}{2}$ in. in width.

The Game. — The game starts with a face-off, the referee's dropping the puck between the opposing centres, who face each other in the exact centre of the rink. Each of the centres seeks to gain possession of the puck, and the one who does contrives to advance it, either by himself or by passing to a teammate, to the region of the opposing team's goal. Passing the puck from the defensive zone beyond the opponent's goal results in a special face-off (see diagram). The passing between members of the same team may be intercepted at any time by the opponent.

The three periods of 20 minutes each have 10-minute intermissions between them. In case of a tie at the end of that time the United States National Collegiate Athletic association rules decree that at the end of the third period there shall be a 5-minute intermission. after which ends shall be changed and a "sudden death" 10-minute overtime period played. In this "sudden death" period, the team that scores first wins, and the game is ended. If no score is made in the overtime period, the game is ended and results in a draw.

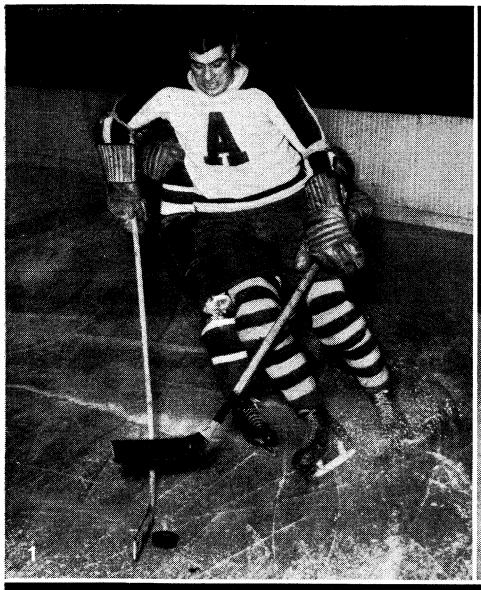
The National Hockey league rules decree that if, at the end of the three regular 20-minute periods. the score shall be tied, the game is over and shall be called a tie. However, "sudden death" applies in Stanley cup play.

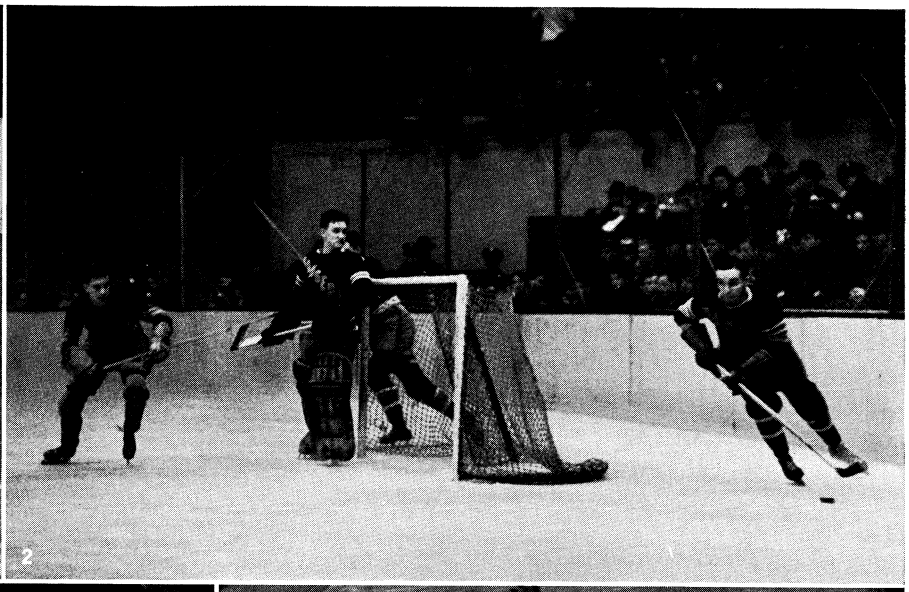
The Stanley Cup and Other Trophies. — The highest prize in professional hockey is the Stanley cup, a trophy put up for competition in Canada in 1893–94 by Lord Stanley, governor general of Canada. Until 1912 only amateur teams played for the cup, but thereafter professionals competed for it exclusively. The winner of the Stanley cup is regarded as the year's hockey champion.

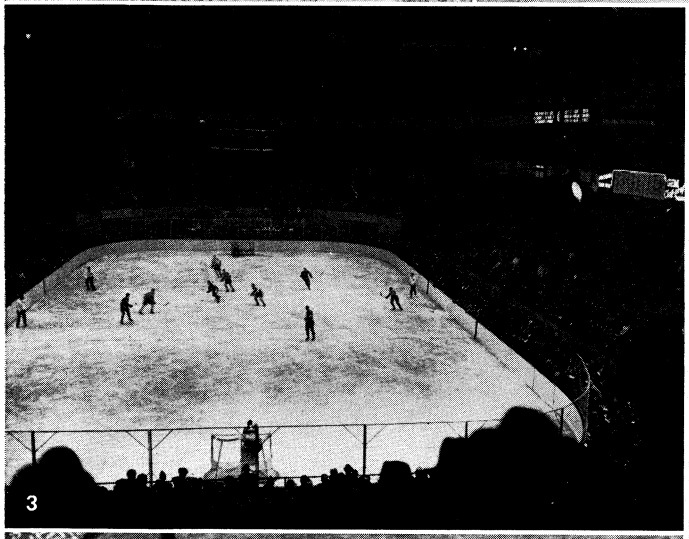
The pattern of the National Hockey league's play-offs is an involved one. Six teams play one another through the regular season, and the teams occupying the first four places in the final standing qualify. The first-place team meets the third-place team, and the second-place meets the fourth-place. These survivors then oppose each other, strictly speaking. for the Stanley cup. All of these postseason series are decided on the basis of the best four out of seven games.

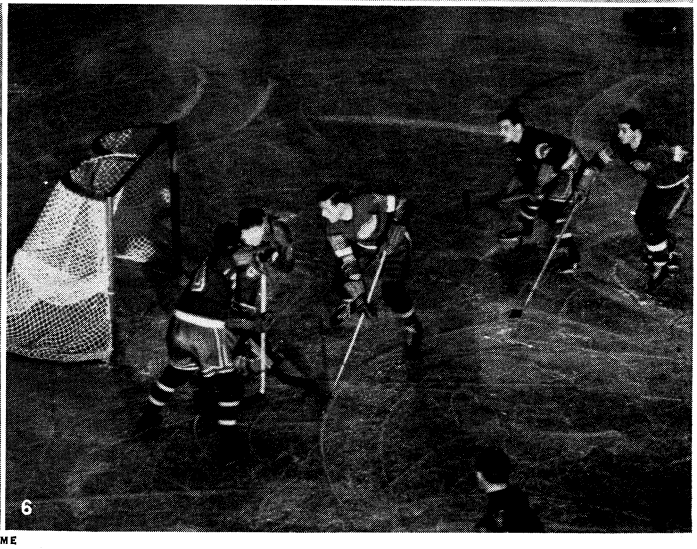
The Hart trophy, awarded to the player voted the "most useful" to his club in the league, was donated in 1923–24 by David **A.** Hart, father of Cecil Hart, who was coach of the Montreal Canadiens for many years. The Vezina trophy, awarded to the goalkeeper who allons the least number of goals to be scored on him during the regular season, was donated by the Montreal Canadiens in 1926–27 in memory of Georges Vezina, a great goal tender for the Montreal Canadiens, who suddenly collapsed in a game on the night of Nov. 28, 1925, and died a few months later of tuberculosis. The Art Ross trophy, donated in 1917 by the former manager and coach of the Boston Bruins, is given to the leading scorer. The Calder Memorial trophy, awarded to the player voted the "outstanding rookie" in his first year of professional hockey, was established in 1936–37 by Frank Calder. first president of the National Hockey league (1917–43). The Lady Bying trophy, instituted in 1927 and awarded the first time by the wife of Canada's governor general for whom it was named, is given to the player who best exemplifies clean play. The Norris trophy, awarded to the defense man who is deemed the best at that position through a season, was first presented at the end of the 1953–54 season as a memo-

ICE HOCKEY









PHOTOGRAPHS, (1) INTERNATIONAL NEWS SPEEDRAY PHOTO, (2) INTERNATIONAL, (3-6) ACME

DETAILS OF PLAY IN ICE HOCKEY

1. Player trying to get control of the puck while he is closely guarded from behind by an opponent
2. Recovering the puck after a missed goal shot by the opposing team, the player at the right is circling behind the net. The player at the left is skating to intercept him
3. General view of a hockey rink, showing position of the two goals
4. Scoring a goal. The puck is entering the net after being shot between the legs of the goalie
5. Goalie makino stop of an attempted goal
6. Teamwork at the net. The player in the left foreground (with back half turned) has just received the puck from a teammate and shoved it past the goalie immediately in front of him to score a goal

rial to James Norris, owner of the Detroit Red Wings. The O'Brien trophy, awarded to the losing team in the Stanley cup finals, was donated in 1909 by Ambrose J. O'Brien. The Prince of Wales trophy, awarded to the team that finishes on top of the National Hockey league at the end of the regular schedule, was donated in 1924–25 by the prince of Wales, later King Edward VIII. (J. C. Ns.; E. J. J.)

TECHNIQUE

Skating. — Ordinary pleasure skating, figure skating and speed skating count for little in ice hockey. The novice must practise hours, days and months to master the stop-turn-and-start. Ice hockey is played in a series of short dashes — fast starting, sudden stopping, feinting, dodging, shifting, weaving and even hurdling being parts of the puck chaser's routine.

Stick Handling. — For fast starting and breakaway purposes, the short, choppy stride is the proper skating form and propels a player rapidly away from opponents. After getting the "jump" with short, choppy strides, the player lengthens out his stride to get the maximum speed benefit of every stride. This lengthening-out stride is more of a hip-striding movement and gives the player a smooth, rhythmic, powerful appearance. The next point is to confine the skating stride to as narrow a path of ice as possible. The professional player rushes a puck in a path as narrow as 3 ft.

After the player has learned the art of good hockey skating technique, he must learn the art of puck control. This is the almost instinctive reaction of taking a quick, wide lateral dribble with the puck as the player nears an opponent; it is known as the protective dribble, whereby the puck carrier keeps his body between the puck and the opponent so that the opponent cannot poke check the puck from the stick blade. The protective dribble is very effective when it is made with a quick, wide movement — the quickness for deception and the width for safety.

Many mediocre skaters have held positions on good teams through their clever stick handling and scoring ability. By such tricks as the delayed dribble (throwing the opponent's timing off by suddenly stopping to "shake" an opponent and then just as suddenly starting off again) a player can baffle opponents who attempt to steal the puck and thereby check the play. Years of constant practice are necessary to crown the efforts of the expert stick handler.

Professional players in the big leagues stick handle the rubber puck in a manner that is uncanny — pushing, dribbling and flipping the small rubber disk about the ice between a maze of sticks and skates with a speed and accuracy too bewildering for the human eye to follow.

Methods of rushing or "carrying" a puck along the ice vary. Some push the disk ahead at stick's length when the play is open; others play the puck from side to side as they approach dangerously close to an opponent. Some flip the rubber against the sideboards, depending on the rebound for recovery of the disk behind the opponent, while others attempt to poke the puck between the opponent's feet and skate around the man to regain possession of the disk while the opponents are off balance or too befuddled to hamper the play effectively.

Checking. — Stick checking calls for quick thinking and clever action on the part of the checker. The poke, sweep and hook checks are effective means of taking the puck away and stopping opposing forwards in their rush toward the goal.

The body check is an effective means of body blocking which, in a sense, disconnects the puck carrier from the puck and thereby interrupts his dash to the goal. A legal body check is one with the hip or upper body from the front or straight from the side and limited to two steps, and only the puck carrier can be body-checked. In the United States the National Collegiate Athletic association rules permit body checking only in the defensive zone. The National Hockey league rules permit body checking in all three zones.

Playing the Game. — With skating and stick handling perfected to a point where they are combined into one mechanical operation, the player can direct his whole attention to playing the game. A good hockey player never looks at his feet, stick or puck during the progress of the play. His eyes must be focused on his opponents at all times. He must look up in order to size up the confronting situation and thereby react intelligently. Once he comes into possession of the puck he has the three forwards, two defense men and goal tender to beat before he can register a score by shooting the disk into the goal net guarded by the opposing team.

Left wing, centre and right wing, commonly known as the forward line, should practise passing the puck from one to the other across the ice, while skating at top speed, until their combination play is perfected to a point which enables them to beat the opposing forwards, swoop past the opposing defense and set up a man in the best scoring position for a shot at the net. Individual rushes by self-styled stars seldom result in tallies going up on the scoreboard. Left- and right-wing players should at all times play their positions in their respective lanes and leave the centre lane or mid-ice section to the centre player. Members of the forward line are supposed to score goals when the opportunity is presented and never at the cost of allowing the opposing forwards to break away for a two- or three-man combination attack on the home team's net. When not participating in an offensive attack, defensive men should position themselves within a 20-yd. radius of the goal net and should never leave their goal tender unguarded. The good defense player must hold, at all times, a position between his goal tender and the opposing forwards who attempt to carry the puck close enough to the net for a shot that may mean a score. Defense players adopt various forms of checking the forward-line attack. Some use a stick check (part of the stick must be on the ice, or the foul of cross-checking is committed) or body check or a combination of the two; others crowd the incoming forwards to the sideboards; or both defense men will simultaneously body-check the puck carrier when he attempts to go between them. The purpose is to spoil the forwards' shots, keep them out of shooting range of the goal net or force them to shoot from impossible angles.

A goalkeeper has 4 by 6 ft. of open net to protect and must study the shots from all angles and positions on the ice. He must cover as much of his net as possible with his body and shift his position between the posts continuously in such a manner that he will cut down the shooting angle and thereby eliminate as much vulnerable opening behind him as possible. Such movement by an experienced goal tender hampers the target range of the opposing sharpshooters. If an opposing left-winger or right-winger goes around the defense for a shot the net guardian crowds the corner of the goal nearest to the shooting wing and edges out to cut down the far corner angle. When a forward skates through the defense and looms up directly in front of the net for a shot, the goalie edges out directly at the shooter and thereby cuts down the shooting angle on both sides. The four most vulnerable spots for scoring are the two upper corners and the two lower corners of the net. Only the most skillful shooters can hit these four vulnerable spots, and only the most skillful of goalies can block these four spots.

BIBLIOGRAPHY.—National Hockey League, *Press and Radio Guide* (annual); National Collegiate Athletic Association, *Official* NCAA *Hockey Rules* (annual); L. Percival, *Hockey Handbook* (1951); L. Patrick and D. L. Monahan, *Let's* Play *Hockey!* (1957); E. Jeremiah, *Ice Hockey,* 2nd ed. (1958). (J. FI.; E. J. J.)

EUROPEAN ICE HOCKEY

The following European countries hold membership in the International Ice Hockey federation: Austria, Belgium, Czechoslovakia, Denmark, East Germany, Finland, France, Great Britain, Hungary, Italy, Norway, Netherlands, Poland, Rumania, Sweden, Switzerland, the Soviet Union, West Germany and Yugoslavia.

In the second half of the 20th century the Big Three in European ice hockey were the Soviet Union, Sweden and Czechoslovakia. Many nations with established ice-hockey tradition, such as Great Britain, France, Austria and Switzerland, fell behind the Big Three.

Czechoslovakia. — Ice hockey has been a leading sport in Czechoslovakia since its introduction in 1909 by a group of field-hockey players. During the first 25 years the sport showed a slow but steady growth. In 1933 the National league was organized

with a few teams of varying abilities competing. The calibre of play in the National league improved greatly in the late 1930s and 1940s, insuring the Czechs of strong representation in international competition.

In the second half of the 20th century. 12 teams of evenly matched ability comprised the first division of the National league. Games in this division were very popular with the public, and attendances exceeding 10,000 per game were commonplace. Senior and intermediate players numbered more than 35,000, while about 30,000 players competed in the junior and juvenile class. Formerly the sport had to depend upon the vagaries of the weather concerning natural ice, but later many artificial ice rinks were built.

Great Britain. — A bandy-type game, similar to ice hockey, was played in England as early as 1895. It was not until the winter of 1902–03, however. that ice hockey was introduced to England at the Prince's Skating club in London, primarily through the efforts of resident Canadian students.

Until about 1926 the game remained a hobby for the participants and created limited public interest. During the next decade the sport passed from the hobby stage to one supported by the public. Club competition prospered and touring Canadian and U.S. teams awakened public interest. Soon the commercial possibilities of the game were realized and teams comprised entirely of imported Canadian players were formed and organized into senior-class British and Scottish leagues The British league operated uith clubs from both England and Scotland. In addition to the top-ranked British league, there were dozens of intermediate, junior and juvenile teams composed entirely of native English and Scottish players.

Scotland's ice-hockey development closely paralleled that of England except that the Scots produced better native players than England. Both countries were hampered in the development of players because of the lack of natural ice and the limited amount of artificial ice available.

Soviet Union. — Ice hockey as an organized sport was introduced to the Soviet Gnion in 1946 and showed a phenomenal growth. As in the Scandinavian countries the time-honoured game of bandy was gradually being replaced by ice hockey. In the second half of the 20th century, according to the Soviet Ice Hockey federation, about 105,000 players were actively engaged in competition in the Soviet Union.

Although the National club of the Soviet Union began competing in world tournaments as late as 1954, it made an enviable record and threatened Canada's supremacy in amateur ice hockey. Players forming the National team were groomed through the ranks of the Group A league. The Group A league. centred in the Moscow-Leningrad area. was composed of two divisions, the first division with nine clubs and the second with six. Sixty-three teams were divided into several divisions to form Group B. In addition to the Group A and B teams there were thousands of teams in the intermediate, junior and juvenile classes.

Sweden. — Sweden was first represented by an ice-hockey team in 1920 when a group of bandy players, under the guidance of the Swedish Soccer association, entered the unofficial Olympic ice-hockey matches at Antwerp, Belg. As in other northern European nations ice hockey in Sweden was replacing bandy as the popular winter sport.

After World War II the game made tremendous progress and in the second half of the 20th century there were 4,100 teams and an estimated 60,000 players. many of whom were not registered members of the Swedish Ice Hockey federation. The construction of numerous artificial ice rinks aided considerably in fostering the sport.

The best calibre of play was in the First Division league, composed of 16 teams, divided into north and south sections. Players from this league formed the Swedish National club, which established a distinguished record in international competition.

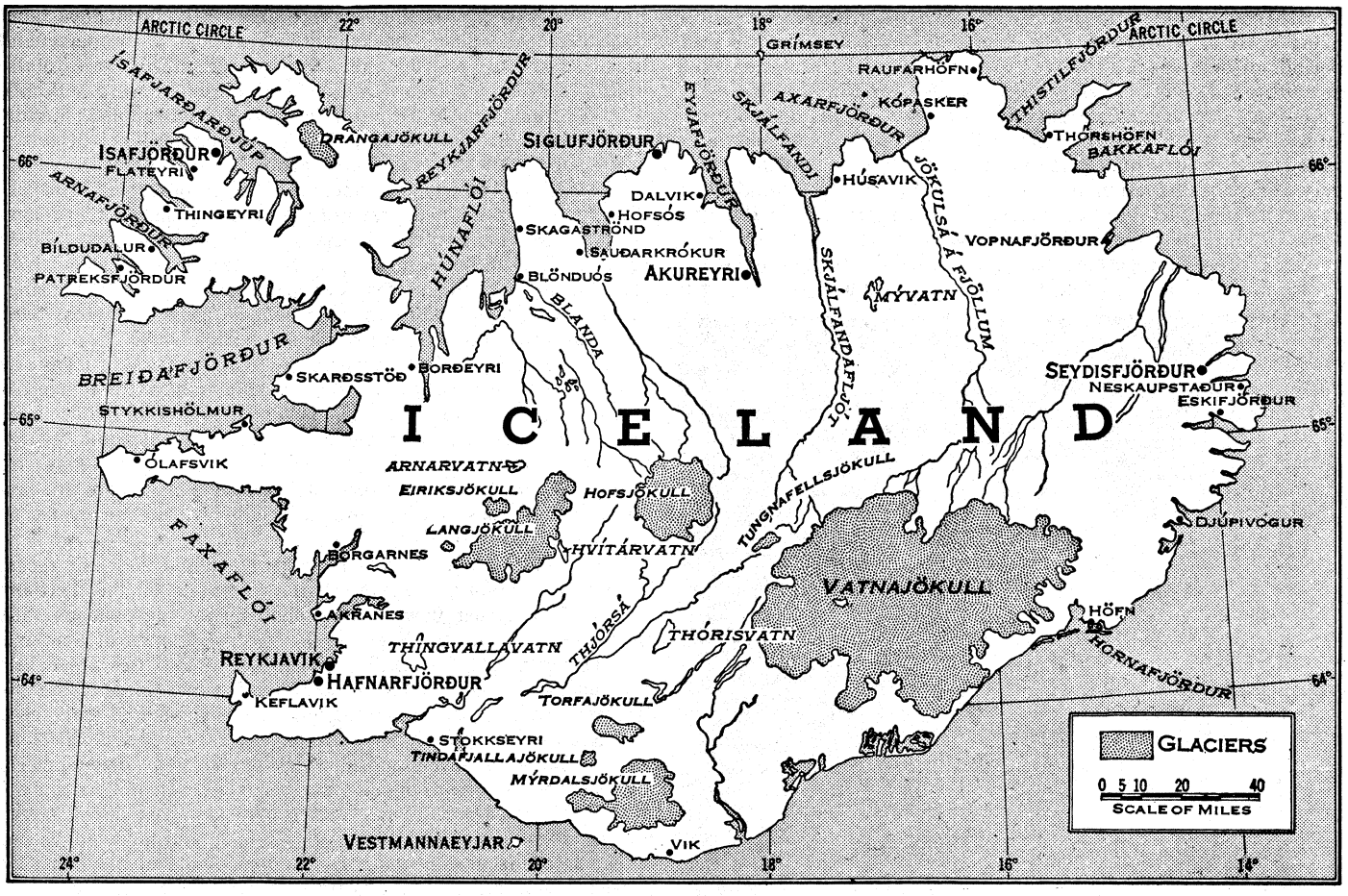
See: B. M. Patton, ***Ice-Hockey*** (1936); ***R.*** J. Brodrick, ***Ice Hockey,*** told ***by*** ***R.*** Giddens (1951). (D. M. C.)

ICELAND, an island in the North Atlantic ocean (Ice. ÍSLAND). Its extreme northerly point is touched by the Arctic circle; it lies between 13° 30′ and 24° 32′ W., and between 63° 24′ and 66° 32′ N., and has an area of 39,768 sq.mi. Its length is 298 mi. and its breadth 194 mi., the shape being a rough oval, broken at the northwest, where a peninsula, diversified by a great number of fjords, projects from the main portion of the island. The total length of the coast line is about 3,730 mi., of which approximately one-third belongs to the northwestern peninsula. Iceland is a plateau or tableland, built up of volcanic rocks of older and younger formation and pierced on all sides by fjords and valleys. Compared with the tableland, the lowlands have a relatively small area, one-fourteenth of the whole; but these lowlands are almost the only inhabited parts of the island Not more than one-fourth of the area of Iceland is inhabited; the rest consists of elevated deserts, lava streams and glaciers. The northwest peninsula is separated from the main mass of the island by the bays Húnaflói and Breiðafjörður, so that there are really two tablelands, a larger and a smaller. The isthmus which connects the two is only $4\frac{1}{4}$ mi. across, but has an altitude of 748 ft. The mean elevation of the northwest peninsula is 2,000 ft. The fjords and glens which cut into it are shut in by precipitous walls of basalt, which plainly shows that they have been formed by erosion through the mass of the plateau. The surface of this tableland is bare and desolate, being covered with gravel and fragments of rock. Here and there are large straggling snow fields, the largest being Glamujokull and Drangajokull, on the culminating points of the plateau. The only inhabited districts are the shores of the fjords, where grass grows capable of supporting sheep; but most of the population gain their livelihood by fishing.

The other and larger tableland, which constitutes the substantial part of Iceland, reaches its culminating point in the southeast, in the gigantic snow field of Vatnajokull, the largest ice mass in Europe. The axis of highest elevation of Iceland stretches from northwest to southeast from the head of Hvammsfjörður to Hornafjörður, and from this water parting the rivers descend on both sides. The crest of the water parting is crowned by a chain of snowcapped mountains, separated by broad patches of lower ground. They are really a chain of minor plateaus, which rise 4,500 to 6,250 ft. above sea level and 2.000 to 3,000 ft. above the tableland itself. Numerous valleys or glens penetrate into the tableland, especially on the north and east, and between them long mountain spurs, sections of the tableland which have resisted the action of erosion, thrust themselves toward the sea. Of these the most considerable is the mass crowned by Mýrdalsjökull, which stretches toward the south. The interior of the tableland consists for the most part of barren, grassless deserts, the surface being covered by gravel. loose fragments of rock, lava, driftsand, volcanic ashes and glacial detritus.

Save the lower parts of the larger glens, there are no lowlands on the north and east. The south coast is flat next the sea; but immediately underneath Vatnajokull there is a strip of gravel and sand, brought down and deposited by the glacial streams. The largest low-lying plain of Iceland, lying between Mýrdalsjökull and Reykjanes, has an area of about 1,550 sq mi. In its lowest parts this plain barely keeps above sea level, but it rises gradually toward the interior, terminating in a ramification of valleys. Its maximum altitude is attained at 381 ft. near Geysir. On the west of Mt Hekla this plain connects by a regular slope directly with the tableland, to the great injury of its inhabited districts, which are thus exposed to the clouds of pumice dust and drift sand that cover large areas of the interior. The plain is drained by three rivers — Markarfljbt. Thjórsá and Ölfusá—all of large volume, and numerous smaller streams. There is another lowland plain around the head of Faxaflbi, nearly 400 sq.mi. in extent. As a rule the surface of this second plain is very marshy. Several dales or glens penetrate the central tableland; the eastern part of this lowland is called Borgarfjörðar, the western part Mýrar.

The great bays on the west of the island (Faxaflbi and Breiðafjorbur), as well as the many bays on the north, which are separated from one another by rocky promontories, appear to owe their origin to subsidences of the surface; whereas the fjords of the northwest peninsula, which make excellent harbours, and those of the east coast seem to be the result chiefly of erosion.



Glaciers and Lakes.—An area of about 5,000 sq.mi., or one-eighth of the total area, is covered with snow fields and glaciers. This extraordinary development of ice and snow is due to the raw, moist climate, the large rainfall and the low summer temperature. The snow line varies greatly in different parts of the island, its range being from 1,300 to 4,250 ft. It is highest on the tableland, on the north side of Vatnajokull, and lowest on the northwest peninsula, to the south of North cape. Without exception the great *névés* of Iceland belong to the interior tableland. They consist of slightly rounded domes or billowy snow fields of vast thickness. In external appearance they bear a closer resemblance to the glaciers of the polar regions than to those of the Alps. The largest snow fields are Vatnajokull (3,385 sq.mi.), Hofsjokull (520 sq.mi.) Langjokull (500 sq.mi.) and Mýrdalsjökull (390 sq.mi.). The glaciers which stream off from these snow fields are often of vast extent, *e.g.*, the largest glacier of Vatnajokull has an area of 150 to 200 sq. mi., but the greater number are small. Altogether, more than 120 glaciers are known in Iceland. It is on the south side of Vatnajokull that they descend lowest; the lower end of Breidamerkurjokull is only about 60 ft. above sea level. The glaciers of the northwest peninsula also descend nearly to sea level. The great number of streams of large volume is due to the moist climate and the abundance of glaciers, and the milky white or yellowish-brown colour of their waters (whence the common name *Hvítá,* white river) is due to the glacial clays. The majority of them change their courses often and vary greatly in volume; frequently they are impetuous torrents: forming numerous waterfalls.

Iceland also possesses a great number of lakes, some of them glacial in origin. The largest are Thingvallavatn and Thórisvatn, each about 27 sq.mi. in area. Mývatn, in the north. is well known for the natural beauty of its surroundings. Above its surface tower a great number of volcanoes and several craters, and its waters are alive with waterfowl, a multitude of ducks of various species breeding on its islands. Mývatn fills a depression between lava streams and has a depth of not more than $8\frac{3}{4}$ ft. The group of lakes called Fiskivotn (or Veiðivötn), which lie in a desolate region to the west of Vatnajokull, consists for the most part of crater lakes. The groups of lakes which lie northwest from Langjokull occupy basins formed between ridges of glacial gravel; and in the valleys numerous lakes are found at the backs of the old moraines.

Earth Movements.—Iceland is one of the most volcanic regions of the earth; volcanic activity has gone on continuously from the formation of the island in the Tertiary period down to the present time. So far as is known, there have in historic times been eruptions from 25 volcanic vents. Altogether 107 volcanoes are known to exist in Iceland, with thcusands of craters, great and small. The lava streams which have flowed from them since the Glacial epoch now cover an area of 4.650 sq.mi. They are grouped in dense masses round the volcanoes from which they have flowed, the bulk of the lava dating from outbreaks which occurred in prehistoric times. The largest volume of lava which has issued at one outflow within historic times is the stream which came from the craters of Laki at Skaptá in 1783. The largest unbroken lava-field in Iceland is Ódáðahraun ("Lava of Evil Deeds"), upon the tableland north from Vatnajokull (2 000 to 4,000 ft. above sea level). It is the accretion of countless eruptions and covers an area of 1,300 sq.mi. (or, including all its ramifications and minor detached streams, 1,700 sq.mi.).

The Icelandic volcanoes may be divided into three classes: (1) cone shaped, like Vesuvius, built up of alternate layers of ashes, scoriae and lava; (2) cupola shaped. with an easy slope and a vast crater opening at the top—these shield-shaped cupolas are composed entirely of layers of lava. and their inclination is seldom steeper than 7°–8°; (3) chains of craters running close alongside a fissure in the ground. For the most part the individual craters are low, generally not exceeding 300 to 500 ft. These crater chains are very common and often very long. The chain of Laki extends 20 mi.. and ernbraces about 100 separate craters. Sometimes, however, the lava streams are vomited

straight out of gigantic fissures in the earth without any crater being formed. Many of the Icelandic volcanoes during their periods of quiescence are covered with snow and ice. Then when an outbreak occurs the snow and ice melt, and in that way they sometimes give rise to serious catastrophes *(jokulhlaup)*, through large areas being suddenly inundated by great floods of water, which bear masses of ice floating on the surfaces. Katla caused very serious destruction in this way by converting several cultivated districts into barren wastes. In the same way in the year 1362 Öræfajökull, the loftiest mountain in Iceland (6,952 ft.), swept 40 farms, together with their inhabitants and livestock, bodily into the ocean. The best-known volcano is Hekla (4,747

BY COURTESY OF "PEPSI-COLA INTERNATIONAL PANORAMA"

THE GREAT GEYSER IN FULL ERUPTION. IT IS LOCATED IN SOUTH-CENTRAL ICELAND NEAR HEKLA

ft.), which was in eruption 23 times within the historic period down to 1947. Katla during the same period was active 14 times down to 1918. The largest volcano is Askja, situated in the middle of the lava field of Ódáðahraun. Its crater has an area of 34 sq.mi. At Mývatn there are several volcanoes, which were particularly active in the years 1724–30. On several occasions there have been volcanic outbreaks under the sea outside the peninsula of Reykjanes, islands appearing and afterward disappearing again. The crater chain of Laki has only been in eruption once in historic times, namely, the violent and disastrous outbreak of 1783.

Iceland, however, possesses no constantly active volcano. There are often long intervals between the successive outbreaks, and many of the volcanoes (and this is especially true of the chains of craters) have only vented themselves in a solitary outburst.

Earthquakes are frequent, especially in the districts which are peculiarly volcanic. Historical evidence shows that they are closely associated with three naturally defined regions: (1) the region between Skjálfandi and Axarfjörður in the north, where violent earth tremblings are extremely common; (2) at Faxaflói, where minor vibrations are frequent; **(3)** the southern lowlands, between Reykjanes and Mýrdalsjökull, have frequently been devastated by violent earthquake shocks, with great loss of property and life, *e.g.*, on Aug. 14–16, 1784, when 92 farmsteads were totally destroyed, and 372 farmsteads and 11 churches were seriously damaged; and again in Aug. and Sept. 1896, when another terrible earthquake destroyed 161 farmsteads and damaged 155 others.

Hot springs are found in every part of Iceland except the region of the eastern fjords, both singly and in groups; they are particularly numerous in the western portion of the southern lowlands, where among others is the famous Geyser (*q.v.*). There are three types of hot springs: (1) fumaroles or steam vents which are all acid; (2) acid springs; (3) alkaline springs. Acid springs occur on dry, high land in volcanic districts after eruptions; their temperature varies and there is not much water. Alkaline springs occur on low land at the foot of hills or at the bottom of lakes and rivers; their temperature is fairly constant and there is a great deal of water. Some hot springs last one day, some hundreds of years; the water at the surface is sometimes two or three degrees above the boiling point. Sulphur springs and boiling mud lakes are also general in the volcanic districts; and in places there are carbonic acid springs, these more especially on the peninsula of Snæfellsnes, north of Faxaflói.

Geology. — Iceland is built up almost entirely of volcanic rocks, none of them older, however, than the middle of the Tertiary period. The earlier flows were probably contemporaneous with those of Greenland, the Faeroes, the western islands of Scotland and the northeast of Ireland. The principal varieties are basalt and palagonitic breccias, the former covering two-thirds of the entire area, the latter the remaining one-third. Compared with these two systems, all other formations have an insignificant development. The palagonitic breccias, which stretch in an irregular belt across the island, are younger than the basalt. In the northwest, north and east the coasts are formed of basalt, and rise in steep, gloomy walls of rock to altitudes of 3,000 ft. and more above sea level. Deposits of clay, with remains of plants of the Tertiary period, lignite and tree trunks pressed flat, which the Icelanders call *surtarbrandur*, occur in places in the heart of the basalt formation. These fossiliferous strata are developed in greatest thickness in the northwest peninsula. Indeed, in some few places well-marked impressions of leaves and fruit have been discovered, proving that in Tertiary times Iceland possessed extensive forests, and its annual mean temperature must have been at least 48° F., whereas the present mean is 35.6°. The palagonitic breccias, which attain their greatest development in the south of the island and on the tableland, consist of reddish, brown or yellowish rocks, tuffs and breccias, belonging to several different groups or divisions, the youngest of which seems to be of a date subsequent to the Glacial epoch.

All over Iceland, in both the basalt and breccia formations, there occur small intrusive beds and dikes of liparite, and as this rock is of a lighter colour than the basalt, it is visible from a distance. In the southeast of the island, in the parish of Lón, there exist a few mountains of gabbro, a rock which does not occur in any other part of Iceland. Near Húsavik in the north there have been found marine deposits containing a number of marine shells; they belong to the Red Crag division of the Pliocene. In the middle of Iceland, where the geological foundation is tuff and breccias, large areas are buried under ancient outflows of lava, which bear evidences of glacial scratching. These lava streams, which are of a doleritic character, flowed before the Glacial age, or during its continuance, out of lava cones with gigantic crater openings, such as may be seen at the present day. During the Glacial epoch the whole of Iceland was covered by a vast sheet of inland ice, except for a few small isolated peaks rising along its outer margins. This ice-cap had on the tableland a thickness of 2,300 to 2,600 ft. Rocks scored by glacial ice and showing plain indications of striation, together with thousands of erratic blocks, are found scattered all over Iceland. Signs of elevation subsequent to the Glacial epoch are common all round the island, especially on the northwest peninsula. There are found strikingly developed marine terraces of gravel, shore lines and surf beaches marked on the solid rock. In several places there are

traces of shells; and sometimes skeletal remains of whales and walruses, as well as ancient driftwood, have been discovered at distances from the present coast. The ancient shore lines occur at two different altitudes. Along the higher. 230 to 260 ft. above the existing sea level, shells have been found which are characteristic of high arctic latitudes and no longer exist in Iceland; whereas on the lower shore line, 100 to 130 ft., the shells belong to species which occur amongst the coast fauna of the present day. A feature of special interest to geologists in the present conditions of the island is the great power of the wind both as a transporting and denuding agent. The rock sculpture is often very similar to that of a tropical desert.

See T. Thoroddsen, "Explorations in Iceland during the years 1881–1898," *Geographical Journal,* vol. xiii, pp. 251–274, 480–513, with map (London, 1899).

Climate. — Iceland has an oceanic climate of moderate heat and cold. The differences in temperature between the coast and the interior are not very marked. At Reykjavik the annual mean air temperature is +3.9° C. (39.0° F.), the mean temperature in January, the coldest month of the year, is −1.2° C. (29.8" F.), while in July, the warmest month, it is +10.9° C. (51.6° F.). The weather is very unsettled. Sudden changes occur from day to day, and the same season may from year to year show great fluctuations. There is rarely the same kind of weather all over the country at the same time. The relative humidity is high, averaging 80%. The wettest regions are in the south and southeast (2,175 mm. [8j.63 in.] of rain in one year at Vik); the north is the driest region (300–550 mm. [11.81 in. to 21.65 in.]) and in the mountains annual precipitation is about 2,000 mm. (about 78.7 in.). The heaviest snowfalls in the winter are in the northwest and northeast. Pressure is always low, especially in winter, but variations are great.

Iceland is situated at the outer edge of the North Atlantic drift, which warms the southern and western coasts. The rate of the clockwise movement of the coastal water is about eight nautical miles per day. Cold currents from the polar basin occasionally touch the northern and, especially, the eastern coasts. The drift ice is very irregular in its appearance; in some years there is none. When it comes, usually in April and May, it arrives on the northwest coast and drifts east. It brings cold, storms and fog. The frequent fogs on the southern coast usually occur with a seawind, those on the southeastern coast with all winds, but chiefly westerly ones. Cyclonic storms make the winds quite variable. In the fjords sudden squalls often arise. Thunder storms are rare.

Flora and Fauna. — About 375 phanerogams and vascular cryptogams, partly arctic in character and partly European, have been identified in Iceland. Most of them are sedges, grasses, composites (including some shrubs), crucifers, rushes and ferns. Other plants include about 350 species of mosses, 250 lichens and 550 fungi. The unstable climate, earthquakes, volcanoes, winds, moving glaciers, etc., all contribute to prevent the vegetation from reaching its highest development. The once large forests have been destroyed so that only about 0.44% of the total area is wooded. The trees are mainly dwarf willows, birches and mountain ash, though re-afforestation is taking place with Norwegian pine and Alaska spruce. There is a thick carpet of moss in areas not snow-covered in winter; grasses and dwarf willows dominate the regions which have a normal winter snow-cover and arctic species are found among them; cotton grass grows with rushes and sedges by the lake sides; above about 2,000 ft., where the soil is porous. lyme grass (*Elymus* arenarius) and seapinks (*Armeria* meritima) are found; and round the hot springs a dense flora often occurs, consisting of dwarf willows, grasses, eyebright, heath, etc.

Of the 30 species of mammals in Iceland, 8 are resident, 14 migratory and 8 vagrant. There are few land mammals, the arctic fox probably being the only indigenous one. The field mouse and brown rat are common everywhere (the rat was probably introduced in the mid-19th century), while the house mouse frequents all inhabited places. The polar bear is sometimes seen in the north and east but has never been known to breed in Iceland. The common seal is found round all the coasts and other seals are often seen. The white-nosed dolphin, porpoise and other whales occur in numbers in the coastal waters. Reindeer have been introduced at various times and are still to be found. Among the many birds resident in or visiting Iceland are the snow bunting, Iceland falcon (decreasing in numbers), whooper swan, red-necked phalarope (often seen near the hot springs), rock ptarmigan, divers, many kinds of duck, whimbrel, grebes, cormorants and many other sea birds. The redwing, wheatear and meadow pipit are among the summer visitors. The turnstone visits Iceland on spring and autumn migration. The hot springs have a special fauna including insects, molluscs, crustacea and a few fish. Many of the rivers abound in salmon, and trout are plentiful in the lakes and streams. There are no reptiles or amphibians. (E. Bz)

History. — Seafarers had some idea of the existence and position of Iceland as early as the 4th century A.D., but no settlement is known to have been there before the 9th century, when Irish hermits set up their dwellings in a few places. Little is known of these people and old Icelandic authorities say that they went away when pagan settlers began to arrive.

Ingolfur Arnarson, a chieftain from west Norway, began the settlement of Iceland when he moved there with his family and dependents in A.D. 874. He established himself on the site of what is now the capital, Reykjavik. For 15 years the flow of new settlers went on slowly and increased in volume toward the end of the century, probably because Harald Fairhair became king of Norway after the battle of Hafursfjörður, *c.* 885, and extended his rule over the Shetland and Orkney Islands about 890. The settlement of Iceland, followed by the discovery of Greenland and Wineland (North America) from there may be said to be consequent on the upheaval of the viking age. The earliest settlers, who were doubtless of mixed descent, came from the countries and districts where the vikings had been dominant for centuries, from the west coast of Norway, from Ireland, Scotland, Orkney, Shetland and the Hebrides.

Some of the first settlers, such as Ingólfur Arnarson, Skallagrímur Kveldúlfsson the father of Egill Skallagrimsson. Auður, the widow of Ólafur the White, king of Ireland, and her kinsman Helgi the Lean, appropriated large areas of land which they distributed later to their friends, followers and protégés. Later settlers secured smaller areas. Until the end of the 10th century the country kept the characteristics of recent settlement. the landholdings were large with few and widely scattered buildings; each homestead contained a large number of people and was practically a self-supporting, economic whole.

In the beginning, the people lived mostly by fishing, but sheep farming soon became the second most important industry. By about 1100 economic conditions were satisfactory. The population at about the time when the tithe laws were passed (1097) was between 70,000 and 80,000, a total which was not exceeded until about 1900.

Before a general system of legislation and organized government could be achieved a kind of local government was evolved by which the people of each district uho had most dealings together formed into groups under the leadership of the most important or influential man of the district; he acted as judge and mediator in the disputes of his neighbours and took the lead in communal activities such as the building of places of worship and the performing of religious rites. These leaders were called *goðar* (sing *goði*) and it is thought that the word derives from this religious function, but in the age of settlement in Iceland the word *goði* primarily means "Chief", although it occurs in its older meaning in Danish and Swedish runic inscriptions. Local assemblies such as *kjalarnesthing* and thorsnesthzng are heard of before the establishment of the *althing* (general assembly) and they show the way in which the local chiefs tried to organize law and order for their own districts, which in turn led to the co-operation of all the chiefs in founding a national parliament (*althing*) and the adoption of a general system of law for the whole country. In 930 the Icelandic commonwealth was established and the first session of the *althing* was held, probably on the site of the *kjalarnesthing,* near Reykjavik, but it was soon moved to Thingvellir by the Öxará

river. The oldest code of laws, called Ulfljóts laws from the name of the man who compiled them, may have been founded partly on the laws then in force in the Gulathing district of Norway.

The old Icelandic commonwealth was based on the first foundations of government laid in the age of settlement. Its main instrument was the *goðorð* (chieftancy). The godar became the rulers of the country and together with their advisers constituted the logrktta (legislature) of the new althing. The godar administered justice in their own districts and matters not settled there were referred to the althing. In this way they held both the legislative and the judicial power. There was no national executive power, but to the godar fell the duty of seeing that such men as accepted their leadership received their rights, and to this extent they held the executive power.

The extent of the *goðorð* was not fixed by territorial boundaries. Those who were dissatisfied with their chief could attach themselves to another *goði*. His power was therefore in direct proportion to his personal prowess and ability. As a result rivalry arose between the godar, as may clearly be seen from the Icelandic sagas. The position of *goði* could be bought and sold, as well as inherited; consequently, with the passing of time the *goðorð* for large areas of the country became concentrated in the hands of one man or a few men, This was the principal weakness of the old form of government: it led to a struggle for power and was the chief reason for the ending of the commonwealth and for the country's submission to the king of Norway (1262–64).

The old form of government became modified in the course of time. (The laws of the commonwealth that remain [the Grágás code] show organizing ability, far-sightedness and accuracy, and skill in resolving procedural and legal difficulties.) Modifications were, for instance, the division of the country into quarters and the setting up of courts of justice for each quarter after the middle of the 10th century, and the establishment of the fifth court, *i.e.*, a court of appeal, about A.D. 1000.

Towards the end of the 10th century Christian missions came to Iceland. In 1000, after great disputes which nearly led to civil war, the althing enacted a law that all inhabitants of the country should be Christian, primarily for political reasons in order to preserve the commonwealth. The old pagan gods were sacrificed to expediency but the power of the *goði* remained as before. The place of the temples of the gods was taken by the old Icelandic church, the church of the *goði*. Until the end of the 12th century it was a common practice for the lay chieftains to have a clerkly education and to receive ordination and the bishops of the country until the end of the 12th century were men of this kind. In 1056 the first Icelandic bishop Ísleifur Gissurarson of Skálaholt was ordained at Bremen; until then Iceland had only known missionary bishops. After 1106 the country possessed two bishoprics, at Skblaholt and at Hólar. In 1096, the tithe laws had been passed, thus ensuring the church's financial security. Yet even after this many churches in the country were privately owned by farmers or chiefs, and disputes arose when the clerics began to try to undermine the secular power after the end of the 12th century. These disputes were not settled until after the fall of the commonwealth, when the church emerged the victor in the struggle.

The traditional culture was fostered in the centres of learning of the old church, at Haukadalur, Oddi, Skblaholt, Hólar, and in the monasteries. Slavery was abolished before 1100. Despite the distinction conferred by power and wealth, men were honoured for their personal qualities. Sports and trials of skill and strength were popular, and from the early days of the commonwealth it was customary for all, even the chiefs themselves, to take part in the labours of husbandry. The people's daily lives were shaped by their occupations of agriculture, fishing, spinning and weaving and boat-building. There was great social activity, especially at Midsummer, in the autumn and at Christmas, when there were feasts and drinking sessions.

Lack of progress in economic life after about 1200 was chiefly due to the fact that the main industry, sheep farming, had reached its peak with the methods then followed. The climate's growing more severe also had some effect, as did the internecine quarrels, which became frequent after 1200. Trade grew more difficult for in the latter part of the commonwealth period it fell more and more into the hands of Norwegian merchants and Icelandic shipping disappeared gradually, largely because of lack of ship-building timber in the country.

In 1262-64 a treaty was made (Gamli sdttmali), bringing the country under the rule of the Norwegian king. It caused great changes. New church laws and the victory of the church in the quarrels over disposal of church property gave the church full independence and made it a state within the state. The old Icelandic chieftains yielded place to the king's officials, the governor and district magistrates. A new code of laws (*Jónsbók*, 1281) replaced the commonwealth code. The climate grew more severe and volcanic activity did more damage than ever before. Epidemic diseases took their toll. Factional brawls and fighting died down but public life lost vigour. Literature, which reached its peak in the saga writing of the 13th century, declined. Agriculture became poorer, though the fishing industry made progress. Trade was weak and there were few imports. About 1400 the arrival of English and German traders and fishermen greatly helped Iceland's trade. The fisheries flourished and fish (stockfish and fish liver oil) became the chief export, in place of skin, hides, wool and woollen goods. In 1402–4 a large proportion of the population perished in the Black Death. Wealth became concentrated in the hands of few rich men, in the monasteries and in the church, while independent farmers declined in number and the poor increased.

From 1380 Iceland and Norway were governed by Denmark. Iceland's government after 1264 had been very uneven. Foreigners were appointed as bishops and sometimes even as governors, and the country was oppressed by the heavy taxes and dues levied upon it. From 1539 to 1551 there was a struggle between the Catholic and Lutheran churches in which Lutheranism, whose cause was assisted by the Danish kings, was victorious. The king and church between them came to own half the land in the country, a state of affairs that lasted until the 19th century. The king also attacked the trade with English and German merchants so from 1602 Iceland's trade was monopolized by Danish merchants, a monopoly that was not lifted until 1787 (in part) and entirely in 1854. This monopoly paralyzed the country's economic life and conditions worsened so quickly that the census of 1703 showed only about 50,000 inhabitants, of whom one-fifth were not self-supporting. Between 1750 and 1760 Skúli Magnhsson (1711–94), with government assistance, tried to revive some forms of industry but the trade monopoly made his efforts' unsuccessful and the same fate befell proposals to improve agriculture and communications which were put forward c. 1770 by Jón Eiriksson (1728–87). In 1783–84 the country suffered severely from volcanic eruptions and earthquakes which caused great famine and the loss of sheep and cattle. When the monopoly was relaxed in 1787 conditions began to improve, especially after the end of the Napoleonic wars.

In the summer of 1809 an English merchant Phelps and his confederate Jorgen Jorgensen imprisoned the governor and proclaimed Iceland free under the protection of Great Britain. This revolt was soon crushed by the intervention of Great Britain at the instance of Magnus Stephensen.

Icelandic politics entered on a new era in 1831. The king of Denmark's move to establish a legislative parliament in his realm led to a movement for the revival of the althing, which had ceased to meet in 1800. This movement had become powerful by 1840 when a new Icelandic leader, Jón Sigurðsson (1811–79), appeared. For nearly 40 years he led his country in the struggle for greater political freedom and economic progress. The *althing* was restored in 1843 and met in Reykjavik in 1845 but it was not until 1874, the millenary of the first settlement, that Iceland was given limited self-government in home affairs.

The latter half of the 19th century was a hard time for Iceland; unusually severe weather conditions and political disappointments caused many people to emigrate to Canada and the United States. The first co-operative societies were founded after 1880 and trade turned more and more to Great Britain. The first bank was

opened in 1886, and fisheries and inland trade expanded. Home rule was granted in 1903. The new government first concerned itself with increasing industry, improving communications by sea and land and acquiring new capital for building and shipping enterprises. A marine cable was laid to Europe in 1906. Harbours and roads were improved. The Iceland Steam Shipping company was founded in 1914. A general education act was passed in 1907 and the University of Iceland was founded in 1911 on the centenary of Jón Sigurðsson's birth.

World War I delayed progress. In 1923 new agricultural laws were passed which, with the aid of modern equipment, revitalized Icelandic agriculture. After 1920 factories were erected for fish and fish products. Communications were further improved, by means of motor roads connecting most of the inhabited parts and regular coastal shipping services. After World War II communications by air both inland and overseas expanded considerably.

In 1918 the long-lasting dispute between Iceland and Denmark was settled by a treaty recognizing Iceland as an independent state under the king of Denmark. This treaty was made for 25 years and was terminable by either party. In 1937 the althing proclaimed that the treaty would not be renewed on its expiry. After the German invasion of Denmark in World War II, the British occupied Iceland in order to prevent a German occupation, and normal communication between Iceland and Denmark ceased. The executive power was of necessity taken over by the Icelandic ministry after April 9. 1940, with Sveinn Bjornsson as regent. In 1941 the althing proclaimed that it considered the treaty to be virtually terminated, as the Danes were not in a position to carry out its terms, and announced that a republic would be founded in Iceland as soon as the treaty was formally annulled. But the war continued and it was considered inadvisable to delay the matter any longer. On May 17, 1942, the althing passed two resolutions: (1) that Iceland did not intend to continue the union when it expired on Jan. 1, 1944; and (2) that Iceland intended to become a republic. On Feb. 2j, 1944, the althing proclaimed the treaty terminated and decided to hold a plebiscite with regard both to this action and to the constitution of the new republic. Of the votes cast, 97.35% supported the decision of the althing. On June 16, 1944, the althing declared the union with Denmark to be at an end and on June 17, the republic was founded at Thingvellir with Bjornsson as its first president.

From 1944 to 1950 two coalition governments were in power, each composed of three political parties. After 1950 two parties, the Progressive party and the Independence party, twice joined in forming a coalition government.

In 1948 Iceland became a member, with Denmark, Norway and Sweden, of a joint northern committee for economic co-operation, and in 1949 it accepted an invitation to join the North Atlantic Treaty organization and took part in the first meeting of the Council of Europe. Two hydroelectric power stations, begun in 1951 with the aid of European Recovery prograrn funds, were completed in 1953. In Jan. 1952 Bjornsson died, and in the presidential elections, held the following June, Asgeir Asgeirsson was elected for a four-year term of office. (T. J.)

Foreign Relations. — On May 1j, 1952, Iceland moved the limits of its fisheries outward to a perimeter four miles from lines drawn between its longest promontories and between islets and rocks offshore, enclosing many productive grounds (particularly Faxaflói and Breiðafjör ður) previously open. In retaliation British trawler owners at Hull and Grimsby refused facilities to Icelandic vessels.

The U.K. government proposed to submit the dispute to the International Court of Justice, but Iceland demanded that the retaliatory measures be lifted first. The British foreign office declared that these measures had been originated by private industries over which the British government had no control. In 1954 the Icelandic government submitted to the Council of Europe a memorandum on this dispute to which the British government replied in May 1jj asking for a compromise.

The refusal of landing facilities to Icelandic fishing vessels in English ports caused Iceland to search for new markets for its fish and fish products. The Soviet government used this opportunity to conclude on Aug. 1, 1953, a trade agreement of $12,000,000 each way, under which the U.S.S.R. was to take fisheries products in exchange for petroleum products, cement and cereals, it being stipulated that Iceland should take no other foreign petroleum products. This agreement was renewed in Sept. 1jj until the end of 1956.

Iceland, although an original member of NATO, has no armed forces. According to the U.S.-Icelandic treaty of May j, 1951. its defense is assured by the U.S. which is entitled to use the air base of Keflavik (35 mi. S.W. of Reykjavik). In Sept. 1953 the opposition Labour party introduced a resolution in the althing calling for a revision of this treaty. On May 25, 1954, the treaty was revised. The planning of defense works was slowed down; the U.S. forces agreed to employ Icelandic labour principally; U.S. military personnel were confined mainly to the air base of Keflavik and to the navy base at Hvalfjörður (30 mi. N.E. of Reykjavik). **(X.)**

Population and Towns. — The Icelanders are primarily of the Nordic race, with some early blending of Irish blood. The population, 144,263 in 1950 (*cf.* 121,579 in 1940), averages about three per square mile, almost four-fifths of the country being uninhabitable. Reykjavik, the capital and only large town, had a population of 56,096 in 1950. Akureyri had 7,143; Hafnarfjör-Bur 5,065; Vestmannaeyjar 3,699; Siglufjörður 3,052; and Ísafjörður 2,826.

During the last quarter of the 19th century there was a considerable emigration to America, chiefly to Canada.

Religion. — The Evangelic Lutheran Church is the established church of Iceland. From the late 19th century, however, there has been full religious liberty, Sectarian bodies are few and inconsiderable in number, only the Roman Catholics and the Adventists having formed their own congregations. Iceland forms one bishopric with its see in Reykjavik.

Education. — There is compulsory elementary education between the ages 7 and 14 years, and practically everybody is able to read and write. In various parts of the country there are junior schools for children 13 to 1j years of age which provide courses of study and further instruction in the subjects taught in the elementary schools. There are also two state-owned coeducational high schools (*menntaskólar*), one in Reykjavik and one in Akureyri. The final examination or *stúdentspróf* (examen artium) entitles those who pass it to matriculation at the university. The country also possesses a number of special (technical) schools, most of which provide general as well as technical instruction.

The University of Iceland (Háskóli Islands) at Reykjavik was founded in 1911 and has five faculties; viz., theology, medicine and dental surgery, law and commerce, philosophy (dealing with the humanities — philosophy, Icelandic studies, languages, etc.) and engineering. Various research and experimental stations work in co-operation with the university. The university library is the second largest in the country, after the national library (Landsbókasafn fslands) founded in 1818. In 1951 the latter contained 185,400 volumes of printed books and more than 10,000 manuscripts.

Constitution. — After 1942 the althing was composed of not more than 52 members, 33 chosen from one- or two-member constituencies, 8 from the capital, and up to 11 supplementary members assigned to parties which had not gained seats in proportion to voting strength. The althing meets every year in Reykjavik and is usually divided into two houses, *efri* deild (upper house) and *neðri* deild (lower house), but on certain occasions both houses work together. Both houses have equal constitutional power.

The seat of the government is Reykjavik. The country is divided into 16 districts (*sýslur*), each of which is administered by a district magistrate (*sýslumaður*), and 8 towns, administered by town magistrates. As to justice, the ordinary judicial court has two instances. The first instance is the lower court, presided over by the magistrates. The second instance is the supreme court (*Hæstiréttur*) in Reykjavik, consisting of five judges. Juries are never employed in the trial of criminal cases.

Health. — In 1949 the birth rate was 27.8 per 1,000 and the death rate 7.9 per 1,000, the latter showing a marked improvement

on the previous figures. The surgeon general, residing in Reykjavik, has the general care of all matters of public health. The country is divided into 52 medical districts with as many government-paid doctors.

There were about 50 hospitals in Iceland in the 1950s, some extremely small; the largest, the national hospital, was in Reykjavik. There were two sanatoriums for tuberculosis patients and, in the neighbourhood of Reykjavik, a model rehabilitation centre for tuberculosis patients. In the same area there were also a mental institution and a leper hospital.

In 1936 a general national insurance scheme was instituted. This was later revised to include insurance against sickness, accident and unemployment, and pensions for the aged and disabled.

Industries. — Though farming is still the chief occupation of the population, it was formerly so in a much higher degree. In 1880 73.2% were engaged in farming compared with 30.0% in 1950. The farmhouses stand apart and isolated, each within the borders of the land belonging to it. They are never found in clusters or villages, but not infrequently two or three or (rarely) even more farmhouses are built together.

The farmers are largely occupied with cattle breeding, and more particularly sheep breeding. All farming in Iceland is based on the cultivation of grass. The hay from the manured homefield *(tun)* is almost exclusively used for cattle (cows) fodder, while horses and sheep are fed with the hay from the meadows (engi). Considerable quantities of potatoes and Swedish turnips are grown in the country. Government expenditure on agriculture increased greatly after 1900.

The decline in numbers of agricultural workers was a reflection of the concomitant development of Iceland's fisheries, which by 1950 were employing one-fifth of the population. The fishing fleet, expanded by the progressive introduction of trawlers and motor ships after 1920, comprised 614 vessels (56,856 gross registered tons) in 1952.

Cod and herring are the most important of all the kinds of fish caught in the Icelandic waters; and foreign trawlers are usually to be seen off Iceland, particularly off the northwest. Icelandic fishing vessels have sometimes visited the fishing grounds off Greenland and Bear Island and in the White sea. On the south and southwest coasts the chief cod fishing is carried on from January to May, but the season varies from one part of the country to another. Most of the catches made in the smaller boats go to quick-freeezing plants. The centre of the cod-fishing industry is Reykjavik, but it is carried on to a greater or less degree in practically all the towns and villages around the coast.

The herring fisheries are chiefly off the north coast, and their big season lasts from July to September, when the waters are crowded with ships from, among others, Norway, Sweden, Finland and the U.S.S.R. The centre of the herring fishing is Siglufjörður, where huge processing plants (a large number of them owned by the state) are situated. Similar factories are to be found in various other places in the north and east, the most important being at Raufarhofn on the northeastern coast. In autumn and winter considerable catches of herring are sometimes made off the southwest coast. The herring are sometimes salted, but otherwise they are processed to produce herring oil and herring meal. Some of the fish is frozen in order to be used for bait. Great Britain normally takes most of the'oil, continental Europe most of the salted herring, Israel and the U.S. most of the fish meal.

Foreign Trade. — Compared with the number of people the total foreign trade of Iceland is larger than that of most other countries. Having a limited range of products, Iceland must depend on foreign countries for a number of necessities. (*See* Table I.)

TABLE *I.*—*Foreign Trade*
(In 000,000 kr.)

Item	1938	1948	1950	1952	1954	1955
Imports	50.5	458.0	543.3	909.8	1,130.4	1,264.3
Exports	56.6	395.7	421.9	641.3	845.9	847.9

The most important articles imported are machinery, ships, oil and gasoline, grains and flour, timber, paper, metals, coal, automobiles, cement, salt, sugar and coffee. The chief articles exported are quick-frozen fish, fish on ice, cured saltfish, salted herrings, cod-liver oil, herring oil, whale oil, fish meal, herring meal, canned fish, guts, salted fish, roes and salted sheepskins. Main sources of imports in 1955 were: United States 23%, U.S.S.R. 14%, U.K. 11%, German Federal Republic 10%. Main destinations of exports in 1955 were: U.S.S.R. 18%, U.S. 12%, Italy 8%, Finland 7%.

Finance and Banking. — During the years 1946–52 Icelandic budgets were constantly in deficit, but that of 1953 had a small surplus. (*See* Table II.)

TABLE II.—*Budgets*
(In 000,000 kr)

Item	1/39	1948	1/50	1951	1952	1953
Revenue.	20.3	273.2	322.9	447.0	452.8	510.0
Expenditure	20.6	334.2	371.8	534.6	516.6	507.5

Iceland is in the Scandinavian monetary union. The unit is called króna (pl. krónur) and is divided into 100 aurar (sing. eyrir). The relation between króna and British and U.S. monetary units was at gold par exchange £1 = 18.16 kr.; $1 = 3.73 kr. The Icelandic króna followed the fluctuation of the Danish krone to 1920, but from the latter half of that year it was quoted independently. In 1955 the official rates of exchange were £1 = 45.70 kr. and $1 = 16.32 kr. Note circulation between the end of 1946 and the end of 1955 increased from 172,000,000 kr. to 305,000,000 kr. Gold and foreign exchange holdings were $9,500,000 in Dec. 1946, $3,100,000 in Dec. 1949 and $6,000,000 in Nov. 1955. The international metric system of weights and measures was introduced in Iceland by law in 1907.

Communications. — Formerly all land journeys were made on horseback and all transport in the interior on pack horses. In the last years of the 19th century the first carriageable roads were made, and thereafter road making progressed rapidly. Many bridges were constructed. After motorcars were introduced in 1913 their number increased rapidly, so that by Dec. 1954 there were 7,195 cars, 4,685 trucks, 315 buses and 312 motorcycles.

Regular automobile services are kept up between the capital and various places around the country. During summer motorcars are also regularly run between the northern and southern districts. Highways (1950) totalled 3,100 mi.

There are regular air services from Reykjavik to many places in the country. Numerous airfields were constructed but some of the aircraft used on the regular lines are flying boats. Postal communication, both inland and abroad, presents no difficulties, although the inland postal service is sometimes held up in winter by snow or bad weather. Great use is made of aircraft in maintaining the postal services. Coastal steamers go around the coasts, touching practically every port. In order to facilitate communications by sea, about 100 lighthouses were built. In 1906 a submarine cable was laid from the Shetland Islands to Seydisfjörður on the east coast. Telegraph and telephone stations were built all over the country. From 1917 Reykjavik had a wireless telegraph station, and in 1929 a regular broadcasting service was established.

(E. Bz.)

BIBLIOGRAPHY.—T. Thoroddsen, *Geschichte der islandischen Geographie,* i–ii (Leipzig, 1897–98), *Lýsing Islands,* i–iv (Copenhagen, 1908–22) (by far the most comprehensive description of the nature of Iceland), "Island Grundriss der Geographie und Geologie," *Petermanns Mitteilungen,* 152–153 (Gotha, 1906); H. Pjeturss, "Island," *Handbuch der regionalen Geologie,* iv, 1 (Heidelberg, 1910); P. Herrmann, *Island in der Vergangenheit und Gegenwart,* vol. 1–3 (Leipzig, Torgau, 1908–13), *Island, das Land und das Volk* (Leipzig, 1914); Valtýr Gundmundsson, *Island am Beginn des 20. Jahrhunderts* (Kattowitz, 1904); Olive Murray Chapman, *Across Iceland* (London, 1930); Hjalmar Lindroth, *Island, motsatsernas ö* (Stockholm, 1930); E. Fors Bergstrom, *Island i stopsleven* (Stockholm, 1930); Daniel Bruun, *Turistruter paa Island,* i–iv, 2nd ed. (Copenhagen, 1921–25); Stefán Stefansson, *Iceland, a Handbook,* 2nd ed. (Reykjavik, 1930); T. Thorsteinsson, *Iceland 1946, a Handbook,* 4th ed. (Reykjavik, 1946); H. Sorensen, "Iceland: A Brief Economic Survey," U.S. Bureau of Foreign and Domestic Commerce, *Trade Information Bulletin 541* (Washington, 1928); Einar Arnórsson, *Den folkeretlige Forbindelse mellem Danmark og Island* (Copenhagen, 1930); K. Gjerset, *A History of Iceland* (London, 1924); *Hagskjrslur Islands* (*Statistique de l'Islande*), no. 1 *et seq.* (Reykjavik, 1914–); *Diplomatarium Islandicum,* i–xv (Copenhagen, Reykjavik, 1853–1951); *Acta*

Comitiorum generalium Islandiae, i–vii (Reykjavik, 1912–50); Þorkell Jóhannesson, *Die Stellung* der freien *Arbeiter* in Island (Reykjavik, Copenhagen, 1933); Páll Eggert Ólason, *Menn og Nenntir siðskiptaaldarinnar á Islandi,* 4 vol. (Reykjavik, 1919–26); *Jón Sigurðsson,* 5 vol. (Reykjavik, 1929–33); Saga *Íslendinga,* iv–vii (Reykjavik, 1942–50); A. Friðriksson and S. L. P. Tuxen (eds.), The Zoology of Iceland (Copenhagen, Reykjavik, 1937–); L. Kolderup-Rosenvinge and J. E. B. Warming (eds.), *The* Botany of *Iceland,* 3 vol. (Copenhagen. London, 1912–32). (X.)

ICELANDIC LANGUAGE. The Icelandic settlers came of Norwegian stock and in the early period their language must have been practically identical with that of western Norway. The oldest linguistic forms are found in 10th and 11th-century poetry, preserved in 13th-century records. Greenland was settled from Iceland, *c.* A.D. 900, but it is not known how the language there developed.

The Latin alphabet was adapted for Icelandic use by 1100. In the earliest manuscripts (c. 1150–1200), Old Icelandic can already be distinguished from Old Norwegian: among its significant features are retention of initial h before l, *n,* r, and regular operation of the so-called "younger" u-mutation (*e.g., land,* dat. pl. *lǫndum,* Norw. *landum*). By about 1300, e, o in endings became i, *u* respectively; *ǫ* fell together with *ø* (modern *ö*), *ǫ́* with *á, æ* with *æ;* short back vowels mere lengthened before 1 plus a labial or guttural (mod. Icelandic *hálfur,* Norwegian kalv). There were sporadic signs of changes fully effected later.

Important phonological changes in the transition period, c. 1300–1550, were: *é* became [jɛ], *vá* became *vó* (now usually vo); between final *r* and a preceding consonant (other than r) *u* was introduced (*maðr,* now *maður*); final k, *t* in weakly stressed syllables became g, *ð* (*mjǫk; mjög;* at: ab); there were certain consonantal assimilations and shortenings. Old distinctions of quantity were largely kept until the 16th century, but then gave way to accentual values. Analogical simplifications occurred in accidence, but too few to disrupt the inflectional system.

In the period 1100–1700, some earlier developments were completed and most sounds attained their present-day pronunciation: *á* to [au], *í* to [i:], *ó* to [ou], *æ* to [ai], *au* to [øy]; y, *ý,* ey fell together with i, *í,* ei; *ll* generally became [dl] in almost all positions, *nn* [dn] after long vowels and diphthongs; *fl,* fn became [bl, bn]. Amongst analogical changes in accidence were the transformation of masc. u-stems to *i*-stems (*fjörður,* acc. pl. *firði,* older *fjörðu*); the replacement of plural subjunctive endings, *-im, -ið,* -i, by indicative endings, *-um* (present and past), *-uð, -u* (past); tne use of *-i* (older *-a*) in the first person singular ending, past indicative weak verbs and present subjunctive all verbs. The dual pronouns, vid, *þið,* replaced *vér, þér* (we, you) in ordinary speech.

Dialects.—Dialectal differences are slight. The chief areas are the Southern (covering about three-quarters of the country) and Northern. Important differences are in the pronunciation of intervocalic *p,* t, k (half-voiced, Southern; voiceless, Northern); of *l,* m, n before *p, t,* k (unvoiced and following consonant unaspirated, Southern; voiced and following consonant aspirated, Northern: *stúlka,* [stu:lka, stu:lkʰa]); and of *hv-* ([χw], Southern; [kv], Northern). There is some dialectal variation in fanning and fishing terms.

Vocabulary.—Loan-words from Celtic and Latin (introduced especially after the Conversion) appear in the early language. In the 13th century, some Romance and German words were borrowed (*e.g., kurteiss, dans, læra*), but there was a strong tendency to translate new terms by native equivalents or compounds. A considerable number of Danish and German words were introduced in the period 1300–1550, although comparatively few remain in use. In the next two centuries, Icelandic was much influenced by Danish. A purist movement, which began towards 1800, has since become all-powerful. Internationally current technical and abstract terms have not generally been adopted, being rendered by direct translation (*framleiða:* producere), by the resuscitation of obsolete words in a special modern sense (*sími* "cord", used in (*tal*)*sími* "telephone"), and by the creation of new words (berkill "tu*berculo*sis"), generally with happy results.

Icelandic and Norwegian underwent dissimilar phonological developments, and Icelandic, unlike Norwegian, has remained extremely conservative in accidence, vocabulary and orthography; the two languages are no longer mutually intelligible. Icelandic is spoken in Iceland (with about 144,000 inhabitants) and by some 20,000 emigrants in North America.

See A. Noreen, Altislandische und *Altnorwegische* Grammatik (Halle, 1923); Halldór Hermannsson, Modern Icelandic (1919); Stefan Einarsson, Icelandic (1945). (P. G. F.)

ICELANDIC LITERATURE. Ever since the 10th century the Icelanders have been famous for their literature, first of all for poetry and later for prose. During many centuries their literature has been as rich and varied as that of any nation in Europe.

Iceland was not peopled by Scandinavians until late in the 9th century, but some of the poetry found in the Icelandic manuscripts must have been composed before that date, whether in Scandinavia, in the Scandinavian settlements of the British Isles, or even further afield.

Practically no early poetry written in a Scandinavian language is found in manuscripts other than the Icelandic, and the study of Icelandic poetry is thus the study of Scandinavian poetry.

Much of the oldest poetry is found in a manuscript called the Poetic Edda (see EDDA). This was written in Iceland during the second half of the 13th century, but was copied from older originals, probably written early in that century. Poetry of the kind found in this manuscript is sometimes called "Eddaic" in order to distinguish it from the "scaldic" poetry, which will be discussed below. The Poetic Edda consists of 45 leaves in quarto, and the poems in it fall naturally into two sections, which represent two distinct classes. The first half of the book consists of lays about pagan gods, and the second of lays about legendary heroes of the Germanic peoples.

Heroic Lays.—Many of the legends upon which the heroic lays are based originated in continental Germany, and even among the Goths of southeastern Europe. Heroes who figure in these lays appear also in the poetry of the Anglo-Saxons, in the *Nibelungen*lied and other mediaeval poetry of Germany. The heroic lays of the Edda are composed in various styles and belong to various ages. Perhaps the oldest is the Hambismdl (Words of Hamdir), which is the last in the book. It is preserved in a poor state and it is plain that it was not clearly remembered by the scribe who first wrote it down. In the *Hamðismál* a story is told of the historical Jormunrekk (Ermanaric), emperor of the Goths in eastern Europe (d. 375). Jormunrekk had married Svanhild, said to be the dadghter of Sigurd (Sigfrid) and of his wife, Gudrun. Believing that Svanhild had committed adultery with his own son, the emperor had caused her to be trodden to death by horses. The poem opens as Gudrún incites Hamdir and Sorli, her sons by a later marriage, to take vengeance for their half sister.

Entering the castle of Jormunrekk, the brothers fought against overwhelming odds. They cut off the arms and legs of the emperor, failing only to cut off his head. Hamdir and Sorli then fell dead upon a heap of Gothic corpses. rejoicing in their own valour and in the fame which would survive them. In no poem are the Germanic ideals of heroism expressed so clearly and forcefully as they are here.

It is not known when the *Hamðismál* received its present form, but several elements in it are very ancient. The story closely resembles one told by the Gothic historian Jordanes in the middle of the 6th century. Jordanes said that Jormunrekk was wounded by two brothers, Ammius and Sarus, because he had caused their sister, Sunilda, to be torn to pieces by wild horses. The account given by Jordanes contains more fiction than history, and he appears to be summarizing a poem. If so, the poem which Jordanes knew in the 6th century was one of the ancestors of the Hambismdl, written down in Iceland in the 13th century. It is possible that an early form of the *Hamðismál* was brought by a traveller from southeastern Europe to Scandinavia and adapted to the Scandinavian language. The story told in the *Hamðismál* changed little between the 6th and the 13th centuries, although it was combined with legends of Gudrún and of Sigurd, which belong to a later date than the legends of Jörmunrekk.

Another of the older lays is the *Atlakviða* (Lay of Atli, Attila),

which contains memories of events which took place in western Germany in the 5th century. In the year 437, the Burgundian tribe, then dwelling on the middle Rhine, had been overcome by a Hunnish army and the Burgundian king, Gundicarius, was killed. Atli (Attila) was not engaged in this campaign, but the poet saw it as a personal quarrel between him and Gunnar (Gundicarius). Atli is said to be married, at this time, to Gudrun, sister of Gunnar. He invites Gunnar and his brother, Hogni, to his castle with promises of gifts and then treacherously kills them. Gudrun takes revenge for her brothers by killing the sons whom she had borne to Atli and then stabbing Atli in his bed.

This story of Atli's death is not far removed from history. According to contemporary writers, he had married a woman, whose name Hildico shows that she was Germanic, and on the wedding night he died of a haemorrhage. Popular report soon had it that Hildico had murdered him. The story of Atli was rehandled by a later poet in the *Atlamál* (Words of Atli), which was probably composed among the Icelandic colony in Greenland.

A third legend was linked with those of Jormunrekk and the Burgundians. This was the German legend of Sigurd and Brynhild, which became one of the most popular in Scandinavia and Iceland, although it is not known how early it was introduced.

In the lays of the *Edda* the Burgundian princess, Gudrún, is married first to Sigurd, the spotless, valiant hero. Sigurd had formerly been betrothed to the warrior woman, Brynhild, but Grimhild, the mother of Gunnar and Gudrún had administered a magic potion, so that he forgot his betrothal and married Gudrun. Brynhild lived in a castle surrounded by flames and had sworne that she would marry none but the man who could ride through them. Gunnar failed to do this, but Sigurd succeeded in the disguise of Gunnar. Brynhild then married Gunnar and was heartbroken to discover that he was the lesser hero. She was stirred by loving hatred for Sigurd, as is most fully described in the *Sigurðar kviða en skamma* (Short Lay of Sigurd). Brynhild incited her husband, Gunnar, and his brothers to murder Sigurd, but when they had done this, she threw herself on the funeral pyre beside him.

The spiritual conflicts of Gudrún are described in several lays with even greater pathos. In the "First Lay of Gudrun" she is described weeping over his dead body, and in the "Second Lay of Gudrun" she looks back on her past life and dwells upon her sufferings. Her conflict was that of loyalties. She was bound by ties of blood to her brothers, who had murdered her beloved husband, and later she took revenge for these brothers upon her own sons and upon her second husband, Atli, who had murdered them.

Many modern critics hold that the lays of the *Edda* in which the spiritual conflicts of Gudrun and Brynhild are described belong to a later age than such austere poems as the *Hamðismál* and the *Atlakviða*. The lays about these heroines tend to be romantic and sentimental and seem to accord better with the tastes of the Christian middle ages than with those of the pagan dark ages. In their present form these lays are Icelandic, but they may well be derived from lost German poems of the 11th or even of the 12th century.

Nearly all heroic lays in the *Edda* are associated in one way or another with the story of Sigurd, although the heroes of three of them, the Helgi lays, have but distant relationship with Sigurd. These lays have another background and their scenes seem to be laid on the shores of the Baltic during the Viking age. One heroic lay in the *Edda*, the *Völundarkviða* (Lay of Wayland the Smith) is altogether divorced from the story of Sigurd. Its hero is the magic smith, Wayland, who seduces Bodvild, daughter of King Nidud. This story was well known in Anglo-Saxon England, for it is also told in the poem "Deor's Lament", and is depicted on panels of the Franks Casket, probably of the 8th century.

The *Poetic Edda* contains only a small proportion of the heroic poetry known in Iceland in the early middle ages. Much has been lost, but several fragments of ancient lays are found in sagas of the 13th and 14th centuries. Among the most important may be counted the "Battle of Goths and Huns," quoted in the *Heiðreks Saga*. The story is of a great battle between Goths, led by Angantýr, and Huns, led by Hlod. The scene appears to be southeastern Europe, in the region of the Black sea. The events celebrated have not been identified in history, but they may well have taken place in the 4th century, when the Gothic empire was invaded by Huns.

Other heroic lays of which fragments survive were concerned with Danish and Swedish heroes who lived between the 5th century and the 7th. Some of these heroes, such as Hrólf Kraki of Denmark and Adils of Sweden, were also known to the author of the Old English *Beowulf*.

Mythological Lays.—The first half of the *Poetic Edda* consists of lays about pagan gods and of wisdom attributed to them. Like the heroic lays, these are of various ages, but it is improbable that any of those which survive originated elsewhere than in Norway, Iceland and the Norse colonies of the British Isles. The most striking lay of this class, the *Völuspá* (Sibyl's Prophecy), is placed first in the *Edda*, and is preserved in another manuscript as well. It is supposed to be spoken by a sibyl, who tells the history of the world, of gods, men and monsters, from the beginning until the Ragnarok (Doom of the Gods), when the gods will fall, the sun turn black, smoke and fire will gush forth and the stars vanish.

Many passages in the *Völuspá* are obscure and it has been discussed more than any other Scandinavian poem. Most scholars would probably agree that it was composed in Iceland, for the scenery, which the poet described, is that of Iceland. The poet's background was pagan, but his thoughts were coloured by Christian legends of the end of the world. He probably worked about the year 1000, when the minds of Icelanders were turning from the old religion to the new.

An interesting story of the gods is told in the *Skirnismdl* (Words of Skirnir). Sitting in Hlidskjálf, the throne of Ódinn, the god Freyr gazed into the world of giants, where he saw the giant maiden, Gerd, whose beauty made him sick with love. Freyr sent his faithful messenger, Skirnir, riding into the world of giants to win the maiden for him. The journey of the messenger in darkness over misty hills is described in few but telling phrases. Skirnir seeks to win the maiden, first with offers of gifts and then with threats, until she gives way and agrees to make a tryst with Freyr in the grove Barri. Scholars have seen an ancient fertility myth in this story. Freyr is the god of fertility and sunshine; Skirnir is a ray of sunshine *(cf. skirr,* bright), and Gerd *(cf. garðr,* enclosure, field) is the cornfield held fast in the clutches of the frost giants, demons of winter. The *Skirnismdl* is one of the older mythological poems and probably originated in Norway.

The *Þrymskviða* contains a tale of Thór. His magic hammer had been stolen by the giant Thrym, who refused to give it back unless he could have the goddess Freyja as his bride. Since Freyja was enraged at the suggestion that she should be given to a giant, Thór himself was decked as a bride, and went to the house of the giant and recovered the hammer by this ruse. The humour of the *Prymskvida* is unique in early Scandinavian poetry.

The mythological poems so far mentioned are all narrative, but many of those contained in the *Edda* are didactic. The *Hdvamdl* (Words of the High One) consists of fragments of at least six poems, all said to be spoken by Ódinn. In the first section, the god speaks of relations between man and man and lays down rules of social conduct. The precepts are cynical and generally amoral, and evidently date from an age of lawlessness and treachery. This section of the *Hdvamdl* is altogether devoid of belief in the supernatural, or in life after death. No greater misfortune can befall than death, which nothing can survive except fame.

In other sections of the *Hdvamdl* Ódinn discourses on relations between men and women, and tells how the love of women may be lost or won with illustrations from his own experience. The last two sections are about runes and magic power. Ódinn describes how he hung fasting for nine nights on a windswept tree and thus discovered the runes. He speaks finally of magic songs, by whose force he can help his friends and destroy his enemies. The different poems of which the *Hdvamdl* is made up belong to different ages, but most of them were probably composed in Norway in the

9th and 10th centuries.

Another didactic poem, placed in an interesting setting, is the *Vafþrúðnismál* (Words of Vafthrúdnir). bdinn, as usual in disguise, comes to the house of the giant, Vafthrudnir, and the god and the giant enter a contest of wits, on which each wagers his head. They ask each other questions about gods, men and giants, until the god asks what Ódinn had whispered into the ear of his son, Baldr, when he was laid on the funeral pyre. No one knows the answer to this question except Ódinn himself, and so the giant forfeits his head. The *Grímnismál* (Words of Grimnir) is a didactic poem of the same kind, and another is the *Alvíssmál* (Words of the All-Knowing), which has rather a different form.

Some important mythological lays are found in manuscripts other than the *Edda*. Perhaps the most beautiful is the *Baldrs Draumar* (Baldr's Dreams), which was so skilfully translated into English by Thomas Gray as "The Descent of Odinn." The poet describes how the god Baldr dreamed baleful dreams, which threatened his life. Ódinn then rode to the grave of a prophetess and awakened her from death by the power of his magic songs, and forced her to tell the fate in store for Baldr. In the *Rígsþula* (Song of Rigr) the god Heimdall, who assumes the name Rigr, wanders through the world and begets three sons by three separate women. The first son is called Thræll, the second Karl and the third Jarl, and from these the three classes of men, thralls, freemen and chieftains, are descended. The name Rigr has been associated with the Irish *rí* (king) and it is not improbable that the poem was composed in Ireland, or by a Norseman who worked under Irish influence.

The **Eddaic** Verse Forms. — Three measures are commonly distinguished in Eddaic poetry, the *Fornyrbislag* (Old Story Measure), the *Málaháttr* (Speech Measure) and the *Ljóðaháttr* (Song Measure). Most of the narrative poems are in the *Fornyrbislag*, which consists of short lines of two beats bound by alliteration in pairs. The number of weakly stressed syllables may vary, but the total number of syllables in the line rarely falls below four. In these things the *Fornyrðislag* resembles the measure used by Anglo-Saxon and early German poets. But, unlike Anglo-Saxon and German poetry, the poems in the *Fornyrðislag* are generally arranged in strophes of eight lines, divided by a deep caesura into half-strophes of four lines. Poems which are considered among the oldest show much irregularity, both in the syllabic length of the line and in the length of the strophes, but the following half-strophe will serve as a typical example (alliterating syllables in italics):

Gengu *ia*rlar alsnotrir fram
þeir's harz hugar hdna lottu.

The *Málaháttr*, used in the *Atlamál*, differs little from the *Fornyrðislag*, although its lines generally have a greater number of weakly stressed syllables. The *Ljdbahdttr* is the most irregular of Eddaic forms and its origins are the most obscure. It is used chiefly in didactic poems and consists generally of strophes of six lines divided into half-strophes of three lines. The first two lines of the half-strophe contain two beats each and alliterate with each other; the third line is independent, alliterating only within itself. This line may contain two beats or three. The following half-strophe will serve as an example:

Deyr fé deyja frændr
deyr *sj*álfr it sama.

Scaldic Poetry. — Besides the Eddaic, the Norwegians and Icelanders of the 9th century to the 13th composed poetry of quite a different kind. This is distinguished as "scaldic" poetry (*cf.* Icelandic *skdld*, poet).

Scaldic poetry differs from the Eddaic in the first place in its form. It is not composed in the free variable measures of Eddaic lays and is quite unlike Anglo-Saxon and early German poetry. It is strictly syllabic and every syllable must be counted and weighed, and every line must end in a given form, trochaic, dactylic or monosyllabic as the case may be. Like the Eddaic lines, the scaldic ones are bound by alliteration in pairs and, besides this, most of them contain some form of internal rime or consonance. The strophe is usually of eight lines, divided into two halves by a caesura after the fourth. About 100 scaldic verse forms have been recorded, but the most popular, and probably the oldest, is the *Dróttkvætt* (Court Metre), which consists of strophes of eight lines, each of six syllables, ending in a trochee.

The scaldic poetry differs from the Eddaic, not only in form, but also in syntax and choice of expression. The word order is much freer than in Eddaic poetry and the scalds use many words never found in Eddaic poetry or in prose, besides periphrases, or kennings, of such complexity that their work often sounds like a riddle. They may denote a ship as "the horse of the sea" or "the bull of bow-sprits"; they call gold the "fire of the sea." Kennings are frequently doubled or trebled; *i.e.*, two or more are combined to denote one subject. Thus, the "fjord-elk" is the "ship," his "field" is the "sea" and its "fire" is "gold."

Little is known about the origins of scaldic verse forms and diction, but there are reasons to believe that they were devised in western Norway during the 9th century. If so, it is probable that the first scalds were influenced by the elaborate metrical forms and diction of the Irish poets of that period. During the 9th century, the Norwegians stood in close contact with Ireland.

The Eddaic poetry is all anonymous, but most of the scaldic is assigned to poets whose names are remembered. The oldest of the scalds whose verses survive was Bragi, nicknamed the Old, who probably worked in Norway in the second half of the 9th century. The chief of Bragi's surviving poems is a description of a painted shield given to him by a chieftain. Pictures of gods and legendary heroes were painted on the shield, and among them were the god Thór, struggling against the World Serpent, and Jormunrekk attacked in his castle by the brothers Hamdir and Sörli.

Much of the scaldic poetry was made in honour of the kings of Norway, nearly all of whom patronized poets. Harald Finehair (died c. 945), first king of all Norway, was eulogized by several poets, among whom were Thorbjorn Hornklofi and Thjódólf of Hvin. The first was the author of the *Haraldskvæði* (Lay of Harald), a remarkable poem, partly in Eddaic and partly in scaldic style. It is in the form of a dialogue between a valkyrie and a raven, who followed the king in search of the carrion which he had left on the battlefield, and sang his praises. An unnamed scald made a similar poem, the *Eiriksmdl*, as a memorial to Eirik Bloodaxe, who was killed in the British Isles soon after the middle of the 10th century, and another, Eyvind the Plagiarist, commemorated Haakon the Good (d. 961) in the same way.

Although the first scalds were Norwegians, it was the Icelanders who developed the art. The greatest of all was Egill Skalla-Grimsson (c. 910–80), who was born and died in Iceland, but lived much of his life in Norway and the British Isles. Among the best-known of his poems is the *Höfuðlausn* (Head Ransom), which he composed in York about the year 948. He had fallen into the hands of his enemy, Eirik Bloodaxe, then ruling in York, and saved his head by making this poem in honour of his enemy in a single night. The *Höfuðlausn* is in an unusual form with end-rime, which is probably due to the influence of hymns in Latin, which the poet had heard in England. Egill also made poetry in honour of Aethelstan, king of England (d. 939), but only scraps of it have survived.

Einar Skálaglamm, another Icelander, was the friend of Egill and chief poet of Haakon the Great (d. 995), in whose honour he made the *Vellekla* (Gold-dearth). Einar commemorated the achievements of Haakon and praised him for his loyalty to the pagan gods.

The Christian kings of Norway, Ólaf Tryggvason (d. 1000) and 61af the Saint (d. 1030), were praised by many Icelandic scalds. Hallfred, nicknamed the "Troublesome Poet," was the favourite of Ólaf Tryggvason and although his work has no great value as art, it is interesting because the poet describes his conversion to the Christian religion and the spiritual conflicts which went with it. Sigvat, the favourite of Ólaf the Saint, was a more notable poet. In his work he commemorated the chief events in Ólaf's life, from his adventures as a youthful viking to his death in the battle of Stiklastadir. Sigvat's work is simpler and easier to understand than that of most of the older scalds. Many sagas include lives of scalds and contain numerous verses which show that, in Iceland, scaldic poetry was admired as an accomplishment by rich and

poor alike.

Scaldic poetry, since it is ornate and difficult to understand, has been little appreciated in modem times. It is a rewarding subject for study, however. Scaldic poems, composed in the 10th and 11th centuries and remembered orally, were among the most valuable sources for the Icelandic historians of the late 12th and 13th centuries.

Histories, Law Codes and Religious Literature. — The Icelanders adopted the Christian religion in the year 1000 and this had far-reaching consequences. Their civilization was not greatly altered at first, but the conversion opened the way for new and powerful influences from Europe.

Details about some of the missionaries who worked in Iceland in the 11th century are recorded, and several of them came from the British Isles, while others were of German origin. Undoubtedly these missionaries taught the Icelanders to use the Latin alphabet. No manuscripts of this period survive, but the oldest preserved, dating from the middle of the 12th century, are written in a script based upon one used in England in the 11th century.

Icelanders soon began to study in the great schools of Europe. Perhaps the first to do this was fsleif (*c.* 1005–80), who was brought up in the convent of Herford in Westphalia and ordained priest. Soon after the middle of the 11th century, fsleif was consecrated bishop. He kept a school at Skálaholt, in the south of Iceland, which was for many centuries the chief bishopric and one of the main centres of learning.

fsleif was succeeded as bishop by his son Gizur (1082–1118), who was also educated at Herford. Historical literature was first written in his time. The oldest historian remembered was Sæmund Sigfússon (1056–1133). Sæmund went to school in France and was the author of a *History of the Kings of Norway*. This book is lost, but references made to it by writers of the later middle ages show that it was written in Latin, and was concerned especially with the chronology of the kings' reigns.

Ari Thorgilsson (*c.* 1067–1148) is regarded as the father of vernacular history. It is not known how many books Ari wrote, but there is a short history of Iceland, the *Libellus Islandorum,* which is signed by Ari. It was written shortly before 1133, although it exists today only in paper transcripts of the 17th century. Ari states in his prologue that he had also written an earlier version of this same work, which contained some account of the kings of Norway and other material not found in the existing book.

The *Landnámabók* (Book of Settlements) has long been associated with Ari's name. It consists of a detailed history of the settlement of Iceland. The settlement is treated district by district and the descendants of the chief settlers are traced. Ari probably compiled the *Landndmabdk,* or part of it, in its original form, but the existing versions date from the 13th and 14th centuries and were expanded after Ari's time.

It is not known how early Icelanders began to keep annals of contemporary events. The extant versions of them are not older than the 13th century, but since they contain records of an eclipse, visible in Iceland in 1131, and of a volcanic eruption in 1104, these extant versions of the annals probably derive from an original made early in the 12th century.

The first code of law, applied to the whole of Iceland. was drawn up by a certain Úlfljót about the year 930. This code was remembered by heart and recited by the law-speaker, the president of the national assembly, at regular intervals. In the year 1096, laws of tithe were introduced and perhaps written down at that time. In 1117 it was resolved that parts of the civil law should be written on parchment, and a few years later laws relating to ecclesiastical practices were also inscribed.

The oldest extant religious manuscripts in Icelandic, dating from about 1150, consist of homilies and lives of saints, which evidently formed the most extensive branch of the literature during the 12th century. Large collections of religious literature are also found in the manuscripts of the late 12th and early 13th centuries.

The Icelandic homilies are based largely upon those ascribed to the great apologists of Europe, such as Jerome, Bede, Gregory. Nevertheless, the Icelanders sometimes treated their models freely and added reflections of their own. Popular handbooks of theology, such as the *Lucidarius* of Honorius Augustodunensis, and the *Dialogues* of Gregory the Great, were also written in Icelandic versions during the 12th century.

Among the most popular religious books were lives of the apostles and of well-known European saints. The lives of the apostles were based largely upon apocryphal Acts and Gospels and partly upon canonical writings. Literature of this kind is little read today, and its importance is often overlooked, but its composition undoubtedly contributed much to the narrative art, in which the Icelanders of the 13th century were to excel.

The First Sagas. — In Icelandic the word "saga" is used for any kind of story or history, whether written or oral *(see* SAGA). In English, on the other hand, this word has a narrower sense and is generally applied to biographies of one hero or a group of heroes written in Iceland between the 12th and 15th centuries. Sagas are generally based upon native tradition, whether preserved orally or in writing. The heroes of sagas are most often kings of Nonvay, icelandic, or legendary Germanic heroes, said to have lived between the 4th and 8th centuries.

If the word "saga" is used in this restricted sense, the oldest saga known is the so-called *First Saga of St. Ólaf* of which some fragments are preserved. It was written about 1180, probably in the Benedictine monastery of Thingeyrar, in northern Iceland. It is cast in the form of a hagiographic narrative, and greatest emphasis is laid upon miracles worked through the agency of St. Ólaf. Stories about these miracles were preserved in oral tales, both in Norway and Iceland. In spite of its hagiographic tone, the *First Saga* has great value as history. The outline of Olaf's career was recorded in verses composed in scaldic form by contemporary poets and handed down orally.

The *First Saga* was used as a source, either directly or indirectly, by later biographers of St. Ólaf, by the author of the *Legendary Saga* (*c.* 1200), by Styrmir Kárason (c. 1220), and ultimately by Snorri Sturluson.

The monastery of Thingeyrar, which had been founded in 1133, played a great part in the cultural life of the Icelanders during the late 12th and early 13th centuries. About 1190, one of its inmates, Odd Snorrason, wrote a life of Ólaf Tryggvason, king of Norway (d. 1000). Odd was, no doubt, inspired to do this work by the *Saga of St. Ólaf.* Besides oral tales and scaldic poems about Ólaf Tryggvason, Odd used several written sources, including the histories of Sæmund and Ari. He wrote in Latin, but his work was translated into Icelandic soon afterward and was freely quoted by those who wrote about Ólaf Tryggvason in later times.

Ólaf Tryggvason was regarded widely as the apostle of Iceland, for it was at his instigation that the Icelanders had adopted Christianity. Odd's life of him was followed by another, whose author, Gunnlaug Leifsson (d. 1218), also belonged to Thingeyrar. Gunnlaug also wrote in Latin, but his work was translated into Icelandic. It was larger and more ambitious than Odd's life. but does not survive in its original form. Gunnlaug was a man of wide learning. He was also the author of a life of Jón Ögmundarson, bishop of northern Iceland (d. 1121), of a life of St. Ambrose, and of a metrical version in Icelandic of Geoffrey of Monmouth's *Prophecies of Merlin.*

The School of **Skálaholt.**—The work of the Thingeyrar monks was fanciful rather than critical or realistic. A more critical style of history had been established in the south of Iceland by Sæmund and Ari, and several notable works of history were written at Skblaholt or near by early in the 13th century. The most remarkable of these was the *Hungrvaka* (Hungerwaker), written about 1206, which is a short history of the bishops of Skálaholt from fsleif (d. 1080) to Klœng (d. 1176). The *Hungrvaka* is admired for its polished style and for its author's balanced judgment and objectivity. It appears to be designed as a prologue to the *Saga of St. Thorldk,* who was bishop of Skblaholt from 1178–93, and was regarded by many Icelanders as a saint. The *Saga of St. Thorldk* was written a few years earlier than the *Hungrvaka,* but stylistic peculiarities suggest that it was the work of the same author. Another work commonly ascribed to the

author of the *Hungrvaka* is the *Saga* of *Bishop Páll* (d. 1211), who succeeded his uncle, Thorlbk, as bishop of Skblaholt. This author was interested in the private lives of his heroes, rather than in their public acts or ecclesiastical policy. He was never extravagant in his praises nor overcredulous of miracles.

Histories of Kings of Norway.— During the latter years of the 12th century some short histories of kings of Norway were written in Norway itself and some of them were brought to Iceland and influenced Icelandic writers. One of these was the *Historia de antiquitate regum Norwagiensium,* which was written in Latin by a Norwegian monk, Theodoricus, about 1180, and was used as a source by Odd Snorrason. Another Norwegian work, which had greater influence. was the so-called *Agrip* (Summary of the History of the Kings), which was written in Norway in the vernacular about the end of the 12th century. The *Agrip* was brought to Iceland soon after it was written and exists only in an Icelandic manuscript of the early 13th century. In its original form it must have covered the history of the kings from the 9th century to the late 12th century, but the beginning and the end are missing. The *Fagrskinna* (Fine Skin) covered the same period as the *Ágrip,* but it is more detailed and its author has made greater use of older writings and of scaldic poetry. The *Fagrskinna* was also written in Norway, probably about 1230, but its author must have been an Icelander, for the sources which he used were chiefly those preserved in Iceland. The *Morkinskinna* (Rotten Skin) was probably written rather earlier than the *Fagrskinna,* and covers a shorter period of the history of the kings, from Magnús the Good (d. 1047) to the late 12th century. It was written in Iceland and based partly upon a lost history of the kings of the 12th century, the *Hryggjarstykki* (Backbone Piece), written by the Icelander Eirik Oddsson about 1170. The *Saga of the Orkney Earls (Orkneyinga Saga)* should also be included in this class. It was written by an Icelander in the first year of the 13th century, and covered the history of the Norwegian dependency, Orkney, from the 9th century to the latter years of the 12th. It survives only in later redactions.

A work of particular interest was the *Sverris Saga,* the life of King Sverrir of Norway (d. 1202). A part of it was written by Karl Jónsson (d. 1215), who was twice abbot of Thingeyrar, and spent several years in Norway as an attendant of King Sverrir. Karl wrote some chapters of this saga in Norway under the supervision of Sverrir himself and it was completed after he returned to Iceland, probably by others. There is no more intimate and detailed biography of a ruler of Norway.

Snorri **Sturluson (1179–1241).**—Snorri was the author of literature of many different kinds and played a prominent part in the political wrangles of his age. He was the son of a chieftain of western Iceland, but was brought up in the south by Jón Loptsson, a grandson of Sæmund Sigfusson. Among the works assigned to Snorri are several poems and the so-called *Prose Edda (see* EDDA), which is a handbook of prosody and poetic diction, probably written soon after 1220. Snorri illustrates his arguments with stories about pagan gods and ancient heroes, and it is these which give the *Prose Edda* its chief interest for modem readers. They have the charm of fairy tales and are told with admirable delicacy and taste.

Snorri twice visited Norway and much of his work consists of lives of its early kings. The first which he wrote was the *Saga of St. Ólaf.* This was based largely upon the lost life of that saint written by Styrmir Kbrason *(see* above), partly upon the work of Ari and other ancient books. and partly upon poems and tales transmitted orally. The chief difference between Snorri's account of St. Ólaf and those of his predecessors was that Snorri wrote neither as a hagiographer nor as an annalist. He depicted Ólaf as a living man, brave but not without faults, who began his career as a typical viking and developed gradually into a statesman, a saint and a martyr.

Snorri probably wrote his *Saga of St. Ólaf* within a few years of his return from Norway in 1220. He afterward combined it with lives of kings who had ruled Norway before and after Ólaf. The complete series is called the *Heimskringla* (Orb of the World). It begins with a short account of the Vnglingar, the ancient kings of the Swedes, from whom rulers of Norway were said to descend. The chief source of this first section is the poem, *Ynglingatal,* which dates from the 9th century. Several of the older kings of Norway are described in close detail and among the most interesting sections of the *Heimskringla* are those about Harald Finehair (d. c. 945), Haakon the Good (d. *c.* 963) and Ólaf Tryggvason (d. 1000). The *Heimskringla* ends with Magnús Erlingsson (d. 1184).

The value of Snorri's lives of the kings as sources of history has long been debated. It must suffice here to say that Snorri was an avid reader of vernacular history and he faithfully reported events about which he had read in older records, many of which are now lost. He also deduced more from the poetry of the scalds than most of his predecessors had done. In outline, Snorri's biographies of the kings may generally be accepted as true, but it was not his objective to write scientific history. His work was constructive; he portrayed his heroes imaginatively and brought them to life.

Many scholars hold that the *Egils Saga* was also written by Snorri, for both internal and external evidence support this opinion. The *Egils Saga* is the life of Egill Skalla-Grimsson, greatest of the scalds. It is among the most stirring and adventurous of sagas about Icelandic heroes.

Icelanders' Sagas.—The terms "Icelanders' Sagas" and "Family Sagas" are commonly applied to sagas about heroes who are supposed to have lived in Iceland in the 10th and 11th centuries. The best sagas of this class excel all others in artistic value; none present characters more vividly, nor show deeper sympathy and understanding of human tragedy.

Questions about the origins and historicity of sagas of this kind have been much discussed. While it is agreed that few, if any, of them were written before the 13th century, many have maintained that the Icelanders' Sagas are faithful records of the history of the 10th and 11th centuries. Consequently, it has been argued that these sagas were composed as early as the 11th century and handed down orally until they were written, almost without alteration, in the 13th century. Although this view was still widespread at mid-20th century. it has been rejected by most modem specialists, who see the individual hand of a literate author in each saga. Nevertheless, it is plain that sagas of this class owe much to tradition, to verses of contemporary poets handed down orally and to oral tales. They also owe much to written works, for their authors drew freely upon the books of Ari, upon the *Landnámabók* and early genealogies. Moreover, the author of one saga would frequently refer to an older one and quote its statements, either with or without acknowledgment.

The historicity of Icelanders' Sagas is difficult to check and few general statements are applicable. Not only the author's sources. but also his aims must be considered. While some of the older ones probably intended to write factual history, others relied rather on the imagination, and thus anticipated the historical novel of modem times.

The first Icelanders' Sagas were written about the beginning of the 13th century and were strongly influenced by the Kings' Sagas. Among the oldest may be counted the *Fóstbræðra Saga* (Saga of the Foster-brothers), whose heroes, Thorgeir and Thormód, were both attendants of St. Ólaf. Many chapters of it are based upon verses which are said to be the work of Thormód. Although somewhat crude in structure, this saga expresses clearly the northern ideals of loyalty and heroism. A great part of the story takes place in the Icelandic colony in Greenland in the 11th century. Both the *Eiriks Saga Rauða* (Saga of Eirik the Red) and the *Grœlendinga Saga* (Saga of the Greenlanders) are also placed in Greenland and contain adventurous tales about voyages to Wineland the Good, as the Norsemen called America.

Another of the older sagas is the *Hallfreðar Saga* (Saga of Hallfred), whose hero, Hallfred. was the favourite of Olaf Tryggvason. The *Hallfreðar Saga* is partly a love story and is smoother and more highly finished than the *Fóstbræðra Saga.* It was written at, or in the neighbourhood of, Thingeyrar, about 1220.

The scenes of several sagas are laid in the Eyjafjord and the northeast of Iceland and were probably written in that region. The most perfect is the *Víga-Glúms Saga* (Saga of Viga-Glum), written about 1230–40, a well-constructed and somewhat conventional story of a grasping peasant. Men of the same district are described

in the *Ljósvetninga Saga,* whose central figure, Gudmund the Mighty, is depicted as the wealthy, but cruel and cowardly, tyrant.

Although it is difficult to determine the ages of many sagas, it is possible to see how the art of saga-writing developed in the course of the 13th century. The *Gísla Saga* (Saga of Gisli) was probably written shortly before the middle of that century and is the story of a poet who lived in northwestern Iceland in outlawry, hunted by his enemies and penalized only because of his loyalty in avenging his foster brother. This saga contains some rich descriptions of nature and a large number of emotional verses, said to be composed by the hero.

The scene of the *Laxdœla Saga* (Saga of the Men of Laxárdal), evidently written a few years later than the *Gísla Saga,* is also western Iceland, and the story covers four or five generations. from the end of the 9th century to the 11th. The *Laxdœla Saga* is a tragedy. but it is finer and more delicately worked than the tragedies told in most sagas Women figure prominently and the most striking of them is Gudrun. Failing to marry the man she loves, Gudrun resorts to loving hatred and causes his death. Her story is plainly influenced by that of Sigurd and Brynhild. The author shows an unusual appreciation of visual beauty.

Many people described in the *Laxdœla Saga* appear also in the *Eyrbyggja Saga,* a work of different stamp. Its author has little sense of structure, but he is an able storyteller and depicts his characters intimately and vividly. He is also an antiquarian and throws valuable light upon popular practices and superstitions, recording many ancient poems.

The scenes of some short sagas are laid in eastern Iceland, a remote, isolated district. Among them is the *Vápnfirðinga Saga,* which takes place in Vapnafjord, and tells the tale of a family feud which passes through two generations. ending in reconciliation. The *Hrafnkels Saga Freysgoða* (Saga of Hrafnkell Freyr's Priest) takes place in a neighbouring district and is a masterpiece among the shorter sagas. Realistic as it is. the story is the author's creation and the saga contains little historical fact. It is improbable that it was written before 1270.

Among other short sagas of particular interest may be mentioned the *Bandamanna Saga* (Saga of the Confederates), which is a bitter, satirical tale, and the *Gunnlaugs Saga Ormstungu* (Saga of Gunnlaug Serpent Tongue), a love story strongly influenced by foreign romance. The *Hávarðar Saga Ísfirðings* (Saga of Hávard of fsafjord) is a spirited tale. which probably dates from the end of the 13th century. Icelandic literature of this period also includes many short stories, or *þættir,* of great value as literature, which describe one event or another in the life of a hero.

As the 13th century drew to its close, the taste for the fantastic and romantic grew stronger. One of the best-known of the sagas is the *Grettis Saga* (Saga of Grettir the Strong), which contains numerous motifs drawn from folklore, including stories about ghosts and trolls against whom the hero fights. In its present form this saga must date from about 1300, but it is based upon an older work about Grettir, probably written by Sturla Thordarson (d. 1284), nephew of Snorri Sturluson.

It is commonly agreed that the greatest of the Icelanders' Sagas is one of the youngest, the *Njáls Saga.* It has two heroes, Gunnar and Njáll. The first is the brave, guileless youth, like Sigurd of the legends, but the second is the wise and prudent man, endowed with prophetic gifts. Njáll faced the terrible death of burning with the resignation of a martyr, but he also had many of the qualities of the traditional Norse hero; he was loyal, upright and resolute The author of the *Njdls Saga* was influenced by a whole library of early literature. by older sagas as well as books on theology and law.

Sagas about Contemporary History. — Many works on contemporary history were wtitten in the 13th century and most of them were combined about the year 1300 in the *Sturlunga Saga* (Saga of the Sturlungar). This compilation includes the *Íslendinga Saga* (Saga of the Icelanders) of Sturla Thórdarson, which begins with the year 1183 and describes in minute detail the politics, intrigues and battles which took place during the greater part of the 13th century. Among other sagas included in the *Sturlunga* are those about Sturla, the father of Snorri (d. 1183), and about Gudmund the Good, the fanatical bishop of the northern Icelanders (d. 1237).

Heroic Sagas. — The growing taste for the fantastic was expressed in the latter years of the 13th century in the heroic sagas (Fornaldar Sogur), whose heroes were supposed to have lived in Scandinavia and in continental Germania before Iceland was peopled. The best-known of these sagas is the *Volsunga Saga* (Saga of the Volsungs), written about 1270, in which the story of Sigurd, the Burgundians and Jormunrekk is retold in prose. Its sources were Eddaic lays about the heroes. some of which are now lost. The *Heidreks Saga* is also based largely on heroic poetry, as in the *Hrdlfs Saga Kraka.* Although they have little value as art, sagas of this kind, since they are often based on lost poetry, have great antiquarian interest.

Translations from Latin. — A considerable quantity of profane literature was translated from Latin between the 12th and 14th centuries. The *Prophecies of Merlin,* mentioned above, were combined with a complete translation of Geoffrey of Monmouth's *Historia regum Britanniae,* the *Breta Sogur* (Tales of the Britons). In a manuscript of the 14th century the *Breta Sogur* is preceded by the *Trójumanna Saga* (Tale of the Trojans), a rendering of De *excidio Trojae* of Dares Phrygius. The *Alexanders Saga* (Saga of Alexander the Great) was a rendering in prose of a Latin poem of the 12th century written by Philip Gautier. The Icelandic version was made by the Abbot Brand Jonsson (d. 1264).

Romances. — These consist of translations and free adaptations of French and other European romances. This branch of literature originated in Norway early in the 13th century, but it soon took root and flourished in Iceland. The oldest work of this class is probably the *Tristrams Saga* (Saga of Tristram), which was mritten in Norway in the year 1226 at the behest of King Haakon. The source was the French poem of Thomas of Brittany. The *Karlamagnús Saga* (Saga of Charles the Great) is a collection of prose renderings of the French *chansons de geste,* whose heroes are Charles the Great and his men. A Norse version of the *Chanson de Roland* is included in this collection.

These romances are little read today, but in the 13th century they influenced the tastes of the Icelanders and the authors of historical sagas. This influence can be seen best in the *Laxdœla Saga, Gunnlaugs Saga* and *Grettis Saga.* The Icelandic romances are very numerous and exist in countless manuscripts, which give an indication of their popularity in Iceland from the 14th to the 18th century.

Post-Classical Literature. — The classical age of Icelandic literature might be said to end in the 14th century. Although literature has flowed richly at all periods during the history of Iceland, comparatively little of that composed between the 14th and the 19th centuries aroused interest outside Iceland itself. During the 14th century, much of the realism and detached objectivity which had characterized the literature during its best period is lost. Sagas and poetry of various kinds continued to be composed, but the fantastic, erotic and sentimental gained the upper hand.

The decline of taste may be attributed to several causes, partly to loss of political independence (1262) and partly to economic straits, resulting in famine and pestilence during the 14th and 15th centuries.

Although literature in the Classical style was no longer composed, interest in the great works of the 13th century persisted and the most valuable manuscripts of them date from the 14th century. when great collections were made. Among them may be mentioned the *Hauksbdk* (Hauk's Book), written early in the 14th century. containing texts of the *Landnámabók,* the *Völuspá* and the *Fóstbræðra Saga,* and the *Möðruvallabók* (Book of Mödruvellir), written about 1350, which contains texts of *Njáls Saga, Víga-Glúms Saga* and other important sagas of Icelandic heroes. The most beautiful of all Icelandic manuscripts is the *Flateyjarbdk* (Book of Flatey), written toward the end of the 14th century. This includes versions of the sagas of Ólaf Tryggvason and of Olaf the Saint. which are combined with texts of sagas about Icelandic and other heroes who were associated with these rulers. Many manuscripts of the classical literature date from the 15th, and some important ones were written as late as the 17th, or even the 18th century.

Post-Classical Sagas. — The prose literature of the 14th century includes several sagas about Icelandic heroes. Among them is the *Finnboga Saga* (Saga of Finnbogi the Strong), an adventurous tale about an Icelander of the 10th century, whose travels brought him to the emperor in Constantinople. The *Víglundar Saga* (Saga of Viglund) is a love story about an Icelandic hero, which is strongly influenced by continental romance. It contains some interesting love poetry in scaldic form. The *Krdka-Refs Saga* is of approximately the same age, and equally unrealistic, although it is one of the most successful of the humorous stories in Icelandic.

Sagas about bishops of Iceland had been written early in the 13th century and this branch of literature flourished vigorously in the 14th century. The *Arna Saga* consists of a detailed account of Arni Thorliksson, bishop of Skilaholt (1269–98). It contains much valuable history and was probably written by Arni's nephew, who succeeded him as bishop. The *Laurentius Saga* is no less interesting, and is a life of Laurentius Kálfsson, bishop of Holar 1324–31.

A number of heroic sagas, about men said to have lived before the settlement of Iceland, must be assigned to the 14th century. Some of them were based upon older traditions and others were largely invented. One of the more interesting is the *Eiríks Saga Víðförla* (Saga of Eirik the Far-traveller), whose hero reaches the *Óðáinsakr*, the land of eternal life, said to lie beyond the farthest India. Lives of foreign saints also flourished in the 14th century. Among the more notable was the *Life of St. Nicholas*, written by Abbot Berg Sokkason (d. 1345). Arni Laurentiusson, a monk of Thingeyrar (b. 1302), compiled a life of the English St. Dunstan. Somewhat later, probably in the 15th century, a short life of St. Oswald was written in Icelandic.

A large collection of *Ævintýri* or *exempla* was also compiled in the 14th century. These consist of tales of foreign origin, illustrating some moral precept. Many of them were said to have been told in Iceland first by Jón Halldórsson, the Norwegian bishop of Skalaholt (1322–39). Others were taken from the well-known *Disciplina Clericalis*, written early in the 12th century by the Christian Jew, Petrus Alphonsus.

Poetry. — After the 13th century no more is heard of Icelandic court poets, patronized by the Norse rulers. Nevertheless, a great deal of poetry was composed in Iceland between the 13th century and the Reformation and many new forms were devised. The most valuable of this poetry was the religious, composed in honour of the Virgin, the apostles, European and northern saints.

The best-known religious poem. of the 14th century is the *Lilja* (Lily), composed by Eysteinn Ásgrímsson (d. 1361), a monk of Thykkvabœr in south Iceland. Using a traditional scaldic measure *(hrynhent)*, Eysteinn surveys the story of the universe in 100 strophes. He passes through the creation, fall of Satan, the first sin, and the birth, life and passion of Christ.

Many poems of the 14th and 15th centuries were dedicated to the Virgin. They include the *Maríulykill* (Clavis Mariae), an experiment in metrical forms composed by Jón Pilsson (c. 1390–1471), and the anonymous *Maríugrátr* (Weeping of Mary). The life of St. Peter is celebrated in the *Pétrsdrápa* (Lay of Peter) and the *Heilagra manna drápa* (Lay of Saints) includes strophes in praise of St. Thomas of Canterbury, St. Edmund and others.

Rímur.—The term *rimur* (singular *ríma*) is used for narrative poetry in forms which developed in the 14th century and were used with undiminished vigour until the 19th century, The *rímur* consist of strophes of lines with end rhyme. Their metrical forms appear to derive from Latin hymns, but they inherit the alliterative system of early Icelandic poetry. The stories told in most of the *rimur* were taken from written texts of sagas and they are especially interesting in cases where the text of the saga itself has been lost. One of the oldest is the *Ólafsríma*, composed by Einar Gilsson (d. 1369), whose subject was the death and miracles of St. Ólaf. The *Griplur* were based upon a lost saga about an ancient hero, Hrómund Gripsson. Other *rimur* contained stories of the god Thór, the Volsungs and Grettir the Strong. Although the value of the *rimur* as literature is not great, they helped to maintain the interest in sagas and in early literature. They also saved scaldic diction from oblivion and are valuable as sources of linguistic history.

Ballads. — Ballads never attained such popularity in Iceland as they did in other European countries. Nevertheless, a number of ballads in Icelandic, dating from the 14th to 16th centuries, are preserved. Most of them are loose translations of Danish and Norwegian originals. The *Tristrams Kvœði* (Ballad of Tristram) is an exception, for it appears to be based upon the Norse saga of Tristram.

The Reformation. — The Reformation was enforced in Iceland by the Danish rulers in the 16th century. The chief political figure and chief poet of the period was Jón Arason, last Catholic bishop of Hblar, who was beheaded in 1550. In his life Jón showed that he was no less a viking than a martyr. Most of his surviving poetry is religious, including the *Píslargrátur*, the story of the Passion, based largely on St. John, the *Niðurstigningarvísur* (Verses on the Harrowing of Hell) and the *Ljómur* (Rays), which is reminiscent of the *Lilja* in structure.

The Reformation had various results for the development of learning and literature in Iceland and the first of them were not wholesome. Catholic poetry was discarded and attempts were made by the first Lutheran bishops to replace it with hymns poorly translated from Danish and German. Traditional rules of form and measure were ignored.

Lutheran teachers took pains to instruct the Icelandic people in the elements of dogma. Already in 1540, Odd Gottskálksson (d. 1556) had a translation of the New Testament in Icelandic printed in Denmark. In the following years several translations of sermons and books of instruction writen by German Lutherans were printed in Icelandic versions.

Bishop Gudbrand Thorliksson of Hblar (1571–1627) was the most energetic and the wisest of the Lutheran teachers and many translations were printed at Hólar under his guidance. Among these was the complete Bible. produced in 1584. The *Sálmabók*, published in 1589, consisted of hymns, mostly of foreign origin. In a remarkable prologue to this volume, Gudbrand showed his appreciation of the poetic traditions of Iceland, and he adhered to Icelandic conventions of alliteration and form. This respect for tradition is even more pronounced in the *Visnabdk*, verses on religious subjects published by Gudbrand in 1612.

The 17th Century. — By far the greatest poet of the 17th century mas Hallgrím Pétursson (1614–74), a clergyman who struggled for many years against poverty and ill-health. His *Passíusálmar* (Hymns on the Passion of Christ) is among the most popular books in Iceland today. The poet meditates on Christ's sufferings, drawing symbolical meaning from his wounds and words. Another interesting poet of this period was Stefán Ólafsson (c. 1620–87), remembered both for religious and profane work.

In Iceland as in other countries, interest in antiquity was stirred in the 17th century, and modern learning may be said to date from that period. Arngrim Jónsson, the Learned (1568–1648), called the attention of Danish and Swedish scholars to Icelandic traditions and to the treasures of Icelandic literature in a series of works in Latin, some of which contain abstracts of sagas now lost. Later in the century, Arni Magnússon (1663–1730) systematically collected the early Icelandic manuscripts. Part of his collection was burned in the fire of Copenhagen (1728), but the remainder passed to the University of Copenhagen, where it is kept.

Although an age of learning, the 17th century was also an age of superstition and witch-hunting. Striking evidence of this is found in the *Pislar Saga* of the clergyman Jón Magnússon (c. 1610–96), who described how he was persecuted by magicians. His complaints had led to the burning of two unfortunate victims in 1656. The *Pislar Saga*, in its lurid language, is an interesting example of the prose of the time.

The **18th Century.**—The best examples of the prose of the early 18th century are to be found in the *Húspostilla*, a collection of sermons written by Jón Vidalin (1666–1720), bishop of Skálaholt. Jón's style is forceful and his judgments forthright and severe.

Among important writers of the later 18th century may be mentioned Eggert Olafsson (1726–68), well-known both as a geog-

rapher and as a poet. Jón Steingrimsson (1728–91) is remembered for his autobiography and accounts of volcanic eruptions which he had experienced. Jón Thorláksson (1744–1819) was a poet and a scholar, and translated John Milton's Paradise Lost, as well as works of Friedrich Klopstock and Alexander Pope into Icelandic.

The greatest historian of the period was Finnur Jónsson (1704–89), bishop of Skilaholt, whose *Historia* ecclesistica Islandiae (1772–78), written in Latin, covers the history of Christianity in Iceland from the beginning to the author's time. It remains an authoritative work. Jón Espólín (1769–1836) was the author of *Árbœkur* fslands, a history of Iceland from 1262. His prose style was modelled on that of the classical period. (G. T.-P.)

MODERN LITERATURE

The later literature of Iceland was more flourishing than it had been since the 13th century. Lyrical poetry is by far the largest and most interesting portion of it. The first great poet of the 19th century was Bjarni Thórarensen (1786–1841), a judge and sheriff, who may be credited with the introduction of the Romantic movement into Iceland. The forms and diction of his poetry are strongly influenced by those of the Eddaic poets.

One of the favourite poets of Iceland is Jónas Hallgrimsson (1807–45), who succeeded best in his descriptions of nature. His touch is light and he has often been compared with Heinrich Heine. The influence of Jónas Hallgrimsson was still felt in the 20th century and his school was the reigning one up to the end of the 19th century, although then a change seemed to be in sight. The most successful poet of this school was Steingrimur Thorsteinsson (1831–1913). He is especially famous for his splendid descriptions of scenery (The Song of Gilsbakki), his love songs and his sarcastic epigrams. Equal in fame is Matthías Jochumsson (1835–1920), who, like Jónas Hallgrimsson, successfully revived the old metres of the classical Icelandic poets, whom he resembles in his majestic but sometimes too gorgeous language. He successfully treated subjects from Icelandic history, as in the *Grettisljóð*, a series of poems about the famous outlaw Grertir.

The great religious poet, Hallgrimur Pétursson, found a worthy successor in Valdimar Briem (1848–1930), whose Songs of the Bible are deservedly popular. An interesting position is occupied by Benedikt Grondal (1826–1907), whose travesties of old romantic stories are among the best satirical and humorous productions of Icelandic literature.

There was another school of poets influenced by Jónas Hallgrímsson but keeping alive the traditions of poetry maintained by Sigurður Breiðfjörð (1798–1846). In the middle of the 19th century this school mas best represented by Hjilmar Jónsson from Bóla (1796–1875), a poor farmer with little education but endowed with great poetic gifts. In the last decades of the 19th century this school produced two poets of a very high order, both distinctly original and Icelandic. One was Páll Ólafsson (1827–1905). His songs are mostly written in the mediaeval quatrains (ferskeytla) and are generally of a humorous and satirical character. The other was Porsteinn Erlingsson (1858–1914). His exquisite satirical songs, in an easy and elegant but still manly and splendid language, raised much discussion. Of his poems may be mentioned The Oath, a series of most beautiful ballads, with a tragical love story of the 17th century as the base, but with many happy satirical allusions to modern life. Near to this school, but standing apart, was Grimur Thomsen (1820–96).

In the beginning of the 1880s a new school arose among the Icelandic students in the University of Copenhagen who had attended the lectures of Georg Brandes. This school was quite different from the half-romantic one of Jónas Hallgrimsson; it was nearer to the national school of Páll Ólafsson and Porsteinn Erlingsson, but differed from these by introducing foreign elements hitherto unknown in Icelandic literature and — especially in the case of the prose writers — by imitating the style and manner of some of the great Norwegian novelists. Their influence brought Icelandic literature into new roads, and it is interesting to see how the tough Icelandic element gradually assimilated the foreign. Of the lyrical poets, Hannes Hafstein (1861–1922) was by far the most important. In his splendid ballad, *The* Death of *Skarphedinn,* and in his beautiful series of songs describing a voyage through some of the more picturesque parts of Iceland, he is entirely original; but in his love songs a strong foreign influence may be felt.

Among the many latei lyric poets Einar Benediktsson (1864–1940) and Stephan G. Stephansson (1853–1927), who lived in Canada, deserve mention, both rather heavy in style but rich in ideas and weighty in thought. Lighter and more elegant in style are Davíð Stefinsson (1895–) and Stefán frá Hvítadal (1887–1933). Tómas Guðmundsson (1901–) and Jón Helgason (1899–) deserve mention as lyrists.

The chief novelist of the 19th century was Jón Thoroddsen (1819–68). The influence of the realistic school became predominant. The most distinguished writer of that school was Gestur Pálsson (1852–91), whose short stories with their biting satire produced many imitators in Iceland. Jónas Jónasson (1856–1918), a clergyman of northern Iceland, in a series of novels and short stories gave accurate but somewhat dry descriptions of the more gloomy sides of Icelandic country life. Other interesting novelists were Einar H. Kvaran (1859–1938) and Gunnar Gunarsson (1889–). Guðmundur Friðjónsson (1869–1944), Jón Trausti (1873–1918) and Guðmundur G. Hagalín (1898–) portray folk life with skill. The most important novelist of the 20th century is undoubtedly Halldór Kiljan Laxness (1902–), whose novels Salka Valka and Independent People were translated into several languages and widely read abroad. In 1955 Laxness was awarded the Nobel prize for literature.

Among dramatists Jóhann Sigurjónsson (1880–1919) deserves mention for his powerful Eyvind of the Hills, which has been produced in many countries.

A great many gifted Icelanders of the 19th and 20th centuries devoted themselves to study and criticism of ancient Icelandic literature. Among these should be mentioned Jón Sigurðsson (1811–79) and Guðbrandur Vigfusson (1827–89), for many years reader in Icelandic at Oxford university. Finnur Jónsson (1858–1934) was professor of Icelandic in Copenhagen and the author of a detailed history of early Icelandic literature in Danish. A more humane approach to the early literature will be noticed in the works of Sigurður Nordal (1886–) and of Einar O. Sveinsson (1899–). (S. BL.; R. P. Co.)

BIBLIOGRAPHY.—The fullest bibliographies of early Icelandic literature are those of Halldór Hermannsson, published in *Islandica,* vol. i (1908), iii (1910), xiii (1920), xxiv (1935), xxvi (1937), and of J. Hannesson, *Islandica,* xxxvii (1955).

Studies of the early poetry include: H M. Chadwick, *The Heroic Age* (1912); *W.* P. Ker, *Epic and Romance* (1908); *A.* Olrik, *The Heroic Legends of Denmark,* trans. *by L.* M. Hollander (1919); A. Heusler, *Die altgermanische Dichtung* (1941).

Studies of the early prose: A. Heusler, *Die Anfange der islandischen Saga* (1914); K. Liestøl, *The Origin of the Icelandic Family Sagas* (1930); H Koht, *The Old Norse Sagas* (1931). On the later period *see* Jón Thorkelsson, *Om digtningen på Island i det 15. og 16. Århundrede* (1888); *M.* Schlauch, *Romance in Iceland* (1934); Páll E. Olason, *Menn og menntir siðskiptaaldarinnar á Islandi* (1919–26); S. Nordal, *Íslenzk Lestrarbdk 1400–1900* (1924).

General studies: Finnur Jónsson, *Drn oldnorske og oldislandske Litteraturs Historie* (1920–24); B. S. (Phillpotts) Newall, *Edda and Saga* (1931); Jón Helgason, *Norrøn Litteraturhistorie* (1934); S. Nordal, *Íslenzk Menning,* i (1942); G. Turville-Petre, *The Heroic Age of Scandinavia* (1951), *Origins of Icelandic Literature* (1953).

For the modern period Stefán Einarsson, *History of Icelandic Prose Writers, 1800–1940* (1948); Richard Beck, *History of Icelandic Poets, 1800–1940* (1950). *(G. T.-P.)*

ICELAND **MOSS,** a lichen (Cetraria islandica) of erect, loosely tufted habit, called moss because in common speech lichens were formerly known as mosses. It varies from deep brown to pale chestnut colour, rarely grayish-white. It grows to a height of from three to four inches, the branches being trough shaped to strap shaped, forking into flattened lobes fringed with short hairs bearing the male organs. The female organs are borne on the margins, usually at the tips of the lobes. It grows in alpine areas of mountains of the northern hemisphere, reaching the Alps in Europe, the Appalachians in North Carolina and Tennessee and the Rocky mountains in Colorado. It is common on the lava slopes and plains of Iceland, whence its name. A narrower variety grows in gravelly soils of the coastal plain of eastern and southern New

England.

A brown dye is sometimes extracted from it. The food processed from it in northern Europe is a light gray substance, resembling gelatin, with a slightly bitter taste. It contains about 70% lichenin or lichen starch, isomeric with common starch.

(C. W. DE.)

ICE MANUFACTURE: *see* REFRIGERATION.

ICENI, a race of ancient Britain who occupied the part of England now known as Norfolk and Suffolk. After the death of their king Prasutagus in A.D. 60 the Romans established their authority, and the Iceni were eventually conquered and became part of the Roman empire.

See BOADICEA.

ICE PLANT, the popular name for *Mesembryanthemum crystallinum* (family Aizoaceae), a hardy annual most effective for rockwork in mild climates. It is a low-growing, spreading, herbaceous plant with the fleshy stem and leaves covered with large glittering papillae which give it the appearance of being coated uith ice. It is a dry-country plant, a native of Greece and other parts of the Mediterranean region, the Canary Islands, south Africa and widely naturalized in California. *Mesembryanthemum* is a large genus (containing more than 1,000 species) of erect or prostrate fleshy herbs or low shrubs, mostly natives of south Africa, and rarely hardy in the British Isles or the northeastern United States, where they are mostly grown as greenhouse plants. They bear conspicuous white, yellow or red flowers with many petals inserted in the calyx tube. The thick fleshy leaves are variable in shape, and often have spiny rigid hairs on the margin. They are essentially sun-loving plants. The best-known member of the genus is *M. cordifolium variegatum,* with heart-shaped green and silvery leaves and bright rosy-purple flowers.

It is extensively used for edging flower beds and borders during the summer months. Besides the ice plant three other species grow on the coast of California, the sea fig or beach apple (*M. aequilaterum*), with thick, three-sided leaves; the small-leaved fig marigold (*M. nodiflorum*); and also the Hottentot fig (M. *edule*), all of south Africa. The latter has fleshy, edible fruit and is cultivated as a sand-dune binder along the coast near Los Angeles.

ICE SKATING, a means of self-propelled locomotion over ice on steel blades fastened to the bottoms of shoes. This article, after a general historical consideration of skating, skate design, rinks and ice shows, has separate sections on figure skating and speed skating and finally a section on skate sailing.

Early History. — From frequent allusions to skating in ancient Scandinavian literature, runic antiquaries and other historians assign to skating an antiquity dating back at least to the 8th century. The present-day skate may have had its origin in the primitive Norse snowshoe made of wood, but the earliest known skate is that of the bone runner. Made of cow bones and sometimes of the bones of reindeer, sheep or other large animals, these bones were ground down and shaped until they presented a flat traveling surface. They were bound to the feet with thongs. The earliest dated example is that found at Bjorko, Swed., a town which flourished between the 8th and 10th centuries. **A** specimen of an ancient skate 11 in. in length was exhibited in 1841 to the London Society of Antiquaries and described as "formed of the bone of some animal, made smooth on one side, with a hole at one extremity for a cord to fasten it to the shoe." This relic was found in the boggy soil in Moorfields. Samples of ancient bones giving evidence of having been used as skates may be seen in the British museum, in the museums of Cambridge, Edinburgh and York and also at Guildhall. Examples of the bone skate have also been found in Norway, Denmark, Scotland, Iceland, the Netherlands, Germany and Switzerland.

The modern Dutch word *schaats,* from which is derived the English word "skates," is at least as old as 1573. The earliest mention of the word in its present sense is found in Henry Hexham's *A Copious English and Netherduytch Dictionarie,* published in 1648, which refers to "Skates, nhich slide upon the ice in Holland." In the vocabulary of the Moravian educator Johann Comenius (1592–1670), *Orbis sensualium pictus* (1658), wooden skates shod with iron are called *Scrickshoes,* from the German, and in the print at the head of the section in that work they are represented as being quite long and with great curls of iron at the toes.

From the days of the Icelandic tales of the *Elder Edda* the early history of skating can be traced by means of casual reference to it in literature. Some contrivance for gliding over the ice was common in England in the 12th century, for William Fitzstephen's *Description of the City of London* states, "When the great fenne or moore (nhich watereth the walls of the citie on the North side) is frozen many young men play on the ice . . . some striding as wide as they may doe slide swiftlie; and some tye bones to their feete and under their heels, and shoving them. selves with a little picked staffe doe slide as swiftlie as a bird flyeth in the air or an arrow out of a cross-bow." Other references are found in the 14th-century Scandinavian saga *Fornmanna Sogur.* In *Historia de Gentibus Septentrionalibus* (1555) Archbishop Olaus Magnus wrote: "they race swiftly upon the slippery ice, having a plain polished iron or plain Deers or Sheep bones, mainly the shank bones that are naturally slippery by reason of their inbred fatness, and are a foot in length, fastened at the bottom of their feet." Among later writers who made mention of skating were Samuel Pepys, who first mentioned skating as an art, and John Evelyn, both of whom wrote in their separate diaries of watching ice skaters in St. James's park. London, on the same day, Dec 1, 1662. Commenting on the origin of skating, Charles Dickens wrote in an essay dated March 18, 1876, "It is curious to note that skating is almost unknown in Russia among the people, and is of entirely foreign and recent introduction." However, bone skates made from walrus teeth have been found in Siberia and are in the National Museum of Ethnology at Leiden, Neth.

Skating is widely recorded in art. One of the earliest known pictures of skating and a bladed skate is a woodcut dated 1448, illustrating the accident which befell St Lidwina, patron saint of skaters, in the year 1396. Pieter Brueghel the Elder, in the 16th century, pictured skaters in striking action in various works and other artists from many lands have immortalized skating. The world's first Christmas card, designed by 16-year-old William Maw Egley, Jr., apprentice to a London engraver, in 1842, included a skating scene. A number of countries have honoured skating with special postage stamp issues, among these being Germany, Hungary, the Netherlands, Rumania, Russia, Norway and Japan.

Skate Design. — It is not known when the metal runner was introduced, but early Dutch prints show the metal skate as having an extremely wide traveling surface. Until the middle of the 19th century the metal portion of the skate was fastened to a wooden base or footplate and the whole of the skate was fastened to the foot with leather thongs or straps. Improvement in skate design began in the 1800s with many ideas being patented, every effort being made by the inventor for security in attachment. One of the best developments was that of the Barney and Berry Co. of Springfield. Mass., which appeared in the early 1860s and which utilized screw clamps. fastening the skate to the welt of the sole and heel of the shoe. Another ingenious arrangement of this time was the Acme clamp skate from Halifax, N.S. The final and most satisfactory development in the securing of the skate to the shoe was simply to attach them permanently with screws, a method in continued use.

There were many experiments in the development of the blade of the skate, especially during the period 1830–80. Henry Boswell of Oxford designed an improved skate in 1837 which eliminated the projecting toe and had an elongated, rounded heel especially for figure skating. A major improvement was made in 1850 when E. W. Bushnell of Philadelphia introduced the all-steel skate, which eliminated the cumbersome wooden footplates and proved universally popular. The main developments in the figure skate after 1900 were the addition of sawlike teeth placed at the toe, enabling the skater to obtain better purchase in the ice when doing certain jumps, and the innovation of the "closed-toe" blade of one-piece steel, manufactured in 1914 by John E. Strauss of St. Paul, Minn. The Strauss design gave added strength to the skate and permitted

a much lighter-weight blade.

An average figure-skating blade is $\frac{5}{32}$ in. wide and is shaped with a curvature approximating that of a circle having a six-foot radius. The blade is hollow ground when sharpened, emphasizing the two edges of each skate. The hockey skate is also given a hollow grinding which allows better purchase in the ice. The speed skate uses a thinner blade and it is sharpened with a flat surface and a very long radius affording the racer a longer stroke. The popular length of the outdoor racing skate is 16 to 17 in., with the skate cups which hold the blade to the footpiece set low to the ice. For indoor racing the cups are heightened, the blade shortened to about 15 in. and the skates set far over to the left of the shoes to allow for the sharper turns.

Rinks. — The invention of refrigeration and the development of mechanically refrigerated ice rinks started the transformation of ice skating from a seasonal pastime to a major sport and launched the eminently practical skate on its way to theatrical history.

The world's first mechanically refrigerated rink was John Gamgee's "Glaciarium" in Kingsroad, Chelsea, London, built in 1876. It was a studio-type room with an ice surface 40 ft. by 24 ft., frozen by means of a mixture of glycerin and water running through copper pipes, chilled by ether. The first artificially frozen rink in the United States was installed in the old Madison Square Garden, New York city, in 1879 by Thomas L. Rankin and had a surface of 6.000 sq.ft. In 1889 a huge outdoor rink was built in Paris, running the full length of the Rue Pergolese. Other early rinks were opened in Glasgom, Frankfurt Berlin, Southampton, San Francisco. Baltimore and Pittsburgh. The popularity of these rinks grew steadily and in the second half of the 20th century there were more than 200 mechanically refriqerated ice arenas in the U.S., more than 200 in nine provinces of Canada, 28 in Great Britain and many others in practically every section of the world.

These ice arenas, many with large seating capacities, not only gave impetus to skating as a recreation and participant sport but they were also a major factor in establishing ice-show productions as leaders in spectator entertainment.

Ice Shows. — The professional skating spectacles, an outgrowth of the amateur ice carnivals, combined the colourful movement of huge casts of skaters with all the arts of the theatre — brilliant lighting, gorgeous costumes, special music and direction — and by the second half of the 20th century were established as among the most popular forms of entertainment. International tours were arranged, including the major cities of the world. One of the pioneer shows, the "Ice Follies," first produced in 1936 by Oscar Johnson, Edward Shipstad and Roy Shipstad, played to more than 40,000,000 people in 20 years. A trade publication, the *World* Ice *Skating Guide,* estimated that 11,000,000 people attended skating shows in Canada and the U.S. alone during one year in the mid-1950s, and paid more than $22,000,000 for admissions. Other prominent American shows of the 1950s were "Ice Capades," produced by John H. Harris; the "Hollywood Ice Review," produced by Arthur M. Wirtz; "Sonja Henie Ice Revue," produced by the Norwegian star. Sonja Henie; and "Holiday on Xce Shows," produced by Morris Chalfen, Emery Gilbert and George Tyson. The last were presented on ingenious mobile rinks, complete with refrigeration equipment, which could be transported anywhere in the world and set up indoors or out of doors. In a single year this company had seven separate full-scale productions playing in five continents at one time — North and South America, Europe, Asia and Africa.

Leading producers of skating spectacles in Great Britain were Sir Arthur Elvin, Gerald Palmer and Claude Langdon. Elaborate pantomimes with stories portrayed on ice were tremendously popular throughout Great Britain.

One of the earliest experiments in ice-show production, staged at the huge Hippodrome theatre in New York city in 1915, featured the German ice ballerina Charlotre (Oelschlagel) and an ice ballet imported from Berlin. Called "Flirting in St. Moritz," the show created a skating furore in New York and ran for 300 days, instigating the production of the first skating motion picture ever made, "The Frozen Warning," released in 1916 and starring Charlotte.

FIGURE SKATING

History. — Figure skating is one of the most scientific of all sports, and the most artistic division of skating. It is also the most difficult, requiring skill in plain skating, both forward and backward, a high degree of body control and assiduous practice. The first comprehensive written treatment of figure skating seems to be *A Treatise of Skating* by Capt. Robert Jones, published in London in 1772. Other early textbooks on the sport are *The Art of Skating* by Cyclos (George Anderson), published in 1830, and "The Skaters Manual," 1831.

Soon after the discovery that inside and outside edges and elementary figure-three turns could easily be done with the steel skate, it was found that turns could be made in the opposite direction or counter to the simple three turn. Combinations of various turns naturally developed, and these turns became increasingly more difficult; the style or the manner in which these turns were made was standardized, and when the course of standardization became general, competitions were organized. (See *School Figures,* below.)

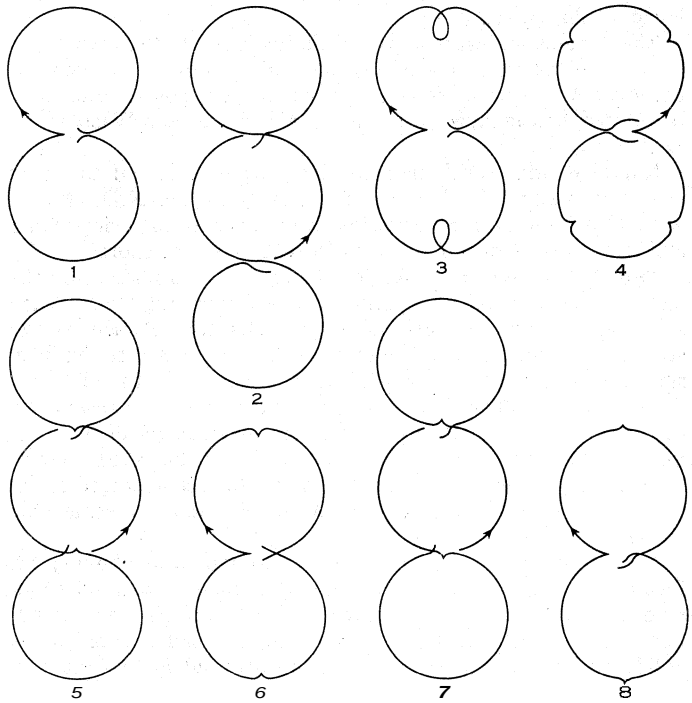
Modern figure skating was influenced to a profound degree by the revolutionary style of the American Jackson Haines (1840–76). Haines, known as the "father of figure skating," gave skating a freedom of movement which it had not formerly possessed. He was born in New York city and first came into prominence in the 1860s. A ballet master, Haines combined dance movements with his skating, novelty in America where figure skating was executed in a stiff and rigid style, and gave exhibitions throughout the eastern states and Canada. After winning the American championship he left for a tour of Europe in 1865. His first appearances in England were not successful; Londoners, like New Yorkers, preferred their own cramped manner to the sensational routines of Haines. It was not until he went to Stockholm in 1866 that his art was fully appreciated and he began a triumphal tour across Europe. In Vienna he was an instantaneous success and there he taught the Viennese to waltz on ice, which resulted in the founding of the Vienna School of Skating. After 11 years abroad Haines planned to return to America but, traveling by sled from St. Petersburg to Stockholm, he contracted pneumonia and died in Finland in Jan. 1876.

The lack of appreciation of Haines in the U.S. and Great Britain was the result of the styles of skating then in vogue. Figures were accomplished by ungainly twisting of the body, together with much kicking of the nonskating leg.

At the continental winter resorts, in Great Britain and to some extent in Canada, a form of figure skating known as the "English" style was popular until the early 1900s. Various modifications of the style were known by other names but the essential features were identical. A branch of this form of skating was the hand-in-hand or "combined" style, in which more than one skater took part, usually four and sometimes six or eight. **A** member of the group was appointed "caller" and it was his duty to call out to the others moves which the group did simultaneously. Interesting patterns were thus performed.

Out of these various styles of skating there developed at the beginning of the 20th century the international style, which became popular and is followed the world over. Irving Brokaw, champion of America in 1906, brought the international method of skating back to the U.S. on his return from a European tour in 1908. Although but little remains of the previously mentioned forms of skating they cannot be easily dismissed, since the present form of skating has its foundations in their essentials and in those set down by Haines.

The development of figure skating from an obscure form of competition in the early 1900s to a major sport was largely the result of control organizations such as the Internationale Eislauf-Vereinigung (I.E.V.; International Skating union) of Europe, the National Skating Association of Great Britain (organized in 1879), the Cnited States Figure Skating association (U.S.F.S.A.; 1921), the Canadian Figure Skating association, and other amateur groups and clubs. The I.E.V., founded July 23, 1892, at Scheveningen. Neth., is the governing body over skating throughout the world. The principal aim of the control organization is to improve



REPRINTED FROM THE U.S.F.S.A. RULEBOOK WITH THE PERMISSION OF THE UNITED STATES FIGURE SKATING ASSOCIATION. HOLDERS OF THE COPYRIGHT

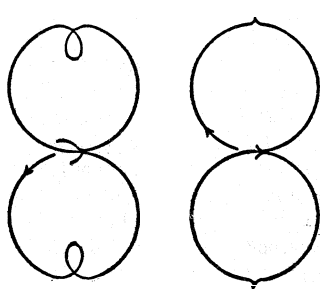
FIG. 1.— SCHOOLFIGURES: (1) CIRCLE EIGHT; (2) CHANGES OF EDGE: (3) LOOPS: (4) DOUBLE THREES; (5) ROCKERS: (6) THREES: (7) COUNTERS AND (8) BRACKETS

and advance figure skating, to provide standards. to prescribe tests and rules for the holding of competitions and generally to take all steps necessary to regulate figure skating through its membership clubs.

The Edinburgh Skating club, instituted in 1642, is the oldest skating club in the world. The Skating Club of London and the Glasgow Skating club were both formed in 1830. A steady increase of interest in the sport has been shown in the U.S. and Canada, especially since the 1930s. The U.S.F.S.A. had 120 member clubs in the second half of the 20th century. Organized in 1849, the Philadelphia Skating Club and Humane society is the oldest skating club in the U.S. Other early groups are the Skating Club of New York (1863) and the Skating Club of Boston (1912). The Canadian Figure Skating association had over 150 member clubs in the 1950s, including the historic Minto Skating Club of Ottawa and the Toronto Skating club.

Divisions.—What is broadly called figure skating is divided into various divisions; these are school figures, free skating, dancing, pairs and fours. In competition, the event for individuals consists of two sections, the prescribed school figures and free skating, or optional routine for a specified number of minutes.

School *Figures.*—The elements of school figures are simple curves or turns, which are done in the direction of motion, and the so-called forced turns, which are done against the direction of motion. There are four directions in which the skate may go: outside edge, both forward and backward, the inside edge, also forward and backward. Skated first on the right and then on the left skate to form full circles, these simple curves become the fundamental figure eights. A combination of these circles becomes the changes of edge. Following in difficulty are, threes, double threes, loops, brackets, counters and rockers. (*See* fig. 1.) Advanced figures are the so-called one-foot figures in which the full figure-eight form is done on the same skate instead of making a transitional change of feet at the point of start, as is done in the elementary figure eights.



REPRINTED FROM THE U.S.F.S.A. RULEBOOK WITH THE PERMISSION OF THE UNITED STATES FIGURE SKATING ASSOCIATION, HOLDERS OF THE COPYRIGHT

FIG. 2.—(1) LOOP-CHANGE-LOOP AND (2) BRACKET-CHANGE-BRACKET

There are 69 possible cornbinations of figures as officially designated by the I.E.V. Each figure is given a factor value from one to five, according to difficulty. The fundamental eights, for example (except the inside back eight), have factor values of one, while the back loop-change-loops and the back bracket-change-brackets have factor values of five. (See fig. 2)

Definite rules have been set down concerning the correct tracings of school figures on the ice. For example, both circles of the eight should be of equal size when divided by the transverse axis; there should be a symmetrical grouping of the individual parts of the figures about the axes; figures should be skated on the specified edge of the skate without changes of edge or flat edges, except, of course, when the figure calls for a change of edge. Three turns, brackets, rockers and counters should be made without changes of edge before or after the turns and the turns should be placed on the long axes.

There are also definite rules for the body positions of the skater while performing the figures. The body should be erect, without bending at the hips; there should be a moderate bending of the skating knee; the head should be held erect and the skater should not look at the ice. The free foot (nonskating leg) should have the toe of the foot turned downward and outward with the free knee slightly bent; the free foot is generally held behind the tracing foot. The arms should hang down easily but without raising the elbows or hands far from the body. Everything violent, angular or stiff is to be avoided. There should be no strong effort and the impression should be given that the skating is executed with ease.

Free Skating.—The second section of the singles events is free skating. Generally speaking it is a "free" adaption of the various parts of the circles and the turns which make up school figures, and is skated to music. The design of a free-skating program must be a varied one and should include spirals (exaggerated edges), dance steps, connecting moves, jumps and spins. Jumps are an important element in a program. They are leaps off the ice with from a half turn to triple turns in the air. Many of the jumps are named after their originators, for example, the Salchow, the Paulsen, the Boeckl, the Pat Low (also known as the W'alley) and the Lutz. Others are the three jump, the loop, the counter (named after school figures) and the flip. Spins are another element; some of these are the flat-foot spin, the toe scratch, the Haines and the arabesque, which is also called the camel spin. A pair skating program is very similar to the singles program in its content and construction. An important element in this branch, besides the jumps, spins and dance steps, is the lift. In this move the man lifts his woman partner in the air while skating. Many daring and exciting lifts have been devised. Fours consists of two men and two women, and is skated as pairs and as a group. Jumps, spins. lifts, pair and group moves comprise the program.

Dancing.—Although ice dancing has been known for many years, it became. after the 1930s, by far the most popular branch of the sport. Unlike ballroom dancing, in which steps may be improvised, ice dancing is skated in set patterns and with set steps which never vary. The steps are, as in free skating, based on parts of circles. The three turn is mostly used with an occasional bracket, rocker or counter.

Competitions.—Although the actual school figures to be skated in a singles competition are not known to the competitor until 15 minutes before the event, they are drawn by lot from a larger group, which is usually made known at some previous date. There must be an odd number of judges, no two of whom may be from the same club. city or country, depending upon whether the competition is local, national or international. When each skater has completed a particular figure, it is given a mark by each judge independently and represents his numerical opinion as to its value. The correctness of the shape of the figuie. the turn, triple repetition, the largeness of the figure and the form with which the figure is skated are the factors upon which judgment is made. The free-skating program is given two marks, one for content, or what the

skater has done, and the other for performance, or the manner in which the skating was done. The pairs, fours and dance competitions are judged in a similar manner except, of course, that there are no school figures skated.

The first amateur women's world champion was Madge Syers of England, who held the title for the years 1906–07. Gilbert Fuchs of Germany won the first world championship for men (1896). European skaters held a tight grasp on all the world's titles until Barbara Ann Scott of Canada triumphed in 1947, the first time a world figure-skating championship had left Europe. The men's world title went to America for the first time when Richard T. Button of the U.S. won the championship in 1948. Button was one of the great modern-day skaters and held all the major championships from 1948 1952. Tenley Albright, Newton Center, Mass., who won the Olympic title in 1956 and the world's in 1953 and 1955, was the first U.S. woman to win the Olympic championship. (For winners in Olympic competition see OLYMPIC GAMES.)

Great Britain dominated the dance championships of the world in the second half of the 20th century which such superb teams as Lawrence Demmy and Jean Westwood; Paul Thomas and Pamela Weight; and Courtney Jones and June Markham. Robert Paul and Barbara Wagner of Canada, always famous for magnificent pair skating teams, won the 1957 world pair title. Among the great pair skating combinations of the world was Montgomery Wilson and his sister, Constance Wilson Samuel, both of whom also held many major singles titles.

The most celebrated figure-skating champion of all time was Sonja Henie, who at ten years of age won the national championship of Norway. Henie was three times Olympic champion and ten times world champion. She turned professional in 1936 and skated in personal appearances before millions throughout the U.S., Canada, Europe and South America, producing many of her own shows, and she starred in 11 motion pictures.

SPEED **SKATING**

History. — Of the earliest skating races no records have been kept. That racing was a popular pastime in the Netherlands earlier than the 17th century is proved by numerous paintings depicting racing scenes. Women's races took place as early as 1805 at Leeuwarden. Keen interest in ice racing was evidenced in England from the early 1800s, especially in the fens or marshy section of the country. The first recorded skating match in England was that in which Youngs of Mepal beat Thomson of Wimblingdon, both men from the fens, in the year 1814. In Jan. 1823, according to the Annals of Sporting, the first amateur match took place between teams of six gentlemen from March and Chatteris, Drake of Chatteris finishing first. In the 1850s the celebrated Smart family entered the racing scene, with William ("Turkey") Smart defeating Larmen Register in 1854 and retaining the championship for more than a decade. His nephew, George ("Fish") Smart, won the championship in 1878 and held it until 1889, only to relinquish it to his younger brother, James. The first amateur championship of England was held in 1880 at Hendon by the newly formed National Skating association and won by F. Norman, a fens skater.

Speed skating was tremendously popular in northern sections of the United States and Canada. Charles June was considered the best U.S. skater for 1838 and many years thereafter, and his place of residence, Newburgh, N.Y., on the Hudson river, became the headquarters of U.S. ice racing. This city also is the birthplace of the Donoghue family, who may be called the Smarts of America. The most noted members of this family were T. Donoghue and his two sons, Tim and Joseph F. Donoghue, each in his day the fastest skater in the world.

J. F. Donoghue went to the Netherlands in 1889 to compete in the Amsterdam races and won the two-mile event, defeating among others the celebrated Russian flyer Alex von Panschin. In 1891 he again competed in the great international races at Amsterdam and on Jan. 6 and 7 won all four events on the program, earning him the title of champion of the world. J. F. Donoghue was the first American to skate one mile under three minutes, his time being 2 min. 59 sec.

The famous Norwegian figure skater Axel Paulsen was also one of the fastest racers of his day. He competed in some of the great American races and in 1884 he won most of the races he entered, first in New York, then in Milwaukee and Washington, D.C.

Norval Baptie, world champion 1905–07, was one of the most colourful skaters of all time. Born at Bathgate, N.D., Baptie was a champion racer, renowned exhibition skater on racing blades and on figure skates and a leading instructor of the sport.

The Stroke. — In speed skating the blade, when planted on the ice with weight upon it, describes a nearly straight line. When stroking, the last few feet only curve slightly outward as the skate leaves the ice. The length of stroke has tended to diminish since the days of the 12–18 yd. stride attributed to the old English champion William Smart on the fen "runners." The modern racing stroke rarely exceeds 10 yd., and is usually 6 or 7. Particular instances vary with conditions of ice, etc., but at St. Petersburg, in 1896, Eden's stroke in the 10,000-m. race averaged about 73 yd., that of Peder Oestlund at Davos, in 1900, the same (for one lap it was 8 yd.).

J. F. Donoghue's stroke in 1891 was computed at about 9 yd. Irving Jaffee, U.S., former Olympic champion, had a powerful 8-yd. stroke in some of his races. Clas Thunberg of Finland, world amateur champion 1923–25–28–29–31, had a tremendous $27\frac{1}{2}$-ft. stroke. He visited the U.S. in 1926 and in two races at Madison Square Garden in New York city was soundly beaten by Joe Moore, New York city, due in large measure to the fact that his stroke was far too long for the small indoor track and he could not negotiate the turns.

Later in the same year, on outdoor tracks, the "Flying Finn" set two U.S. records which had not been broken by the second half of the 20th century.

Courses. — The international system of ice racing involves a course with straight sides and curved ends of such a radius that no slackening of speed is necessary. The competitors race two at a time on a double track, and the time test is used. Each skater must keep his own course, to prevent either from using the other as pacemaker or windshield. The advantage of inner curve on a continental course is given alternately and a space left open between the tracks at one point for the skaters to cross. The official I.E.V. track measures 400 m.; the official U.S. outdoor track is 6 laps to the mile.

Form. — Competitive speed skating requires skill, strength, muscular co-ordination and great stamina. The body should be poised so that the centre of balance is in the hips. At racing pace the body should follow an imaginary straight line. The stroke should be kept as straight as possible, for swaying widely from side to side results in loss of momentum. To obtain the most effective stroke with minimum effort, the skater must lean forward from the waist and bend the knees. The force of the leg drive is directed forward, not upward; the push should be made toward the side, not backward; and the push is from the centre of the blade, not from the toe.

Records. — The official amateur world records are: 500 m., Yevgeni Grishin, U.S.S.R., 40.2 sec. (1956); 1,500 m., Grishin and Jurij Michailov, U.S.S.R., 2 min. 8.6 sec. (1956); 5,000 m., Boris Shilkov, U.S.S.R., 7 min. 48.7 sec. (1956); 10,000 m., Knut Johannesen, Norway, 15 min 46.6 sec. (1960).

For winners in Olympic competitions, see OLYMPIC GAMES.

The official U.S. amateur outdoor records were: 220 yd., R. Fitzgerald, 18.1 sec. (1943); 440 yd., C. Gorman (1937), R. Fitzgerald (1942), K. Bartholomew (1942), 35.4 sec.; 880 yd., R. Fitzgerald, 1 min. 14.2 sec. (1945); $\frac{3}{4}$ mi., C. Thunberg, 1 min. 55.2 sec. (1926); 1 mi., C. Thunberg, 2 min. 38.2 sec. (1926); 2 mi., E. Schroeder, 5 min. 38.8 sec. (1934); 3 mi., R. Robinson, 8 min. 19.6 sec. (1930); 5 mi., R. Robinson, 14 min. 30.4 sec. (1927).

The official British amateur outdoor records are: 220 yd., F. Tomlins, 18.2 sec. (1940); 440 yd., R. Wyman, 36.8 sec. (1933); 880 yd., C. W. Horn, 1 min. 31.8 sec. (1929); 1 mi., F. W. Dix, 2 min. 27.2 sec. (1912); $1\frac{1}{2}$ mi., N. A. Holwell, 4 min. 12.2 sec. (1952); 3 mi., C. W. Horn, 9 min. 52.8 sec. (1929).

SKATE SAILING

Skate sailing is the sport of moving over the ice on skates propelled by the wind. It is probable that skate sailing originated in the Scandinavian countries and was practised in some form or another almost immediately after the invention of the skate. One of the first skate-sailing organizations was the "Ice-Skate Sailing club" formed in Stockholm in 1901. The sport was taken up by members of the London Skating club in England in the 1890s and was introduced to North America in the early 1900s. The Skate Sailing Association of America, governing body over the sport in the United States. was organized in 1922.

The modern skate sail, generally rectangular or triangular in shape, has approximately 50 to 60 sq.ft. of area. The Skate Sailing Association of America recommends that the sail be perfectly flat and stretched to drumhead tightness. The spars and rigging should be moderately light, yet strong and as simple as possible so that they can be handled easily in cold, windy weather. In sailing, the skate sail is always carried on the windward shoulder, that is, between the sailor and the wind. The sail material can be a good grade of sheeting or unbleached muslin but for best results should be a nonporous, lightweight sailcloth or balloon silk. Long, tubular racing skates 16 to 18 in. in length are used.

Learning how to skate sail on the ice before and against the wind requires only a basic proficiency in skating, for the sail gives added stability and bears much of the sailor's weight. Speeds up to 55 m.p.h. are reported to have been recorded over measured courses.

BIBLIOGRAPHY.—W. R. Boeckl, *Willy Boeckl on Figure Skating* (1937); Sonja Henie, *Wings on* My *Feet* (1940); Robert Dench and Rosemarie Stewart, *Pair Skating and Dancing on Ice* (1943); Paul von Gassner, *Figure and Dance Skating* (1949); Dick Button, *Dick Button on Skates* (1955); Barbara Ann Scott and Michael Kirby, *Skating for Beginners* (1953); Gustave Lussi and Maurice Richards, *Championship Figure Skating* (1951); *T*. D. Richardson, *Ice Skating* (1956); *R*. C. Jefferson, *Skate Sailing* (1957); Skate Sailing Association of America, *Practical Suggestions for Making and Using Skate Sails* (1930); *W*. Van B Claussen, *Evolution of Skate Sailing* (192;) ; *E*. Van der Weyden. *Instructions to Young Skaters* (1957); N. Brown, *Ice-Skating* (1959); *Skating; World Ice Skating Guide; The Skater; The Skating Times*. **(A.** R. *G*)

ICE YACHTING. The sport of sailing and racing ice yachts, once a rich man's hobby involving boats costing several thousands of dollars and professional skippers and crews, became, in the second half of the 20th century, confined almost entirely to small, light but extremely fast boats, often built by their owners and costing from $500 to $1,500 apiece. By taking advantage of modern highways and car-top carriers and trailers, iceboatmen were able to widen the area and lengthen the season for iceboating. The most active regions in North America are Wisconsin, Illinois, Michigan, Ontario, southeastern New York, northern New Jersey, Connecticut and eastern Massachusetts. European areas where the sport is active include Sweden, the Netherlands and Germany —in general. the Baltic basin region.

The Dutch seem to have been the first iceboaters, although the Finns, Latvians and others living around the Baltic sea no doubt contrived some sort of "sailing sleigh." as the Austrians call it, at a very early date. **A** dram-ing of a Dutch iceboat dating from 1790 shows a regular sailing craft with a strong cross plank under the hull near the bow, a runner at each end and a sharp iron shoe at the stern, on the bottom of the boat's regular rudder.

Similar craft appeared in America along the banks of the Dutch-settled Hudson river. In 1790 Oliver Booth sailed an iceboat on the frozen river at Poughkeepsie. N.Y. Within a few years iceboats were sailing the frozen waters around Red Bank and Long Branch, N.J.

Immediately after the Civil War interest in iceboating increased rapidly. The Poughkeepsie Ice Yacht club was formed in 1861, followed within a few years by the New Hamburgh and Hudson River Ice Yacht clubs. The latter organization, located at Hyde Park. N.Y., flourished under the patronage of a large group of millionaire sportsmen. including Archibald Rogers and John E. Roosevelt. an uncle of Franklin D. Roosevelt, who was himself an officer of the club at one time. In 1900 the club fleet mustered over 50 yachts, including 6 giants of the first class with over 600 sq.ft. of sail apiece. The development of the sport at Long Branch and Red Bank followed the same pattern and the boats were similar to those on the Hudson.

When iceboating on the Hudson died out after 1902, activity shifted to these Jersey rivers and to the midwest. where the sport had become active and flourished in Kalamazoo, Mich., and Madison and Oshkosh, Wis. The boats in use were almost all of the basic Hudson river pattern. consisting of a single fore-and-aft spar, called the backbone, mounted just ahead of its midpoint on a broad. flexible wooden plank called the runner plank. which had a runner mounted at each end. The third running blade was pivoted through the after end of the backbone and controlled by a tiller. The helmsman and crew (only two men sailed these huge boats as a rule) clung precariously to a shallow, elliptical tray just ahead of the steering runner. The mast was stepped on the backbone, several feet ahead of the runner plank. The rig, almost without exception, was jib and mainsail. From 1879, when H. Relyea built the "Robert Scott" on the Hudson, until 1947, when Carl Bernard and Frank Tetzlaff constructed the "Mary B." at Madison, the only changes made in the design of this type of yacht were refinements of materials and rigging.

Some of the speeds recorded were notable. In 1885 Commodore James Weaver sailed the "Scud" at 107 m.p.h. on the Navesink river at Red Bank; in 1907 Commodore Elisha Price sailed the "Clarel" at 140 m.p.h. on the Shrewsbury river at Long Branch; in 1908 the "Wolverine" of Kalamazoo, Mich., sailed the fastest 20 mi, to windward and return recorded. covering the course from a standing start in 39 min. 4 sec. Clearly, in those days, the iceboat was the fastest vehicle man had yet produced.

Experiments show that the best speed the iceboat can accomplish is approximately four times the speed of the wind that is blowing at the time. This phenomenon is not easy to explain, but it must be borne in mind that (1) the boat is sailing across the wind and is not being pushed along by it and (2) by her very motion the boat creates an increase in the velocity of the wind she sails with. These principles were only vaguely known in the early days, and the traditional jib-and-mainsail rig with stern rudder was so firmly entrenched that experiments with other designs were usually unsuccessful. The forward thrust sometimes lifted the stern rudder from the ice, sending the whole boat into a spin. Perfect tuning of the boat and perfect handling by the sailor could minimize but never eliminate this built-in tendency to become unmanageable in strong winds.

About 1931 Starke Meyer of Milwaukee, Wis., became convinced that a boat with steering runner at the bow and runner plank aft, like a tricycle, would not spin. He reasoned that the downward and forward thrust of the mast. now located between steering runner and runner plank. could serve only to increase rudder traction. His first bow-steerer easily defeated all competition in her first season on the ice. It mas clear that the bow-steerer would not spin—that she was correctly balanced and directionally stable.

Smaller versions, mith a sail of only 75 sq.ft., showed they could sail safely and fast. By 1940 the design had crystallized and the 75-sq.ft. class enjoyed a rapid growth. By 1950 boats of this class were winning not only 75-sq.ft. class races, but also open and free-for-all events of all sorts. Other classes continued to exist, but very few boats mere built in them, and as the older large boats were discarded, they were not replaced.

Iceboats have always been classified for racing purposes by sail area. The classes of the Hudson River Ice Yacht club before 1900 were as follows: first class, over 600 sq.ft.; second class, 450 to 600 sq.ft.; third class. 300 to 450 sq.ft.; fourth class, 225 to 300 sq.ft.; fifth class, under 225 sq.ft. In 1935 the classes recognized by the Northwestern Ice Yachting association were as follows: class A, 250 to 350 sq.ft.; class B, 175 to 250 sq ft ; class C, 125 to 175 sq.ft.; class D, 75 to 125 sq.ft.; class E, up to 75 sq.ft.

In 1937 seven eastern clubs formed the Eastern Ice Yachting association, patterned after the Northnestern association (founded in Oshkosh, Wis., in 1912) and recognizing the same classes. Membership in both associations varies as their member clubs

prosper, but in general the Eastern association includes a group of clubs in the New York-New Jersey-Connecticut area, and the Northwestern association includes clubs from eastern Wisconsin, northern Illinois, Michigan and Ontario. Both the Northwestern and the Eastern associations conduct an annual championship regatta, to which member clubs may send their best boats in all recognized classes.

The growth of the "skeeter," or class E, at 75 sq.ft. was so rapid that by 1939 there was a need for an organization devoted to this class alone and the International Skeeter association was founded, with headquarters in Chicago. Activity was also brisk around Detroit, which fostered a great deal of experimentation and development in class E.

Most racing skeeters are single-seaters, precluding the possibility of carrying a passenger for pleasure sailing or for instruction. The need for a two-seater was felt strongly and crystallized in the founding in 1948 of a second one-design class, this time in the east. This new class was, appropriately, called the "Yankee," and had an orthodox two-seater as the accepted design. Yankees competed on even terms with single-seater racers, and in 1952, 1954, 1956 and 1957 the Eastern Ice Yachting association class E and open championships went to Homer Sieder's "Rebel," a Yankee one-design craft.

In 1951 the New Hamburgh Ice Yacht club, inactive for 25 years, turned over custody of the famous Ice Yacht Challenge Pennant of America to the Eastern Ice Yachting association. This trophy is open to any type or size boat and to any club in the world. An open invitation regatta was held at Greenwood Lake, N.J., Feb. 18, 1951, to which all known clubs in the world were invited. The most distant challenger was the Fox Lake (Ill.) Ice Yacht club, represented by Ed Rollberg's "Black Magic," which won a close series from Elmer Millenbach's "Renegade" of Detroit. Both easily defeated 15 eastern clubs. On March 1, 1953, Fox Lake lost the trophy to Pewaukee Ice Yacht club at Lake Geneva, Wis., which club successfully defended the flag for five years.

In the midwest, interest in the larger boats was kept alive by competition for two cups, by tradition open only to the boats of class A and larger, the Stuart cup, put up in 1903, and the Hearst Cup, put up in 1904 by William Randolph Hearst for competition in the 450-foot class (later opened to class A at 350).

Before World War II, European iceboating was very active and well organized under the European Ice Yachting union. Member nations included Sweden, Latvia, Estonia, Germany and Austria. Competitions were held annually in several classes, and a one-design class of 15 sq.m. sail area. Rigs were almost universally single-sail, or "cat"; the backbone was a hull, or fuselage, with pilot and passenger sitting upright, and steering done by a wheel. Although contact was never formally established across the Atlantic, correspondence and comparisons of ideas went on with the result that Americans, borrowing freely the efficient cat rig, fuselage backbone and safe, comfortable pilot's position, developed the modern fast racer when they made it into a bow-steering design. On the other hand, Europeans have steadfastly refused to use the bow-steerer.

After World War II some iceboating was again carried on in Germany. Sweden continued through the years.

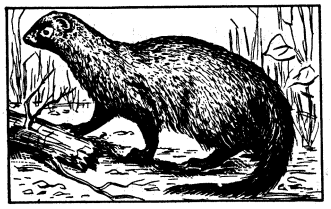
See F. M. Gardiner, *Wings on the Ice* (1938); *Yachting* (Nov.–Dec. 1942; Jan.–Feb. 1943; Jan.–Feb. 1944). (R. A. R.)

I-CH'ANG, a port of China on the north bank of the Yangtze river in western Hupeh province. Although a relatively small town, with about (1953 est.) 100,000 inhabitants, it plays an important economic role in the trade of Szechwan province and the Yangtze valley. In 1958 it was one of five municipalities in Hupeh under direct provincial administration, as well as being the seat of eight districts forming a special *ch'u* (region). Ten miles above the port begins the rugged country through which the Yangtze breaks in a series of four great limestone gorges and about 60 rapids and whirlpools, the grandeur of which has been a favourite theme of many Chinese poets, especially Li Po (*q.v.*). A short distance above I-ch'ang is the prospective site of a hydroelectric dam that has vast promise for the industrialization of central China. During flood stages 1,000-ton steamboats can navigate up to I-ch'ang where transshipment takes place between upriver and downriver traffic. Formerly, carriage upriver was entirely hauled by junks pulled over the rapids by gangs of men. After 1909 small, high-powered river steamers carried a large proportion of the commodities passing upstream, though much of the traffic remains junk-borne. A motor highway also reaches westward from Wu-han to I-ch'ang.

The city, captured in 1940, marked the farthest Japanese advance up the Yangtze valley in World War II. I-ch'ang, a treaty port (1876–1943), has a city wall between which and the sheltered anchorage stood the small foreign settlement. (H. J. Ws.)

ICHINOMIYA, a commercial town in Aichi prefecture in Japan, about 11 mi. N.N.W. of Nagoya. Pop. (1955) 157,025. There are approximately 1,000 factories which manufacture about 60% of the nation's woolen fabrics. The cotton-textile industry is also important. The town developed in the 7th century from the Masumida shrine. During the Edō period (1603–1867), Ichinomiya was an important stage on the Gifukaido highway. The suburbs form a part of the Owari horticultural zone. (R. B. H.)

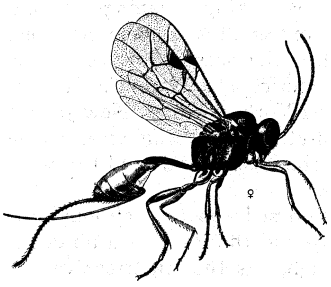
ICHNEUMON, the name applied to a large mongoose (*Herpestes ichneumon*) found throughout Africa and also in southern Spain. In size this species exceeds a domestic cat. It is covered with long, harsh, many-banded hairs, which results in a shaggy appearance and grayish-brown colour, darker on the head and along the middle of the back; its legs are reddish and its feet and tail black. It lives largely on rats and mice, birds and reptiles, and for this reason it is sometimes domesticated. *See* CARNIVORA: *Feloidea.* (J. E. HL.)



ICHNEUMON OR MONGOOSE OF AFRICA AND SOUTHERN SPAIN

ICHNEUMON FLY, common name for parasitic insects comprising the superfamily Ichneumonoidea, order Hymenoptera, from the genus *Ichneumon,* typical genus of the largest family of this group, Ichneumonidae. "Fly" in the common name is unfortunate since these insects are not flies at all (true flies, order Diptera, have only two wings whereas ichneumon flies have four) but are really parasitic wasps.

The Ichneumonoidea contains four families: Megalyridae, with less than 50 known species, mostly Australian; Stephanidae, with a few hundred known species, most of them native to tropical regions; and two very extensive families, Braconidae and Ichneumonidae, both widely distributed. and each with thousands of described species and even more thousands of undescribed ones. This superfamily includes most of the larger species of parasitic Hymenoptera, and also many that are very small; body lengths range from less than one-eighth inch to nearly two inches. The body, often brilliantly coloured, is usually comparatively narrow; the head is free and has long, slender antennae that very rarely have as few as 11 segments and often have more than 50. The compound eyes are large, and the forewings usually have rather complete venation. Some species, however, are wingless, at least in the female sex. The abdomen, sometimes petiolate (attached by a narrow "waist") and sometimes sessile, is, in the female, provided with an egg-depositing organ (ovipositor) which ranges in length from so short as to be unnoticed to several times as long as the body.



FROM CUSHMAN "JOURNAL OF AGRICULTURAL RESEARCH 1916

ICHNEUMON FLY (THERSILOCHUS CONOTRACHELI), A BENEFICIAL PARASITE

All species are parasitic, many on the caterpillars of moths and butterflies and larvae of sawflies and of wood-infesting beetles. Some of the smallest species are parasites on plant lice; a few on adult beetles, true bugs or spiders; and some are even parasites

of other ichneumon flies, these being called hyperparasites or secondary parasites.

The females deposit their eggs in or on the larvae or pupae (rarely eggs or adults) of the host species; the legless, maggot-like larvae that hatch from these eggs feed on the body fats and fluids of the host until fully grown. At this time the plump larvae usually spin silken cocoons, within which they pupate and from which the adult parasites eventually emerge. Those species parasitizing exposed hosts usually develop as internal parasites, whereas those attacking hosts concealed in wood burrows, plant stems, cocoons or leaf mines feed externally. In the case of the internal parasites the hosts feed and behave normally until shortly before the parasitic larvae have completed their development, but the hosts of the external feeders are paralyzed by the female parasites and do not regain activity. In most cases a single parasitic larva completes its development within or upon its host, but in some species many larvae develop in a single host. Twenty or more larvae of *Apanteles glomeratus,* a common and widely distributed parasite of cabbage butterfly caterpillars, complete development within a single caterpillar and then emerge to spin their cocoons beside the destroyed host.

Adults of ichneumon flies feed principally on honeydew secreted by aphids (*q.v.*) and certain related insects, or on host juices that exude from punctures made by the ovipositor. All species can, and under certain conditions do, reproduce without fertilization (parthenogenesis; *q.v.*). In most instances the progeny of such parthenogenetic reproduction are exclusively males, but certain species produce females regularly in parthenogenesis, the male sex being very rare or unknown.

Except for those that live as hyperparasites — and thus lower the numbers of other ichneumonids — ichneumon flies are generally beneficial and under certain conditions may play an important role in the control of plant pests. Some species have been transported from their original homes and colonized in new areas where their normal hosts became established and could not be controlled by sprays or other artificial treatment. See also INSECT.

BIBLIOGRAPHY.—A. D Imms, *A General Textbook of Entomology,* 9th ed. (1957); J. H. Cornstock, *An Introduction to Entomology,* 9th ed. (1950); C. P. Clausen, *Entomophagous Insects* (1940); H K. Townes, *A Catalogue and Reclassification of the Nearctic Ichneumonidae,* part i (1944), part ii (1945). (C. F. W. M.)

ICHTHYOLOGY, that branch of zoology (*q.v.*) dealing with the study of fishes (*q.v.*). As a foundation for an understanding of the anatomy and physiology of fishes, one may start with the simple, diagrammatic lower chordate amphioxus (*q.v.*), then consider the characteristics of the subphylum Vertebrata (see VERTEBRATE) in general before approaching fishes as a special group.

Paleontology (*q.v.*) includes the study of fossil fishes (see OSTRACODERM). The lowest living fishes belong to the jawless Cyclostomata (see CYCLOSTOME). Higher in development of structures are the jawed selachians, or sharks and rays (see CHONDRICHTHYES), characterized by having a cartilaginous skeleton. The bony fishes first developed a combination cartilage-and-bone skeleton (see STURGEON; GAR PIKE; BOWFIN). Then the true bony fishes, or Teleostei (*q.v.*), appeared. The student may be interested in a particular fish or group of fishes, such as the herring. anchovy, char, salmon and trout, smelt, pike, electric eel, goldfish, catfish, eel, moray or *Muraena,* flying fish, sea horse, cod, barracuda, mullet, mackerel, swordfish, tuna or tunny, bass, drum, perch, sunfish, parrot fishes, angelfishes, goby, flatfish or flounder, sole, triggerfish (see FILEFISH), globefish or angler (*qq.v.*).

ICHTHYORNIS, a group of extinct birds known from the Upper Cretaceous deposits (from about 70,000,000 to 130,000,000 years ago) or the Great Plains area of the United States (Kansas and Texas), now classified in the order Ichthyornithiformes. These flying birds, with strongly developed wings, were one of O. C. Marsh's notable discoveries, the two best-known species being about the size of the domestic pigeon. Marsh identified parts of a maxilla and a lower jaw bearing teeth set in sockets as belonging to this group of birds, an allocation that has led to considerable discussion. It is generally accepted now that these jaw fragments are those of a reptile, probably a small species of mosasaur (an extinct marine lizard). Indications are that Ichthyornis, like its modern relatives, lacked teeth.

The brain showed greater development than that of another extinct bird, Hesperornis, but still was smaller than that of modern birds. The vertebrae differ from those of other birds in being biconcave. The breastbone (sternum) is large, with a strong keel, and the wing bones are long and well developed, with the shoulder girdle similar in general type to that of living birds of strong flight. The legs were moderately strong with short shank (tarsus), fairly long anterior toes and a small, slightly elevated hind toe. The tail had a well-developed terminal plate of bone (pygostyle).

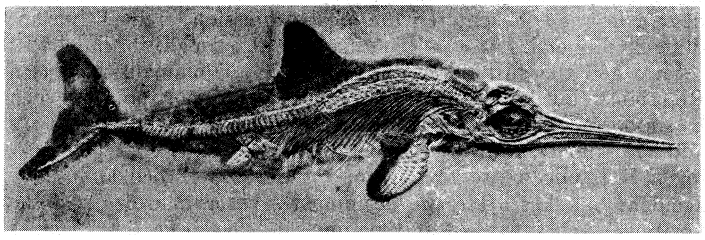
The indication is that these were birds of active flight, probably with webbed feet, in general form like modern gulls and terns. This resemblance, however, is superficial as the species are primitive, and are to be placed in the superorder Ichthyornithes, apart from the Neognathae, the modern birds.

Seven species are recognized in the genus Ichthyornis, of which *Ichthyornis* dispar and I. *victor* are known from partial skeletons and the others from fragments. These form the family Ichthyornithidae. Apatornis *celer* from western Kansas, placed in the family Apatornithidae, completes the list, the two families forming the order Ichthyornithiformes.

Though only two groups of birds are known from the Cretaceous — the divers, like *Hesperornis,* and the strong flyers, also probably of aquatic habit, like Ichthyornis — it is probable that the bird life of that period was more diversified. The two known are both highly specialized so that they stand alone and cannot be considered as directly ancestral to any of the known groups of birds which have been found in fossil deposits of later age or which are living.

BIBLIOGRAPHY.—A. S. Romer, *Vertebrate Paleontology,* 2nd ed. (1945); O. C. Marsh, *Odontornithes: a Monograph of the Extinct Toothed Birds of North America,* pp. 118–189, *192,* 197–199 (1880); Kálmán Lambrecht, *Handbuch der Palaeornithologie,* pp. 579–586 (1933); J. T. Gregory, "The Jaws of the Cretaceous Toothed Birds," *Condor,* vol. 54, pp. 73–88 (1952). (A. WT.)

ICHTHYOSAUR, an extinct sharklike reptile of the Mesozoic era (about 70,000,000 to 200,000,000 years ago) that showed far-reaching adaptations toward life in the seas and held much the same position in the marine community as do the toothed whales of today. As is true of the whales, the ichthyosaurs descended from animals that lived on land; however, in the course of their adaptation to life in the water, their bodies became so highly modified that it is virtually impossible to recognize their ancestry.



BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

SKELETON WITH OUTLINE OF BODY OF THE EXTINCT MARINE REPTILE STENOPTERYGIUS QUADRICISSUS, ICHTHYOSAUR FROM THE LOWER JURASSIC OF HOLZMADEN. GER.

Intact skeletons of ichthyosaurs are known from a number of famous localities in Europe and North America, but the most interesting specimens come from Boll-Holzmaden in southern Germany., where skeletons of Stenopterygius often occur with remains of the skin preserved (see fig.) and with embryos or eaten young in the abdominal cavity. Their mode of reproduction (bearing live young from eggs hatched in the body) and their food (belemnites — relatives of the cuttlefish — and fish), as well as their at least occasional cannibalistic behaviour, have been inferred from the contents of the abdominal cavity.

The ichthyosaur body was thoroughly streamlined, pointed in front and ending in a vertical, membranous tail fin which was the principal organ of propulsion; the lower lobe of the tail fin was supported by the backbone. Along the mid-line of the back was a

large membranous fin acting as a keel during propulsion. The fore and hind limbs were modified as lobelike steering paddles supported by greatly shortened and flattened limb bones and additional finger and toe bones. All these features suggest that the ichthyosaurs swam in a way similar to the sharks, by beating the tail fin from side to side and by steering with the fore and hind paddles or fins.

The relatively large skull tapered into a slender, elongated snout; the large eyes were within a ring of bony plates. The jaws were armed with a large number of sharp, conical teeth that were set in individual tooth sockets in the early ichthyosaurs (e g., *Mixo*saurus) and in continuous tooth grooves in the later ones; some forms became practically toothless. The backbone consisted of short vertebrae with biconcave vertebral bodies. In *Mixosaurus* the end of the tail region of the backbone was almost straight; in the later forms it was bent sharply downward, a matter closely tied to the size and efficiency of the tail fin. This evolutionary change from straight to bent tail end seems to have occurred to some extent during the growth process of individuals as demonstrated in specimens of young and old *Stenopterygius*.

Although most ichthyosaurs were of moderate size, even some of the earliest ones attained a length of 25 ft. Toward the end of the Mesozoic era just prior to their extinction, ichthyosaurs reached nearly world-wide distribution.

BIBLIOGRAPHY—W. E. Scheele, *Prehistoric Animals* (1954); P E. Raymond, *Prehistoric Life* (1939); A. S. Romer, *Vertebrate Paleontology*, 2nd *ed.* (1945), *The Osteology of the Reptiles* (1956); S. W. Williston, *Water Reptiles of the Past and Present* (1914); Bernhard Hauff, *Das Holzmadenbuch* (1953), containing superb photographs of ichthyosaurs. (R. ZL.)

ICHTHYOSIS (XERODERMA), a general thickening of the skin and marked accumulation of the epidermic elements, with atrophy of the sebaceous glands, giving rise to a hard, dry, scaly condition. This disease generally first appears in infancy and is probably congenital. It differs in intensity and in distribution, and is little amenable to treatment. (F. L. A.)

ICKES, HAROLD LE CLAIR (1874–1952), U.S. secretary of the interior under Pres. Franklin D. Roosevelt, was notable as a political reformer, conservationist and peppery controversialist and diarist. Born March 15, 1874. in Frankstown township, Pa., he was active in Chicago politics even before his graduation from The University of Chicago in 1897. After receiving his law degree in 1907, he entered the legal profession, frequently handling civil liberties cases without pay; he also fought for municipal reform and the curbing of public utilities. Nominally he was a Republican but he frequently bolted the party, most notably when he supported Theodore Roosevelt's Bull Moose candidacy in 1912 and Franklin D. Roosevelt's New Deal in 1932. Roosevelt, seeking a Republican progressive for his cabinet, turned almost by accident to Ickes after two prominent senators had declined the position. Ickes was 58 at the time, and has been described as "a rather thickset bespectacled vigorous man." He made the most of his position, becoming one of the most energetic members of the Roosevelt cabinet. As secretary of the interior he fought for the preservation of natural resources against what he considered to be unfair exploitation by private interests.

He was also in charge of the Public Works administration, which during the New Deal spent over $5,000,000,000 on federal and nonfederal public works, ranging from municipal buildings to the enormous federal dam projects in western states. Ickes, who was dubbed "Honest Harold," in 1933 went about the spending of the money so carefully that the projects were very slow getting under way. Consequently the program did not have the desired effect of putting large sums immediately into circulation to prime the economic pump and help pull the nation out of the depression. Late in the New Deal heavy expenditures for construction did significantly stimulate the economy and left the nation enriched with numerous useful permanent structures. During World War II Ickes added to his other duties the administration of petroleum, coal mines and fisheries. In presidential campaigns he became known as "Roosevelt's hatchet man" because of his colourful attacks upon the Republican candidates; between campaigns he feuded with almost equal vigour with several of his Democratic colleagues, and in his lively diary, published after his death (The Secret Diary of Harold L. Ickes, 3 vol.. 1953–54), recorded trenchant opinions of many others. He resigned Feb. 13, 1946, after a dispute with Pres. Harry S. Truman, and died in Washington, D.C., on Feb. 3, 1952. (FK. F.)

ICKNIELD WAY, the name, first recorded in the 10th century, of an unmetaled track which led from the eastern side of the Wash to the Berkshire downs and which was of great importance in prehistoric and early historic times. Beginning near Brancaster and following approximately a line marked by Swaffham. Thetford, Newmarket and Royston, it traverses the lower slopes of the Chilterns and crosses the Thames at Wallingford and at Goring. On Royston heath its several tracks span a width of a quarter of a mile. Because it was one of the four privileged roads in the late Anglo-Saxon period, its name came to be applied to other roads. The etymology of the name is uncertain. Sometimes it occurs in the form Ricknield street which arises from Middle English at there Ikenilde strete and which by wrong division of words became at the Rikenilde strete. (P. H. BR.)

ICON, generally any image or portrait figure. The word is specially applied to the representatives in the Eastern Church of sacred personages, which are either flat paintings or in very low relief, sculptured figures being forbidden. (See BYZANTINE ART.)

The term "iconography," once confined to the study of engravings, is now applied to the history of portrait images in Christian art, though it is also used with a qualifying adjective of Greek, Roman and other art.

ICONIUM (mod. KONYA, KONIA), a city of Asia Minor standing on the edge of the semidesert plateau of Lycaonia, backed on the west by the Pisidian mountains. The indigenous inhabitants were Phrygian in speech and culture. With the extension of Hellenic civilization in the time of the Seleucids, the place was gradually Hellenized and became a self-governing city, largely Greek in language, education and culture. It was probably among its Phrygian section that the Jewish community stirred up opposition to Paul on his first visit of A.D. 47 or 48. He returned in 50 and 53.

From 25 B.C. td the end of the 3rd century A.D. it was included in the Roman province of Galatia. In about A.D. 297 it was probably taken as the capital of the province Pisidia, and on the division of this province in about A.D. 371–72 it became the capital of the province Lycaonia. In later Byzantine times Iconium was the headquarters of the Anatolic theme (province). It was conquered by the Seljuk Turks about A.D. 1072, and in 1099 they chose it as their capital. See also KONIA; JALAL-UD-DIN RUMI. (WM. C. B.)

ICONOCLASTS, breakers of images, a name applied A.D. 726–842 to the opponents of the use of images in Christian worship. (See BYZANTINE EMPIRE.)

At the period of the Reformation (*q.v.*) the name was given to those who advocated the destruction of images in the churches.

ICONOSTASIS, the screen in a Greek, Russian or Armenian church, which encloses the sanctuary. It is generally of masonry, high enough to reach the spring of the vault, and extends into the body of the church as far as the easternmost nave pier. In its nave front there are usually three doors. The face of the screen is often decorated with many tiers of small arcades; each arch encloses the representation of a saint. In Russian churches only the hands, feet and faces of the painted representation or icon are exposed; the rest of the panel is covered with elaborate, engraved, embossed metalwork. In earlier times in Greece, however, the entire image was painted.

ICTERUS, a genus of birds belonging to the family Icteridae, intermediate between the finches (*q.v.*) and starlings (*q.v.*); many of them are called troupials; others are known as the American grackles (*q.v.*). One of the best-known species is Icterus *spurius*, the orchard oriole, an inhabitant of northern South and Central America and the United States. Very many species exist in the neotropical region, though a few migrate northward in summer. They are nearly all gregarious, many of them with loud and melodious notes, rendering them favourites in captivity. Some have a plumage wholly black, others are richly clad; the well-known Baltimore oriole, golden robin or hangnest

of the United States, *Icterus galbula,* has plumage of brightly contrasted black and orange, the tinctures of the armorial bearing of Lord Baltimore, the original grantee of Maryland. The most divergent form of Icteridae seems to be that known in the United States as the meadow lark (*q.v.*), *Sturnella magna,* while the bobolink (*q.v.*) or ricebird with its buntinglike bill is not much less aberrant. There are about 88 species in the family Icteridae, mostly in South America, of which only 10 genera and 21 species reach the United States. *See* BLACKBIRD, RED-WINGED; COWBIRD; ORIOLE.

BY COURTESY OF THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

BALTIMORE ORIOLES COMPLETING NEST THE CONSTRUCTION OF THEIR

ICTINUS, Greek architect of the 5th century B.C., was the architect of the Parthenon at Athens, of the Hall of the Mysteries at Eleusis and of the temple of Apollo Epicurius at Bassae, near Phigalia.

IDA (d. 559), first king of Bernicia. became king in 547, soon after the foundation of the kingdom by the Angles. He built the fortress of Bebbanburh (Bamborough), and after his death his kingdom, ahich did not extend south of the Tees, passed in turn to six of his sons. The surname of "flame bearer," sometimes applied to him, refers not to Ida but to his son Theodoric (d. 587).

IDA, classical name of a mountain range in northwest Asia Minor, at the head of the Gulf of Adramyttium (Edremit) and a short distance to the southeast of the site of ancient Troy. Its highest peak, about 5,000 ft., provides a view of the Marmara and Aegean seas, and from its heights, it is said, the gods witnessed the battle between the Greeks and Trojans. It was known as a classic shrine and is famous in mythology as the site where Paris passed judgment on the rival goddesses and as the scene of the rape of Ganymede. Its modem name is Kaz Dagi. Ida is also the classical name of a mountain traversing the island of Crete and site of a cave where Zeus was said to have been reared. The mountain is associated with the worship of Zeus, and relics of the classical Greek period, found there in cave excavations, substantiate the view that it was a shrine of the period. It is known as Psiloriti.

IDAHO, popularly known as the "Gem state," in the Pacific northwest of the United States, occupies most of the southern and northwestern part of the area enclosed by 42° and 49° N. and 113° 03' and 117° 16' W. To the north lies British Columbia, which Idaho borders for 45 mi. To the east are Montana and Wyoming; to the south, Utah and Nevada; and to the west, Oregon and Washington. Idaho extends nearly 315 mi. on its southern boundary and over 483 mi. from north to south, but an irregular northeastern mountain boundary limits Idaho's area to 83,557 sqmi. Thirteenth in size among the states of the United States, Idaho is about as large as England and Scotland combined or nearly twice as large as the New England states. The capital is Boise. Idaho became the 43rd state in the union in 1890. The state flower is the syringa. The state bird is the mountain bluebird.

The word Idaho as a name for the territory apparently originated in Washington, D.C., early in 1860 as a suggested name for Colorado; a dozen Indian language derivations for the name have been offered, but none of them has been substantiated.

PHYSICAL GEOGRAPHY

Physical Features.— Idaho's terrain is marked by startling diversity. Almost all physical features typical of the United States, except seacoast, may be found somewhere in Idaho: broad valleys and rugged mountains, arid plains and green prairies, sagebrush deserts and humid forests, spectacular canyons, great waterfalls, volcanic deposits and old limestone coast lines, major rivers and wandering streams that sink into the lava, gentle hills and glaciated peaks, sand dunes and hot springs, natural lakes and artificial reservoirs, range land and all types of farms: dry, irrigated and naturally watered.

All of Idaho is in the Columbia river basin, except the southeastern corner, which is drained by the Bear river flowing into the Great Salt lake basin. Most of the state is tributary to the Snake river and consists of a series of steep mountain masses and ranges running north and south. The highest peak is Mt. Borah (12,662 ft.), in the Lost river range. But across southern Idaho from east to west the broad valley of the Snake curves in a great geologic down warp that cuts across the bordering mountain ridges, which are buried in the valley. The valley surface—a series of geologically complex lake beds and lava flows—is furrowed by a number of almost unbelievably deep and narrow canyons. Within the canyons are spectacular waterfalls, the most notable being Shoshone falls (212 ft.) and Twin falls. Turning north, the Snake flows along Idaho's western boundary through Hell's canyon (*q.v.*)—the deepest gorge in North America—and then turns west to the Columbia. The Salmon river and Clearwater mountains, together with their attendant river canyons, form a barrier to transportation that has divided the state into sections. Most of northern Idaho is mountainous also, but elevations are lower. Three of the state's four large lakes, Coeur d'Alene, Pend Oreille and Priest, are in northern Idaho; the other, Bear lake, is in the southeast corner. Other natural attractions include Soda springs near Bear lake, and the magnificent Sawtooth range, with its multitude of alpine lakes, in the Sun valley area.

Climate.— Idaho's climate is as diverse as its physical features. Altitude, more than latitude, determines the climate: Lewiston, in north Idaho, is the warmest place in the state. Western prevailing winds from the Pacific are mild but are robbed of most of their moisture by the Cascade mountains before reaching Idaho. Mountain barriers on the east protect the state from cold waves that sweep down the Great Plains. Most of the mountain wilderness has cool summers and severe winters; the populated valleys, however, generally are mild in climate. Temperatures range from 108° to −45° F.; the mean annual temperature varies from about 36° F., with the coldest region centring in Custer county around the Sawtooth range, to 55° F. along the middle reaches of the Snake river. Annual rainfall varies even more than temperature, averaging 25 in. in the north and 8 in. on the dry plains of the south. Tornadoes are virtually unknown.

Soil.— Most Idaho soils are volcanic in origin, high in lime and potash but low in nitrogen and organic material. The deficiencies are easily overcome by plowing in alfalfa and clover. The windblown soils of the Palouse region, which straddles the Idaho-Washington boundary, are of special note, being fine and light and easy to till.

Vegetation.— Idaho's diversified climate produces a corresponding diversification in vegetation. Arid southern plains support only such plants as sagebrush, greasewood and salt grass. Greater precipitation in the north makes possible heavy evergreen forests of pine, cedar, fir and spruce, which extend southward into these higher altitudes where late-melting snow provides moisture. Deciduous forests are almost unknown, but a startling variety and profusion of colourful flowers—camas, columbine, mountain daisy, to name a few—may be found almost everywhere in the spring.

Animal Life.— Buffalo roamed the upper Snake river plains until 1840, but since then the deserts have been given over mainly to coyotes and hosts of jack rabbits. Beaver are historically important in Idaho because they attracted the trappers. Although relatively few in number, they are holding their own under careful state supervision. Weasels (ermine), mink and martens are fairly common. Badgers are plentiful, otters quite rare and wolverines on the brink of extinction. All of the following large mammals are found: elk, moose, white-tailed deer, mule deer, pronghorn, bighorn, black bears, grizzly bears and coyotes.

Ignoring common birds. there are ducks, geese, sage grouse, sharptails, pheasants, quail and doves. Hawks, owls, eagles, vultures, crows, ravens and magpies are common. The principal snakes include the Rocky mountain rubber boa, wandering garter, bull snake and prairie rattlesnake.

Parks and Recreation Areas.—There were 26 state parks and recreational areas, many historic as well as scenic, which constituted the state park system when a major development program was undertaken in 1958. Craters of the Moon National monument, established in 1924, is the product of Snake river lava flows as late as 200 to 1,000 years ago and is an awesome example of the result of volcanic activity.

Sun Valley.—This is a delightful valley located on Big Wood river, which drains a portion of the rugged Sawtooth mountains. The area was developed by Union Pacific railway officials because of the beautiful scenery, ample fine snow pack and calm weather. In about 20 years Sun Valley became world famous as a winter resort.

Primitive *Areas.*—In 1931 the state legislature passed the Primitive Area act, which reserved 1,250,000 ac. across the southern watershed of the Salmon river as a primitive area. Primitive conditions are expected to prevail because roads and buildings are prohibited.

Another area as large and nearly as primitive may be found on the Selway-Bitterroot drainage; there are several additional areas of this type. Idaho is one of the last frontiers in this respect.

HISTORY

What is now the state of Idaho was originally in Oregon country, claimed in turn by Spain, Russia, Great Britain and the United States, the last two settling, by treaty in 1846, on the 49th parallel as the northern U.S. border. Oregon territory (1848) included the present state of Idaho, as well as what is now Oregon, Washington and part of Montana. A half century of exploration and fur trade preceded white settlement which began in 1860. By the time Idaho reached the political maturity of statehood in 1890, there had begun a gradual shift from a primarily mining and stock-raising economy to a farming and lumbering one. Industrial development, confined almost entirely to mining in the 19th century, began to diversify after 1900 and to expand rapidly after 1940.

Explorers who came to Idaho at the beginning of the 19th century found practically the entire area occupied by Indian peoples of diverse language and seminomadic culture, notably the Shoshone and the Bannock in the south, and the Nez Perck, Pend d'Oreille and Kutenai in the north. Horses acquired from the Spaniards had given them mobility soon after 1700. Lewis and Clark from the United States, whose explorations through the Oregon country (1805–06) were the main basis for the U.S. claim, and the fur trader David Thompson from the British Northwest company (1808–12) established friendly relations with the Indians, and Thompson erected the first fort Kullyspell (Kalispell) house on Lake Pend Oreille in 1809. Other fur trappers soon entered Idaho. Andrew Henry of the Missouri Fur company crossed the continental divide into the valley of the upper Snake in order to escape from hostile Blackfeet warriors near the three forks of the Missouri and put up Ft. Henry, a temporary winter shelter, in 1810. John Jacob Astor's overland party from St. Louis to the Pacific crossed southern Idaho in 1811. The Astor enterprise failed, however, and was sold out to the Northwest company, for whom Donald Mackenzie organized the annual Snake river brigade that trapped in southern Idaho from 1818 to 1832. The U.S. gave up the region during the War of 1812, and Great Britain controlled it until the treaty of 1846.

A new era in the fur trade commenced in 1821, with reorganization of operations of the Hudson's Bay company (successor to the Northwest company) and with penetration of St. Louis mountain men under Jedediah Smith into the Snake country. Competition was sharp, and the British sent Peter Skene Ogden to trap the Snake country bare so that the mountain men would be kept away from rich beaver lands in British Columbia. Overexploitation, together with a style shift from fur to silk hats, reduced the fur industry to a small operation. At the end of the fur trade, the British company had two important Idaho posts—Ft. Hall (built in 1834 by Nathaniel J. Wyeth of Boston, but soon sold to the Hudson's Bay company) and Ft. Boise. The missions of Henry Harmon Spalding among the Nez Percé after 1836 and of Father Nicholas Point among the Coeur d'Alenes after 1842 grew out of the fur trade, which declined after 1840 with the coming of a large immigration through Idaho over the Oregon trail. A Mormon Salmon river mission at Ft. Lemhi (1855–58), followed in 1860 by Mormon settlement of Franklin and by a gold rush to northern Idaho, marked the transition from the wanderers of the fur trade to permanent white settlement.

Thousands of miners rushed to the Clearwater and Salmon river country after Elias Davidson Pierce's party discovered gold at Pierce on Sept. 30, 1860. Fabulous reports from Florence a year later brought in more than 10,000 prospectors. Important new discoveries in the summer of 1862 expanded the mining regions by hundreds of miles and thousands of men, and on March 4, 1863, Idaho territory was created to include all the new mines in what until then had been eastern Washington and western Dakota. (Until May 26, 1864, Idaho territory included all of Montana and practically all of Wyoming; final boundaries were not established until 1868.)

More than 32,000 miners, merchants, packers and farmers lived in the newly organized territory. Over one-half of them were in the Boise region, and another one-third in what soon was to be Montana. Continuation of the gold fever kept the mining population high in southwestern Idaho through the early years of the territorial period, and in 1864 Boise became the permanent territorial capital, as it later was of the state.

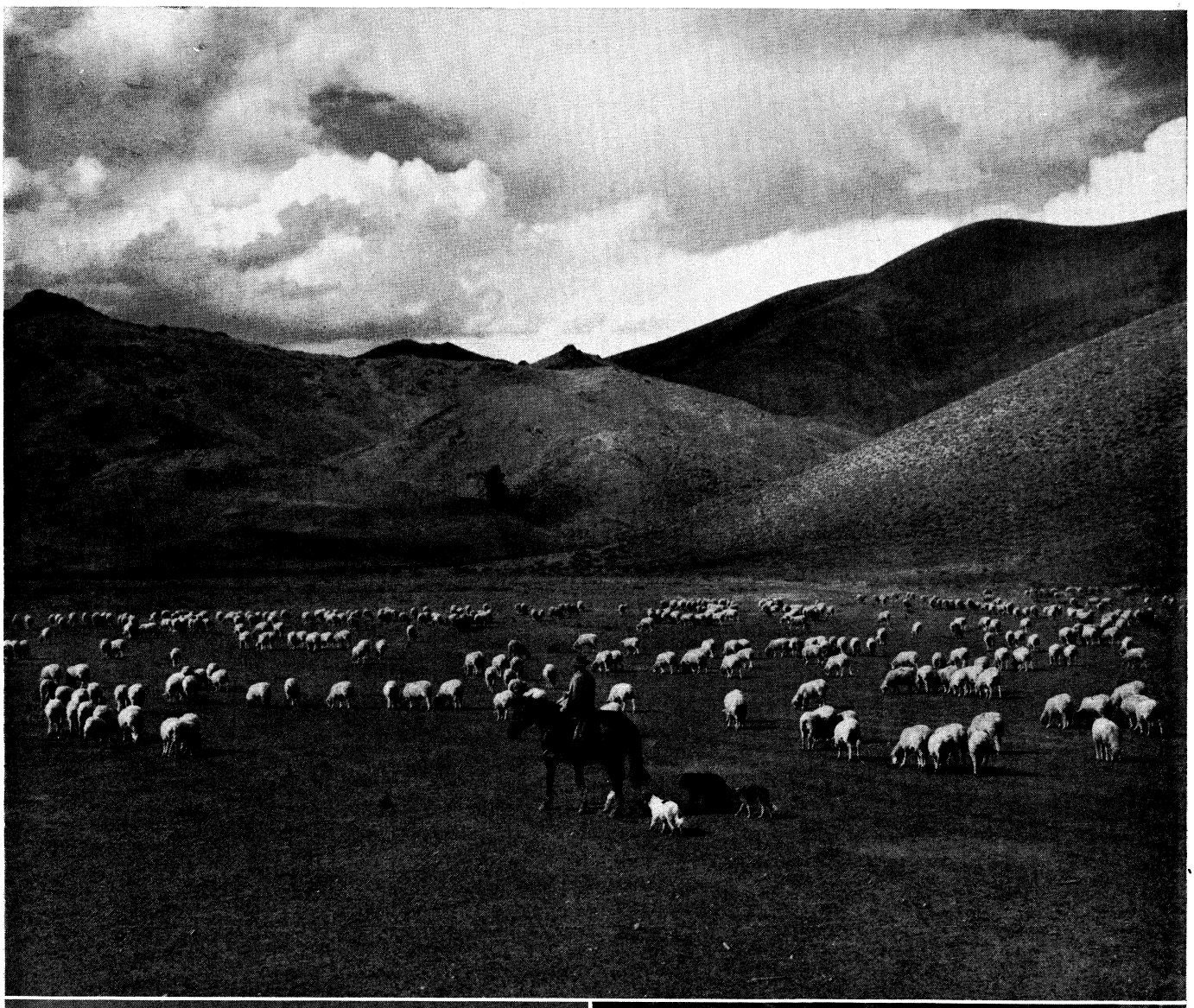
Quartz mining—both of gold and silver—became prominent in the Boise basin, Rocky Bar and Silver City in 1864 and at Atlanta and Warren shortly thereafter. A complex mining economy developed, with problems of capital and labour and with an advanced industrial technology. Quartz mining was relatively permanent in nature; farm and service communities grew up in irrigated valleys, and range cattle were driven in from California and Texas to form the basis for large Idaho herds.

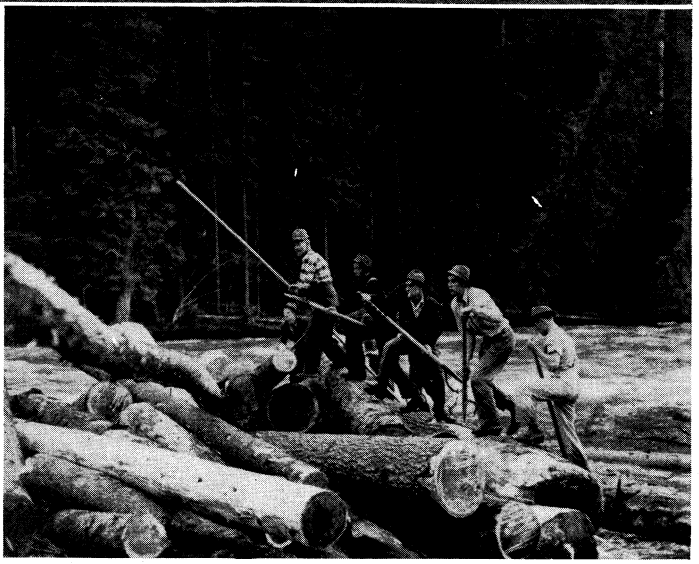
Expansion of white occupation of Indian lands—particularly for cattle ranging—led to friction and hostility with the Indians. Three wars (Nez Percé, 1877; Bannock, 1878; and Sheepeater, 1879) resulted. Certain Nez Percé bands, forced to move onto the reservation in June 1877, became embroiled with white ranchers; the Indians crushed a U.S. army force at White Bird and then fought the battle of the Clearwater on nearly even terms with a force commanded by Gen. O. O. Howard. Deciding to join their friends the Crows of Montana, the Nez Perck made a hard journey over the mountains, only to have to beat off forces under Col. John Gibbon at the battle of Big Hole. Chief White Bird and many of the warriors eventually took refuge in Canada, but Chief Joseph finally made a deal with General Howard to return to the Idaho reservation—a bargain which the U.S. failed to keep.

In 1878 the Bannock Indians, disturbed by white intrusion into their lands on Camas prairie in southern Idaho, went on the warpath; after military defeat at South mountain, they wandered over much of eastern Oregon before returning across southern Idaho into Wyoming before capture. Finally the Sheepeaters, who inhabited the Salmon river mountain wilderness, were rounded up in 1879 after they had been accused (perhaps unjustly) of massacring a settlement of Chinese miners on remote Loon creek.

Improved transportation, so necessary for large-scale quartz and base-metal mining, came with the construction of railways. By 1880 the Utah and Northern had been completed across southeastern Idaho; the Oregon Short Line was completed through the Snake river valley in 1884; and the Northern Pacific crossed north Idaho at the same time. Thus it was possible to develop important lead-silver mines on Wood river and in the Coeur d'Alene mountains. Idaho grew rapidly with the new mining and railways, and the consequent expansion of irrigation, after 1880. Admission as a state came on July 3, 1890, after a scheme to divide the territory between Washington and Nevada had been rejected at the end of a long and bitter north-south sectional controversy.

Idaho was one of the most prominent of western silver states and voted Populist in its first national presidential election in 1892. The more radical Populist element of the Coeur d'Alene mining district, however, became involved in a long series of labour wars (1892–99) that culminated in the dynamiting of the Bunker Hill and Sullivan concentrator at Wardner, April 29, 1899. Local sup-



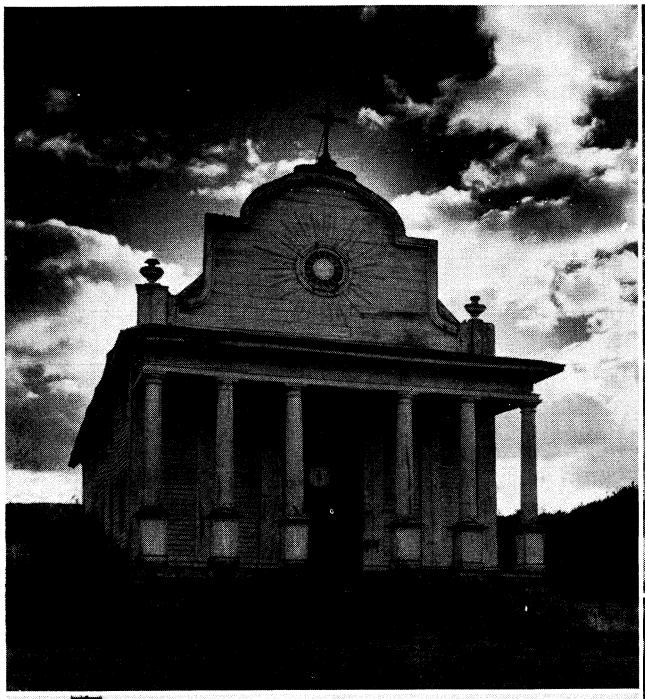


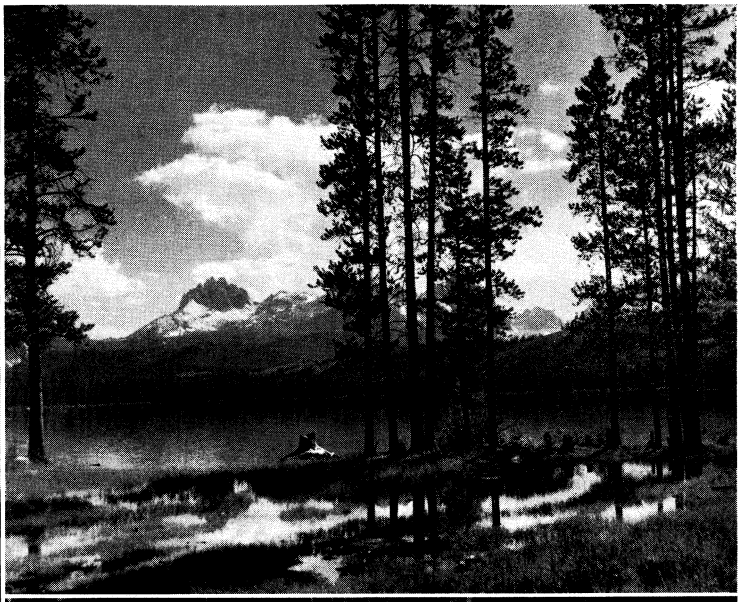
PHOTOGRAPHS, (TOP) DAVID W. CORSON FROM A. DEVANEY, (BOTTOM LEFT) RAY ATKESON, (BOTTOM RIGHT) PHILIP GENDREAU

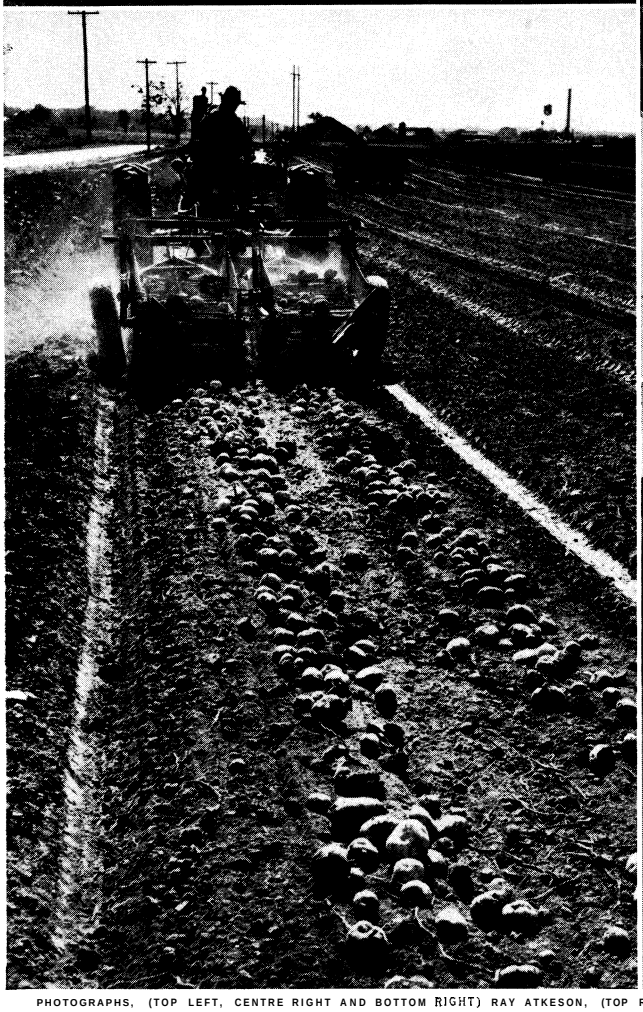
OUTDOOR WORK AND PLAY IN IDAHO

Top: A sheepherder with his flock in Sun Valley
Bottom left: A skier on a slope of Baldy mountain above the resort in Sun Valley
Bottom right: A log drive on tne Priest river. Lumbering and forest products are important in the state's economy

IDAHO







PHOTOGRAPHS, (TOP LEFT, CENTRE RIGHT AND BOTTOM RIGHT) RAY ATKESON, (TOP RIGHT) ANSGAR JOHNSON, (BOTTOM LEFT) H. ARMSTRONG ROBERTS

SCENES IN IDAHO

Top left: The Cataldo mission built in 1848 by Father Antonio Ravalli and a group of Indians. The church, restored in 1930, is the site of an annual Indian pilgrimage

Top right: Little Redfish lake, near the Sawtooth mountains

Centre right: Deer, driven down from the higher mountains by winter snow, seeking forage in Sun Valley

Bottom left: Harvesting potatoes. The state produces the second largest potato crop in the U.S.

Bottom right: Shoshone falls on the Snake river

pression of the union, the Western Federation of Miners, followed during a two-year period of martial law. A shocking aftermath of the Coeur d'Alene labour war came six years later with the assassination of former Governor Frank Steunenberg by Harry Orchard, one of the disaffected miners. National leaders of the federation were arrested for conspiracy in the case. Newly elected Senator William E. Borah gained a national reputation as prosecutor during the resulting trial and acquittal of William D. Haywood, secretary of the federation and organizer of the Industrial Workers of the World (I.W.W.). Borah continued to be Idaho's most prominent political figure until his death in 1940.

At the beginning of the 20th century an important commercial lumber industry began to develop, especially in the valuable white-pine forests of northern Idaho. Ponderosa pine also was utilized commercially, and lumbering gained a position second only to agriculture in economic importance. Irrigation in Idaho expanded dramatically at the same time. Co-operative and private canal systems proved successful in the upper Snake river valley, settled primarily by Mormons moving northward from Utah. Canal companies in the Boise area, though, were unable to develop the major projects with success, and farmers' irrigation districts took over. In the Twin Falls region important projects carried on under the provision of the Carey act (1894) turned large tracts of sagebrush desert into fertile irrigated farms between 1902 and 1908; establishment of the Boise and the Minidoka projects under the United States reclamation service led to the construction of important dams with large reservoirs (Arrowrock, American Falls, Anderson Ranch, Palisades), so that by the second half of the 20th century roughly half of Idaho's potentially irrigable land had been reclaimed, and miles of farms existed where a desert had been before.

GOVERNMENT

Idaho's constitution, adopted Aug. 6, 1889, was detailed and codelike in nature; it therefore has required frequent amendment. A legislature meets every two years for 60 days, with special sessions at the call of the governor. There are 44 senators and 59 representatives, whose districts have close correspondence to the state's urban-rural population distribution. A supreme court, district courts, county probate courts and precinct justice's courts comprise the judiciary. A governor, lieutenant governor and six other elective officers, together with a large number of administrators, make up the executive branch. A reorganization in 1919 consolidated most state agencies into departments under the governor, but subsequent alterations again gave the state administration a more complex pattern.

The state operates on a biennia1 budget: departmental requests are screened by the state budget officer, who is advised by an interim prelegislative budget committee of the outgoing session; a report is released six weeks before the new legislative session convenes. The governor presents his final recommendations on the fifth legislative day. All funds are subject to legislative appropriation and to strict budgetary control; actual expenditures from the general fund are authorized by the state board of examiners, made up of the governor, secretary of state, auditor and attorney general, in accord with the pattern of actual anticipated state income.

Local government in Idaho is decentralized. More than half of the nearly 850 units which existed in the second half of the 20th century were special districts: cemetery, highway, irrigation, drainage, soil conservation, etc. More important were the 44 counties and 199 municipalities.

POPULATION

At the time Idaho was admitted as a state the population was 88,548; in 1910, 325,594; in 1940, 524,873; and in 1960, 667,191. In the second half of the 20th century the population was distributed primarily along the Snake river and near the western boundary of north Idaho. The state was still predominantly rural (48.0% urban in 1960), but the farm population gradually was decreasing and the cities growing. Less than 3.3% were foreign-born in 1950, and only about ½% were Indians. There was an interesting Basque concentration in the Boise area.

*Idaho: Places of 5,000 or More-Population 11960 Census)**

Place	Population				
	1960	1950	1940	1920	1900
Total state	667,191	588,637	524,873	431,866	161,772
Alameda	10,660	4,694	2,691	772	—
Blackfoot	1,378	5,180	3,681	3,937	—
Boise	34,481	34,393	26,130	21,393	5,957
Burley	7,508	5,924	5,329	5,408	—
Caldnell	12,230	10,487	7,272	5,106	997
Coeur d'Alene	14,291	12,198	10,049	6,447	508
Collister	5,436	—	—	—	—
Franklin	7,222	3,489	1,559	—	—
Idaho Falls	33,161	19,218	15,024	8,064	1,262
Kellogg	5,061	4,913	4,235	—	—
Lewiston	12,691	12,985	10,548	6,574	2,425
Lewiston Orchards	9,680	—	—	—	—
Moscow	11,183	10,593	6,014	3,956	2,484
Mountain Home	9,314	1,887	1,193	1,614	529
Nampa	18,013	16,185	12,149	7,621	799
Pocatello	28,534	26,131	18,133	15,001	4,046
Twin Falls	20,126	17,600	11,851	8,324	—
Whitney	13,603	—	—	—	—

*Populations are reported as constituted at date of each census.
Note: Dash indicates place did not exist during reported census, or data not available.

EDUCATION

In Idaho, education started in the several Indian missions. In the fall of 1860 Hannah Comish taught the children of Franklin in her log cabin. Several years later. similar efforts were made in the mining towns. The office of territorial superintendent of instruction was created in 1864. Thereafter, the usual formal integrated organization of school districts was effected. Administration of the various state educational programs, higher education, elementary and secondary schools, and vocational education was assigned to the state board of education, established in 1913; local school management, however, remained under local school boards. Reorganization of school districts, provided for by statute in 1947, resulted in a 40% decrease in the number of schools, and in the consolidation of 1,088 districts into 168 within a decade. Economies gained in consolidation, together with greatly increased state appropriations, made possible a rise in average salaries for teachers from $1.190 in 1942 to more than $4,000.

Schools of higher learning include the University of Idaho in Moscow (1889), the College of Idaho at Caldwell (1891), Idaho State college in Pocatello (1901), Northwest Nazarene college at Nampa (1913) and Magic Valley Christian college at Albion (1958). There are also two-year institutions: Boise junior college (1932). Ricks college at Rexburg (1888), and Lewis-Clark Normal school, a branch of the University of Idaho, at Lewiston (1955).

Idaho State college consists of a liberal arts college, a teachers college and a professional and graduate school. It was incorporated as the Academy of Idaho in 1901, and the name was changed to Idaho Technical institute in 1915, to the Southern Branch of the University of Idaho in 1927 and to the present name in 1947. The school of trade and industrial education is a nonacademic division of the college. The Gniversity of Idaho, the state university and land-grant college, includes the colleges of agriculture, letters and science, engineering, law, mines, forestry, education, and business administration, and a graduate school. The Lewis-Clark Normal school is a division of the state university, offering a two-year program for elementary-school teachers.

HEALTH AND WELFARE

The state department of health administers a mental health service, two state mental hospitals. a tuberculosis hospital, a maternal and child health program, a crippled children's service, a dental health program and a public health nursing service. Water pollution control, milk and food sanitation and health education are additional activities of the department. The state department of public assistance has social service and child neliare divisions, and the department of labor and the state mine inspector are charged with industrial safety programs. The state board of corrections administers the state penitentiary at Boise and undertakes rehabilitation of prisoners.

ECONOMY

The shift to an agricultural economy is shown by the fact that in the second half of the 20th century one-third of the men em-

ployed in Idaho were in agricultural occupations; one-quarter were in transportation and trade; of the remainder, one-tenth were in manufacturing, and almost that many in construction. Seasonal variation in employment was pronounced. Industrial wages reflected the relatively small size of most of the state's industries. Per capita income for the state rose from $1,436 in 1951 to more than $1,500 by 1960.

The total labour force in 1950 was 218,309, with 18,989 and 15,501 engaged in manufacturing and construction, respectively. Idaho ranked lowest among the mountain states in per capita income because of an unbalance between the primary occupations of agriculture, forestry and stock raising vis-à-vis manufacturing, mining and construction. Greater industrial development was warranted by the resources.

Agriculture. — Agricultural production produced more income in Idaho in the second half of the 20th century than any other source, field crops making up more than 95% of the total, truck crops and fruits comprising the remainder. The major grain crops are wheat, barley and oats. Other important crops include hay, potatoes, beet sugar, dry beans, dry peas, clover seed and field corn. Crops of lesser importance include hops, alfalfa seed, onions and sweet corn; and green peas, apples, prunes, peaches, pears and cherries are the economically important fruits in Idaho.

Industry. — The growing shift to industry is shown by the fact that after livestock (primarily cattle and sheep) and dairy products in the second half of the 20th century, industry followed agriculture in value, being followed in turn by lumbering and mining. Industry in Idaho grew rapidly in the decade before 1950 and continued to rise. Phosphate plants in the southeast and the national reactor testing station at Arco — where atomic electric power was pioneered from 1951 to 1955 — were the main industrial development after World War II. The phosphorus industry developed markedly after 1950, with four large companies producing a variety of products.

Transportation. — Four transcontinental railways serve Idaho: the Union Pacific, the Northern Pacific, the Great Northern, and the Chicago, Milwaukee, St. Paul and Pacific. Mountain barriers separating northern Idaho from the rest of the state delayed completion of a paved north-south highway until 1938. Construction on Idaho's more than 600 mi. of the interstate system of completely unimpeded, controlled access highways began in 1956. Air transportation is especially important in linking Idaho's widely separated centres of population and in penetrating the extensive wilderness areas of the state.

BIBLIOGRAPHY. — *Idaho Yesterdays* is the quarterly journal of the Idaho Historical society. Other useful references are *Public Education in Idaho: a Report of the Idaho Education Survey Commission (1946)*; Federal Writers Project, *Idaho: a Guide in Word and Picture,* 2nd ed. *(1950); The Idaho Encyclopedia (1938)*; Thomas Donaldson, *Idaho of Yesterday* (1941); Merrill D. Beal, *A History of Southeastern Idaho (1942)*; and Floyd R. Barber and Dan W. Martin, *Idaho in the Pacific Northwest (1956).* Current statistics on production, employment, industry, etc., may be obtained from the pertinent state departments; the principal figures, together with the current history, are summarized annually in the *Britannica Book of the Year,* American edition.

(M. D. B.; M. W. W.)

IDAHO FALLS, a city of southeastern Idaho, U.S., and the seat of Bonneville county, originated as Eagle Rock, a community that grew up at Taylor's Ferry (1863), later Taylor's Bridge, over the Snake river. Serving heavy traffic on the Salt Lake-Montana road, the town prospered as a division point on the Utah and Northern railway (1879) but declined with removal of the railway shops to Pocatello in 1887. Reorganized as Idaho Falls in 1890, the community flourished again: irrigated farming grew rapidly, and an early sugar factory came in 1903. Other agricultural industrial plants were installed, and Idaho Falls became the marketing centre for upper Snake river valley potatoes. Municipal generators utilize the hydroelectric potential of the falls, and headquarters for the national atomic reactor testing station are there. Idaho Falls also has a Mormon temple, built in 1937. For comparative population figures see table in IDAHO: Population. (M. D. B.)

IDAS, in Greek legend, son of Aphareus of the royal house of Messene, brother of Lynceus. In Homer (*Iliad,* ix, 556 *et seq.*), he is called the strongest of men on earth. He carried off Marpessa, daughter of Evenus, as his wife, and dared to bend his bow against Apollo, who was also her suitor. Zeus intervened and left the choice to Marpessa, who declared in favour of Idas, fearing that the god might desert her when she grew old (Apollodorus i, 60–61).

The Apharetidae are best known for their fight with the Dioscuri. A quarrel had arisen about the division of a herd of cattle which the four had stolen. Idas claimed the whole and drove the cattle off to Messene. The Dioscuri overtook him and lay in wait in a hollow oak. But Lynceus, whose keenness of sight was proverbial, saw Castor through the trunk and warned his brother, who thereupon slew the mortal Castor; finally Polydeuces slew Lynceus, and Idas was struck by lightning (Apollodorus iii, 134–137; Pindar, *Nem.,* x, 60; Pausanias iv, 3, 1).

According to others, the Dioscuri had carried off the daughters of Leucippus, who had been betrothed to the Apharetidae (Ovid, *Fasti,* v, 699; Theocritus xxii, 137). The scene of the combat is placed near the grave of Aphareus at Messene, at Aphidne in Attica, or in Laconia; and there are other variations of detail in the accounts (see also Hyginus, *Fab.* 80). Idas and Lynceus were originally gods of light, probably the sun and moon, and the herd of cattle (for the possession of which they strove with the Dioscuri) represented the heavenly bodies. The annihilation of the Apharetidae in the legend indicates the subordinate position held by the Messenians after the loss of their independence and subjugation by Sparta, the Dioscuri being distinctly Spartan, as the Apharetidae were Messenian heroes. The grave of Idas and Lynceus was shown at Sparta, according to Pausanias (iii, 13), whose own opinion, however, is that they were buried in Messenia. On the chest of Cypselus, Marpessa is represented as following Idas from the temple of Apollo (by whom, according to some, she had been carried off), and there was a painting by Polygnotus of the rape of the Leucippidae in the temple of the Dioscuri at Athens.

IDDESLEIGH, STAFFORD HENRY NORTHCOTE, 1ST EARL OF (1818–1887), British statesman, was born in London, on Oct. 27, 1818. On leaving Balliol college, Oxford, he became in 1843 private secretary to Gladstone at the board of trade. He was afterward legal secretary to the board; and after acting as one of the secretaries to the Great Exhibition of 1851, co-operated with Sir Charles Trevelyan in framing the report which revolutionized the conditions of appointment to the civil service. He succeeded his grandfather as 8th baronet in 1851. He entered parliament in 1855 as Conservative M.P. for Dudley and was elected for Stamford in 1858, a seat which he exchanged in 1866 for North Devon. Steadily supporting his party, he became president of the board of trade in 1866, secretary of state for India in 1867 and chancellor of the exchequer in 1874. In the interval between these last two appointments he had been one of the commissioners for the settlement of the "Alabama" difficulty with the United States, and on Disraeli's elevation to the house of lords in 1876 he became leader of the Conservative party in the commons. As a finance minister he was largely dominated by the lines of policy laid down by Gladstone; but he distinguished himself by his dealings with the debt, especially his introduction of the new sinking fund (1876), by which he fixed the annual charge for the debt in such a way as to provide for a regular series of payments off the capital. His temper as leader was, however, too gentle to satisfy the more ardent spirits among his own followers, and party cabals led to Sir Stafford's transfer to the Lords in 1885, when Salisbury became prime minister. Taking the titles of earl of Iddesleigh and Viscount St. Cyres, he was included in the cabinet as first lord of the treasury. In Lord Salisbury's 1886 ministry he became secretary of state for foreign affairs, but the arrangement was not satisfactory, and his resignation had just been decided upon when on Jan. 12, 1887, he died suddenly at Salisbury's official residence in Downing street.

His second son, STAFFORD HENRY NORTHCOTE, 1st Baron Northcote (1846–1911) was appointed governor of Bombay (1899–1903), being created a peer in 1900. Lord Northcote was appointed governor general of the Commonwealth of Australia in 1903 and held this post till 1908. He married in 1873, Alice,

adopted daughter of the 1st Lord Mount Stephen.

IDDINGS, JOSEPH PAXSON (1857–1920), U.S. petrographer, who demonstrated the genetic relationships of igneous rocks formed during any one period of igneous activity within a region, was born in Baltimore, Md., on Jan. 21, 1857, and received his education at Yale, Columbia and Heidelberg universities. He was assistant geologist (1880–88) and geologist (1888–92) with the United States geological survey; in 1892 he became associate professor and, from 1895 to 1908, professor of petrology at The University of Chicago.

In his technical papers he emphasized the textural and chemical graduation of rocks and recognized the role of water in magmas. He concluded that physical conditions affect the essential mineral composition of rocks as well as their crystalline texture and that variations in crystallinity depend upon temperature and rate of cooling, and so contested the widely held opinion that granular rocks necessarily hardened at great depths and in very large masses.

Iddings worked with other petrographers on "Quantitative Classification of Igneous Rocks," published in the Journal of Geology (1902) and later as a book, and his important Igneous Rocks, in two volumes, appeared in 1909–13. His other publications include Rock Minerals (1906) and The Problem of Volcanism (1914). Iddings died at Brinklow, Md., on Sept. 8, 1920.

(M.A.F.; C. L. FE.; X.)

IDE, HENRY CLAY (1844–1921), U.S. diplomat and representative in the Samoan and Philippine Islands, was born at Barnet, Vt., on Sept. 18, 1844. Ide graduated from Dartmouth college, Hanover, N.H., in 1866, and later was a secondary-school principal at St. Johnsbury, Vt., and Arlington, Mass. Admitted to the Vermont bar in 1871, Ide was state's attorney in Caledonia county and served in the Vermont senate from 1882 to 1885.

In March 1891 he was appointed U.S. land commissioner in Samoa, where he won the praise of Robert Louis Stevenson for his "capacity, moderation, tact, and temper" before leaving Samoa in November of that year.

Under the joint appointment of the United States, Great Britain and Germany, he was chief justice of Samoa from 1893 to 1897.

From 1900 to 1906 Ide served in various official capacities in the Philippine Islands, including the offices of acting governor and governor general in 1905–06. He played an important role in framing new laws on civil procedure and internal revenue and in the reform of the currency of the Philippines.

In 1909 he was appointed U.S. envoy extraordinary and minister plenipotentiary to Spain. He held that position until 1913, when he returned to St. Johnsbury. Ide, who was a director of a number of banks and railway and manufacturing companies, died on June 13, 1921.

A Life of Henry Clay ***Ide*** (1935) was printed privately by the author, A. F. Stone.

IDEA. This word, brought into English from the Greek, was for some time most commonly used roughly in the technical sense (or senses) given to it by Plato in his theory of forms (see UNIVERSAL). But by the 17th century it had come to be used more or less in its modem sense of "thought," "conception," "concept"; sometimes of "belief"; sometimes of "intention" or "plan."

In the 17th and 18th centuries the word "idea" was in very general use as a technical term of philosophy, not with its Platonic meaning, but in a variety of senses mostly traceable to Locke, some of which were derived by him from Descartes. Locke introduces it first as "that term which, I think, serves best to stand for whatsoever is the object of the understanding when a man thinks" and later as signifying "the immediate object of perception, thought, or understanding." But this vague usage leads him into serious difficulties. In the first place, he holds that ideas are "in the mind"; so that, if ideas are said to be the objects of perception, he is faced with the problem of explaining how perception of things in our minds could lead us to knowledge of the "external" world. Secondly, he is led to overlook the important respects in which thinking and understanding must be distinguished from perception: he speaks indeed as if thinking and understanding really are essentially forms of perception, or as if all three consisted alike in "having ideas." George Berkeley retained the word "idea," with which he sometimes used "sensation" as a synonym, to stand for the objects of perception; he retained the view that ideas are "in the mind"; and he sought to evade the problem which Locke had failed to solve—the problem of founding our knowledge of the material world on perception of mind-dependent ideas—by refusing to draw any distinction between ideas and material objects. Material objects, he held, are "collections" of ideas, and hence they too can exist "only in the mind."

Hume introduced a distinction between ideas and impressions—the latter term being designed to cover "all our sensations, passions, and emotions," the former "the faint images of these in thinking and reasoning." In so doing, however, he did not much improve upon Locke: he still held that the objects of perception are "in the mind" and for the most part he retained in his account of thinking the fatally misleading analogy with perception. It was urged by an early critic, Thomas Reid, that most of the perplexities in which Locke, Berkeley and Hume had been entangled arose from initial confusions in the use of the word "idea," for which he thought Descartes ultimately responsible; and even though it can hardly be adequate to trace all difficulties to this one source, it can certainly be said that their uses of the term "idea" require very close and critical scrutiny, if their problems are to be resolved or even rightly understood.

See also IDEALISM; KNOWLEDGE, THEORY OF; and PSYCHOLOGY.

(G. J. WK.)

IDEAL means primarily that which is of the nature of an idea. It is, however, more commonly used to denote that which is perfect or supreme of its kind. See IDEA; IDEALISM.

IDEALISM is the name of a group of distinct but allied philosophical theories all of which agree (1) in denying that mind has originated from or may be reduced to matter and (2) in affirming that mind is a more fundamental feature of the universe than matter is. Some writers (*e.g.,* Marxists) define philosophical idealism as the view that mind is primary and matter secondary, but this would not clearly distinguish it from theism, the view that matter and finite minds were created and are sustained by an eternal, infinite and immaterial deity. It is thus convenient to adhere to the more common practice of regarding idealism as the philosophy which not only denies the truth of materialism and asserts the reality and importance of mind but also maintains either that matter does not exist at all or else that, if it does exist, it is more closely dependent on the existence of mind than it need be by the sole fact of having been created by God. Like theism, idealism is a religious philosophy, as any philosophy must be which regards the material world as somehow less real than the world of mind or spirit. But although idealists all seek to establish a view of the world that lays the foundations for a rational religion, they are not all committed to belief in a personal God or, indeed, to belief in God at all.

In what follows, the word "idealism" and its different meanings will be considered first. Then, since idealism is a group of modern philosophical views associated in its beginnings particularly with the arguments of George Berkeley, the survey is begun with a brief account of his system. The third section is a short account of phenomenalism, a theory about the material world that is briefly indicated in Berkeley's writings, but which was subsequently developed in ways that bring it into conflict with the religious aspects of idealism properly so called. Next, Immanuel Kant's transcendental idealism is discussed; and finally, after a fifth section on the absolute idealism of the 19th century, the article closes with a discussion of the main criticisms that have been brought against idealism.

Origin and Use of the Term.—The word "idealism" is derived from the' Greek word idea, which means, in untechnical language, a visible form or the look or appearance of something. This word became a technical term in the philosophy of Plato, who used it to mean a universal by contrast with particulars, or a standard, limit or ideal by comparison with the particular things which merely approached or approximated to it.

1. The word "idea," then, was first used in philosophy to mean Platonic ideas; *i.e.,* suprasensible universals or forms held to be

truly apprehended by the intellect and contrasted with particular things deceptively presented to the senses. In this sense Beauty Itself or Absolute Straightness are ideas in contrast with the particular things that may appear beautiful in one context and ugly in another, or with the more or less but never perfectly straight lines that we see or feel by our senses.

2. "Idea" was used in the 16th and 17th centuries for a form or shape impressed by a hard object upon some soft material, as when Descartes (in his *Rules for the Direction of the Understanding,* xii) wrote of "shapes or ideas" formed in the brain by things outside the body as if by the action of a seal on wax.

3. "Idea" was also used for a supposed representative *in the mind* (not in the brain, which is, of course, material) of an external object perceived by means of this representative. Descartes, in *Meditation III* contrasts such ideas, which, he says, "are, as it were, pictures of things," with activities of the mind such as acts of will and assertions. To perceive a man or the sky was, according to Descartes, directly to perceive such a representative idea in the mind, so that material things were never perceived except indirectly.

4. Not all of these picture ideas, however, are copies of something external to the mind, and according to Descartes we also have ideas such as that of a chimaera formed by combining at will ideas of colour and shape originally received from the senses. Such ideas were called ideas of the imagination.

John Locke, by frequent use in his *Essay Concerning Human Understanding* (1690) of the word "idea" in sense 3, gave wide currency to the theory that external objects cannot be directly known but must be known indirectly by means of representative ideas that are themselves directly perceived and exist only in the mind Locke and his followers were called "ideists" by contemporary critics, and the theory of representative ideas "the new way of ideas." In this philosophical usage, ideas are contrasted with material objects, are likened to pictures or images and are said to exist "in the mind." Usage 2, however, encourages the belief that they are somehow impressed *on* the mind as if by physical pressure, and usage 1, lingering alongside usage 3, made it possible to think of them also as objective existences just as independent of perception as Plato's ideas were. But the fact that ideas in sense 3 exist "in the mind" makes it easy to assimilate them to ideas of the imagination which no one supposes to exist except while they are actually being experienced.

Now the word '(idealism." as most commonly used by philosophers, is based upon the word "idea" in sense 3. It is true that Leibnitz, when he wrote in 1702 that "what is good in the hypotheses of Epicurus and Plato, of the greatest Materialists and the greatest Idealists, is combined in my view" (*Werke,* ed. by C. J. Gerhardt. iv, p 560), appears to have had sense 1 in mind; but when the word came into general philosophical use about the middle of the 18th century, idealism was taken as the view that there was no material world but only ideas existing in immaterial minds. Thus Denis Diderot wrote in 1j49 *(Oeuvres,* ed. by J. Assézat, vol i, p. 304). "We call *idealists* those philosophers who, knowing only their own existence and that of the sensations that follow one another within them, do not grant anything else . . . a system which. to the shame of the human mind and of philosophy, is the most difficult to oppose although the most absurd of all. . . . Whether we raise ourselves to the skies, whether we go down to the bottom of the abyss, we never get outside ourselves. now that is the result of the first of Berkeley's dialogues and the foundation of his whole system." It will be noticed that Diderot attributed to Berkeley not only the view that we have direct knowledge of ideas only, but also the view that it is impossible to have knowledge of anything beyond one's own existence and one's own ideas. This latter view is today called solipsism, but in the 18th century it was called idealism or egoism *(see* the *Encyclopédie, s.v.* "Égoistes"). It will be seen, then, that we must begin with Berkeley, to whose philosophy, which was little understood in his lifetime. the name "idealism" was given.

Immaterialism. — Berkeley called his philosophical system immaterialism. In denying the existence of matefial substance he held that the universe consists of God, the infinite spirit, of finite active spirits, including, of course, human beings; of passive, inert ideas, which exist only "in the mind" of spirits; of the relations between all these; and of nothing else. He believed that his denial of the existence of material substance enabled materialism, scepticism and atheism to be refuted and the cause of religion to be more firmly established than hitherto. That this system, if true, refuted materialism is obvious. That it refuted scepticism, Berkeley held, followed from the fact that we are each certain of our own existence and of the ideas in our minds. Scepticism arises from the inevitable disappointment at being unable to get knowledge of something beyond these ideas. Atheism is refuted "by this simple reflection on the repugnancy included in supposing the whole, or any part, even the most rude and shapeless of the visible world, to exist without a mind." In Berkeley's view, what exists independently of finite minds must exist in God's mind.

The first step in the arguments leading to these conclusions had been taken by Descartes and Locke when they said that ideas which cannot exist apart from a mind's awareness of them are the immediate objects of perception. These philosophers had held that, whereas ideas of colours, sounds, tastes and smells (the so-called ideas of secondary qualities) were not, ideas of shape, size and movement (the so-called ideas of primary qualities) were copies of physical features of independently existing material things. Put in its briefest terms, Berkeley's argument was that, once it is granted that what we immediately experience are ideas or sensations (he used both words) and that our knowledge of the world is based on what we immediately experience, then we can form no conception of anything besides or beyond ideas or sensations and the minds in which they exist. If our knowledge of things in nature is derived from experience, he argued, then it is derived from ideas and cannot reach to anything fundamentally different from them, apart from the minds in which they exist. The very being of ideas is their being experienced, for just as it would be absurd to say that a pain could exist unfelt, so it is absurd to say that an odour could exist unsmelled, that a sound could exist unheard, that a feel could exist unfelt, or that a colour could exist unseen. Berkeley added the further argument that the very notion of something existing unexperienced is contradictory since it implies that something not experienced is experienced. He was, however, as anxious to avoid scepticism as he was to refute materialism, and he therefore argued that his denial of material substance was not a denial of the familiar world in which men know one another and come across all sorts of physical bodies. Although material substance does not exist. trees and rocks and cherries do, and these are nothing but "collections" of ideas. Since they are collections of ideas we know them directly, without any dubious intermediaries, and hence we have no cause for doubt concerning them. And as they exist independently of human will and appear to us in a regular order. they must be results of the Divine will and exist in the Divine mind when not perceived by humans.

Berkeley was anxious to accommodate his immaterialism to the beliefs of ordinary men, and he therefore stressed the differences between ideas of sense and ideas of imagination, pointing out that the latter are more under the control of the will than are the former and are less vivid and regular. Arthur Collier, however, in his *Clavis universalis* (1713), which seems to have been written in complete independence of Berkeley, stressed the likeness between ideas of sense and of imagination. He asserted that in denying the independent existence of a material world he was saying that bodies exist in mind in the way in which "objects seen in a looking glass, by men light-headed. ecstatic. etc." exist only in mind In order to prove that the objects perceived by sense are in the mind in the same way as are the objects of the imagination, Collier appeals to the fact that an imagined object may appear just as external to the mind as a perceived object. He sharpens the paradox which Berkeley had blunted.

The arguments for immaterialism which have so far been considered are, with one exception, based on an examination of sense experience and assume that sense knowledge is immediate and, as such, indubitable. The exception is the argument that the very

notion of unexperienced material substance is self-contradictory. Now Collier put forward further arguments to show that matter was a self-contradictory conception. He held, for example. that it can be proved both that the external world is finite and that it is infinite in extent, both that it is finitely and that it is infinitely divisible. From this he concluded that there is no more ground for believing that there is an external world than for believing that there is a triangular square. Leibnitz, too, upheld a version of the immaterialist thesis Starting from the assumption that, if something complex or containing parts exists (as it does), then there must be ultimate elements which are simple and without parts, he asked whether these ultimate simples could possibly be material. Now anything material, he argued, is necessarily divisible into parts which are themselves divisible into further parts, and so on *in infinitum*. Hence, he concluded, nothing material could possibly be an ultimate element of the world, but since there must be ultimate elements, they are necessarily immaterial. These ultimate immaterial elements of the world he called monads. Not all monads were held by him to be minds, but they were all mindlike rather than material, and hence Leibnitz' monadism (as it is called) is a sort of immaterialism. Now arguments such as these do not start from Berkeley's assumption that sense experience is reliable and fundamental. On the contrary, they show, if successful, that the view of the world suggested by sense experience needs to be corrected by philosophical thinking. Immaterialism, then, may be supported by the appeal to experience in the manner generally adopted by Berkeley, or by arguments which purport to show that experience is misleading, in the manner of Leibnitz. Those who, like Berkeley, accept the fundamental reliability of sense experience are called empiricists. Those who, like Leibnitz, hold that sense experience is misleading by comparison with properly conducted philosophical argumentation, are called rationalists. Thus immaterialism has been supported both by empiricist and by rationalist arguments.

Phenomenalism. — Berkeley's idealism was intended not only as a defense of religion, but also, as he put it in the title of his *Treatise Concerning the Principles of Human Knowledge* (1710), as a step toward removing "the chief causes of error and difficulty in the sciences." The denial of material substance, he thought, put out of the way a notion that could only cause confusion. On Berkeley's view, to say that a physical object, a tree, for example, exists is to say that if someone looks he will see certain colours and shapes, that if someone touches he will feel certain hardnesses and temperatures, and so on. Thus Berkeley defined material objects in terms of actual and possible sensations, that is, in terms of what is or may be directly observed. He held that this principle of defining entirely in terms of observed or observable entities should be extended to the natural sciences and even to mathematics. In following out this plan he endeavoured to show that the only genuine causation is that exercised by minds with wills and that what goes by that name in the physical world is nothing but a regular sequence of ideas or sensations. He argued, too, that there is no absolute or empty space, but that space is definable in terms of touch and felt movement. Thus within Berkeley's philosophy there may be seen the beginnings of a radical philosophy of empiricism. Hume later in the 18th century and J. S. Mill and Ernst Mach in the 19th detached this element from the religious part of Berkeley's philosophy in order to develop what they regarded as a consistent form of empiricism. Berkeley's view that material things are collections of ideas was thus transformed by Mill into the definition of matter as a permanent possibility of sensation; and Mach made ingenious attempts to show that atoms and other unobservables of the natural sciences were "economical ways of symbolizing experience" *(The Analysis of Sensatzons,* 1886). The view that statements about physical objects and statements about the unobservables of natural science are reducible to statements about actual and possible sense experiences is called phenomenalism. It occupies a somewhat uneasy position between idealism and materialism, although it is, in its general bearing, more akin to the latter than to the former. But insofar as the ultimates to which phenomenalism refers are ideas, sensations, impressions or (to use a 20th-century expression) sense data, and insofar as these, as items of immediate experience, seem to be unthinkable apart from some percipient, there is an immaterialist look about phenomenalism which it inherits from its idealist ancestry. *(See* also PHENOMENALISM.*)*

Transcendental Idealism. — It has been shown that there are two forms of immaterialism and that there are two different types of argument purporting to establish it: there is the empiricist form, which starts from the premiss that there is immediate acquaintance with mind-dependent ideas and concludes that the notion of material substances beyond these ideas and causing them is redundant; and there is also the rationalist form, according to which material substances could not possibly exist, or at any rate could not be ultimate features of the world. The empiricist form is held to be a consequence of the policy of limiting one's view of the world to what sense experience reveals. The rationalist form is an attempt to prove by rational deduction that there is some logical absurdity in the very notion of material substance, so that it is impossible that material substances should exist or should be more than appearances of ultimate immaterial substances. In this second line of argument the court of appeal is not sense experience but rational conceivability. Now it was argued by Kant, in his *Critique of Pure Reason* (1781), that *a* consistent empiricism leads to skepticism, for in mere sense experience the percipient would be passively immersed first in one and then in another sight or feel or smell or sound or taste without there being any memory of past or recognition of new ones. To this disconnected sensible phantasmagoria he gave the name "manifold of sense"; and the phrase "perceptions without concepts are blind" *(Critique of Pure Reason,* 1st ed., p. 51) expresses his view that acquaintance with particular items of this manifold would not constitute knowledge. On the other hand, Kant argued, philosophical rationalism in its extreme form (he sometimes called it dogmatism) is nothing but an uncontrolled play of concepts or mere thoughts. From a mere concept or thought it is possible only to deduce another concept or thought, not to draw conclusions about what exists in the world. The rationalists erroneously thought that they could prove things about the nature of the substances in the world, or could prove that the world is or is not caused, or is infinitely or only finitely divisible, by arguments based only on the concept of substance, the concept of cause or the concept of infinity. This view is expressed in the phrase with which he balanced that already quoted: "thoughts without content are empty." Kant therefore argued that if there is to be genuine knowledge, the data of sense must fall within forms of space and time contributed by the mind itself and must be brought into some form of conceptual order by the activity of the understanding. It is only because the mind contributes the forms of space and time that we can be absolutely certain, as we are, that anything perceived must fall within one or both of them; and it is only because we impose conceptual forms such as those of substance and cause upon our sensations that we are quite sure that anything experienced must be in an ordered world of interacting things. If experience of a natural world is to be possible. the data of sense must be actively arranged (Kant's word is "synthesized") by the understanding in terms of concepts, principles or categories such as substance and cause. A sensation or idea on its own, for example, gives no knowledge at all and can only co-operate in doing so when it is regarded as belonging to some substance, whether it be a material thing or an embodied mind.

Kant believed. of course, that the ideas which are the raw material of our knowledge must somehow be due to realities existing independent of human minds; but he held that human knowledge cannot reach to them because it can only arise in the course of synthesizing the ideas of sense themselves. Things-in-themselves must remain forever unknown to us. He therefore called himself a formal or transcendental idealist, because the mind determines the form in which reality appears to us. "The mind does not derive its laws (a *priori*) from nature, but prescribes them to her" *(Prolegomena to Every Future Metaphysic* [1783], section *36).* Nevertheless Kant thought that he could refute both the idealism of Descartes and that of Berkeley. The former he called "prob-

lematic idealism," because Descartes merely held that the existence of matter could be doubted; and the latter "dogmatic idealism," because Berkeley maintained outright that matter does not exist. As Kant falsely believed that Berkeley's theory was that things in space are mere imaginations, his "refutation" of Berkeley need not detain us. His argument against problematic idealism was that the man who doubts the existence of objects in space outside him must be sure of his own existence but could not know of it unless he was aware of continuing physical things with which his own continually changing ideas could be contrasted. It will be seen, therefore, that Kant held both that the understanding is responsible for so ordering our sense experiences that they constitute the natural world (this is his transcendental idealism) and also that the embodied selves existing in the natural world are correlative with material objects of which they have as direct a knowledge as they have of themselves (this is his "empirical realism"; *cf. Crztique of Pure Reason,* 1st ed., p. 375). But how can the understanding both be a condition without which there could not be a natural world at all and also be a part of it belonging to embodied selves in space and time? Kant's answer was that experience is made possible by the synthesizing activity of a transcendental self of which we can know nothing except that it is a condition of our knowledge of the natural world and of ourselves as empirical selves within it. If Kant was right, the immaterialists made the mistake of supposing the sensible world depended upon empirical selves, whereas in fact there could be no experience of empirical selves any more than of the sensible world without the activity of a transcendental self.

According to this argument, therefore, there must be things-in-themselves and transcendental synthesizing activities, but any attempt to discover what sort of thing they are is doomed to inevitable failure. Kant recognized, nevertheless, that we do not remain content with this limitation but endeavour to extend our knowledge beyond the bounds of possible experience. He gave the name "reason" to the intellectual faculty with which we undertake this fruitless task. Prompted by reason, we speculate about the ultimate nature of the world, its source and its destiny, but in doing so we run into antinomies (*i.e.*, equally cogent arguments leading to incompatible conclusions). It was Kant's view that the traditional arguments for the existence of God inevitably call forth equally plausible counterarguments and hence cannot be relied upon as defenses of the religious viewpoint Theoretical reason, indeed, cannot even establish the freedom of the will, in spite of the importance of this notion for our moral life. On the other hand, however, Kant argued that reason has a practical use in which the moral law is revealed and with it the fact of freedom. Thus man's practical reason reveals him as a member of two worlds: the sensible world in which he is a natural being with desires that are subject to the law of causation; and an intelligible world in which he is spontaneous and free. (*See* also TRANSCENDENTALISM.)

Absolute Idealism. — Absolute idealism, which, along with positivism and materialism, was one of the most influential philosophies of the 19th century, is, in its essentials, the work of Hegel. It was largely due to his writings that the positivism and materialism that were so congenial to the new scientific outlook and to the developing industrial society had to face objections not only from the traditional religious teachers but also from philosophers who were free to speak their minds untrammeled by specific religious dogmas. In spite, therefore, of the difficulties to which his highly individual style and the scope of his writings give rise, the most characteristic traits of his idealist view must here be sketched in. The most convenient way of doing this will be to consider some ways in which he criticized and transformed Kant's transcendental idealism. He discussed Kant's views very fully in paragraphs 40–60 of his *Encyclopaedia of the Philosophical Sciences* (1817) and at the end of his *Lectures on the History of Philosophy.*

"Every philosophy" wrote Hegel in his *Science of Logic* (1812) "is essentially idealism"; but he did not mean by this that every philosophy was immaterialist. He said, indeed. that all that Berkeley's immaterialism amounted to was that the word "ideas" was applied to what previously had been called "things,' everything else being left just as it had been. Nor was he impressed by Kant's "refutation of idealism." for this merely rectified Berkeley's paradox by a return to the common sense that Berkeley had disturbed. By "idealism" Hegel meant "the proposition that the finite is ideal" — "ideal" being used to mean "not truly existing." In the passage in the *Science of Logic* from which these definitions are taken Hegel goes on to say that, in denying that the finite is real, idealism is at one with religion. Hegel argues that finite or limited being presupposes infinite unlimited being, within which the finite is a dependent element. The infinite contains the finite within it, for if the infinite were distinct from and external to the finite it would be limited by it and therefore not be infinite. Now Kant had said that the reason was the faculty by which we fruitlessly seek to transcend the limitations imposed by sense experience and the categories of the understanding. According to Hegel, however, this urge toward completeness shows that the reason is a superior, less limited faculty than the understanding, tending toward genuine philosophical knowledge of the infinite. He believed that Kant should not have remained satisfied with the notion of distinct faculties of sensibility, understanding and reason but should have seen that the sensibility is that part of experience that is most refractory to rational explanation and that the reason is the understanding freed from the restrictions of fixed and limited forms. According to Hegel there is a progress in knowledge from the vague blind stare of the senses, through the neatly distinguished categories of common sense and natural science, to the unified knowledge that is philosophy. The movement toward philosophical completeness necessarily leads away from mere sense experience. In this connection reference may be made to Kant's refutation of the ontological argument for the existence of God (*see* THEISM). According to this argument God, defined as the All-Perfect Being, must exist since existence is a perfection and a being without it would not be perfect. To this Kant objected that existence is not a predicate and therefore not a perfection and that it is impossible to deduce the existence of anything from a mere definition. This, of course, is a particular application of Kant's principle that thoughts without content are empty. Hegel, however, accepted the ontological argument, arguing that, although it does not follow from the thought of some finite thing, such as a hundred dollars. that that thing exists, the thought of an All-Perfect or Infinite Being is different and does imply existence. The principle behind this defense of the ontological argument is that the simple sort of verification that is appropriate when we are concerned with the existence of sensible objects is quite inappropriate for highly complex beings. It is absurd to think of verifying the existence of the Infinite Being in the way in which we verify the existence of a hundred dollars, and hence Kant's refutation rests on a confusion of categories. Hegel's defense of the ontological argument is thus a defense of the view that some thoughts are so coherent, comprehensive and compelling that the nonexistence of their object is unthinkable. He considered that if perceptions without concepts are blind, then the choice is between more or less adequate thoughts rather than between those that are supported by sense experience and those that are not.

Another way of approaching Hegel's absolute idealism is by reference to his criticisms of Kant's theory of the categories. In the section on transcendental idealism three categories only have been indicated, those of substance, cause and interaction; but Kant in fact held that there are 12 in all, which he arrived at by consideration of the forms of judgment distinguished in the traditional Aristotelian formal logic. Kant's general idea was that formal logic showed the forms of thought which the understanding uses in bringing order to the manifold of sense. On the one hand there is the manifold of sense, on the other 12 distinct categories. Hegel argued that the categories and that to which they apply should not be divorced from one another, and that the categories themselves should be considered in their relations to one another. If the categories and that to which they apply are inseparable, then an examination of the forms of thought is at the same time an exploration of the forms of being, and logic and metaphysics are one. And if the categories are not to be regarded as ultimate

items on a short list, then it may be possible for us to discover why it is that antinomies arise. They arise, Hegel held, from the limitation or abstract character of each form of thought considered on its own,

The aim, therefore, should be to show how our thinking becomes more and more adequate as, from the contradictions involved in the less satisfactory categories, we proceed toward those that are complex and comprehensive. This is the aim which Hegel claimed to fulfil in his *Science of Logic,* where, commencing with the most abstract category. "being." he passed through mathematical, physical, chemical and biological categories to the absolute idea. Just as the absolute idea contains within itself the truth of all the more abstract categories, so the later and more comprehensive systems of philosophy contain within themselves the truth of all the earlier and partial ones. "The latest philosophy contains therefore those which went before; it embraces in itself all the different stages of them; it is the product and result of those that preceded it. We can now, for example, be Platonists no longer" *(Lectures on the History of Philosophy).*

Absolute idealism, then, comprised the following main themes. It was held that the common-sense world of distinct things and embodied minds in space and time is not the world as it really is but merely the world as it appears in terms of uncriticized categories. It was held in the second place that the mathematical and physical categories are the least adequate for grasping the truth of things and that the world as a whole is best conceived in terms of self-conscious mind. It was held in the third place that thought does not consist in the imposition of ready-made forms upon merely given material, but is, in its most characteristic features, the relating of each particular experience with the infinite whole of which it is an expression. This was the general view which, in the latter part of the 19th century and in the beginning of the 20th, spread from Germany to Great Britain and the British empire, to the United States and. in rather different forms, to France and Italy too. The British writer who most consistently reproduced the central features of Hegel's absolute idealism was Bernard Bosanquet, especially in his *Logic* (1888) and *The Principle of Individuality and Value* (1912). In the former he traced the types of judgment and inference appropriate to the various stages of thought. from the rudimentary forms that are closest to mere sense experience to its highest systematic development. In the latter he showed the consequences of the view that no particular thing is real in isolation from the whole and that rational understanding and inference would be impossible unless the world were a system no part of which could be what it is apart from its relations to the other members. A somewhat more idiosyncratic version of absolute idealism is presented in the writings of F. H. Bradley. His *Ethical Studies* (1876) turned the Hegelian weapons against the utilitarian ethics and underlying empiricist assumptions of the time, while his influential *Appearance and Reality* (1893) was an attempt to show that, in spite of the appearances, the world is really "one comprehensive sentience." Josiah Royce's *The World and the Individual* (1901) was the most impressive American work in the tradition of absolute idealism. Mention should also be made of J. M. E. McTaggart's *The Nature of Existence* (2 vol., 1921–27), in which a subtly argued chain of reasoning is employed to establish the conclusion that the ultimate constituents of the world are a system of timeless selves who need no God to maintain the order that they observe. About the year rgoo absolute idealism had come to be by far the most active philosophical influence in the universities of the British empire and the United States, permeating the teaching of ethics, aesthetics and politics as well as the more fundamental disciplines of logic and metaphysics. Philosophy was thought to justify at any rate some of the religious hopes and to point the way to moral and political improvement.

Criticisms **of** Idealism. — By the middle of the 20th century philosophical idealism had lost its position of predominance and had few upholders in academic circles. The following paragraphs contain a summary of the types of argument that have led to this.

1. Immaterialism has never had wide support from philosophers, and both transcendental idealists and absolute idealists were chary of it. Now the first step in the empiricist form of immaterialism is the assertion that the objects immediately perceived are ideas or sensations which exist only "in the mind." This step has been challenged in two ways. In the first place it has been urged that immaterialists fail to distinguish between the object perceived (*e.g.,* a coloured patch) and the act of perceiving it and that it is the latter, not the former, that is really "in the mind." Those who use this argument, however. admit that the idea or sensation (for which the 20th-century name is "sense datum" or "sensum") only exists while it is being perceived and can only have those characteristics which it is perceived to have. They still have the problem, therefore, of determining the relationship of this entity to the material objects which, in any view, continue to exist when not perceived by any finite observer. The result is either a revised version of Locke's representationalism or else some form of phenomenalism. A second line of argument, therefore, takes the course of denying that there are such entities as sense data at all. Powerful support for this view is given by the reflection that if sense data have only those characteristics which they are perceived to have, then they must literally be vague or indefinite objects. For if someone sees a coloured patch with many speckles on it and yet does not see how many speckles there are, then according to the sense-datum theory he must be seeing a sense datum that has many speckles but has no definite number of them. Unless this paradox can be removed, upholders of sense data are in danger of maintaining the existence of entities with properties that seem to be logically impossible. If the analysis of perception in terms of ideas or sense data is untenable, then the arguments for immaterialism, as well as those for phenomenalism, cannot even get started.

2. The rationalist arguments for immaterialism and the arguments for the other types of idealism meet with criticisms of a type first clearly formulated by G. E. Moore. Idealists assert conclusions that conflict with common sense. Not only do they talk about transcendental selves and absolute ideas, but they deny that tables and embodied selves and other finite beings are real at all. But we do *say* that tables and people exist, and anyone who denied this would be *commonly* held to be saying what is false. Again, idealists have denied that time is real, and yet it certainly took time for this sentence to be written. Thus we have to choose between accepting the truth of statements that are universally understood and are universally held to be true, and accepting the truth of statements that are understood by very few and need a lot of philosophical argumentation in their support. The opponents of idealism argue that it is the first alternative that ought to be accepted, for, they say, it is ultimately only by means of the ordinary language which we are brought up to speak that anything at all can be explained to anybody. Someone who says that tables and people are not real is misusing the word "real," for it is commonly used just to indicate that it is tables and people that exist and such things as chimaeras and unicorns that do not. According to this argument, then, rationalist immaterialism and absolute idealism must be false because they deny the truth of commonsense statements that are certainly true if anything is true, and assert the truth of other statements whose meaning cannot be clearly explained in terms of the ordinary language in which everything explainable must ultimately be explained.

3. The absolute idealist holds that truth is a relationship of coherence between thoughts rather than a correspondence between thoughts and external realities. Against this empiricists argue that, important as coherence may be, it is secondary to the prime condition that statements are true by virtue of their stating what is the case. The idealist's objection to this, however, is that ascertaining what is the case (*i.e.,* verifying) is not a mere irrational seeing or touching, but is the testing of a theory and, since verification has its meaning and point only in the context of the theory that is being tested, it cannot take us beyond judgment, thought or inference (Brand Blanshard, *The Nature of Thought,* vol. ii, pp. 227–259, George Allen & Unwin Ltd., London, 1939; new impression, 1948).

4. The absolute idealist also maintains the view expressed by Hegel as "The truth is the whole." Understanding the world is discovering the place of subordinate things in subordinate wholes,

of subordinate wholes in less subordinate ones and, ultimately, of everything subordinate in the infinite whole. All our reasoning, it is held. rests on the assumption that everything is necessarily connected with everything else. The properties that things have they necessarily have, although we may not always see that this is so. It has been objected to this part of the idealist view that it is meaningless to say of any fact that it is necessarily as it is, since necessity is a property of elements of a symbolic system or of linguistic expressions: facts are the case, propositions may be necessarily true in the light of certain definitions and rules of inference. To this the idealist's reply is that necessity is a relationship between the elements of systems, so that the necessity of linguistic systems is one instance of a much wider notion. To understand anything, on his view, is to see it in its place in the various systems to which it belongs and is hence to grasp its necessity. "In what we take as the real world we can see the outlines of a necessary structure that is the counterpart of thought's ideal" (B. Blanshard, ibid. p. 516). See also MATERIALISM.

See further DESCARTES, RENE; BERKELEY, GEORGE; COLLIER, ARTHUR; KANT, IMMANUEL; FICHTE, JOHANN GOTTLIEB; SCHELLING, FRIEDRICH WILHELM JOSEPH VON; SCHOPENHAUER, ARTHUR; HEGEL, GEORG WILHELM FRIEDRICH; BOSANQUET, BERNARD; BRADLEY, FRANCIS HERBERT; ROYCE, JOSIAH; CROCE, BENEDETTO.

BIBLIOGRAPHY.—W. Wallace, *The Logic of Hegel: With Prolegomena* (1874, and subsequent editions); J. M. E McTaggart, *Studies in Hegelian Dialectic* (1896); Josiah Royce, *Lectures on Modern Idealism* (1919); *N.* Hartmann, *Die Philosophie des deutschen Idealismus,* vol i, *Fichte, Schelling und die Romantik* (1923), and vol. ii, *Hegel* (1929); J. H. Muirhead, *The Platonic Tradition in Anglo-Saxon Philosophy (1931)*; *G.* Watts Cunningham, *The Idealistic Argument in Recent British and American Phzlosophy* (1933); *A* C. Ewing, *Idealism: a Critical Survey* (1934); *G.* F. Stout, *God and Nature (1952)*; and works cited in the text above. (H. B. A.)

IDENTIFICATION: see FINGERPRINTS; EVIDENCE; INVESTIGATION, CRIMINAL.

IDENTITY, LAWS OF: see THOUGHT, LAWS OF.

IDEOGRAM, a pictorial symbol that conveys an idea or a meaning directly, as distinguished from a logogram (a word sign), syllabogram (a syllabic sign) or letter (an alphabetic sign), which represent sounds or linguistic elements. See PICTOGRAPHY; WRITING; LOGOGRAM AND SYLLABARY.

IDES, the name given in the Roman calendar to the 13th day of the month with the exception of March, May, July and October, the Ides in these months falling on the 15th day. See CALENDAR.

IDIOCY: see MENTAL DEFICIENCY.

IDOCRASE, a rock-forming mineral of variable composition also known as vesuvianite. Idocrase, a hydrous calcium aluminum silicate with some magnesium and iron, is transparent or translucent, has a vitreous lustre and is commonly brown or green. Transparent crystals of a good green or brown colour may be cut as gem stones. A compact green variety resembling jade is found at several localities in California and is known as californite. A sky-blue variety, cyprine, has traces of copper. Some varieties contain fluorine or boron. The crystals of idocrase have tetragonal symmetry, and the structural formula is $Ca_{10}(Mg,Fe)_2Al_4(Si_2O_7)_2(SiO_4)_5(OH)_4$. The crystal structure resembles in some ways that of garnet (*q.v.*). The crystals are four- or eight-sided prisms terminated by basal planes and pyramids. Idocrase occurs commonly as well-developed crystals, also as striated columnar aggregates. The specific gravity is about 3.4 and the hardness 6.5. Most varieties are optically uniaxial and negative. Viluite, a variety containing boron, is optically positive and may be biaxial.

Idocrase is found principally in crystalline limestones near their contacts with igneous rocks (see METAMORPHISM) and in beds of marble and calc-silicate granulite associated with gneiss and mica schist. It is also found in association with serpentinite and in chlorite schist and amphibolite. Minerals commonly occurring with it are calcite, garnet, diopside, wollastonite, phlogopite and amphibole.

Localities where fine crystals have been found are the Ala valley in the Piedmont; Monte Somma (Vesuvius); the Vilui river, Sib.; Christiansand, Nor.; and, in North America, at Auburn, Me.; Amity, N.Y.; Franklin, N.J.; and Litchfield, Que. (J. B. T.)

IDOL, literally an image (Gr. eidolon), particularly an image used as an object of worship. In philosophy, the word can mean a prejudice of some kind that hinders clear thought. It was used in this sense by Giordano Bruno and adopted from him by Francis Bacon (*q.v.*), who in a celebrated passage of his Novum Organum distinguished four kinds of idol, namely: (1) "idols of the tribe," prejudices more or less common to the whole human race; (2) "idols of the cave," prejudices peculiar to individuals; (3) "idols of the market place," prejudices encouraged by one's social group and mother tongue; and (4) "idols of the theatre," prejudices or false notions taught and encouraged by various schools of thought.

IDOLATRY, the worship of idols; *i.e.,* images or other objects believed to represent or be the abode of a superhuman personality. The term is often used generically to include such varied forms as litholatry, dendrolatry, pyrolatry, zoolatry and even necrolatry. In an age when the study of religion was practically confined to Judaism and Christianity, idolatry was regarded as a degeneration from an uncorrupt primeval faith, but the comparative and historical investigation of religion has shown it to be rather a stage of an upward movement. and that by no means the earliest.

According to Varro the Romans had no animal or human image of a god for 170 years after the founding of the city. Herodotus says that the Persians had no temples or idols before Artaxerxes I. Lucian bears similar testimony for Greece and as to idols for Egypt. Eusebius sums up the theory of antiquity in his statement "the oldest peoples had no idols."

Images of the gods indeed presuppose a definiteness of conception and powers of discrimination that could only be the result of history and reflection.

As the earlier stages in the development of the religious consciousness persist and are often manifest in idolatry, so in the higher stages, when men have attained loftier spiritual ideas, idolatry itself survives and is abundantly visible as a reactionary tendency.

The history of the Jewish people whom the prophets sought, for long in vain, to wean from worshipping images is an illustration; so, too, certain practices of modern popular Hinduism contrasted with the lofty teaching of the Indian sacred books.

In the New Testament the word εἰδωλολατρεία (idololatria), afterward shortened occasionally to εἰδωλατρεία (idolatria), occurs in all four times, viz., in 1 Cor. x, 14; Gal. v, 20; 1 Peter iv, 3; Col. iii, 5. In the last of these passages it is used to describe the sin of covetousness or "mammon worship." In the other places it indicates with the utmost generality all the rites and practices of those special forms of paganism with which Christianity first came into collision. It can only be understood by reference to the LXX, where εἴδωλον (like the word "idol" in the Authorized Version) occasionally translates indifferently no fewer than 16 words by which in the Old Testament the objects of what the later Jews called "strange worship" are denoted (see Encyclopaedia Biblica).

In the widest acceptation of the word, idolatry in any form is absolutely forbidden in the second commandment, which runs: "Thou shalt not make unto thee a graven image; [and] to no visible shape in heaven above, or in the earth beneath, or in the water under the earth, shalt thou bow down or render service." (See DECALOGUE.)

It is obvious that two religious votaries in an attitude of reverence before an image may be moved by very different ideas of what the image is and signifies, although their outward attitude is the same. The one may regard it as merely an image, picture or representation of a higher being, and in itself void of value or power. Its value is that of mere resemblance or some kind of acquired association. But the other may regard it as the tenement or vehicle of the god and fraught with divine influence. In modern Christendom the former is the attitude which the Roman Church officially inculcates toward sacred pictures and statues; they are intended to convey to the eyes of the faithful, especially to the illiterate among them, facts about Jesus, the

Virgin and the saints.

The other attitude is that into which simple-minded persons may easily lapse, as it is that which characterizes other religions, ancient or modern, which use images of any kind; and it is this attitude which may be conveniently called "idolatry" or image worship.

The invectives against idolatry of the early Jewish and Christian apologists, of Philo, Minucius, Tertullian, Arnobius, Lactantius and others, throw light on the question how an ancient pagan regarded his idols. One capital argument of the Christians was the absurdity of a man making an idol and then adoring or being afraid of the work of his own hands. Lactantius preserves the answer of the pagans so criticized (De *origine erroris,* ii, 2): we do not, they said, fear the images themselves but those beings after whose likeness they were fashioned and by whose names they were consecrated. And Augustine (De *civ.* dei, viii, 23) relates how, according to Hermes, the spirits entered "by invitation" so that the images became "bodies of the gods." Image worship is essentially a form or rather an outcome of animism, now known to represent a type of religion arising subsequently to its really primitive forms. An image fashioned like a god and having this advantage over a mere stock or stone, that it declares itself and reveals at a glance to what god it is sacred, is believed to attract and influence the god to choose it as his home and tenement. Religious ceremonial is much more hopeful and efficacious for a worshipper who thus has means of approaching the god he worships in visible and tangible form, and even of coercing it. Having the god thus at hand and bound up with the material object, the simple-minded worshipper can punish it if his prayers are left unanswered (cf. Tylor, Primitive Culture). Suetonius relates (Aug. 16) that Augustus, having lost some ships in a storm, punished Neptune by refusing to allow his image to be carried in procession at the games.

See RELIGION and ANIMISM with references to be found in those articles.

BIBLIOGRAPHY.—On the whole subject *see* "Images and Idols" in Hastings, *Encyclopaedia of Religion and Ethics,* vol. vii (1914), with extensive bibliography and references; also Sir Edward Burnett Tylor, *Printitive Culture,* 7th ed. (New York, 1924); L. R. Farnell, *Evolution of Religion* (1905).

IDOMENEUS, in Greek legend, son of Deucalion, grandson of Minos and Pasiphae, and king of Crete. He courted Helen and took a distinguished part in the Trojan War. According to the Odyssey, he returned home safely with all his countrymen who had survived the war. In later tradition, having been overtaken by a violent storm, he vowed to sacrifice to Poseidon the first living thing that met him when he reached home. This proved to be his son, whom he slew in accordance with his vow; whereupon a plague broke out and Idomeneus was driven out. He fled to the district of Sallentum in Calabria and subsequently to Colophon in Asia Minor, where he settled near the temple of the Clarian Apollo and was buried on Mt. Cercaphus. But the Cretans showed his grave at Cnossus, where he was worshiped as a hero with Meriones.

IDRIS I (MOHAMMED IDRIS EL-MAHDI ES-SENUSSI) (1890–), first king of the United Kingdom of Libya, was the grandson of Mohammed ben Ali ben es-Senussi (1791?–1859), an Algerian from Mostaganem who from 1843 onward lived in Cyrenaica and founded a powerful Moslem fraternity known as Senussiya. and the son of Senussi el-Mahdi (1845–1902).

Since Idris was a minor at the time of his father's death, the chieftainship passed to his cousin Ahmed esh-Sherif who fought against Italy in the Italian-Turkish war of 1911–12 and in World War I.

In 1917 Idris secured an agreement with the British and Italian governments, was recognized by the Senussi chiefs as Grand Senussi and in Nov. 1920 acknowledged Italian suzerainty over Cyrenaica. He was given the hereditary title of amir with jurisdiction over the oases of Kufra, Jaghbub, Jalo, Aujila and Jedabia. On the rise of fascism in Italy, he withdrew in Jan. 1923 to Egypt with his family. while his lieutenants continued to rule in the oases. In 1940, under an agreement with the British government, he organized an auxiliary military force which fought with the British 8th army.

In Nov. 1947 he returned to Cyrenaica and the following year was installed in the palace of the former Italian governor at Benghazi. On June 1, 1949, he was recognized by Great Britain as ruler of Cyrenaica.

In Dec. 1950 he was chosen by the national assembly representing Cyrenaica, Tripolitania and the Fezzan to be king of Libya when that state came into being.

On Dec. 24, 1951, Great Britain and France relinquished their administrative authority, and Idris proclaimed the independence of the new state. (K. SM.)

IDRISI (ABU 'ABDULLAH MOHAMMED IBN MOHAMMED ASH-SHARIF AL-IDRISI) (1100–*c.* 1166), Arab geographer, scientist and poet, was a descendant of the prophet Mohammed through Idris I of Morocco and the Banu Hammud, princes of Malaga. According to a very late authority Idrisi was born at Ceuta in A.H. 493 (A.D. 1099–1100). He studied at Córdoba and traveled widely in Spain, north Africa and Asia Minor. Roger II of Sicily (1101–05) treated him with great honour and entrusted him with the compilation of a treatise on the whole of the known world in which information from existing geographical works was collated with reports of travelers. After 15 years Idrisi completed early in 1154 the Nuzhat al-mushtdq *fi'khtirāq* al-dfdq ("Delight of him who wishes to traverse the regions of the world"), generally known as *Kitāb Rūjār* ("The Book of Roger"). He constructed a silver globe and planisphere, both of which have perished. The treatise was illustrated with maps and it can be shown that these were based upon the text, not the text upon the maps. He compiled another recension for William the Bad (1154–66) but it has been lost. A manuscript of a third version was found in the Hakimoglu Ali Pasha mosque in Istanbul in 1906; this is dedicated to an anonymous but not royal patron and omits the descriptive part of *The* Book of *Roger* but retains the itineraries and includes some new material. A manuscript of Idrisi's work on botany and materia medica also survives in Istanbul and a few of his verses have been preserved. It is unlikely that he remained in Sicily after the anti-Moslem riots of 1161 but it is not known when or where he died. No life of him has been traced in Arabic biographical literature and the account by Leo Africanus in De *viris illustribus apud Arabes* (Zurich, 1664) is of no value.

The Book of Roger is divided according to the seven climates of Greek geographers, beginning at the equator and extending northward as far as the latitude at which cold made the earth uninhabitable. Each climate is then subdivided by vertical lines into ten equal sections numbered from west to east. All divisions which do not coincide with these are ignored in the arrangement of the book. There is evidence of hasty compilation, and of misunderstanding of the written sources. Some legendary matter is included such as descriptions of the land of Gog and Magog, the wonders of Rome and the islands of St. Brandan; mathematical and descriptive errors are common. The maps seem to have been reduced by eye and areas well known to the author are shown as disproportionately large. The preface mentions written sources consulted by Roger which include Ptolemy and Orosius but no other European writers. Mas'udi and Ibn Hawqal are among the chief Arabic authorities Idrisi used but he appears not to have known Biruni or Maqdisi. Much of the information given was not derived from these sources and must have been taken from travelers' accounts and in Roger's own dominions from official records. The description of Sicily is the most detailed and is of great historical interest, for it includes much more than purely topographical information. Idrisi's place names are often difficult to identify because of corrupt manuscripts and the ambiguities of the script. In Italy, Greece, parts of France and even in Sicily some of them seem to have been taken from classical rather than Arabic maps or contemporary vernacular usage. In other parts of France and in northern Europe generally he gives versions of contemporary spoken forms. Ireland occupies the first and Britain the second section of the seventh climate. Some of his English place names are French in form. He knew something of the coast between Dartmouth and Grimsby, mentions Dover, London, probably Oxford and perhaps the Scilly Isles but he knows no British

river by name except the Thames and nothing of the interior or the west coast.

A garbled abridgment of his work was printed in Arabic (Rome. 1592), and in a Latin translation as *Geographia Nubiensis* (Paris, 1619), the title being due to a misunderstanding. His influence on European cartography and exploration was not important but it has been suggested that his delineation of Africa influenced the maps of Marino Sanudo and Pietro Vesconte. Like Ptolemy, Idrisi believed that Africa extended to the east and enclosed the Indian ocean on the south. It has also been suggested. without evidence. that his account of a voyage, apparently to Madeira and one of the Canaries. may have influenced the exploration of the Atlantic.

The most important manuscripts of *The Book of Roger* are in the Bibliothèque Nationale, Paris, and the Bodleian Library, Oxford The maps they contain were reproduced by Konrad Miller. *Mappae arabicae* (1926–31). The maps of the greater part of the British Isles were reproduced by D. M. Dunlop, "Scotland According to al-Idrisi," *Scottish Historical Review,* vol. xxvi (1947). There is no edition of the complete Arabic text. The French translation of A. Jaubert, 2 vol. (1836–40), is complete but very unsatisfactory. Sections of the text, especially those relating to Europe and north Africa, have been studied, and sometimes edited and translated in monographs and papers, many of which are in the academic journals of the countries concerned. For details of these *see* G. Sarton, *Introduction to the History of Science* (1927–48), vol. ii, pp. 410–412; C. Brockelmann, *Geschichte der arabischen Litterutur* (1898–1902) and the article "Idrisi" by C. F. Seybold in the *Encyclopaedia of Islam,* vol. ii (1930). The account of the British Isles was edited, translated and discussed by A. F. L. Beeston, "Idrisi's Account of the British Isles." *Bull. Schl orient. Stud. Lond. Univ.,* vol. xiii (1949–50).

On Idrisi's life and work generally, *see* especially M. Amari, *Storia dei musulmani di Sicilia,* 2nd ed. by C. A. Nallino, vol i, pp 49–51; vol. iii, pp. 460–468, 677–701 (1933–37). (C. F. Bm.)

IDUMAEA: *see* EDOM.

IDUN (IDUNA), in Norse mythology, is the wife of Bragi (*q.v.*), god of poetry. She guarded the apples which the gods must eat to preserve their youth. When she and her apples were seized by a giant, the gods quickly began to grow old. This story is mentioned in a Norwegian poem as early as the late 9th century.

(G. T.-P.)

IDYL or IDYLL, a short poem of a pastoral or rural character, in which something of the element of landscape is preserved or felt. The earliest commentators of antiquity used the term to designate a great variety of brief and homely poems, in which the description of natural objects was introduced, but the pastoral idea came into existence in connection with the Alexandrian school and particularly with Theocritus, Bion and Moschus, in the 3rd century B.C. It appears, however, that *eidyllion* was not, even then, used consciously as the name of a form of verse. but as a diminutive of *eidos,* and merely signified "a little piece in the style of" whatever adjective might follow. Thus the idyls of the pastoral poets were *eidylliu aipolkai,* "little pieces in the goatherd style." Ten of the so-called "Idyls" of Theocritus are extant, and these are the type from which the popular idea of this kind of poem is taken. The word was revived at the Renaissance. In 1658 the English critic, Edward Phillips, defined an "idyl" as "a kind of eclogue," but it was seldom used to describe a modern poem. The general use, or abuse, of the word in the second half of the 19th century, both in English and French, arises from the popularity of two works, by two eminent poets. The *Idylles héroiqztes* (1858) of Victor de Laprade and the *Idylls of the King* (1859) of Tennyson enjoyed a success in either country which led to a aide imitation of the title among those who had. perhaps, a very inexact idea of its meaning. On the whole, it is impossible to admit that the idyl has a place among definite literary forms.

IESI (anc. AESIS), a town and episcopal see of the Marche. Italy. province of Ancona, 17 mi. S.W. from Ancona town by rail. 318 ft. above sea level. The pop. (1951) 21,409. It lies on the left bank of the river Aesis (mod. Esino). It still retains its picturesque medieval town walls. S. Marco is an interesting 13th century church. The Palazzo del Comune is a fine, simple, early Renaissance building (1487–1503) by Francesco di Giorgio Martini. The courtyard with its loggie was built by Andrea Sansovino in 1519 The picture gallery contains some good pictures by Lorenzo Lotto The castle was built by Baccio Pontelli (1488). Iesi nas the birthplace of the emperor Frederic II (1194), and of the composer Giovanni Battista Pergolesi (1710–36). The silk spinning industry is of considerable importance The Aesis formed the boundary of Italy proper from about 250 B C to the time of Sulla (*c* 82 B C.); and, in Augustus' division of Italy, that between Umbria (the 6th region) and Picenum (the 5th).

See L Marinelli, "Le Mure di Iesi" in *Cronache d'Arte* iv (1928).

IF, a small island in the Mediterranean sea off the south coast of France, about 2 mi. S W. of Marseille. Its fortress prison, the Château d'If, was built by Francis I in the early 16th century and was made famous by Alexandre Dumas' novel, *Tlze Count of Monte Cristo.*

IFE, a town of the Western Region of Nigeria, Africa, lies at about 750 ft above sea level and 45 mi. E of Ibadan, in the rain forest area and within the main cocoa growing regions. Pop. (1953) 110,790 (Africans only). Formerly called Ile-Ife, it is one of the larger, and possibly the oldest, of the Yoruba towns. It has been described as the "holy city" of the Yoruba (*q* v.) and at its centre is the palace (afin) of the oni of Ife, the spiritual head of the Yoruba people. Apart from some modern two-story buildings, the houses are mostly of red mud with pan (metal) roofing.

In the palace compound (about two acres) is the Ife museum containing examples of Ife bronze and terra-cotta heads and figures. *Cire-perdue* bronze castings of uncertain date were first discovered by the archaeologist Leo Frobenius in 1910; further bronze heads were found in 1938 and terra-cotta figures in 1957. Another notable relic in the custody of the oni is the staff of Oranyan, an 18-ft. granite monolith in the shape of an elephant's tusk

At the north of the town stands Oduduwa college, named in honour of the reputed ancestor of the Yoruba.

Ife is linked by main road westward with Ibadan and Lagos, northnard with Oshogbo, Ilorin and the Northern Region, and eastward with Benin and the Eastern Region. The people are by tradition town-dwelling farmers and live mainly by farming the surrounding country. A substantial cocoa crop is also exported.

A local legend relates that Ile-Ife was the place where mankind was created. The Yoruba at least appear to have been established there at an early date Ife seems to have largely escaped the contacts made by Benin uith the first European explorers and was later less affected by the Fulani attacks and the civil wars of the 19th century than were the neighbouring Yoruba kingdoms of Oyo, Ibadan and Abeokuta. (W. H. I.)

IFFLAND, AUGUST WILHELM (1759–1814), German actor, dramatist and manager. was born in Hanover on April 19, 1759. At the age of 18 he broke nith parental authority and joined the Gotha court theatre to study acting under Konrad Ekhof's direction. In 1779 he went to Mannheim uhere he created the part of Franz Moor in Schiller's *Die Räuber.* In 1796, upon Goethe's invitation, he appeared as guest star on the Weimar court stage, charming his audiences with truthful and yet stylized portraits of pathetic and comic middle-class characters. His flights into tragedy (Lear, Wallenstein, Egmont) were less successful As an author Iffland achieved likewise fame in the field of domestic drama and sentimental comedy *(Verbrechen aus Ehrsucht, Die Jager, Der Spieler, Die Hagestolzen).* In 1798 he was appointed manager of the Berlin National theatre, and in 1811 director-general of all the royal theatres in Prussia. He died in Berlin on Sept. 22. 1814.

See his autobiography *Meine Theatralische Laufbahn* (republished 1885). (A. M. N.)

IGARA, a people closely resembling the Yoruba, inhabiting the provinces of Munshi and Nassarawa, northern Nigeria, and who speak a Yoruba dialect.

See Meek, *The Northern Tribes of Nigeria* (1925).

IGARKA, a port in the Krasnoyarsk *kray* of the Russian

S.F.S.R. It is located on the Yenisei river, 62 mi. N. of the Arctic circle and 418 mi. S. of the Kara sea. It is a station on the air route from Krasnoyarsk to Dickson Island, at the mouth of the Yenisei. The population, which varies considerably with the season, is approximately 12,000 in winter and 15,000–20,000 in summer, when migratory labour arrives to help load ships.

Igarka was founded in 1929 across the river from an old fishing village of the same name, to provide a seaport from which Siberian products might be shipped to other parts of the world. A natural harbour is formed in the Yenisei by a small island opposite the city, and since the river is 10 fathoms deep and 5 mi. wide here, ocean-going vessels can easily penetrate to Igarka, to which they are convoyed from the Kara sea by icebreakers. In addition, the river flows smoothly at that point, providing a suitable base for floating timber down the river after it has been processed in Igarka's sawmills.

Although the soil thaws only to a depth of two or three feet even in summer, marshes were drained for cultivation. The Soviet government established a Polar Agricultural station at Igarka which proved successful in growing grain and some vegetables as well as in maintaining dairy farms.

The name Igarka is commonly thought to have been derived from Yegor or Yegorka, the name of one of the first settlers in the old fishing village. The British, who sailed up the Yenisei in the 19th century, corrupted the word to Igarka. In 1929, when construction began on the new city, there were only 43 inhabitants of the old Igarka.

IGLESIAS POSSE, PABLO (1850–1925), Spanish politician was born at El Ferrol on Oct. 15, 1850. On the death of his father he was placed in a foundling asylum where after repeated attempts at escape he remained for some years. In 1871 he became secretary of the International Proletarian federation and in 1872 founded the Typographical societies of which he became president in 1885. He helped form the first Spanish Socialist group in 1879 and was elected to the house of deputies in 1910. In 1923, when Primo de Rivera overthrew the constitution and closed the doors of the cortes, he was chief of the Parliamentary socialist party. He became editor of *El Socialista,* the organ of the Spanish labour movement in 1886. For activities on behalf of the workers he served eight terms of imprisonment. He died in Madrid on Dec. 8, 1925.

See Meliá, Pabto *Iglesias* Posse. Rasgos *de su vida íntima* (1926).

IGNATIEV, NICHOLAS PAVLOVICH, COUNT (1832–1908), Russian diplomatist, was born at St. Petersburg (Leningrad) on Jan. 29, 1832. At 17 he became an officer of the Guards. His diplomatic career began at the Congress of Paris, after the Crimean War, where he took an active part as military attaché in the negotiations regarding the rectification of the Russian frontier on the Lower Danube. Two years later (1858) he was sent with a small escort on a dangerous mission to Khiva and Bokhara. The khan of Khiva laid a plan for detaining him as a hostage, but he returned safely, after concluding with the khan of Bokhara a treaty of friendship. He was Russian envoy at Peking nhen the Chinese government was terrified by the advance of the Anglo-French expedition of 1860 and the burning of the Summer palace; he used the occasion to secure for Russia not only the left bank of the Amur, the original object of the mission, but also a large extent of territory and seacoast south of that river. Ignatiev was ambassador at Constantinople from 1864 till 1877. Here his chief aim was to liberate from Turkish domination and bring under the influence of Russia the Christian nationalities in general and the Bulgarians in particular. His diplomacy led up to the Russo-Turkish war of 1877–78, at the close of which he negotiated with the Turkish plenipotentiaries the treaty of San Stefano. Ignatiev then retired in semidisgrace. After the accession of Alexander III in 1881, he was appointed minister of the interior to carry out a nationalist, reactionary policy, but was dismissed in 1882. He died on July 3, 1908.

IGNATIUS (Ἰγνάτιος), bishop of Antioch, a father of the Church. Our only trustworthy information is derived from the letters which he wrote to various churches on his last journey from Antioch to Rome, and from the short epistle of Polycarp to the Philippians. For the complicated controversy over the three recensions of the letters of Ignatius the reader is referred to the authorities quoted in the bibliography. The general consensus appears to be that the letters contained in the Medicean ms. at Florence, addressed to the Ephesians, Magnesians, Trallians, Romans, Philadelphians, Smyrnaeans and to Polycarp are genuine, and that they were written in the reign of Trajan. Harnack placed them in the latter years of Trajan or possibly 117–12j. Most scholars date them a few years earlier (110–117).

The letters of Ignatius unfortunately, unlike the Epistles of St. Paul, contain scant autobiographical material. We are told absolutely nothing about the history of his career. The fact that like St. Paul he describes himself as an ἔκτρωμα (Rom. 9), and that he speaks of himself as "the last of the Antiochene Christians" (*Trall.* 13; *Smyrn.* xi.), seems to suggest that he had been converted from paganism somewhat late in life and that the process of conversion had been abrupt and violent. He bore the surname of Theophorus, *i.e.,* "God-clad" or "bearing God." At the time when the Epistles were written he had just been sentenced to death, and was being sent in charge of a band of soldiers to Rome to fight the beasts in the amphitheatre The fact that he was condemned to the amphitheatre proves that he could not have been a Roman citizen. We lose sight of him at Troas, but the presumption is that he was martyred at Rome.

But if the Epistles tell us little of the life of Ignatius, they give us an excellent picture of the man himself, and are a mirror in which we see reflected certain ideals of the life and thought of the day. Ignatius, as Schaff says. "is the incarnation of three closely connected ideas: the glory of martyrdom, the omnipotence of episcopacy, and the hatred of heresy and schism."

Zeal for martyrdom in later days became a disease in the Church, but in the case of Ignatius it is the mark of a hero. The heroic note runs through all the Epistles; thus he says:

> I bid all men know that of my own free will I die for God, unless ye should hinder me . . . Let me be given to the wild beasts, for through them I can attain unto God. I am God's wheat, and I am ground by the wild beasts that I may be found the pure bread of Christ. Entice the wild beasts that they may become my sepulchre . . . ; come fire and cross and grapplings with wild beasts, wrenching of bones, hacking of limbs, crushings of my whole body; only be it mine to attain unto Jesus Christ (*Rom.* 4–5).

Ignatius constantly contends for the recognition of the authority of the ministers of the church. "Do nothing," he writes to the Magnesians, "without the bishop and the presbyters." The "three orders" are essential to the church; without them no church is worthy of the name (cf. Trall. 3). "It is not lawful apart from the bishop either to baptize or to hold a love-feast" (*Smyrn.* 8). Respect is due to the bishop as to God, to the presbyters as the council of God and the college of apostles, to the deacons as to Jesus Christ (Trall. 3). These terms must not, of course, be taken in their developed modern sense. The "bishop" of Ignatius seems to represent the modern pastor of a church. As Zahn has shown, Ignatius is not striving to introduce a special form of ministry, nor is he endeavouring to substitute one form for another. His particular interest is not so much in the form of ministry as in the unity of the church. Centrifugal forces were at work.

Ignatius was resisting this fatal tendency which threatened ruin to the faith. The only remedy for it in those days was to exalt the authority of the ministry and make it the centre of church life. It should be noted that (1) there is no trace of the later doctrine of apostolical succession; (2) the ministry is never sacerdotal in the letters of Ignatius As Lightfoot puts it: "The ecclesiastical order was enforced by him (Ignatius) almost solely as a security for doctrinal purity. The threefold ministry was the husk, the shell, which protected the precious kernel of the truth" (i. 40).

Ignatius fights most vehemently against the current forms of heresy The chief danger to the church came from the Docetists who denied the reality of the humanity of Christ and ascribed to him a phantom body Hence we find Ignatius laying the utmost stress on the fact that Christ "was *truly* born and ate and drank,

was *truly* persecuted under Pontius Pilate . . . was *truly* raised from the dead" *(Trall.* 9) "I know that He was in the flesh even after the resurrection, and when He came to Peter and his company, He said to them, 'Lay hold and handle me, and see that I am not an incorporeal spirit' " (*Smyrn.* 3). Equally emphatic is Ignatius's protest against a return to Judaism. "It is monstrous to talk of Jesus Christ and to practise Judaism, for Christianity did not believe in Judaism but Judaism in Christianity" *(Magn.* 10).

As far as Christology is concerned, there are two points to be noted: (1) Ignatius is the earliest writer outside the New Testament to describe Christ under the categories of current philosophy; *cf.* the famous passage in *Eph.* 7. "There is one only physician, of flesh and of spirit (σαρκικὸς καὶ πνευματικός), generate and ingenerate (γεννητὸς καὶ ἀγέννητος), God in man, true life in death, son of Mary and son of God, first passible and then impassible" (πρῶτον παθητὸς καὶ ἀπαθής). (2) Ignatius is also the first writer outside the New Testament to mention the Virgin Birth, upon which he lays the utmost stress. "Hidden from the prince of this world were the virginity of Mary and her child-bearing and likewise also the death of the Lord, three mysteries to be cried aloud, the which were wrought in the silence of God" (*Eph.* 19). Here, it will be observed, we have the nucleus of the later doctrine of the deception of Satan. In regard to the Eucharist also later ideas occur in Ignatius. It is termed a μυστήριον *(Trall.* 2), and the influence of the Greek mysteries is seen in such language as that used in *Eph.* 20, where Ignatius describes the Eucharistic bread as "the medicine of immortality and the antidote against death."

When Ignatius says, too, that "the heretics abstain from Eucharist because they do not allow that the Eucharist is the flesh of Christ," the words seem to imply that materialistic ideas were beginning to find an entrance into the church *(Smyrn* 6). Other points that call for special notice are: (1) Ignatius's rather extravagant angelology. In one place, for instance. he speaks of himself as being able to comprehend heavenly things and "the arrays of angels and the musterings of principalities" *(Trall.* j). (2) His view of the Old Testament. In one important passage Ignatius emphatically states his belief in the supremacy of Christ even over "the archives" of the faith, *i.e.,* the Old Testament: "As for me, my archives—my inviolable archives—are Jesus Christ, His cross, His death, His resurrection and faith through Him" *(Philadel.* 8).

See T. Zahn, *Ignatius von Antiochien* (Gotha, 1873); J. B. Lightfoot, *Apostolic Fathers,* part ii. (London, 2nd ed., 1889); F. X. Funk, *Die Echtheit der ignat. Briefe* (Tubingen, 1892); A. Harnack, *Chronologie der altchristlichen Litteratur* (Leipzig, 1897). There is a good bibliography in G. Kruger, *Early Christian Literature* (Eng. trans., 1897, pp. 28–29); Rackl, *Die Christologie des heil. Ignaz von Antiochien* (1914). *See* also APOSTOLIC FATHERS.

IGNIS FATUUS (Lat. *ignis,* "fire"; *fatuus,* "foolish"). The name applied to the pale flame, also called will-o'-the-wisp and jack-o'-lantern, sometimes seen flickering over marshy ground and, it is said, over churchyards. No entirely satisfactory explanation has been put forward but it is generally believed that the effect is due to the spontaneous ignition of gases (especially methane, CH_4 or phosphine, PH_3) produced by the disintegration of dead plant and, possibly, animal matter.

IGNORANCE. In the law among the English-speaking peoples, as in Roman law, ignorance of the law is, in general, no ground for avoiding the consequences of an act. As regards criminal offences, the maxim as to *ignorantia juris* admits of no exception, even in the case of a foreigner temporarily in England, who is likely to be ignorant of English law. In Roman law the harshness of the rule was mitigate8 in the case of women, soldiers and persons under the age of 2 j, unless they had good legal advice within reach *(Dig.* xxii. 6. g), while in England judges often inflict mitigated sentences when a criminal did not and could not reasonably be expected to know the law, especially if it be very recent. Ignorance of foreign law is ignorance of fact. A compromise of claims, doubtful in law, is good and cannot be upset by subsequent solving of the doubt *(Stewart* v. *Stewart* 6 Cl. and F. 911). Ignorance of a matter of fact may in general be alleged in avoidance of the consequences of acts and agreements, but such ignorance cannot be pleaded where it is the duty of a person to know, or where, having the means of knowledge at his disposal, he willfully or negligently fails to avail himself of it. (See CONTRACT.)

In logic, ignorance is that state of mind which for want of evidence is equally unable to affirm or deny one thing or another. Doubt, on the other hand, can neither affirm nor deny because the evidence seems equally strong for both. For *Ignoratio Elenchi* [irrelevant conclusion] *see* FALLACY.

IGOROT, a general name (meaning "mountaineer") for "non-Christian" peoples of the central Cordillera of north Luzon, Philippines; also used for specific ethnic groups within the region; *e.g.,* the Bontok. Some live in the tropical forests of the foothills, but most live in rugged grassland and pine forest zones from about the 3,500 to 8,000-ft. levels. Still imperfect censuses showed a total of about 250,000 at mid-20th century, with slowly rising numbers in most communities. Usually medium in height with brown skin and straight hair, the Igorot peoples are genetically composite, with varying frequencies of later Malayan and earlier Indonesian type characters, and an understratum of Negritoid.

Notorious in earlier days for their warmaking and head-hunting, they were partially pacified by the Spanish and the process was completed during the U.S. period; but local killings may still occur in remote areas.

Ethnologists distinguish about ten main ethnic groups, each with its own dialect and special types of houses, clothing, art design, social structure and other distinctions. These units in turn have subgroup variations, and indeed such differences show even between local communities, since formerly each settlement was likely to be politically separate and often feuding with its neighbours.

There are also two broad groupings of the Igorot as a whole: one, by far the larger, comprises the peoples of the higher country in the south, central and west zones, having intensive wet rice cultivation mostly in steplike terraces-up the mountainsides; the other, peoples of the lower rain forest areas in the east and north, growing dry rice in seasonally shifting gardens. The first group nearly all live in populous villages (the Nabaloi or Ibaloi, Kankanay, Lepanto or Northern Kankanay, Bontok, Southern Kalinga, Tinguian), but one ethnic unit (Ifugao) has small farmsteads of kinsmen dotted through the rice terraces. The second group are sparsely settled in hamlets or farmsteads around which new gardens are cleared as the soil is worked out (the Gaddang, Northern Kalinga, Isneg or Apayao); some Gaddang live in tree houses.

Cultural elements common to the Igorot area as a whole include use of iron and brass worked by local smiths from metal traded from the lowlands, weaving, beliefs relating to sacred trees and mountains, and animal sacrifice (pigs, chickens, dogs) for omen reading. Modern trade, peaceful travel on roads, Christian mission work, schools and other government activities, and urban influences especially from two mountain centres (Baguio, summer capital of the Philippines, with its gold mines, and the Mountain Province capital, Bontoc) are slowly bringing about assimilation of the Igorot to the general life of the Philippines.

See also BONTOK; TINGUIAN.

BIBLIOGRAPHY.—A. L. Kroeber, *Peoples of the Philippines* (1928); F. M. and Marie Keesing, *Taming Philippine Headhunters: a Study of Government and of Cultural Change in Northern Luzon* (1934); H. W. Krieger, *Peoples of the Philippines* (1942); F. C. Cole, *The Peoples of Malaysia* (1945). (F. M. KG.)

IGUAÇU (IGUASSÚ; Spanish IGUAZÚ), a river which rises near the crest of the great coastal escarpment Serra do Mar in Paraná state, Braz., just east of Curitiba, and flows west for 745 mi. to join the ParanL river. It is thus part of the Plata river system *(see* PLATA, RÍO DE LA), and for the last 75 mi. of its course it forms the boundary between Brazil and Argentina. About 14 mi. above its mouth the river cascades over the famous Iguaqu falls. The Iguaçu river follows a meandering course westward across the Paraná plateau, but is frequently interrupted by rapids. It is only navigable for river boats for a short distance from Pôrto Amazonas to União da Vitória. Between prairie-covered uplands, the valley of the Iguaqu is filled with dense semideciduous forest, cleared

in part by pioneer farmers.

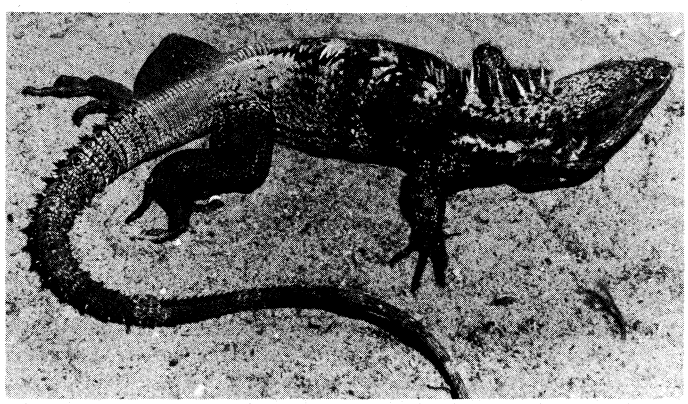
At Iguaqu falls the river drops about 269 ft. into a narrow gorge before emptying into the Paraná. The falls are about 2½ mi. wide, but the water is divided into hundreds of individual falls separated by rocky and heavily forested islands. National parks have been established on either side of the boundary by Argentina (1928) and Brazil (1939). Modern tourist hotels have been built at Foz do Iguaqu and Puerto Iguazú. The falls can be reached most easily by air. but many tourists prefer the river boat trip up the Paraná. The Brazilians have built a highway across Parana state to Foz do Iguaqu. About 30 to 40 ft. higher than Niagara falls, Iguaqu is often described as a potential hydroelectric power site but there are difficulties in the way of such development. First, the volume of water in the Iguaqu river varies greatly during the year, being highest in the southern hemisphere winter; it has been estimated that the rate of flow over the falls is about 62,000 cu.ft. per second for mean annual volume, which under extreme flood conditions may reach more than 450,000 cu.ft. per second. Second, such power development would require co-operation between Argentina and Brazil — traditionally un-co-operative with each other. Third, there is no potential market for power within range of transmission lines.

The name of the river and the falls is a Guarani word meaning "great water." The first Spanish explorers named the cataracts Salto de Santa María (Santa María falls), but the Indian name persisted. (P. E. J.)

IGUANA, the common name for lizards of the family Iguanidae, particularly the larger forms of the family. The same name or its corruption "goanna," is misapplied to the monitors (family Varanidae). With three exceptions all the genera (numbering about 65 and containing about 700 species) .belong to the new world; the exceptional genera are Brachylophus (nearing extinction) in the Fiji Islands and *Hoplurus* and Chalarodon in Madagascar. The Iguanidae can be regarded as the new world analogue of the old world Agamidae, which family it closely resembles in its structure and in the modifications which its members have undergone.

The only absolute distinction between the two families is in the position of the teeth; in the Agamidae they are fused to the crest of the jaw bones and in the Iguanidae attached to the inner slope below this crest. In many, however, the teeth are peculiar in being blade- or spear-shaped, with the upper cutting edges strongly serrated. Most iguanas are clothed with small scales and have a large dewlap, a pouch situated beneath the head and neck. Often a crest on the back and tail is composed of narrow, elongate scales which gradually diminish in size posteriorly. The tongue is short and cannot be thrust out.

Perhaps the best-known species is the common iguana (Iguana iguana), which occurs throughout tropical Central and South America. Reaching a length of as much as six feet (including the tail), this animal is much sought for as an article of diet; the flesh, white and tender, tastes somewhat like that of frogs' legs and is greatly esteemed by the Indians. The iguana is arboreal, its favourite haunts being trees overhanging water, into which it will unhesitatingly plunge if disturbed. Like most of the arboreal species, the ground colour is greenish, relieved in this particular case by brown bands. which form regular rings on the tail. The food consists largely of tender leaves and fruits but the lizards will also readily eat small birds and mammals. Another semi-arboreal genus of tropical America is Basiliscus, whose members exhibit some curious modifications. The body is compressed from side to side, the tail very long and whiplike, the hinder part of the head produced into a flat lobe like a cock's comb and the outer edges of the toes provided with a wide fringe of elongate scales; the males of all species have a crest along the back but in two species (B. *basiliscus* and B. *plumifrons*) this is enormously developed. being as deep as the body, supported by rays like the fins of a fish, and covered with very thin scales. In addition to these structural peculiarities they have the power, shared only by a few other forms of this family, of being able to run across the surface of water; if disturbed near the water they scutter across it on their hindlimbs, the body being held almost upright with the tail raised as a counterpoise and the forelimbs folded against their sides.



BY COURTESY OF JOHN E. WERLER, HOUSTON ZOOLOGICAL GARDENS

BLACK IGUANA (CTENOSAURA ACANTHURA), MANY OF WHICH ARE SOLD FOR FOOD IN MEXICAN MARKETS

Basiliscus often dives to the bottom as does Deiroptyx of Cuba, which rushes across the surface in the same way and in some quiet corner dives to the bottom, where it remains until the alarm has passed. Amblyvhynchus has achieved fame as the only marine lizard. Its aquatic nature has usually been exaggerated, however, and actually it seldom takes to the water. Large herds of these lizards used to frequent the rocky shores of the Galápagos Islands, feeding on the seaweeds between tidemarks. The ground iguana, *Cyclura,* one of the most primitive members of the family, was formerly found in the Galápagos but now is found on only a few islands of the West Indies. Ctenosaura species are the rather large black iguanas of Central America.

About ten genera of small iguanids are found in the U.S.; they are by far the most conspicuous lizards of the southwest. and include the desert iguana (crested lizard), the earless, zebra-tailed (gridiron-tailed), fringe-toed, collared, leopard and spiny lizards; the anoles, chuckwallas, utas and horned toads (*q.v.*).

The terrestrial species of the family are usually duller in colour than the arboreal ones and the body is, as a rule, depressed rather than compressed; this flattening has been carried to an extreme in the so-called horned toads (Phrynosoma) of the deserts of the United States and Mexico. As well as being flattened, they have, like many desert dwelling animals, developed an armour of spines, the largest of which occur on the back of the head and neck. This lizard greatly resembles the Australian moloch lizard, an agamid that under the influence of similar conditions has developed a very similar appearance. A unique characteristic of the homed toads is their ability to squirt a fine jet of blood from the eye; this extraordinary phenomenon, which has never been satisfactorily explained, only occurs under stress of great emotion, fright or anger. The lizard puffs itself up until the eyes bulge and then a very fine stream of blood is shot out of the eye, sometimes to a distance of ; ft. The special mechanism for this discharge is an agglomeration of blood vessels at the corner of the eye.

Another peculiarly modified genus is Anolis, which occurs throughout the warmer districts of both North and South America and which is particularly abundant among the West Indian islands. All of the lizards of this genus have the basal joints of their fingers and toes dilated and covered with transverse lamellae like those of the gecko (*q.v.*) and these adhesive pads, together with the powerful claws, render the animals excellent climbers. They have wonderful powers of changing colour, rivaling in this respect the true chameleons; in fact they are frequently called American chameleons. Anoles or anole would be a better term. The males often have enormously developed dewlaps which may be brilliantly coloured and can be expanded and contracted at will, like a fan.

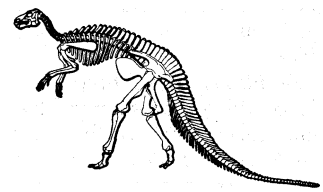
Iguanids, except for a few species, reproduce by means of eggs laid in the ground. The few exceptions, iguanids living in cool, mountain climates, hatch their eggs within their bodies and bear

live young.

See also LIZARD; REPTILES.

See K. P. Schmidt and R. F. Inger, Living Reptiles of the World (1957). (H. W. P.; X.)

IGUANODON, a large extinct amphibious reptile. Its remains were first discovered in the Wealden (Lower Cretaceous) estuarine deposits of Sussex by G. A. Mantell, who named it Iguanodon, in allusion to the resemblance between its teeth and those of the lizard *Iguana* of tropical America. In 1877 several nearly complete skeletons now in the Royal Museum of Natural History at Brussels were found in the Wealden rocks near Mons, Belgium. Another nearly complete skeleton, now in the British museum, was found by R. W. Hooley in the same rocks at Atherfield in the Isle of Wight. *Iguanodon* is interesting as being the first gigantic extinct reptile which it was attempted to restore by comparison with a modern lizard. Mantell's early restoration proved a failure, because it mas unknonn at the time that this reptile belonged to an extinct group, the Dinosauria (*q.v.*), in which the limbs did not have the sprawling posture found in modern reptiles, but were adapted for maintaining the body well off the ground when at rest. Like all the more active dinosaurs, it had comparatively large and heavy hind quarters, passing into a long tail; and footprints show that it walked only on its hind limbs, using the tail for balancing the fore-quarters.



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

SKELETON (RECONSTRUCTED) OF THE IGUANODON, AN EXTINCT MAMMOTH REPTILE THAT RANGED SOUTHERN ENGLAND AND NORTHERN EUROPE DURING THE CRETACEOUS PERIOD

The typical species, *I. mantelli,* is from 16 to 20 ft. long, and must have measured about 13 ft. in height when standing upright. The largest known species seem to have been sometimes 33 ft. long. The head is relatively large, laterally compressed, and about twice as long as deep. Its long axis is bent downwards for cropping its vegetable food. The front of both jaws is toothless and must have been covered with a horny beak. The lower half of the beak is supported by a separate "predentary" bone. The edge of each jaw further back bears a single row of teeth, which differ from those of all existing reptiles in being often worn down to stumps by mastication. Under the teeth actually in use are numerous successional teeth. The neck and front half of the back are made flexible by ball-and-socket joints between the vertebrae. The front half of the tail is deep and laterally compressed, evidently for swimming. The small fore-limbs must have been very mobile, and the thumb in the five-fingered hand is reduced to a bony spur. The supporting bones of the hind-limbs are much like those of ostriches, though they differ in never being fused into one mass. The three toes of the heavy hind-foot are so much like those of birds that the fossilized footprints were originally mistaken for those of birds. The body lacks armour, but the skin was hardened with a close covering of small irregular tubercles. Footprints are common on the Wealden sandstones of Sussex, and several series have been observed without any trace of the forefeet and rarely a mark of the tail.

Nothing is satisfactorily known about the possible ancestors of Iguanodon, and few of its closely allied contemporaries have been discovered. The comparatively small *Hypsilophodon,* which occurs with it in the Wealden of the Isle of Wight, differs in having the teeth extending to the front of each jaw. The equally small Psittacosaurus, from rocks of nearly the same geological age in Mongolia, has the toothless front of the jaws shaped almost like the beak of a parrot. The successors of Iguanodon, the Trachodontidae, in the Upper Cretaceous, were more adapted for aquatic life, and their toothless beak was shaped almost like the end of the bill of a duck. The side of each jaw bore a powerful grinding dentition, several rows of teeth being in use at one time. Many of the trachodonts were peculiar in exhibiting a bony crest on the top of the head. (A. S. W.; X.)

IGUVIUM (mod. Gubbio, *q.v.*), a town of Umbria. among the mountains, about 23 mi. N.-N.E. of Perusia and connected with it by a by-road, which joined the Via Flaminia near the temple of Iuppiter Appenninus, at the modern Scheggia. It appears to have been important in pre-Roman times, both from its coins and from the celebrated tabulae *Iguvinae.*

Iguvium was in possession of a treaty with Rome. similar to that of the Camertes Umbri; and in 167 B.C. it was used as a place of safe custody for the Illyrian King Gentius and his sons. After the Social War, in which it took no part, it received full citizen rights and was included in the tribus Clustumina. Under the empire almost nothing was heard of it. Silius Italicus mentioned it as subject to fogs. A bishop of Iguvium is mentioned as early as A.D. 413. It was taken and destroyed by the Goths in 552, but rebuilt with the help of Narses. The Umbrian town had three gates only, and probably lay on the steep mountainside as the present town does, while the Roman city lay in the lower ground. There is the theatre, restored by Cn. Satrius Rufus in the time of Augustus. The diameter of the orchestra is 76½ ft. and of the whole 230 ft.; the stage is well preserved and so are parts of the external arcades of the auditorium. Not far off are ruins probably of ancient baths, and the concrete core of a large tomb with a vaulted chamber within.

Iguvine Tables.—The famous Iguvine (less correctly Eugubine) tables were discovered at Iguvium in 1444, bought by the municipality in 1456, and are still preserved in the town hall. They were originally nine in number, and two of the nine were taken to Venice in 1 j40 and never reappeared. The existing seven were first published in 1724.

Otfried Müller (Die *Etrusker,* 1828), pointed out that though their alphabet was akin to the Etruscan their language was Italic. Karl Lepsius, in his essay De *tabulis Eugubinis* (1833), finally determined the value of the Umbrian signs and the received order of the tables, pointing out that those in Latin alphabet were the latest. He published what may be called the editio *princeps* in 1841. The first edition, with a full commentary based on scientific principles, was that of S. T. Aufrecht and J. W. H. Kirchoff in 1849–51, and on this all subsequent interpretations were based (M. J. A. Bréal, Paris. 1875; F. Bücheler, *Umbrica,* Bonn, 1853, a reprint and enlargement of articles in Fleckeisen's Jahrbuch, 1875, pp. 127 and 313). See also UMBRIAN LANGUAGE.

IHARA (or IBARA) **SAIKAKU** (original name probably HIRAYAMA TŌGO) (1642–1693), Japanese poet and novelist, one of the most brilliant figures of the 17th-century literary revival, was born at Osaka in 1642. His early fame was occasioned chiefly by his amazing facility in composing haiku (see JAPANESE LITERATURE) and linked verse. In 1677 he turned out in the space of "a day and a night" 1.600 verses. Not surprisingly, these were not all of first quality, but to compose at the rate of one verse a minute for 24 hours was an achievement that few poets could match. He steadily increased the number of verses produced in a day, reaching 4.000 in 1680 and the incredible figure of 23,500 verses in 1684. This was somewhat over 16 a minute, and the performance earned him the nickname of the "20,000 poet." Saikaku continued to write verses at more normal speeds, but his style (essentially that of the Danrin school: headed by Nishiyama Soin, his master) was considered so bizarre that rival poets called it "Dutch" to indicate its extreme outlandishness.

Besides poetry Saikaku wrote some unsuccessful puppet plays and works of poetic criticism, but he is best known as a novelist. The style of Saikaku's novels is swift, allusive and elliptic, all qualities stemming from his training as a *haiku* poet. Their content reflects from many angles the Japanese society of the time. After many years of bitter warfare Japan was enjoying peace and prosperity. The merchant class had so risen in importance that its tastes now prevailed in the arts, and the licensed quarters catered to its whims. Many of Saikaku's novels are concerned with the voluptuary pleasures of these quarters. The first and most famous: Koshoku *Ichidai* Otoko ("The Man Who Spent His Life at Love-making," 1682), relates the amorous adventures of its hero, Yonosuke, from his precocious experiences at the age of 6 to his departure at 60 for an island of women. The popularity of this novel led Saikaku to write others in a similar vein, of which the best is Koshoku Gonin *Onna* ("Five Women Who Loved

Love," 1686), a work based on actual events.

Saikaku also wrote novels about the samurai. These are generally considered inferior to his amorous tales or to such accounts of tradesmen's life as *Nippon* Eitagura ("The Japanese Family Storehouse," 1688), a collection of stories on how to make (or lose) a fortune. Whatever the subject, Saikaku's satirical humour and his knack (derived from the haiku) of being able to seize the one detail that best evokes a person's character or his milieu are always conspicuous. Although Saikaku's works reveal a particular affinity for the lively spirit of Osaka, he wrote with facility about all Japan His Saikaku *Shokokubanashi* ("Saikaku's Tales of the Provinces," 1685), for example, records many stories picked up during his travels. His popularity was enormous everywhere and his influence on fiction continued for many years after his death.

BIBLIOGRAPHY.—Koshin Noma, *Saikaku Nempu Kosho* (1952); *Five Women Who Loved Love,* trans *by* de Bary (1956); *Japanese Family Storehouse,* trans. *by G.* W. Sargent (1958). (DD. K.)

IJAW, a people inhabiting the provinces of Owerri and Warri, southern Nigeria. No tribal organization exists; hereditary chiefs in the tonns have civil and religious functions, aided by councils of elders. Extended family groups live side by side. Marriage is permitted between near relations. When the bride-price is high, the wife cannot leave her husband and children belong to the iather; when it is small, divorce is possible and children belong to the mother. The brother inherits. They practise agriculture and arboriculture. are animists, have secret societies and age classes.

IJOLITE, in petrology an igneous rock composed essentially of nepheline and an alkali pyroxene, usually aegirine-augite. The rock was originally described from Iivaara in the parish of Kuusamo. northern Finland. Typically the pyroxene is well crystallized. the nepheline allotriomorphic. Accessory minerals include melanite, titanite, perofskite. apatite, cancrinite and calcite. The rock is the plutonic equivalent of the volcanic nephelinites and nepheline dolerites. Ijolites form characteristic members of carbonatite-alkali igneous complexes like those of Alno (Sweden). Fen (Norway), Khabozero (Kola peninsula—there carrying abundant wollastonite) and Iron hill (Colorado). The ijolites of Magnet cove (Arkansas), Ice river (British Columbia) and Sekukuniland (Transvaal) are among the better-known representatives found in rock collections. The rocks known as urtite (type locality Lujaur Urt, Kola peninsula) and melteigite (Melteig, Fen district, Norway) are essentially similar assemblages. In the former nepheline largely preponderates while melteigite is a melanocratic variant with excess pyroxene. (C. E. T.)

IJSSELMEER, a shallow fresh-water lake in the northern Netherlands formed (1932) by the IJsselmeer dam (Xfsluitdijk) between North Holland and Friesland. It takes its name from the IJssel, one of several rivers which flow into it. Much of the IJsselmeer was formerly the Zuider Zee. See ZUIDER ZEE.

IKHNATON (sometimes spelt AKHENATON), the name assumed by Amenhotep IV. of Egypt.

An adequate understanding of the origins and the history of the religious revolution carried through by this earliest known idealist is impossible without some knowledge of the historical and political situation of his generation. When he came to the throne (c. 1375 B.C.) there were plenty of men still living whose fathers had fought in the great wars of Thutmose III., who consolidated the conquests of his ancestors and united the contiguous regions of Asia and Africa into the first stable empire in history. His genius and his far reaching victories made him the first character of universal aspects, the first world hero. Such a towering personality inevitably affected the thought of the early world. The earliest gods of Egypt had been nature-gods. As the great Pharaonic State arose, the impressive figure of the sovereign profoundly influenced religion; the forms of the State passed over into human conceptions of the gods, and the Sun-god, the greatest of them all, was conceived as a pharaoh ruling the other divinities.

When therefore the power of the Pharaohs was extended to include a world empire, this greatly expanded arena of action deeply affected Egyptian conceptions of the Sun-god's realm. In the career of Thutmose III. the idea of universal power, of a world-empire was personalized and visibly bodied forth. This first great *human* personality of world wide aspects began to affect Egyptian ideas of *divine* personality. Men began to feel the thrill of universalism, expressed, it should be observed, in terms of *political* power. Other relations with the outside world beyond the limits of the Nile valley had not clearly disengaged for the Nile-dwellers the "world idea" as we may call it. For example, a net-work of commercial connections with surrounding countries had arisen centuries earlier and had resulted in a literature of adventure in far-off countries, as illustrated by such tales as the shipwrecked sailor or the story of the wandering hero. Sinuhe; but such knowledge of distant lands had done little toward bringing the great world without into the purview of Egyptian thinking. Neither did the universal power of natural laws, everywhere visibly active in uniform operation, suggest to these early men the world idea. Many a merchant had seen a stone fall in distant Babylon precisely as it did in Egyptian Thebes, but it had not occurred to him or to any man in that far-off age, that the same natural force reigned in these widely separated countries. It was universalism expressed in terms of *imperial* ***power*** which first caught the imagination of the thinking men of the Egyptian empire, and disclosed to them the universal sweep of the Sun-god's dominion as a physical fact. In the ancient East monotheism was but imperialism in religion

The Sun-god Aton.—As early as 1400 B.C. under the magnificent emperor, Amenhotep III., great-grandson of Thutmose III., the expanded conception of the Sun-god's power was gaining currency. In order to give this magnified Sun-god a new identity, not embarrassed by older and more limited conceptions, "Aton," an ancient name for the physical sun, was employed to designate him. When Amenhotep III. died (c. 1408 B.C.), his son and successor, Amenhotep IV., was closely associated with the new ideas. He assumed the office of the High Priest of Aton, with the same title, ('Great Seer," as that of the high priest of the old Sun-god Re at Heliopolis. It is clear therefore, that the new movement was closely connected with the old Solar theology and probably with its organized priesthood likewise.

The new and transformed Sun-god was obviously conceived as far more than the merely material sun. It is evident that the young Pharaoh was deifying the light of the sun or its vital heat, which he found accompanying all life. Light or heat plays an important part in the new faith, similar to that which we find it assuming in the early cosmogonic philosophies of the Greeks. In harmony with this conception the god is constantly stated to be everywhere active by means of his "rays." It is perfectly certain that in an age so early in the development of natural science the king could not have had the vaguest notion of the physico-chemical aspects of his assumption that all life issued from the rays of the sun, any more than had the Greeks in dealing with a similar thought. Yet the fundamental idea is surprisingly true, and as we shall see surprisingly fruitful.

With the international arena of his empire in view the Pharaoh devised a new symbol for the new god. It depicted the sun as a disk from which diverging rays radiated downward, each ray terminating in a human hand. As suggesting a power issuing from its celestial source and putting its hand upon the world and the affairs of men, it was a masterly symbol. It broke sharply with tradition, and for that very reason it was capable of practical introduction into the many countries making up the empire; for it could be understood by a foreigner at a glance, and this was far from being the case with any of the traditional symbols of the old Egyptian religion. To indicate the imperial power of Aton, however, Amenhotep IV. did employ an Egyptian device. He now enclosed the god's full name, as already introduced by the king's father, in two royal cartoucnes identical with those of the Pharaoh, thus suggesting for the god an earthly dominion like that of the Pharaoh.

Conflict Between Amon and Aton.—The king's zeal for the new cult was evident from the beginning. To Thebes, the imperial capital, he gave the new name, "City of the Brightness of Aton," its temple quarter was called, "Brightness of Aton

the Great," while the new Aton sanctuary itself was designated as "Gem-Aton," a term of unknown meaning. The priesthood of Amon who had long been the State god at Thebes, was a rich and influential body, and the high priest of Amon was head of a national sacerdotal organization including all the priesthoods of the country. Politically this Amonite priesthood had gained great power. A bitter conflict thus broke out, at first probably, chiefly between Amon and the intruder Aton, but eventually also between Aton and the older gods. The struggle eventually rendered Thebes intolerable to the young revolutionary. He broke with all the old priesthoods and began a drastic persecution to make Aton the sole god of the empire, not merely in the king's own thought, but in very fact. As far as their visible and external manifestations were concerned, this extermination of the old gods could be and was accomplished. Even the word "gods," the plural of the common noun "god," was carefully expunged from the monuments. In the tomb of Ramose, his father's old prime minister, a tomb still surviving in the Theban cemetery, Amenhotep IV.'s emissaries hewed out the word "gods" no less than nine times, clearly indicating their intentions, notwithstanding three untouched occurrences of the word which escaped their notice and which we still find in out-of-the-way corners of this marvellously sculptured tomb.

The persecution of Amon was especially severe and to-day the splendid monuments of Thebes are still dotted with unsightly holes where the hated god's name once stood. The young iconoclast was even involved in the expungement of his own father's name, Amenhotep, for it contained the name of the hostile god. Living as he probably was, in his father's splendid Theban palace, the wreckage of which is still visible, he finally brought himself to disfigure its sumptuous wall and ceiling decorations with unsightly blemishes where he blotted out his own father's name. With regard to his own name he was himself in the same embarrassing predicament, bearing as he also did, the illustrious throne name "Amenhotep," meaning "He in whom Amon is content." The king therefore cast off his old name, with all its traditional associations of power and splendor, and chose another of similar significance, "Ikhnaton," which means "Aton is satisfied," or "He in whom Aton is satisfied"

The New Capital, **Akhetaton.**—It is evident that this terrible revolution, violating all that was dearest and most sacred in Egyptian life and traditions, must have been a devastating experience for the young sovereign. Thebes became an impossible place of residence. His father's palace was disfigured by his own hand and the towering pylons and obelisks of Karnak and Luxor were a continual reminder of all that his fathers had contributed to the glory of Amon and the old gods. He therefore determined to forsake the capital and imperial residence of his ancestors. In each of the three great divisions of the empire, Egypt, Nubia and Asia, he built a city consecrated to Aton, and in the Egyptian Aton city he took up his own residence. He chose as its site a spacious bay in the Nile cliffs about 160 m. above the Delta and nearly 300 m. below Thebes. He called it "Xkhetaton," which means "Horizon of Aton" and it is known in modern times as Tell el-Amarna. The city thus established was designated as the real capital of the empire. In the sixth year of his reign and shortly after he had changed his name, we find the young king living in his new residence.

The evidence indicates that all that was devised and done in the new city and in the development and propagation of the Aton faith, was the work of the king himself. Everything bears the stamp of his individuality. The men about him must have been irresistibly swayed by his unbending will, for he was evidently not one to stop half way. But Ikhnaton understood enough of the old policy of the Pharaohs to know that he must hold his party by tangible rewards, and his leading followers enjoyed liberal bounty at his hands. Thus one of his priests of Aton and at the same time his master of the royal horse, named Eye, who had by good fortune happened to marry the childhood nurse of the king, states in his tomb inscriptions: "He doubles to me my favours in silver and gold." The commander of Ikhnaton's army likewise says: "He hath doubled to me my favours like the numbers of the sand. I am the head of the officials, at the head of the people; my lord has advanced me because I have carried out his teaching, and I hear his word without ceasing. My eyes behold thy beauty every day, O my lord, wise like Aton, satisfied with truth. How prosperous is he who hears thy teaching of life!" Although there probably was a nucleus of men who really appreciated the ideal aspects of the king's teaching, such inscriptions make it evident that many were not uninfluenced by "the loaves and the fishes."

A beautiful cliff-tomb hewn in the eastern cliffs by royal crafts' men at the king's command was the Pharaoh's most welcome demonstration of favour to each one of his followers. The walls of such a tomb chapel bore fresh and natural pictures from the life of the people in Akhetaton, the new capital, particularly incidents in the life of the dead man, and preferably his intercourse with the king. Thus the city of Akhetaton is now better known to us from its cemetery than from its ruins.

Throughout these tombs, both in relief and inscription, the nobles take delight in reiterating the intimate relation between Aton and the king. Over and over again they show the king and the queen standing together under the disk of Aton, whose enveloping rays terminating in hands, descend and embrace the king's figure. The nobles constantly pray to the god for the king, saying that he "came forth from thy rays," or "thou hast formed him out of thine own rays"; and interspersed through their prayers were numerous current phrases of the Aton faith, which had now become conventional, replacing those of the old orthodox religion which it must have been very awkward for them to cease using. On State occasions instead of the old stock phrases, with innumerable references to the traditional gods, every noble who would enjoy the king's favour was evidently obliged to display his familiarity with the Aton faith by a liberal use of these new allusions. The source of such phrases was really the king himself, and something of the "teaching" whence they were taken, so often attributed to him, is preserved in these "Amarna tombs," as we now commonly call them.

Hymn to Aton.—Among the fragments of the Aton faith which have survived in these tombs are two hymns to Aton, the longer and finer of which is worthy of being known in modern literature. It was probably written by the king himself. In the following translation the effort has been chiefly to furnish an accurate rendering. The headings of the strophes are insertions by the present writer, intended to make clear the arrangement of the subject matter, especially striking because it is identical with that in Psalm civ. of the Old Testament, which is many centuries later.

NIGHT

When thou settest in the western horizon of **the sky,**
The earth is in darkness like the dead;
They sleep in their chambers,
Their heads are wrapped up,
Their nostrils are stopped,
And none seeth the other,
While all their things are stolen,
Which are under their heads,
And they know it not.
Every lion cometh forth from his den,
All serpents, they sting.
Darkness . . .
The world is in silence,
He that made them resteth in his horizon.

DAY AND MAN

Bright is the earth when thou risest in the horizon.
When thou shinest as Aton by day
Thou drivest away the darkness.
When thou sendest forth thy rays,
The Two Lands (Egypt) are in daily festivity,
Awake and standing upon their feet
When thou hast raised them up.
Their limbs bathed, they take their clothing,
Their arms uplifted in adoration to thy dawning
(Then) in all the world they do their work.

DAY AND THE ANIMALS AND PLANTS

All cattle rest upon their pasturage,
The trees and the plants flourish,
The birds flutter in their marshes,

Their wings uplifted in adoration to thee.
All the sheep dance upon their feet,
All winged things fly,
They live when thou hast shone upon them.

DAY AND THE WATERS

The barques sail up-stream and down-stream alike.
Every highway is open because thou dawnest.
The fish in the river leap up before thee.
Thy rays are in the midst of the great green sea.

CREATION OF MAN

Creator of the germ in woman,
Maker of seed in man,
Giving life to the son in the body of his mother,
Soothing him that he may not weep,
Nurse (even) in the womb,
Giver of breath to animate every one that he maketh!
When he cometh forth from the womb . . . on the day of his birth,
Thou openest his mouth in speech,
Thou suppliest his necessities.

CREATION OF ANIMALS

When the fledgling in the egg chirps in the shell
Thou givest him breath therein to preserve him alive.
When thou hast brought him together (?)
To (the point of) bursting it in the egg,
He cometh forth from the egg
To chirp with all his might (?).
He goeth about upon his two feet
When he hath come forth therefrom.

THE WHOLE CREATION

How manifold are thy works!
They are hidden from before (us),
O sole God, whose powers no other possesseth.
Thou didst create the earth according to thy heart
While thou wast alone:
Men, all cattle, large and small,
All that are upon the earth,
That go about upon their feet;
(All) that are on high,
That fly with their wings.
The foreign countries, Syria and Kush,
The land of Egypt,
Thou settest every man into his place,
Thou suppliest their necessities.
Every one has his possessions,
And his days are reckoned.
The tongues are divers in speech,
Their forms likewise and their skins are distinguished.
(For) thou makest different the strangers.

We may conjecture that this hymn, partially reproduced above, was a fragment from the ritual of Aton as it was celebrated from day to day in the Aton temple at Amarna. Unhappily it was copied in but one tomb; in the others we have a miscellany of current quotations and stock phrases which made up the knowledge of the new faith as it had been apprehended by the scribes and painters who decorated these tombs. It is our misfortune that the fragments of the Aton faith, which have survived to us in the Amarna cemetery, our chief source, have thus filtered mechanically through the indifferent hands and the starved and listless minds of a few petty bureaucrats on the outskirts of a great religious and intellectual movement.

The New Universalism. — Nevertheless in this great hymn the new universalism of the empire finds full expression and the royal singer sweeps his eye from the far-off cataracts of the Nubian Nile to the remotest lands of Syria. He was looking beyond the nationalism which had prevailed for over 2,000 years, and he was consciously endeavouring to displace it by a world religion. Irrespective of race or nationality, he bases the universal sway of God upon his fatherly care of all men alike. He calls Aton "the father and the mother of all that he has made," and the hymn which we have just quoted above is very explicit in its insistence that Aton's fatherly care of all men entirely disregards diversity of speech or difference in colour. To the proud and exclusive Egyptian he points to the all-embracing bounty of the common father of humanity, even placing Syria and Nubia before Egypt as he catalogues the divisions of his empire.

Ikhnaton had gained the conception of a world-lord in two aspects: first, as the creator of the natural world; and second, as a benevolent father actively concerned for the daily maintenance of all his creatures, even the meanest. His hymns are the earliest known expression of deep emotion in the recognition of divine goodness and benevolence. Mingled with it is an almost ecstatic rapture in the thought of the all-enveloping light in which he saw revealed both the beauty and the goodness of the natural order. It reminds us of Him who bade us "consider the lilies." The picture of the lily-grown marshes, where, as another hymn tells us, the flowers are "drunken" in the intoxicating radiance of Aton, where the birds unfold their wings and lift them "in adoration of the living Aton," where the cattle dance with delight in the sunshine, and the fish in the river beyond leap up to greet the light, the universal light whose beams are even "in the midst of the great green sea"—all this discloses a discernment of the presence of God in nature, and an appreciation of the revelation of God in the visible world such as we find centuries later in the Hebrew psalms, and especially in our own poets since Wordsworth.

While the creative power and the benevolence of his god were very explicitly affirmed by Ikhnaton, our sources do not show us that he had risen from a discernment of the beneficence to a conception of the righteousness in the character of God, nor of his demand for this in the character of men. Nevertheless, there is in Ikhnaton's "teaching," as it is thus fragmentarily preserved in the hymns and tomb-inscriptions of his nobles, a constant emphasis upon "truth" such as is not found before nor since. The king always attached to his name the extraordinary phrase "living in truth," and that this phrase was not meaningless is evident as we discern the character of his daily life.

To him "living in truth" meant sincere acceptance of the daily facts of living in a simple and unconventional manner never before seen in the life of a sovereign and quite impossible of harmonization with the outward pomp and splendour of an oriental emperor. For him what *was* was right, and its propriety was evident by its very existence. Even in public he divested his daily round of those outward and formal observances which his royal ancestors had observed for 2,000 years. Thus, his family life was open and unconcealed before the people, even in intimate manifestations of family affection. He took the greatest delight in his children and appeared with them and the queen their mother on all possible occasions as if he had been but the humblest scribe in the Aton-temple. He had himself depicted on the monuments while enjoying the most familiar and unaffected intercourse with his family, and when he drove in his chariot to the temple to carry on its formal service, the queen and the daughters she had borne him likewise drove thither through the acclaiming multitudes and shared with the king the temple service. All that was natural was to him true, and he never failed practically to exemplify this belief, however radically he was obliged to disregard tradition.

Effect of the Revolution on Art. — These revolutionary changes in religion and in the position and character of the head of the State were not confined to theology, statecraft or palace proprieties. They unavoidably affected also the art of the time, and it was the intention of Ikhnaton to modify art in accordance with his regard for "truth." His chief sculptor, Bek, appended to his title the words, "whom his majesty himself taught." It is evident that the artists of Ikhnaton's court were taught by him to make the chisel and the brush tell the story of what they actually saw. The result was a simple and beautiful realism that saw more clearly than any art had ever seen before. They caught the instantaneous postures of animal life; the coursing hound, the fleeing game, the wild bull leaping in the marsh; for all these belonged to the "truth" in which Ikhnaton lived. The exalted divinity which for untold centuries had invested the Pharaoh's person with inviolable sacredness was stripped away without hesitation. Ikhnaton's artists represented him as they saw him, in attitudes of parental affection as he fondled his little daughters, or even as the object of the wifely solicitude of his queen as she stands in his presence in affectionate concern for his needs Such is the lovely scene on the back of the famous palace chair, preserved to us in the tomb of Tutankhamun. For the first time in

the history of art the subject of a great composition was a human relationship, and to depict it the artists of the day shook off the shackles of immemorial tradition. The monuments of Egypt and even the furniture and equipment of daily life bore what they had never borne before, a Pharaoh depicted in the natural and unaffected relations of life, and completely liberated from the rigid and conventional posture demanded by both the traditions of court propriety and by the venerable teachings of the State theology regarding the divinity of the sovereign. It is in this extraordinary art, which we commonly call the "Amarna school" or "Amarna art," that the revolution of Ikhnaton is most clearly disclosed as the earliest known age of spiritual emancipation.

Loss of the Empire.—A man wholly absorbed in a revolution like this found little time or inclination to devote any attention to the critical state of the empire. For three generations the royal house of Egypt had stood in close relations to the kings of Western Asia, and especially the kings of Mitanni on the Upper Euphrates had given their daughters in marriage to the Pharaoh. Supported by such alliances Ikhnaton failed to appreciate the gravity of the new movements which were transforming the political situation in Western Asia. In the north the expanding power of the Hittites gradually absorbed all the Pharaoh's vassal States in Syria; while in the south, *i.e.*, in Palestine, the incoming mercenary bands of nomads were steadily taking possession of Palestine, which the Pharaohs had held for centuries. It was this movement of nomadic hordes from the desert toward a settled life in the Palestinian towns, which carried the Hebrews into Palestine. At Akhetaton, the new and beautiful home of the Aton faith, the temple of Aton resounded with hymns to the new god of the empire, while the empire itself was no more,

The storm which had thus broken over Ikhnaton's Asiatic empire was not more disastrous than that which threatened him in Egypt; but there was no faltering in his steadfast policy. At his command temples of Aton had arisen all over a land which was now convulsed with revolution. Some years after Ikhnaton had disappeared, his son-in-law, Tutankhamun, left the following description of the hopeless situation of Egypt both at home and abroad: "The temples of the gods and goddesses were [desolated] from Elephantine [First Cataract] as far the marshes of the delta. . . . Their holy places were forsaken and had become overgrown tracts . . ., their sanctuaries were like that which has never been, and their houses were trodden roads. The land was in an evil pass, and as for the gods, they had forsaken this land. If people were sent to Syria to extend the borders of Egypt, they prospered not at all; if men prayed to a god for succour, he came not; . . . if men besought a goddess likewise, she came not at all."

***Opposition to* the New Religion.**—Ikhnaton had endeavoured to exterminate some of the most cherished beliefs of the people, especially those regarding the hereafter. Throughout the entire cemetery of his new capital not a single tomb contains the name of Osiris, upon whom every Egyptian, following the faith and practice of his ancestors, expected to depend for protection and guidance through the terrible fears and dangers that beset the dead in the world beyond the grave. This attempted banishment of Osiris must have aroused the fiercest opposition among the people. Eighteen hundred years after Ikhnaton's revolution, the Christian emperor, Theodosius, endeavoured to banish from Egypt the old pagan gods of the people, in an effort to introduce exclusively the God of the Christians. Long after the death of Theodosius the old gods of Egypt continued nevertheless to be worshiped by the people of Upper Egypt. What the power of the Roman emperor failed to accomplish could not of course be attained under much less favourable circumstances by Ikhnaton. The Aton-faith remained but the cherished theory of the idealist Ikhnaton and a little court circle surrounding his person; it never really became the religion of the people.

To the secret resentment and opposition of the people we must also add the dangerous activities of the dispossessed priesthoods, especially the politically powerful former priests of Amon, the old State god. Even more dangerous was the disaffection and discontent among the leaders of the army as they beheld the Egyptian empire in Asia falling to pieces for lack of effective military intervention. One of these leaders indeed, an officer named Haremhab who had long been a favoured partisan of Ikhnaton, not only contrived to win the support of the military class, but also gained the favor of the priests of Amon, who were of course looking for just such a man. Thus both the people and the priestly and military groups alike were united in plans for the overthrow of the hated dreamer in the palace of the Pharaohs, of whose thoughts they understood so little, and who incensed them with the teaching that both the Asiatics and the Egyptians were all children of the same kindly Father. In this dangerous situation, having no son to succeed him, he gave his eldest daughter in marriage to one of his favourites, and needing support, appointed his son-in-law as co-regent with himself. His position seems to have been complicated by family troubles in these closing days, and we find the name of his queen expunged from some of the family monuments at Amarna. He survived but a short time after arranging the co-regency and about 1358 B.C., in the 17th year of his reign, when he was probably not yet 30 years of age, he passed away.

It must be admitted that Ikhnaton pursued his aims with fatuous blindness and feverish fanaticism regardless of the destructive costs. There is something hectic and abnormal in this extraordinary man, suggesting a mind which may even have been diseased. Some question has been raised regarding the identity of the body found in his coffin; but it should be noted that the skull found with this body is one of the largest human crania ever found. However much we may censure him for the loss of his empire, however much we may condemn the fanaticism with which he pursued his aim, it must be recognized that there died with him a spirit such as the world had never seen before—a brave soul, undauntedly facing and opposing the momentum of century long tradition, in which it had never occurred to any mind before his to do anything but thoughtlessly acquiesce. He was the first of the long line of revolters against tradition and thoughtless acceptance of the past. He stepped out of the long line of conventionally colourless Pharaohs that he might disseminate ideas far beyond and above the capacity of his age to understand. He is looked upon not only as the world's first idealist and the world's first individual, but also as the earliest monotheist and the first prophet of internationalism—the most remarkable figure of the ancient world before the Hebrews.

BIBLIOGRAPHY.—*Monuments:* N. de G. Davies, *Rock Tombs of Tell el Amarna,* Archaeological Survey, Egypt Exploration Society, 6 vol. (1903 *sqq.*); T. M. Davis, *Tomb of Queen I'iyi* (1910), *Tombs of Harmhabi and Touatankhanzanou* (1912); T. E. Peet and C. L. Woolley, *City of Akhenaton,* vol 1 (1923); Howard Carter and A. C. Mace, *Tomb of Tutankhamen* (1923); *Mittheilungen der Deutschen Orient-Gesellschaft,* no 34, 46, 50, 52, 55, j7. *Treatises:* J. H Breasted, *Development of Religion and Thought in Ancient Egypt* (1912) and *History of Egypt* (1912); *Cambridge Ancient History,* vol II, ch 5, 6, from which the above article quotes liberally. (J. H. BR.)

IKI, an island of Japan. lying about 10 mi. off the northwest coast of Nagasaki prefecture of which it is part. Area, 53 sq.mi.; pop. (1955) 51,765. Most of the island is tableland and about 70% is under cultivation; cereals and tobacco are the important crops. Some of Kublai Khan's invading Mongols landed at Iki in the 13th century for the island lies in the Tsushima strait (eastern channel) on the direct route from Korea to Kyushu. Anchorages are at Gōnoura, Katsumoto and Ashibe. The chief town is Gōnoura. (R. B. H.)

ILCHESTER, a small agricultural town in the Yeovil rural district of Somerset, England, on the Ivel or Yeo river, 5 mi. N.W. of Yeovil Pop. (1951 est.) 731. Ilchester (Gifelcestre, *Ivel*cestre, Yevelchester, Ivelchester) was the Lendiniae of the Romans, the northern tribal capital of the Durotriges and the largest Roman town in Somerset. A royal mint was established by the time of Edgar (959–97j), and money was coined there until the reign of Henry III. In 1086 Ilchester was a royal borough with 107 burgesses and was granted a charter by Henry II. confirmed by John in 1203, giving it the same liberties as Winchester. It had a king's jail from before 1166 until 1843. From the 14th to the 19th centuries it was the centre of the county administration and the assizes and quarter sessions were held there. The town

was governed by a bailiff and 12 capital burgesses; the corporation, established in 1556. was abolished in 1886. From 1298 until 1832 Ilchester returned two members to parliament (among them Richard Brinsley Sheridan). It had two annual fairs, and its Wednesday market dated from Saxon times until the mid-19th century. In the middle ages there were seven parish churches in the town, St. Mary Major being the only one left; there were also a Dominican friary, an Augustinian nunnery, a lepers' hospital and an almshouse. Roger Bacon was born there *c.* 1214.

See J. Stevens Cox, *The llchester Mint* (1948) and other *Ilchester Historical Monographs* (Ilchester, 1947–); *Proc. of Somerset Arch. Soc.*, vol. 96 (Taunton, 1951). (J. S. C.)

ILE-DE-FRANCE, an ancient region of France. The name "Francia," given under the Merovingians to the region between the Rhine and the Seine, was restricted under the Carolingians to the country bounded by the Aisne. the Oise and the Seine. In the 10th and 11th centuries it signified only the territory limited by the Seine, the Marne. the Reuvronne, the Oise and the Nonette. In the middle ages the word "isle" often designated countries more or less bounded by rivers, but we do not find it given specifically to France before 1387. In the 16th century the *gouvernement* of Ile-de-France was constituted under a governor or a lieutenant of the king. In the 18th century Ile-de-France was divided between the two *généralités* or *intendances* of Paris and Soissons. Under the Revolution the department of the Seine was formed from the territory of Ile-de-France, other sectors going to the departments of Seine-et-Oise, Seine-et-Marne, Oise and Aisne and smaller sectors to Loiret and Nièvre. The name Ile-de-France is also used for Mauritius (*q.v.*).

See P. Bernus, *Histoire de l'Ile de France* (1936); *A.* Leynitz, *L'Ile de France, sa géographie, sop histoire* (1948). (MI. M.)

ILERDA, CAMPAIGN OF (49 B.C.), the victory of Julius Caesar over Pompey's forces in Spain *(see* CAESAR. GAIUS JULIUS). When Caesar had forced Pompey to evacuate Italy, he decided not to follow him to Greece, but first to deal with Pompey's seven legions in Spain. In the spring of 49 B.C. he sent forward six legions from Gaul under Gaius Fabius. and joined them as soon as possible at Ilerda (Lerida) on the Sicoris (Segre) river, a tributary of the Ebro. Five Pompeian legions. together with many Spanish auxiliaries, commanded by L. Afranius and M. Petreius. concentrated against Caesar. They held Ilerda, which stood on a hill, and occupied a steep ridge (Gardeny) to the southwest. while below the city was a stone bridge over the river which was vital to their supplies. The river was subject to violent spring flooding. Caesar, who failed to provoke Afranius to battle, formed a camp near the enemy in order to hamper their foragers, but his attempt to seize a strong point between Ilerda and Gardeny was beaten back. When floods swept away his bridges, he was in a precarious position and short of supplies, although he managed to get one convoy safely across the river about 20 mi. to the north. Then he diverted part of the river just below Ilerda to make a ford near his camp; this forced the Pompeians to move two legions over the Sicoris to cover their communications against Caesar's superior cavalry. The tables thus being turned. Afranius retired toward the Ebro. Caesar, however, pursued him and headed him off: after a week of maneuvering the Pompeians. short of food and water, had to surrender. Caesar. having won a great victory with little loss, then showed his clemency: the enemy troops were disbanded, Afranius and Petreius were spared, and within two months all Spain was Caesar's.

See T. Rice Holmes, *The Roman Republic and the Founder of the Empire*, vol. ii (1923). (H. H. SD.)

ILESHA, a town of Western Region, Nigeria, lies on hills in the heart of the region and is the centre of an administrative division, bounded by the divisions of Ondo, Ife and Oshun. Pop. (1960) 82,427 (African pop.). The divisional council offices and the council hall (1934) are situated on Market square. Near this square are the Afin (king's palace), the central mosque and the principal park. The Wesley guild hospital was established in 1913.

Among the educational institutions are the women's training college; Ilesha grammar school, oldest secondary school of the town; and St. Margaret's secondary school. The main occupations are farming and trade; chief exports are cocoa and kola nuts; imports are consumer goods, such as cottons and hardware. Ilesha is linked by trunk roads with Ibadan and Lagos to the west, Oshogbo to the northwest and Benin to the southeast. The town has relics of its past as a warlike centre of the Yoruba people, such as the memorial to the warrior Ogedengbe, a native of Ilesha. who died in 1910. The inhabitants are of the Ijesha subgroup of the Yoruba; they are much interrelated and hold some land in common. They consider it a great advantage "to be an Ijesha who lives in Ilesha." (F. O. E.)

ILFORD, a municipal and parliamentary borough of Essex, England, 7 mi. E.N.E. of London bridge by road. Pop. (1961) 178,210. Area 13.2 sq.mi. Its popularity as a residential centre for London workers dates from the late 19th century (the population in 1901 was 41,279) and the borough (incorporated in 1926) now includes parts of Becontree and Hainault. Ilford returns two members to parliament. Photographic materials are manufactured.

Built where the Roman road from London to Colchester crossed the marshes. Ilford covers fertile land formerly used as a market garden for London. The name (Hile-ford in 1231) denotes the early site at a crossing of the Hyle river. non the Roding.

ILFRACOMBE, an urban district and holiday resort of Devonshire. England, on the southern shore of the Bristol channel, 52 mi. N.W. of Exeter by road, in the North Devon parliamentary division. Pop. (1961) 8,701. Area 8.8 sq.mi. The oldest part lines the winding valley breaking the steep coastal cliffs and forming the harbour between Capstone and Hillsborough (447 ft) hills. The town has spread over these hills on the edge of Exmoor, and tunnels lead to beaches at the foot of the cliffs The church of Holy Trinity, dating originally from the 12th century, is of various periods and has a beautiful wagon roof.

ILI, river of central Asia. in the Sinkiang-Uigur Autonomous Region of China and the Kazakh Soviet Socialist Republic of the Soviet Union. The length of the Ili from the confluence of its two headstreams, the Tekes and the Kunges, is 590 mi.; including the Tekes, it is 869 mi. The Tekes rises east of Lake Issyk-Kul on the north slopes of the Khan-Tengri mountain knot of the Tien-shan in the southeastern corner of Alma-Ata *oblast* of the Kazakh S.S.R. At first the Tekes flows eastward into Sinkiang until it meets the Kunges, which rises farther east in the Tien-shan. The combined stream, assuming the name Ili, then turns westward past Kulja (I-ning) and re-enters the Kazakh S.S.R.. where it flows past the town of Ili to Lake Balkhash (*q.v.*). In its upper reaches. the Ili is a mountain torrent with a steep gradient. Belon the confluence with the Kash, a right-hand tributary, the Ili emerges from the Tien-shan on the broad Ili valley, characterized by low swampy banks overgrown with reeds. The valley, enclosed by outlying spurs of the Tien-shan, ends at the Kapchagay gorge, 7 mi. below the town of Ili. where the Turkestan-Siberian (Turksib) railroad crosses the Ili. Beyond the Kapchagay gorge, which is the site of a proposed dam and hydroelectric station, the Ili flows through desert sands past the small settlement of Bakanas. forming a narrow delta on Lake Balkhash. Muskrats introduced among the reeds of the Ili delta before World War II have acclimatized and are being trapped for their pelts The Ili is fed mainly by the melting snows and glaciers of the Tien-shan and reaches its high-water stage in July and August, when the rate of flow rises to 100,000 cu.ft. per second (average annual rate of flow is 15,000 cu.ft. per second). The short tributaries that join the Ili along its middle course are used for irrigation. The main stream is navigable during the ice-free season from April to October.

The proposed Kapchagay project will create an 800-sq.mi. reservoir that will require the relocation of the town of Ili and of the Turksib railroad crossing. The reservoir project also was a factor in the realignment of the Urumchi-Alma Ata railroad from the Ili valley to the Dzungarian gate.

The Russians moved into the Ili valley in the conquest of central Asia in the mid-19th century and clashed repeatedly with the Chinese. who had reached the area earlier. From 1871 to 1881,

the Russians occupied the entire valley. including China's Kulja district. before the valley was divided between China and Russia along the present border.

In addition to being the designation of the river and of the Soviet town on the lower course. Ili is also the name of a former Chinese headquarters of the upper valley. This town was sacked in a Moslem rebellion in 1868 and was superseded by Rulja. The remains of old Chinese Ili are called Hui-yiian. (T. SD.)

ILION, a village of Herkiiner county, N.Y., U.S., 12 mi. S.E. of Utica (*q.v.*) on the Mohawk river (the New York State Barge canal); a part of the Utica-Rome standard metropolitan statistical area. Originally part of a Palatinate German settlement. Ilion was unimportant until 1825 when the Erie canal was built. In that decade Eliphalet Remington, Jr., perfected a rifle of such excellence that it was adopted by the U.S. army and several foreign governments. Remington factories thereafter became the principal support of Ilion and the villages around it. Searching for diversification, the company in 1873 introduced the first practical typewriter. Further diversification into office machinery and equipment led to the Univac electronic computer, developed in the 1950s.

The community was known successively as German Flats. Morgan's Landing and Remington Corners before it was incorporated as Ilion in 1852. For comparative population figures *see* table in NEW YORK: *Population.* (V. C. C.)

ILIPA, BATTLE OF (206 B.C.. or, less probably, 207), the final victory of the Roman general P. Cornelius Scipio (later surnamed Africanus) over the Carthaginian forces in Spain during the Second Punic War *(see* PUNIC WARS). Scipio! who had been campaigning against the Carthaginian armies in Spain since 210, met their combined forces under Hasdrubal Gisco and Mago near Ilipa (Alcalá del Rio, about 8 mi. N. of Seville). With 45.000 infantry and 3.000 cavalry, he had about 10.000 men less than the enemy. For several days the two armies faced each other in battle array, with their best troops in the centre, and their allies on the wings. Early one morning a Roman cavalry attack forced Hasdrubal Gisco to lead out his men in their normal formation. only to find too late that Scipio had put his Roman troops on the wings and his Spanish allies in the centre. A complicated maneuver followed. Scipio's centre advanced slowly, declining battle but "fixing" the enemy's centre; meanwhile his wings were extended. then they advanced in column and wheeled again into line, thus outflanking the enemy, whose resistance soon crumpled. By a rapid pursuit Scipio cut off the enemy's retreat. Few Carthaginians escaped. This victory was won by brilliant tactics, such as no Roman army could have performed a few years earlier; they were made possible only by Scipio's recent reforms and training. The battle smashed Carthaginian power in Spain once and for all, and this affected the whole course of the war against Hannibal.

See H. H. Scullard. *Scipio Africanus in the Serond Punic War* (1930). with bibliography; for 'the site, *Journal of Roman Studies,* vol. 26 (1936). (H. H. SD.)

ILKESTON, a market town and municipal borough in the Ilkeston parliamentary division of Derbyshire, Eng.. 10½ mi. N.E. of Derby and 7 mi. W. of Nottingham by road. Pop. (1951) 33.677. Area 4.7 sq.mi. It is a mining and manufacturing town standing on a hill overlooking the Erewash valley to the east. In the market place. used for a market on Saturdays and illuminated by fluorescent lighting, stands the church of St. Mary the Virgin, a Norman and Early English building with a fine 13th-century chancel screen. The town obtained a grant for a market and fair in 1252 and was incorporated in 1887. Coal mining and the making of iron and concrete pipes. hosiery, needles, plastics. clothing, various fabrics and coffee are its chief industries.

ILKLEY, a small town and urban district in the Ripon parliamentary division of the \Vest Riding of Yorkshire, Eng.. 17 mi. N.W. of Leeds by road, lying in mid-Wharfedale. bounded by the Wharfe river (north) and the crest of Ilkley moor (south). rich in legend. Pop. (1951) 17,284. Area 13.5 sq.mi. "Cup and ring" and "swastika" markings on the rocks of the moor, as well as stone circles in the vicinity, give ample evidence of prehistoric occupation. In 1919 Roman remains were excavated in the town and the 1st-century fort was possibly the Olicana of Ptolomy and the *Ravenna Cosmography.* Ilkley was originally a spa but is now residential. There is a large open-air swimming pool which attracts many visitors to this place which has become famous through the popular song beginning:

Wheer wer' ta bahn w'en **Aw** saw thee,
On Ilkla Moor baht 'at?

The ruins of Bolton abbey (*q.v.*) stand by the Wharfe, absut 6 mi. above Ilkley.

ILLAWARRA, a coastal district south of Sydney, New South Wales, Austr.. covering 2,234 sq.mi. (Illawarra is a corruption of the aboriginal name Alowrie meaning "from the sea to the mountain.") The district, which is cut off from the inland plateau by steep cliffs rising to 1,200 ft., comprises the industrial city of greater Wollongong and the fertile agricultural land to the south. More than 80% of the population is in the city of greater Wollongong, where the chief industries are steel manufacture and coal mining. The main rural industry is dairying, about 18,000,000 gal. of milk being produced annually. The climate is mellow, with generally warm winters, moderately hot summers and a sustained average annual rainfall of 48 in. The region contains many popular seaside holiday resorts.

ILLE-ET-VILAINE, a maritime *département* of northwestern France, formed in 1790 out of the eastern part of the old province of Brittany. Pop. (1954) 586.812. Area 2,700 sq.mi. It is bounded north by the English channel: the Bay of St, Michel and the *département* of Manche; east by Mayenne; south by Loire-Inférieure; and west by Morbihan and Côtes-du-Nord. The *département* consists of the basin of the upper Vilaine, with those of its tributaries (all navigable): the Ille from the north. the Seiche from the east and the Meu from the west, and the coastland north of the low watershed from the estuary of the Rance on the west to that of the Couesnon on the east. The Vilaine is navigable as far north as Rennes, which is connected by canal via the Ille with Evran on the Rance. The rich Marais de Dol, protected by dykes from the sea. occupies most of the north coastal plain. The coast is rocky and dangerous. The climate is oceanic, temperate and rainy, with fogs in spring and autumn. The soil, originally poor, has been improved by the use of artificial manure. Cereals are grown, chiefly wheat, buckwheat. oats and barley. Potatoes. beetroot. early vegetables, flax and hemp are also largely grown, and tobacco is cultivated in the arrondissement of St. Malo. Orchards are abundant. especially near Dol. Stock raising and dairying are important. Lead mines and quarries of slate, granite, etc.. are worked. There are boatbuilding yards, iron and copper foundries and forges and a widespread tanning industry. Sailcloth, rope, pottery. boots and shoes (Fougères), farming implements, paper and furniture are also made. The chief ports are St. Malo and St. Servan. Fishing is very active on the coast, and St. Malo, St. Servan and Cancale send fleets to the Newfoundland codbanks. There are also important oyster fisheries in the Bay of St. Michel, especially at Cancale. Dinard is the chief of a group of fashionable bathing resorts. Exports include agricultural products. butter, mine posts and dried fish; imports, livestock, coal, timber, building materials and wheat. The *département* is served by the Ouest-État railway. Ille-et-Vilaine is divided into the *arrondissements* of Fougères, St. Malo, Redon and Rennes, and it consists of 43 cantons and 361 communes. The chief town is Rennes, which is the seat of an archbishop and of a court of appeal, headquarters of the 10th army corps and the centre of an *académie* (educational division).

ILLEGITIMACY, the state of being of illegitimate birth (from Lat. *illegitimus,* "not in accordance with the law," hence born out of wedlock). All societies need to perpetuate themselves and are concerned with how they do so, generally approving or preferring procreation only within marriage. A socially recognized and regulated relationship between the sexes is in the interests of social order, and the systematic care and attention of both parents is best for the child. Illegitimacy is universally condemned. although the forms of punishment vary from place to place and from time to time in the same place. Not to condemn illegitimacy would be to attach no special significance to marriage. Recognizing the

great importance of marriage for social responsibility and stability, and the corresponding dangers of nonmarriage, the state makes marriage easy, the requirements being few and simple.

Limitations of the Data. — The amount of illegitimacy is unknown in most countries. In the United States a shifting number of states do not require a report on legitimacy status. The illegitimacy rate for the United States as a whole is but an estimate based on the data from those states reporting on illegitimacy, and is therefore subject to error. There is, moreover, a social stigma attaching to illegitimacy, which encourages false statements on birth certificates or even failure to record illegitimate births at all. The estimates of illegitimacy for the United States do not contain statistical adjustments for these contingencies.

Methods of Computing Rate. — There are two widely used methods of computing the illegitimacy rate. The more common method is the ratio of illegitimate births to 1,000 live births. This measure is useful for showing the proportion of all births that is illegitimate, but it may give a false picture of the illegitimacy problem. For example in the United States in 1949 the ratio of illegitimate births to 1.000 live births was 41.2, whereas in 1940 it had been 37.9, suggesting a relatively small increase in the interval. Actually there was a considerable increase which was obscured because there was an even greater increase in total births during the period. The explanation is as follows. There was a phenomenal increase in marriages during highly favourable economic conditions, and the proportion of U.S. women ever married reached a record high level. The increase in the proportion of women ever married was much greater in the decade 1940–50 than in the whole half-century prior to 1940. There were more families, and in addition the birth rate was higher. So the lower rate of illegitimacy reflected only the greater increase in total births. The estimated number of children born out of wedlock in 1953 was 160,800, or 79% more than the number (89,500) in 1940. This was an especially significant increase since the number of unmarried women in the country decreased.

A better measure of the illegitimacy problem for many purposes is the rate based on the number of illegitimate births per 1,000 unmarried women, 15–44 years old (the childbearing ages). The unmarried includes "never married." "widowed" and "divorced." On this basis the rate in the United States was 7.0 in 1938 and 17.0 in 1953, an increase of 143%.

Variation in Rates Within a Country. — The illegitimate births in a country are likely to be distributed unevenly throughout the population, with certain groups having more than their proportionate share. In the United States in 1953 a little more than two-fifths (40.4%) of illegitimate live births were to mothers in their teens, with 34,300 such births to girls 17 years old or younger. The probabilities of conception are greater in youth, which also has greater emotional immaturity. The percentage of illegitimate births in the United States in 1953 by age groups of mothers was as follows: under 15 years old, 2.1%; 15–19, 38.2%; 20–24, 30.3%; 25-29, 15.2%; 30–34, 8.3%; 35-39, 4.4%; 40 and over, 1.3%.

Illegitimacy rates vary by type of community. The rate per 1,000 unmarried women aged 15-44 years in the United States in 1947 was 10.5 for urban areas and 1j.3 for rural areas. However about a third of all women having babies in that year went outside their home areas for confinement. Unmarried mothers in rural areas are not so likely to move to an urban area for confinement as are married women. This has the effect of increasing the rural rate of illegitimacy. Unwed mothers who do migrate for their confinement are more likely to go to the big cities because the social agencies serving them are located there. Also the large city affords more opportunity for anonymity.

Illegitimacy rates also vary by race. The estimated number of illegitimate live births for nonwhites in the United States in 1953 (104,200) appreciably exceeded that for whites (56,600), although nonwhites were less than one-tenth as numerous as whites. If the ratio is calculated per 1,000 registered live births in each group, the ratio for the nonwhites in 1953 was 11.3 times that for whites. It is believed that illegitimacy is more fully reported by nonwhites than whites but this is probably a relatively minor factor in accounting for the difference in ratios. It is not to be inferred that the high ratio among nonwhites involves a racial or genetic factor and is therefore inevitable. On the contrary, the higher ratio among nonwhites in the United States represents differences in degree of cultural assimilation. the nonwhites not having fully acquired the cultural traditions of the dominant white society regarding marriage, largely because of economic handicaps.

The percentage of illegitimacy for nonwhites declined greatly from the estimated figure of 25% at the beginning of the 20th century. In small stable communities of the northern U.S. the illegitimacy ratio of nonwhites is very low. In the rural south illegitimacy is not regarded as an acute problem. The illegitimate child is usually accepted by the girl's mother and her people. If the unmarried mother must work, a relative may take over the responsibility of the child's care. The unmarried mother suffers little or no loss of status, nor are her chances of marriage lessened. The father of the child, even when known, is not prosecuted and generally is not even pressed to assume responsibility for mother and child. There are few or no data on representative samples of unmarried mothers which throw light on their socioeconomic and educational status and their personality traits. Only those mothers who come to the attention of social agencies are known, and they are largely from the lower class. In U.S. cities they are concentrated in such occupations as domestic servants, waitresses and other jobs with special opportunities for contact with men. Agency cases tend also to be mentally subnormal. In France in 1950 it was found that the chances for illegitimate children being born dead were 50% greater than for legitimate children, suggesting the biological or social inferiority of unmarried mothers.

Variations Among Countries. — There are wide differences among nations in the rate of illegitimacy, as the accompanying table indicates. Such variations cannot be understood without knowledge of many factors including the marital status and age composition of the female population and the cultural traditions of the respective countries. In Latin America, for example, there is a large native population to whom legal marriage is an alien concept. In such countries, common-law marriage (living together without benefit of clergy or civil ceremony) is often not legally recognized and the children born of such unions are considered illegitimate. In the United States in the 1950s about half the states still considered common-law marriage legal, although the trend had been to outlaw such marriage. Still another factor is war, when it results in a great surplus of women. In Germany in 1919 the first post-World War I census showed a surplus of 2,214,000 between 20 and 49 years of age. Social disorganization resulting from war or other causes encourages illegitimacy. For example from 1891 to 1926 New Zealand had a steady illegitimate birth rate of just a little more than 9 per 1,000 unmarried women at the reproductive ages; but in 1945 the rate was 11.6;. mainly, it is thought, because of war influences resulting in unusual movements of the population and the influx of servicemen to the more heavily

Illegitimate Births per 1,000 Live Births

Country and year	Number	Country and year	Number
Algeria (Europeans) (1957)	31	Iceland (1956)	251
Algeria (Moslems) (1953)	15	Ireland (Republic) (1958)	16
Argentina (1958)	240	Italy (1957)	28
Australia (1958)	46	Japan (1957)	15
Austria (1958)	132	Mexico (1957)	236
Belgium 11958)	20	Netherlands (1958)	12
Berlin (1958)	153	New Zealand (1958)	50
Bolivia (1955)	208	Nicaragua (1957)	563
Bulgaria 11958)	76	Northern Ireland (1958)	23
Canada (1958)	40	Norway (1957)	35
Chile (1958)	173	Panamá (1958)	739
Colombia (1958)	245	Paraguay (1957)	455
Costa Rica (1958)	235	Portugal (1958)	105
Denmark (1957)	69	Rumania (1947)	119
Dominican Republic (1958)	616	Scotland (1958)	41
Ecuador (1957)	351	Spain (1958)	29
El Salvador (1953)	613	Sweden (1958)	100
England and Wales (1958)	49	Switzerland (1958)	36
Finland (1958)	40	Union of South Africa (Europeans) (1957)	16
France (1958)	61	United States (1957)	47
Germany (western) (1958)	67	Uruguay (1954)	211
Guatemala (1958)	716	Venezuela (1956)	564
Honduras (1957)	645		
Hungary (1958)	57		

populated centres. Comparisons between countries are affected also by the differences in completeness of birth registration and the extent of misrepresentation on the birth record to conceal illegitimacy of a birth. These are serious sources of error and may vary greatly from country to country.

Social Policy.— What happens to the unmarried mother and her illegitimate child? There are three principal stages in the history of social policy affecting illegitimacy in the United States. In colonial times the prevailing idea was to punish the mother by ostracizing her socially, as dramatized by Nathaniel Hawthorne in *The* Scarlet *Letter.* At a later time care for the mother was provided in maternity homes until the child was born, after which the child was separated from its mother. By the 1950s the policy was to permit the child to remain with the mother, unless there were special reasons to the contrary. In actuality the latter policy had worked out very differently in different countries. In the Cnited States the illegitimate child had more often been separated from its mother than in Scandinavia, where such a course of action had been frowned upon. The trend in social policy affecting illegitimacy during the first half of the 20th century was to lessen the social stigma attaching to the illegitimate child by removing legal disabilities and according equal rights with other children, beginning with the exclusion from the birth certificate of any record of illegitimacy. A large number of illegitimate children are legitimatized by the subsequent marriage of their parents; in Italy by 1950 about one-third of the children were so affected. The trend had also been to provide more effectively for the child's economic support by providing a closer check on paternity, and if paternity were established by law, to hold the legal father to a stricter accounting of his duties. Furthermore, there had been a tendency to extend to the illegitimate child and his guardian the same economic benefits granted by the state to legitimate children. In the United States the federal social security benefits entitled Aid to Dependent Children were available to illegitimate children.

The policies regarding illegitimate children have been especially liberal in the Scandinavian countries, and studies conducted in these countries produced no evidence that such a liberal policy promoted illegitimacy. On the other hand, in the late 1930s, the U.S.S.R. reversed the liberal policies that had been established after the Revolution of 1917 and denied the right of an unmarried mother to appeal to the court for the purpose of establishing fatherhood and claiming alimony for the upkeep of the child. It appears that despite variations in social policy, the trend of legislation affecting the illegitimate child had been liberal.

See Lena ***M.*** Jeger, ***Illegitimate*** *Children* and ***Their Parents,*** National Council for the Unmarried Mother and Her Child (London, 1951); Leontine Young, Out of ***Wedlock*** (New York, London, 1954).

(M. F. N.)

ILLINOIS, the "Prairie state," is one of the north central group of the conterminous United States. It is bounded on the north by Wisconsin, east by Lake Michigan and Indiana, southeast and south by the Ohio river, which separates it from Kentucky, and southwest and west by the Mississippi river, which separates it from Missouri and Iowa. The enabling act of Congress providing for the organization of Illinois territory into a state extended its jurisdiction to the middle of Lake Michigan and the Mississippi river. The greatest length of Illinois is 382.1 mi. and the extreme width is 212.6 mi.; the total area of the state. exclusive of its Lake Michigan jurisdiction (1,526 sq.mi.), is 56,400 sq.mi., and the total land area is 55,930 sq.mi., giving it the rank of 24th in size among the states. It was admitted to the union on Dec. 3, 1818, the 21st state; the capital, since 1839, is Springfield. The official tree is the oak, of which 19 species grow in the state; the official flower is the violet; and the official bird is the cardinal (*Cardinalis cardinalis*). The state flag consists of a symbol based on the perched eagle, prairie boulder, shield, olive branch and scroll (bearing the state motto, "State Sovereignty, National Union") of the state seal on a white field edged with gold. The official state slogan is "Land of Lincoln."

PHYSICAL GEOGRAPHY

Physical Features.— Illinois is located with its southernmost point at 36° 58'; northernmost point, 42" 30'; easternmost point, 87" 30'; and its westernmost point, 91° 31'; except for its extreme southern point, it lies entirely in the prairie region. The southern end of the state is within the Coastal Plain belt at its northward extension along the Mississippi river. The surface is an inclined plane, sloping generally toward the south and southwest. The average elevation above mean sea level is 600 ft.; the highest elevation is Charles Mound (1.241 ft.), located on the Wisconsin-Illinois boundary in the northwestern corner of the state, in Jo Daviess county.

An elevation from 15 to 40 mi. wide, called the Illinois Ozarks, crosses the southern part of the state, from Grand Tower in Jackson county, on the Mississippi river, in the west to Shawneetown in Gallatin county, on the Ohio. in the east. The highest point in this southern range of hills is 1,065 ft. at Williams hill, in Pope county.

The drainage of Illinois is far better than its low elevations and comparatively level surface would indicate. There are nearly 500 streams in the state, grouped into two river systems; three-fourths of the waters flow into the Mississippi river, and the remaining one-fourth flow into the Wabash or Ohio rivers. The most important river is the Illinois, formed by the junction of the Des Plaines and Kankakee rivers in Grundy county; the Illinois river in its course of 273 mi. drains approximately 25,000 sq.mi. and in a few places broadens into wide, lake-like expanses, notably at Lake Peoria. The Kaskaskia, in the south, notorious for its variation of volume, and the Rock, in the north, are other important rivers emptying into the Mississippi; the Embarrass, Little Wabash. Saline and Cache in the east are important tributaries of the Wabash and Ohio rivers. Generally the Ohio river bottoms are so low and level that they are poorly drained. The Chicago river originally emptied into Lake Michigan, but by the construction in 1900 of a drainage canal, the direction of the river was reversed so that it now flows into the Mississippi.

Climate.— Illinois has a typical continental climate with a wide range in temperature and frequent short-period fluctuations in temperature, humidity, cloudiness and wind direction. Particularly in the winter, therefore, Illinois' geographical location results in temperatures that reflect both the northern and southern temperature belts of the United States. The north-south range in average temperature is 14" in January but only 5° in July. The mean annual temperature at Freeport, in the far northwest, is 48.4" F.; at Springfield, in central Illinois, 52.4"; at Cairo, the southernmost city, 59.8°. The mean annual temperature increases approximately 2° for every degree of latitude. The lowest temperature ever recorded was −35° F. on Jan. 22, 1930, at Mount Carroll, and the highest was 117° F., July 14, 1954, at East St. Louis, a maximum range of 152".

Precipitation ranges from 33 in. in the far north to 48 in. in the far south, 20–22 in. falling May–Sept. in most sections; but in the period Oct.–March there are only 11 in. in the extreme northwest and as high as 22 in. in the extreme south. Seasonal snowfall at Chicago has ranged from 10 to 66 in.; Cairo has had 48 in, in one winter, yet ⅓ of Cairo winters have less than 5 in. The average seasonal number of days with a snow cover of one inch or more is 80 in the extreme north but less than 20 in the extreme south; frost penetration in the soil ranges from about 36 in. in the extreme north to 6 in. in the extreme south. At Cairo, precipitation during winter is 25% of the annual total, while at Moline it is only 13%. Illinois is generally affected by most of the storm systems that move east or northeast through the central U.S.; precipitation is associated with air masses which have moved north from the Gulf of Mexico. Summer thunderstorms are occasionally severe with damaging winds or hail in local areas. Tornadoes are most likely during spring and early summer and are more numerous in the southwest, but may occur anywhere in the state. The heayily populated southern Illinois area probably has more severe tornadoes per unit of population than any other part of the U.S. The most disastrous tornado on record struck southern Illinois, March 18, 192.5, causing property loss estimated at $16,500,000, with 742 persons killed and 2,756 injured.

Soil.—The soil of Illinois is well known for its fertility. The surface soils are largely composed of drift deposits, varying from

2 to 100 ft. in depth; they are often overlaid with a dark-coloured loam 10 in. or more deep, and in a large portion of the state there is a subsoil of mottled clay; the clay pan in the central area of southern Illinois is not particularly productive. The soil of the prairies is darker and more granular than that of the forests, although most differences disappear with cultivation. The alluvial soil of the river bottoms is exceptionally fertile. and the American bottoms, extending along the Mississippi from Alton to Chester, have been cultivated for more than 200 years. Along the river bluffs there is a deposit of loess. well suited for orchards and vegetable production. The excellent drainage has always been advantageous to agricultural development. For the control of soil erosion. to preserve land resources and to perform similar conservation functions, 98.4% of all Illinois farms are in soil conservation districts, and all but one of the 102 counties (Du Page) are included in the state's 99 soil conservation districts.

Vegetation. — Illinois stretches about 380 mi. north and south in the centre of the North American continent and its vegetation is accordingly varied, ranging from the white pine and tamarack of the north to the bald cypress and tupelo gum of the south. Before the coming of the white man the area was an interspersion of tall prairie and eastern deciduous forest; the popular nickname "Prairie state" derives more from the fact that pioneers first encountered prairie there than from the actual amount of prairie, which is less extensive in Illinois than in many more westward states. Forest originally covered about 40% of the area; by the 1960s, through commercial use of timber and clearing of the land for agriculture, this had been reduced to about 10%, as compared with the 15% which agricultural experts consider desirable for best use of the land. With the establishment of the Shannee National forest in southern Illinois and an increasing interest in timber production, there was evident, in the second part of the 20th century, both an increase in acreage and a more intelligent use of forests and their products.

Animal Life. — Illinois once supported a great variety of animal life, now greatly depleted. Fur trading was an important commercial enterprise in the period of exploration and settlement, mink, muskrat, beaver and fox being significant; although some trapping is still carried on, it is of minor importance and the sporting value of fur animals has become relatively more important, especially since World War II. Three kinds of rabbits are native to the state: the white-tailed jack rabbit in the northwest, the swamp rabbit in the south and the cottontail throughout the state; they make up over one-third of the gamebag annually. Perhaps no mammals are enjoyed by more people than the gray and fox squirrels which inhabit town and city parks as well as woodlands. Deer have an interesting history: when white settlers first came they were common but not generally numerous, and as settlement increased their numbers increased, probably reaching a peak in the mid-19th century. Further clearing of land and more intensive agriculture eliminated their habitats and by 1910 native wild deer were virtually extinct. In 1933 the department of conservation placed four deer on a state game refuge. These and groups subsequently released gradually built up their number and in 1957 the first deer-hunting season since 1900 was inaugurated. The deer are concentrated in the southern and northwestern parts of the state. Quail increase from the northern to the southern part of the state, the majority being south of a line drawn from Rock Island southeastward through Peoria to the Indiana line. Pheasants are less numerous and are concentrated in northern Illinois. The state is in the heart of the Mississippi Flyway and is frequented by hundreds of thousands of waterfowl during the fall and spring migrations and in the winter. About 20 species of waterfowl are common in the state but only the wood duck nests there in appreciable numbers. Illinois has produced sizable catches of commercial fish for many years; the most important game fish is the largemouthed bass, common in all types of lakes and ponds.

State Parks and Memorials. — A consciousness of the value of the state's many historic sites and the need for recreational facilities. particularly for the great urban population, have led to the establishment of many state parks and memorials in Illinois. Places of interest in connection with Abraham Lincoln include Lincoln's New Salem State park, 20 mi. N.W. of Springfield, a reproduction of the village as it was in his time; the Lincoln Log Cabin State park, south of Charleston; and the Lincoln tomb, home and other memorials in Springfield. Stephen A. Douglas is commemorated by a monument on the site of his tomb in Chicago, and the sites of the seven Lincoln-Douglas debates (at Ottawa, Freeport, Jonesboro, Charleston. Galesburg, Quincy and Alton) are marked Other places of historic interest include Cahokia Mounds State park near East St. Louis and Dickson Mound State memorial on the Illinois river near Havana; Pere Marquette State park, at the junction of the Illinois and Mississippi rivers and Starved Rock State park, on the upper Illinois river, associated with the French period in Illinois history; Ft. Kaskaskia and Ft. Chartres State parks along the Mississippi below East St. Louis and Ft. Massac State park on the Ohio, all of which were French military strongholds of the 18th century; Nauvoo State park, on the Mississippi river north of Quincy, the site of the Mormon settlement; and the Ulysses S. Grant home in Galena, now a museum.

Among the state parks primarily of scenic and naturalistic interest are the Mississippi Palisades and Apple River Canyon parks in northwestern Illinois, the White Pines Forest, Buffalo Rock. Matthiessen, Illini and Gebhard Woods parks in north central Illinois, the Spitler Woods park near Decatur and the Giant City, Ferne Clyffe and Dixon Springs parks in southern Illinois. Among those with water areas (in some cases with facilities for camping and swimming) are Illinois Beach State park on Lake Michigan near Waukegan; Illinois and Michigan Canal State parkway along the old canal in Will. Grundy and La Salle counties; Kickapoo State park near Danville; Grand Marais State park near East St. Louis; and Fox Ridge State park near Charleston. Lake areas which are now state parks include Argyle lake in McDonough county, Beaver dam in Macoupin county, Lake Le-Aqua-Na in Stephenson county, Lake Murphysboro in Jackson county, Ramsey lake in Fayette county, Spring lake in Tazewell county and Weldon springs in De Witt county.

Chicago Portage, which preserves a portion of the famous portage discovered by Marquette and Jolliet, was designated as a national historic site in 1952; not owned by the federal government, it is under the jurisdiction of the Cook County Forest preserve.

HISTORY

French Exploration and Settlement. — The first Europeans to visit the region now known as Illinois were the French. In 1673, the Jesuit father Jacques Marquette, under orders to begin a mission to the Indians, and the explorer Louis Jolliet, who acted under orders of Jean Talon, intendant of Canada, ascended the Fox river, crossed the portage between it and the Wisconsin river and followed that stream to the Mississippi, which they descended to a point below the mouth of the Arkansas. On their return journey they ascended the Illinois river and crossed the portage to Lake Michigan; in 1675 Marquette founded a mission at the Indian town of Kaskaskia, near the present Utica, Ill. In 1679 the explorer René Robert Cavalier, sieur de la Salle. attempting to find the mouth of the Mississippi, ascended the St. Joseph river, crossed the portage separating it from the Kankakee, which he descended to the Illinois and built in the neighbourhood of Lake Peoria a fort which he called Ft. Crèvecoeur. La Salle reached the mouth of the Illinois Feb. 6. 1682. After such preliminary explorations, the French made permanent settlements, which had their origin in Jesuit missions and French trading posts. Chief of these were Kaskaskia, established near the mouth of the Kaskaskia river, about 1703; Cahokia. a few miles below present East St. Louis, Illinois, founded about 1699; and Ft. Chartres, on the Mississippi between Cahokia and Kaskaskia, founded in 1719 to be a link in a chain of fortifications intended to extend from the St. Lawrence to the Gulf of Mexico.

By the treaty of Paris, 1763, France ceded to Great Britain its claims to the country between the Ohio and Mississippi rivers, but because of the resistance of Pontiac, a chief of the Ottawas, who drew into conspiracy most of the tribes between the Ottawa river and the lower Mississippi, the English were not able to take possession until Capt. Thomas Stirling arrived at Ft. Chartres,

Oct. 10, 1765—the last place in North America to lower the French flag

British Rule.—British policy mas not favourable to the economic development of the newly acquired country, since it was feared that its prosperity might react against the trade and industry of Great Britain. But in 1769 this policy nas relaxed. and immigration began from the seaboard colonies, especially from Virginia In 1771 the people of the Illinois country demanded a form of self-government similar to that of Connecticut. The petition was rejected by Gen. Thomas Gage; and William Legge. 2nd earl of Dartmouth (1731–1801), secretary of state for the colonies and president of the board of trade and foreign plantations. drew up a plan of government for Illinois in which all officials were appointed by the cronn. This. however, was never operative for in 1774 the Quebec act (*q.v*) extended the boundaries of Quebec to the Ohio on the south and the Mississippi on the east. recognized French civil law and brought the Illinois country under an appointive governor and council. Most of the Illinois French were loyalists in the Revolutionary War; when the English instigated Indian attacks on the frontier, George Rogers Clark (*q.v.*), nho acted under orders of Patrick Henry, governor of Virginia, captured the British posts of Cahokia and Kaskaskia in 1778 and Vincennes in 1779. These conquests had much to do with the United States' securing the country west of the Alleghenies and north of the Ohio in the treaty of Paris. 1783.

Territorial Status and Statehood.—The Virginia house of delegates in 1778 extended the civil jurisdiction of Virginia to the northwest, and appointed Capt. John Todd (1750–82) of Kentucky governor of the entire territory north of the Ohio, organized as "the county of Illinois." This government. confined to the old French settlements. was short-lived and inefficient. In 1787 after Virginia and the other states relinquished their claims to the country west of the Alleghenies, the Northnest territory was organized by congress by the famous ordinance of 1787. Two years later St Clair county was formed out of the southwest part of the Illinois country. while the eastern portion and the settlements arbund Vincennes, Ind., were united into the county of Knox In 1795 the southern part of St. Clair county was organized into Randolph county, with Kaskaskia as the scat of administration. In 1800 the Illinois country nas included in the territory of Indiana, and in 1809 the western part of that territory, from Vincennes north to Canada. was organized as the territory of Illinois; it included. besides the present state, all of Wisconsin except the northern part of the Green Bay peninsula, a large part of Michigan and all of Minnesota east of the Mississippi In 1812, by permission of congress, a representative assembly was chosen, a territorial constitution was adopted and ,the territorial delegate in congress was elected directly by the people.

In 1818 Illinois became a state of the American union (see *Government,* belon). the enabling act fixing the line 42° 30' as the northern boundary. instead of that provided by the ordinance of 1787, nhich passed through the south bend of Lake Michigan. The reason given for this change was that if the Mississippi and Ohio rivers were the only outlets of Illinois trade, the interests of the state would become identified with those of the southern states; but if a Lake Michigan outlet were provided, closer relations would be established with the northern and middle states so that "additional security for the perpetuity of the Union" would be afforded.

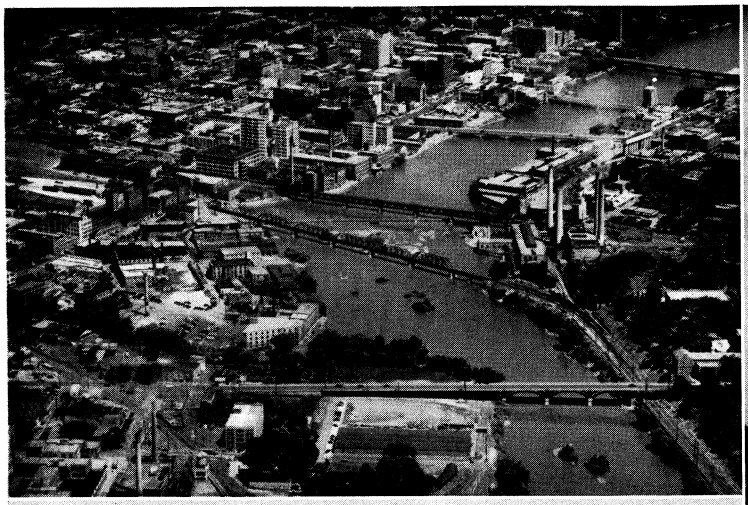
Because there was conflict betneen French and English land claims, congress in 1804 established land offices at Kaskaskia and Vincennes to examine existing claims and to eliminate conflict with future grants; in 1812 new offices were established at Shawneetown and Edwardsville for the sale of public lands; and in 1816 more than 500 000 ac were sold. In 1818. honever. many citizens were in debt for their lands, and squatters invaded the rights of settlers Congress therefore reduced the price of land from $2 to $1 25 per acre and adopted the policy of pre-emption. preference being given to the claims of existing settlers. The Indians, honever. resisted measures looking toward the extinguishment of their claims to the country. Their dissatisfaction with treaties signed in 1795 and 1804 caused them to espouse the British cause in the War of 1812, and in 1812 they overpowered a body of soldiers and settlers who had abandoned Ft. Dearborn (*see* CHICAGO). For a number of years after the end of the conflict, the Indians mere comparatively peaceful; but in 1831 the delay of one band of Sauks and Foxes in withdrawing from lands in northern Illinois caused Gov. John Reynolds (1788–1865) to call out the militia. The following year the return of the Sauk leader Black Hawk resulted in war in northern Illinois and Wisconsin (the Black Hank War); and by 1833 the United States had acquired title to all the Indian land in Illinois.

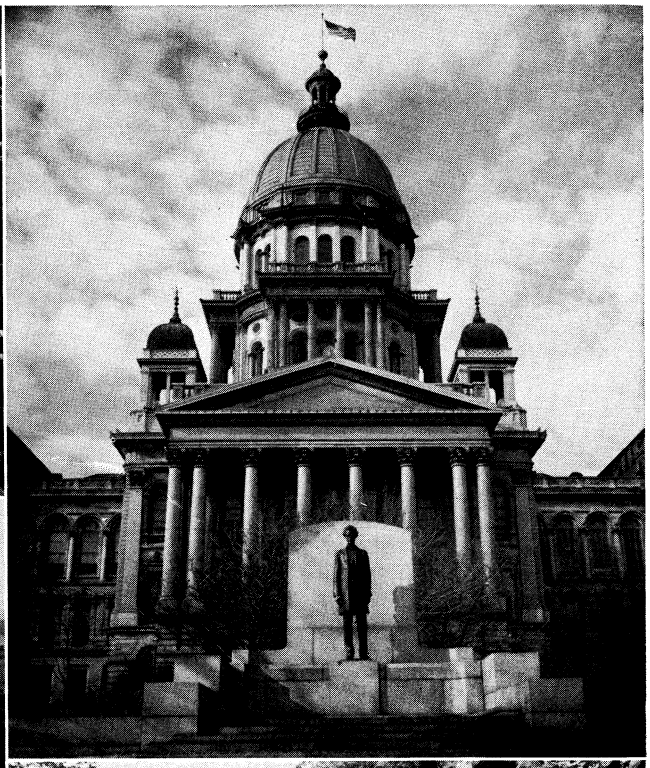
The financial and industrial policy of the state was unfortunate. Money being scarce, the legislature in 1819 chartered a state bank nhich nas authorized to do business on the credit of the state. This bank never operated and a second was chartered in 1820. In a few years the bank failed. and the state in 1831 borrowed money to redeem the depreciated notes issued by the bank. A third state bank was chartered in 1835; two years later it suspended payment. and in 1843 the legislature provided for its liquidation. The state also undertook to establish a system of internal improvements, granting a loan for the construction of the Illinois and Michigan canal in 1836. and in 1837 appropriating $10.000.000 for the building of railroads and other improvements. The experiment proved unsuccessful; the state's credit declined and a heavy debt was incurred. and in 1840 the policy of aiding public improvements nas abandoned. Through the efforts of Gov. Thomas Ford (1800–50) a movement to repudiate the debt was defeated, and a plan was adopted by nhich the entire debt could be reduced nithout excessive taxation; by 1880 practically the entire debt was extinguished.

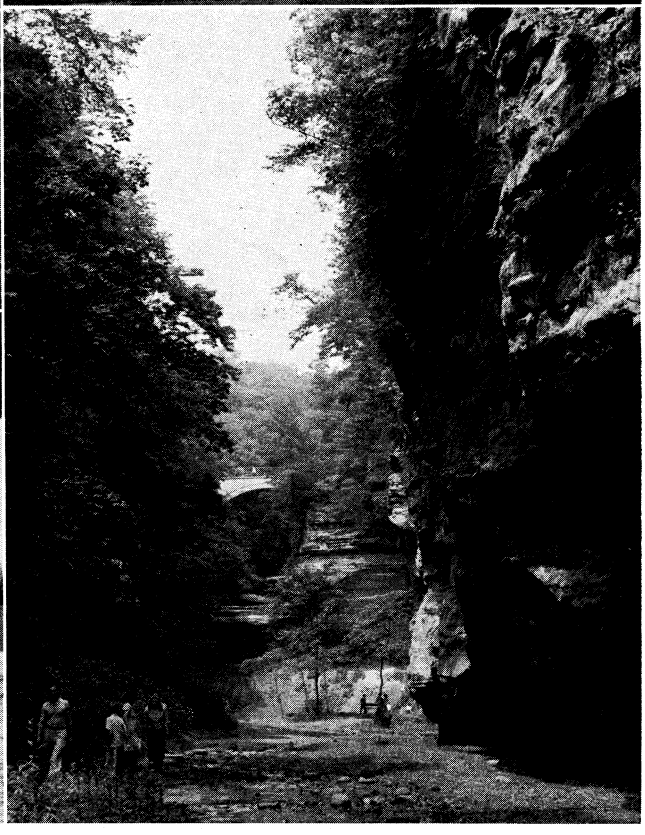
A notable incident in the history of the state was the immigration of the Mormons from Missouri about 1839. They succeeded in securing favours from the legislature, and their city of Nauvoo had courts and a military organization that were independent of state control. Political intrigue and claims of independence from the state. as well as charges of polygamy and lawless conduct, aroused such intense opposition that in 1844 a civil mar broke out in Hancock county resulting in the murder of the leader of the Mormons, Joseph Smith, and the removal of the Mormons from Illinois in 1846.

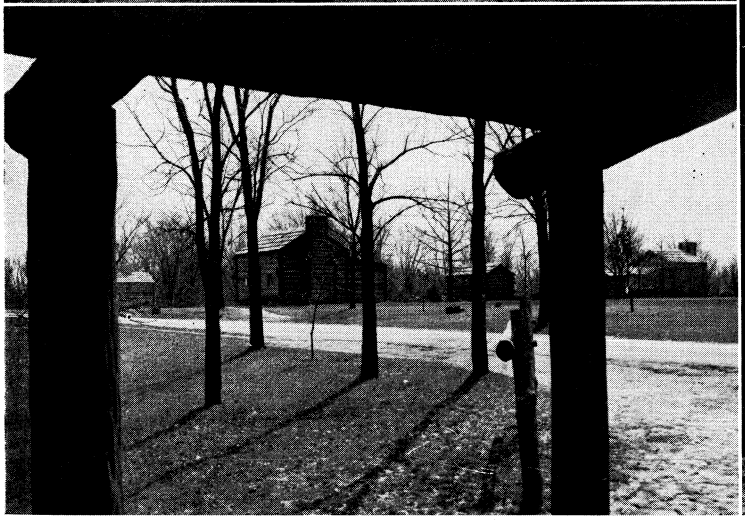
Slavery Question and the Civil War.—The slavery question was a problem of lasting political importance. Slaves had been brought into the Illinois country by the French, and Gov Arthur St. Clair (1736–1818) interpreted the article of the ordinance of 1787 forbidding slavery in the Northwest territory as a prohibition of the introduction of slaves into the territory, not an interference with existing conditions. Negroes were held as indentured servants. and such servitude was recognized in the Indiana code of 1803, the Illinois constitution of 1818 and statutes of 1819; indeed, slavery would have been recognized in the constitution of 1818 had it not been feared that recognition would have prevented the admission of the state to the union. In 1824 the voters rejected a legislative proposal calling for a constitutional convention; the aim, not expressed, was the legalization of slavery. But the resolution of the legislature was rejected. the leader of the opposition being Gov. Edward Coles (1786–1868), a Virginia slaveholder who had freed his slaves on coming to Illinois. The opposition to slavery. however, was at first economic. not philanthropic. In 1837 there was only one abolition society in the state, but chiefly through the agitation of Elijah P. Lovejoy (*q.v.*), abolition sentiment grew.

By 1840 the moral issue had become political and the Liberty party was organized. In 1818 it united with the Free-Soil party; but as the Whig party approved the policy of nonextension of slavery, these parties did not succeed. In 1854. however, the Liberty and Free-Soil parties united with some Whigs and those Democrats opposed to the Kansas-Nebraska bill; they secured a majority in the legislature and elected Lyman Trumbull to the U.S. senate. Two years later these elements were absorbed by the Republican party and elected candidates to state offices—the first time that the Democratic party had been defeated. its organization having been in control since the admission of Illinois to the union. Important in this political revolution was a change in the character









BY COURTESY OF (TOP LEFT) ROCKFORD CHAMBER OF COMMERCE, (CENTRE LEFT) INTERNATIONAL HARVESTER CO. FROM "HARVESTER WORLD," (BOTTOM LEFT, BOTTOM RIGHT) ILLINOIS DIVISION OF PARKS AND MEMORIALS; PHOTOGRAPH, (TOP RIGHT) A. DEVANEY, INC.

VIEWS OF NORTHERN AND CENTRAL ILLINOIS

Top **left:** Rockford, showing downtown area and the Rock river

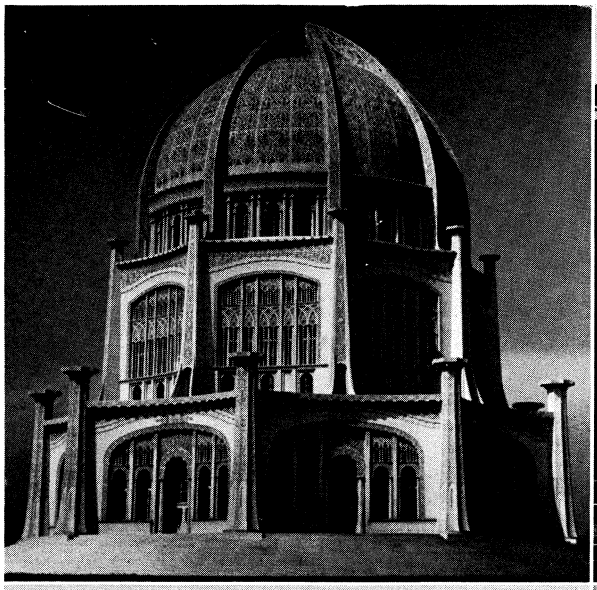
Top **right:** State capitol at Springfield and statue of Abraham Lincoln

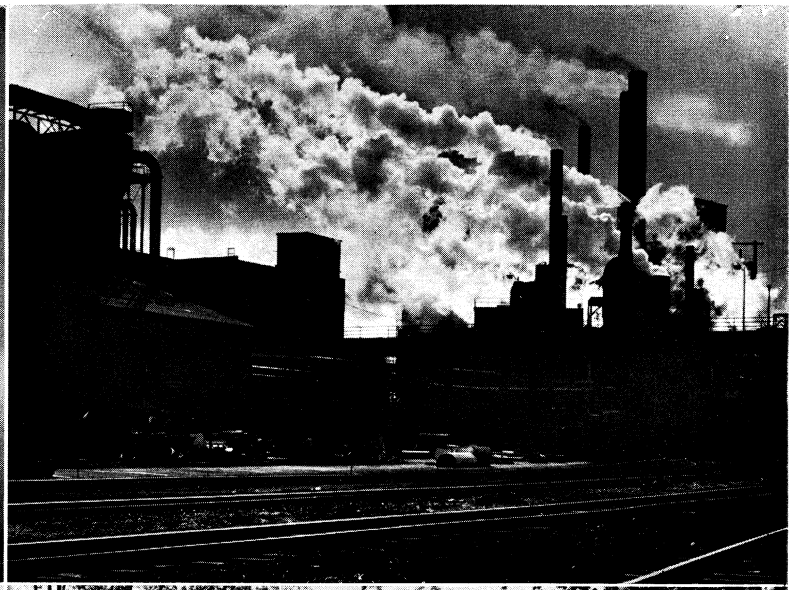
Centre left: Rolling farmland in Jo Daviess county near the Mississippi river. More than three-fourths of the land area in Illinois is in farms

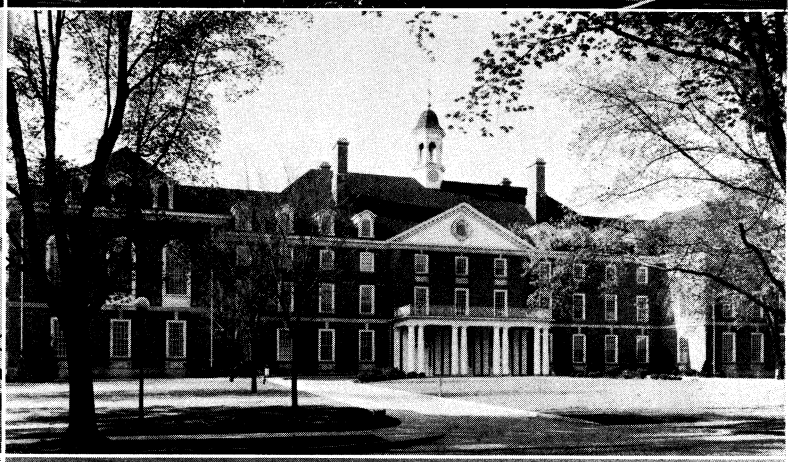
Bottom left: New Salem State park, north of Springfield. Cabins are reproductions of homes built in New Salem village during the 1830s when Abraham Lincoln lived there

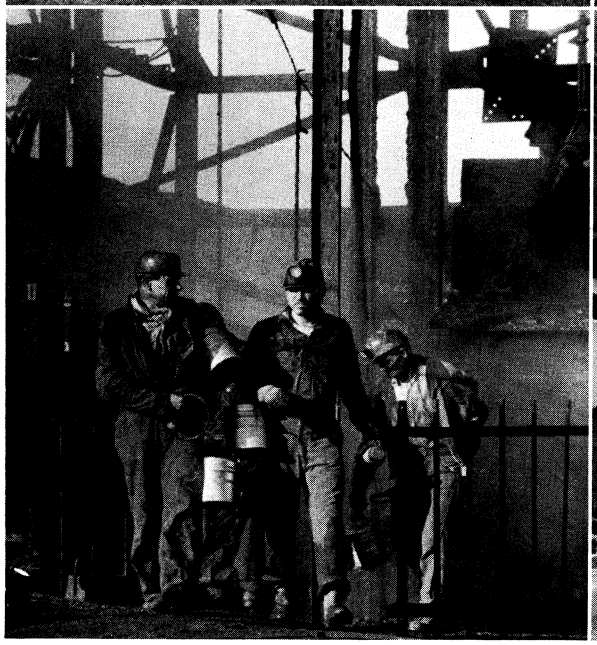
Bottom **right:** Nature trails at Matthiessen State park, LaSalle county

ILLINOIS









BY COURTESY OF (TOP RIGHT) A. E. STALEY MANUFACTURING CO., (CENTRE LEFT) ILLINOIS DEPARTMENTAL INFORMATION SERVICE, (CENTRE RIGHT) UNIVERSITY OF ILLINOIS; PHOTOGRAPHS, (TOP LEFT) LIL AND AL BLOOM FROM BLACK STAR, (BOTTOM LEFT) BENEDICT GELMAN FROM 'SOUTHERN ILLINOISAN," (BOTTOM RIGHT) FAIRCHILD AERIAL SURVEYS, INC.

SCENES IN ILLINOIS

Top left: Baha'i temple in Wilmette, north of Chicago.
Top right: Corn processing plant at Decatur, central Illinois
Centre left: Fort Massac State park, near Metropolis in the southernmost part of the state. Statue is of George Rogers Clark (1752–1818) who crossed the Ohio river there in 1778 to capture Kaskaskia from the British
Centre right: Illini Union building, social and recreational centre of the University of Illinois at Urbana
Bottom left: Coal miners leaving the shafts at Elkville. Soft coal is mined in the southwestern section of the state
Bottom right: Confluence of the Ohio (top) and Mississippi rivsrs at Cairo

of the population. Until 1848 southerners predominated in the population. but after that year immigration from the northern states was greater than that from the south, and the number of foreigners also increased. The influence of immigration and sectionalism upon Illinois politics is well illustrated by the fact that the first six governors (1818–38) were born in the southern states, six of the eight U.S. senators of that period were also southern born and all of the representatives, with one exception, also came to Illinois from the southern states. After 1838 the eastern states began to be represented among the governors but until 1901 no governor was elected who was a native of Illinois.

The opposition to slavery continued to be political and economic rather than philanthropic. The constitution of 1848, which abolished slavery, also forbade the immigration of slaves into the state. The famous contest for the office of U.S. senator between Stephen A. Douglas (Democrat) and Abraham Lincoln (Republican) took place in 1858. Douglas was elected but the vote showed increasing northern sympathy, and two years later Lincoln, then candidate for the presidency, carried the state. The policy of Illinois in the early period of secession was one of marked loyalty to the union; even in the southern part of the state the majority of the people had no sympathy with proslavery men in their efforts to dissolve the union. The state contributed more than 250,000 men to the federal armies. From 1862 to 1864, however, there mas some opposition to a continuance of the war. The legislature of 1862 was Democratic, and for political purposes that body adopted resolutions against further conflict and recommended an armistice and a national convention to conclude peace. A constitutional convention that same year attempted to assume legislative powers; it wrote into the proposed constitution clauses preventing Negroes and mulattoes from immigrating into the state and from voting and holding office; and although the constitution as a nhole was rejected by the people, these clauses were ratified. A Democratic mass meeting, which met at Springfield in July 1863, adopted resolutions that condemned the suspension of the writ of habeas corpus. endorsed the doctrine of state sovereignty, demanded a national assembly to determine terms of peace and asked President Lincoln to withdraw the Emancipation Proclamation in order to permit the people of Illinois to fight only for "Union, the Constitution and the enforcement of the lams." Anti-war and pro-southern secret societies, including the Knights of the Golden Circle (*q.v.*), began to flourish, and so did exaggerated stories about their activities and strength. Capt. T. Henry Hines of the Confederate army led an elaborate attempt to liberate Confederate prisoners in Chicago (knonn as the Camp Douglas conspiracy) which mas thwarted by a discovery of the plans. In the elections of 1864 the Republicans and Union Democrats united, and after an exciting campaign they were successful. The new legislature was the first state legislature to ratify (Feb. 1, 1865) the 13th amendment.

Political Record. — From the close of the Civil War until the end of the 19th century the Republican party was generally dominant, but the trend of political development was not without interest.

In 1872 many prominent men joined the Liberal Republican party. among them Gov. John M. Palmer, Sen. Lyman Trumbull and Gustav Korner (1809–96), one of the most prominent representatives of Illinois' German population. Economic depression gave the Granger movement considerable popularity, and an outgrowth of the Granger organization was the Independent Reform party of 1874 which advocated retrenchment of expenses, the state regulation of railways and a tariff for revenue only. A Democratic Liberal party was organized in the same year, one of its leaders being Governor Palmer; consequently, no party had a majority in the legislature elected in 1874. In 1876 the Greenback party, the successor in Illinois of the Independent Reform party, secured a strong following; although its candidate for governor was endorsed by the Democrats, the Republicans regained control of the state administration.

In 1912, as a result of the Progressive secession, the Republican party lost control of the state for the first time in 16 years, the Democratic presidential electors winning by a vote of 405.038, as compared with 386,478 for the Progressives and 253,593 for the Republicans. By 1914 the normal Republican majority in Illinois reasserted itself. and two years later Pres. Woodrow Wilson lost the electoral vote of the state. At the same time the Republicans recaptured the governorship, which it held without interruption for the next 16 years. But in 1932 the people of the commonwealth cast their vote heavily for Franklin Delano Roosevelt and also elected a Democratic governor. Henry Horner. This political shift was confirmed in 1934 when 22 of the state's 27 seats in the house of representatives were filled by Democrats and again in 1936 and 1940 when President Roosevelt carried the state.

After 1944, when Roosevelt again carried the state but a Republican governor was elected, no pronounced trend developed. Harry S. Truman carried Illinois in 1948, and Paul Douglas and Adlai E. Stevenson, both Democrats, were elected U.S. senator and governor, respectively. But in 1950 a Republican G.S. senator. Everett McKinley Dirksen, was elected and in 1952 Dwight D. Eisenhower and a Republican governor, William G. Stratton, uere voted into office. In 1954 the Democratic senator Paul Douglas was returned to Washington while in 1956 Eisenhower carried the state for the Republicans. In 1960 Douglas was re-elected for a third term in the senate and the presidential vote uent to the Democratic candidate John F. Kennedy.

GOVERNMENT

Constitution and Apportionment. — On July 4, 1800, the Northwest territory was divided and the Illinois country was made a part of Indiana territory; Illinois territory was formed March 1, 1809, by dividing Indiana territory. The first legislative body of Illinois territory — the governor and three judges, all appointed by the president — met June 16, 1809, and passed a code of laws, keeping most of the laws previously in force; the first representative assembly passed a similar bill confirming the laws in force. On April 18, 1818, congress made provision for a state convention to form an Illinois state constitution and government; on Aug. 26 the delegates adopted a constitution which went into effect when Illinois was admitted as the 21st state on Dec. 3, 1818.

In 1848 a second constitution was adopted, and in July 1870 the electorate adopted a third. Agitation for a new constitution resulted in a constitutional convention which in 1922 submitted a new constitution to the voters who rejected it by 921,398 to 185,298. A proposal for a constitutional convention was passed by the legislature in 1933 but was defeated by the electorate in 1934, 23.5% for, 20% against and 56.5% not voting.

At that time, amendments to the constitution could be made either by a constitutional convention or by the affirmative vote of two-thirds of the members of each house of the legislature; the amendment then had to be ratified by a majority of the electors voting in the next general election. Prior to 1950, 19 amendments were submitted to the voters; of these, 7 were adopted. Many amendments were defeated because citizens who voted for candidates but neither for nor against a proposed amendment were in effect voting against the amendment, since a majority of those voting in the election had to approve the amendment. In the period 1908–50 no amendment carried in a general election.

Constitutional amendment mas made much simpler by the adoption of the Gateway amendment in 1950. The Gateway amendment provided that as many as three amendment propositions may be submitted to the voters at an election, instead of only one as formerly. Adoption requires a two-thirds majority of those voting on the amendment, or a simple majority of those voting in the election, whichever is less. Since the Gateway amendment was adopted, ten amendments have been voted on by the electorate, five being adopted and five failing.

The most important new constitutional amendment changed sections 6–8 of article iv, senatorial apportionment; as a result, for the first time in half a century the districts from which state senators and representatives were chosen received revision. Members of the legislature had been chosen by districts, 3 representatives and 1 senator from each of 51 districts; total membership in the legislature had been 204. The amendment adopted designated

58 senatorial and 59 representative districts, increasing the number of senators by 7 and the number of representatives by 24, for a total legislative membership of 235. Under the amendment the 101 downstate counties elect 34 rather than 32 senators, and Cook county (in which Chicago is located) elects 24 rather than 19; 30 representative districts were placed in Cook county (previously 19) and 29 (previously 32) were located downstate. The new senate district boundaries and apportionment were meant to be permanent; the representative districts were to be reapportioned on a population basis every ten years, beginning in 1963.

Legislature. — Regular sessions of the legislature meet on the first Wednesday after the first Monday in January in odd-numbered years. The term of senators is four years, that of representatives two years. The constitution of 1870 provided for minority representation in the election of representatives; by cumulative voting each voter may cast as many votes for one candidate as there are representatives to be chosen, or he may distribute his votes (giving three votes to one, or one-and-one-half votes to each of two, or one vote each to three candidates), the candidate or candidates receiving the highest number of votes being elected. Special legislation is prohibited when general laws are applicable, and special and local legislation is forbidden in any of 23 specified cases. The general assembly may pass an act over the governor's veto by a two-thirds vote of all members elected to each house. In practice, the governor's veto is not often overridden; if the governor's political party controls either of the two houses, it is all but impossible to secure legislation not desired by the governor.

Executive. — The constitution provides for an executive department consisting of a governor, lieutenant governor, secretary of state. auditor of public accounts. treasurer, attorney general and superintendent of public instruction; all except the treasurer may be re-elected to succeeding terms (Illinois has never elected a governor to three successive terms). The most far-reaching administrative change in state government occurred in 1917 with the enactment of the Consolidation act combining more than 100 state boards. divisions and commissions into nine departments. By 1960 the number of major departments had increased to 17, each directed by a departmental administrative officer appointed by the governor: aeronautics, agriculture, audits, conservation, finance, financial institutions, insurance, labour, military and naval, mines and minerals, personnel, public health, public safety, public welfare, public works and buildings, registration and education and revenue.

In addition, a number of boards and commissions are charged with varying responsibilities; the most significant include the budgetary, commerce, legislative audit, public aid and youth commission's.

Illinois enacted a civil service law in 1905 under which approximately two thirds of the state's employees were covered by 1960. The civil service commission is a division of the department of personnel; certain employees, including the scientific and academic staffs of the state universities and clerks in offices headed by elected officers, are exempted.

Judicial. — The judicial powers are vested in a supreme court, appellate courts, circuit courts, county courts, justices of the peace and police magistrates, and such courts as may be created by law in and for cities and incorporated towns. The supreme court is composed of seven members elected from districts for a term of nine years. The four appellate courts consist of one for Cook county (which has also two branch appellate courts, both the court and branches being presided over by three judges appointed by the supreme court) and three other districts, each with three judges appointed in a like manner. The state outside of Cook county is divided into 20 circuits, 3 of which have 4 judges each and 17 have 3 judges each, all elected for terms of six years. The constitution provides for separate courts in Cook county: a superior court consisting of 36 judges, a circuit court consisting of 20 judges all elected for six years, a criminal court, a county court and a probate court.

The city of Chicago has a municipal court composed of a chief justice and 36 judges. Each county has a county court consisting of one judge who serves for four years; in some counties there are probate courts, and juvenile courts are provided for in counties of more than 500,000 population. Each county elects a state's attorney for four years. Cities or other local units meeting certain requirements may establish city or municipal courts by referendum.

Local Government. — The local government of Illinois includes both county and township systems. The earliest American settlers came from the southern states and introduced the county system; but the increase of population from New England and the middle states led to a recognition of township organization in the constitution of 1848, and this form of government, at first prevalent only in the northern counties, is found in most of the middle and southern counties. Cook county, although it has a township system, is governed by a board of commissioners elected by the townships and the city of Chicago. Incorporated cities must have a population of at least 2,500. Requirements for suffrage are: age of 21 years or more, citizenship in the United States and residence in the state for 1 year, in the county 90 days and in the election precinct 30 days preceding the exercise of suffrage.

Relation to Corporations. — The relation of the state to corporations and industrial problems has been a subject of important legislation. The constitution declares that the state's rights of eminent domain shall never be so abridged as to prevent the legislature from taking the property and franchises of incorporated companies and subjecting them to the public necessity in a way similar to the treatment of individuals. In 1903 the legislature authorized the municipal ownership of public-service corporations. Railways organized or doing business in the state are required by the constitution to have a public office where books for public inspection are kept, showing the amount of stock, the owners and the amount of liabilities and assets. An antitrust law of 1893 exempted from the definition of trust combinations those which were formed by producers of agricultural products and livestock, but the United States supreme court in 2902 declared the statute unconstitutional as class legislation. The employment of children under 14 years of age in factories or mines, as well as working employees under 16 years of age for more than 48 hours a week, is forbidden by statute.

Finance. — The cost of state government, at the end of the fifth decade of the 20th century, exclusive of revolving funds and tax refunds, exceeded $900,000,000 annually; including revolving funds and tax refunds, total expenditures for the fiscal year ending June 30, 1959, reached $960,300,000. If revolving funds and tax refunds are excepted, there was an excess of receipts over expenditures of $74,000,000. The outstanding indebtedness of the state, on June 30, 1959, was about $150,000,000 for bonds issued to pay a bonus to soldiers from Illinois who served in World War II.

The revenue system employed by local units of government is based on the general property tax. There is local assessment of all real and personal property (except railroad property, which is state assessed). The basic revenue source of the state is the retailers' occupation or sales tax. Other state revenue sources include an indirect tax on corporations, motor vehicle licence and fuel fees, inheritance tax, beverage-liquor revenue tax, cigarette tax, pari-mutuel taxes, insurance fees and taxes, public utility gross receipts taxes as well as a number of miscellaneous fees and taxes. Faced with rising state expenditures in the second half of the 20th century and handicapped by an apparent constitutional prohibition of the graduated income tax and a reluctance to levy a general property tax, Illinois more frequently considered financing capital improvements through long-term bond issues.

The constitution also prohibits the state from lending its credit or making appropriations in aid of any corporation, association or individual, and from constructing internal improvements; counties, townships and other political units cannot incur indebtedness in excess of 5% of their assessed property evaluation. The legislature may not contract a debt of more than $250,000 except

*Illinois: Places of 5,000 or More Population (1960 Census)**

Place	Population				
	1960	1950	1940	1920	1900
Total state	10,081,158	8,712,176	7,897,241	6,485,280	4,821,550
Addison	6,741	813	819	510	591
Alton	43,047	32,550	31,255	24,682	14,210
Arlington Heights	27,878	8,768	5,668	2,250	1,380
Aurora	63,715	50,576	47,170	36,397	24,147
Barrington	5,434	4,209	3,560	1,743	1,162
Bartonville	7,253	2,437	1,879	1,588	—
Batavia	7,496	5,838	5,101	4,395	3,871
Beardstown	6,294	6,080	6,505	7,111	4,827
Belleville	37,264	32,721	28,405	24,823	17,484
Bellwood	20,729	8,746	5,220	1,881	—
Belvidere	11,223	9,422	8,049	7,804	6,937
Bensenville	9,141	3,754	1,869	650	374
Benton	7,023	7,848	7,372	7,201	1,341
Berkeley	5,792	1,882	724	—	—
Berwyn	54,224	51,280	48,451	14,150	—
Bloomington	36,271	34,163	32,868	28,725	23,286
Blue Island	19,618	17,622	16,638	11,424	6,114
Bradley	8,082	5,699	3,689	2,128	1,518
Bridge View	7,334	1,393	—	—	—
Broadview	8,588	5,196	1,457	430	—
Brookfield	20,429	15,472	10,817	3,589	—
Cahokia	15,829	794	465	—	—
Cairo	9,348	12,123	14,407	15,203	12,566
Calumet 'City	25,000	15,799	13,241	—	—
Calumet Park	8,448	2,500	1,593	—	—
Canton	13,588	11,927	11,577	10,928	6,564
Carbondale	14,670	10,921	8,550	6,267	3,318
Carlinville	5,440	5,116	4,965	5,212	3,502
Carmi	6,152	5,574	4,098	2,667	2,939
Carpentersville	17,424	1,523	1,289	1,036	1,002
Centralia	13,904	13,863	16,343	12,491	6,721
Centreville	12,769	—	—	—	—
Champaign	49,583	39,563	23,302	15,873†	9,098
Charleston	10,505	9,164	8,197	6,615	5,488
Chicago	3,550,404	3,620,962	3,396,808	2,701,705	1,698,575
Chicago Heights	34,331	24,551	22,461	19,653	5,100
Chicago Ridge	5,748	888	376	176	—
Cicero	69,130	67,544	64,712	44,995	16,310
Clarendon Hills	5,885	2,437	1,281	—	—
Clinton	7,355	5,945	6,331	5,898	4,452
Collinsville	14,217	11,862	9,767	9,753	4,021
Crest Hill	5,887	—	—	—	—
Creve Coeur	6,684	5,499	3,535	—	—
Crystal Lake	8,314	4,832	3,917	2,249	950
Danville	41,856	37,864	36,919	33,776	16,354
Decatur	78,004	66,269	59,305	43,818	20,754
Deerfield	11,786	3,288	2,283	610	—
De Kalb	18,486	11,708	9,146	7,871	5,904
Des Plaines	34,886	14,994	9,518	3,451	1,666
Dixon	19,565	11,523	10,671	8,191	7,917
Dolton	18,746	5,558	3,068	2,076	1,229
Downers Grove	21,154	11,886	9,526	3,543	2,103
Du Quoin	6,558	7,147	7,515	7,285	4,353
East Alton	7,630	7,290	4,680	1,669	454
East Moline	16,732	13,913	12,359	8,657	—
East Peoria	12,310	8,698	6,806	2,214	899
East St. Louis	81,712	82,295	75,609	66,767	29,655
Edwardsville	9,996	8,776	8,008	5,336	4,157
Effingham	8,172	6,892	6,180	4,024	3,774
Elgin	49,447	44,223	38,333	27,454	22,433
Elk Grove Village	6,608	—	—	—	—
Elmhurst	36,991	21,273	15,458	4,594	1,728
Elmwood Park	23,866	18,801	13,689	1,380	—
Evanston	79,283	73,641	65,389	37,234	19,259
Evergreen Park	24,178	10,531	3,313	705	445
Fairfield	6,362	5,576	4,008	2,754	2,338
Flora	5,331	5,255	5,474	3,558	2,311
Forest Park	14,452	14,969	14,840	10,768	4,085
Franklin Park	18,322	8,899	3,007	914	483
Freeport	26,628	22,467	22,366	19,669	13,258
Galesburg	37,243	31,425	28,876	23,834	18,607
Geneseo	5,169	4,325	3,824	3,375	3,356
Geneva	7,646	5,139	4,101	2,803	2,446
Glencoe	10,472	6,980	6,825	3,381	1,020
Glen Ellyn	15,972	9,524	8,055	2,851	793
Glenview	18,132	6,142	2,500	760	—
Granite City	40,073	29,465	22,974	14,757	3,122
Harrisburg	9,171	10,999	11,453	7,125	2,202
Harvey	29,071	20,683	17,878	9,216	5,395
Harwood Heights	5,688	655	—	—	—
Hazel Crest	6,205	2,129	1,299	438	—
Herrin	9,474	9,331	9,352	10,986	1,559
Highland Park	25,532	16,808	14,476	6,167	2,806
Hillside	7,794	2,131	1,080	555	—
Hinsdale	12,859	8,676	7,336	4,042	2,578
Hometomn	7,479	—	—	—	—
Homewood	13,371	5,887	4,078	1,389	352
Hoopeston	6,606	5,992	5,381	5,451	3,823
Jacksonville	21,690	20,387	19,844	15,713	15,078
Jerseyville	7,420	5,792	4,809	3,839	3,517
Joliet	66,780	51,601	42,365	38,442	29,353
Kankakee	27,666	25,856	22,241	16,753	13,595
Kemanee	16,324	16,821	16,901	16,026	8,382
La Grange	15,285	12,002	10,479	6,525	3,969
La Grange Park	13,793	6,176	3,406	1,684	730
Lake Forest	10,687	7,819	6,885	3,657	2,215
Lansing	18,098	8,682	4,462	1,409	830
La Salle	11,897	12,083	12,812	11,537	10,446
Lawrenceville	5,492	6,328	6,213	5,080	1,300
Libertyville	8,560	5,425	3,930	2,125	864
Lincoln	16,890	14,362	12,752	11,882	8,962
Lincolnwood	11,744	3,072	752‡	355	—
Litchfield	7,330	7,208	7,048	6,215	5,918
Lockport	7,560	4,955	3,475	2,684	2,659
Lombard	22,561	9,817	7,075	1,331	590
Loves Park	9,086	5,366	—	—	—
Lyons	9,936	6,120	4,960	2,564	951
Macomb	12,135	10,592	8,764	6,714	5,375
Madison	6,861	7,963	7,782	4,996	1,979
Marion	11,274	10,459	9,251	9,582	2,510
Markham	11,704	2,753	1,388	—	—
Mattoon	19,088	17,547	15,827	13,552	9,622
Maywood	27,330	27,473	26,648	12,072	4,532
Melrose Park	22,291	13,366	10,933	7,147	2,592
Mendota	6,154	5,129	4,215	3,934	3,736
Metropolis	7,339	6,093	6,287	5,055	4,069
Midlothian	6,605	3,216	2,430	—	—
Moline	42,705	37,397	34,608	30,734	17,248
Monmouth	10,372	10,193	9,096	8,116	7,460
Morris	7,935	6,926	6,145	4,505	4,273
Morton	5,325	3,693	2,241	1,179	894
Morton Grove	20,533	3,926	2,010	1,079	564
Mount Carmel	8,594	8,732	6,987	7,456	4,311
Mount Prospect	18,906	4,009	1,720	349	—
Mount Vernon	15,566	15,600	14,724	9,815	5,216
Mundelein	10,526	3,189	1,328	—	—
Murphysboro	8,673	9,241	8,976	10,703	6,463
Taperville	12,933	7,013	5,272	3,830	2,629
Niles	20,393	3,587	2,168	1,258	514
Normal	13,357	9,772	6,983	5,143	3,795
Norridge	14,087	3,428	—	—	—
Northbrook	11,635	3,348	1,265	—	—
North Chicago	20,517	8,628	8,465	5,839	1,150
North Lake	12,318	4,361	—	—	—
North Riverside	7,989	3,230	1,036	—	—
Oak Lawn	27,471	8,751	3,483	489	—
Oak Park	61,093	63,529	66,015	39,858	—
Olney	8,780	8,612	7,831	4,491	4,260
Ottawa	19,408	16,957	16,005	10,816	10,588
Palatine	11,504	4,079	2,222	1,210	1,020
Pana	6,432	6,178	5,966	6,122	5,530
Paris	9,823	9,460	9,281	7,985	6,105
Park Forest	29,993	8,138	—	—	—
Park Ridge	32,659	16,602	12,063	3,383	1,340
Pekin	28,146	21,858	19,407	12,086	8,420
Peoria	103,162	111,856	105,087	76,121	56,100
Peoria Heights	7,064	5,425	4,376	1,111	309
Peru	10,460	8,653	8,983	8,869	6,863
Pontiac	8,435	8,990	9,585	6,664	4,266
Princeton	6,250	5,765	5,224	4,126	4,023
Quincy	43,793	41,450	40,469	35,978	36,252
Rantoul	22,116	6,387	2,367	1,551	1,207
Riverdale	12,008	5,840	2,865	1,166	558
River Forest	12,695	10,823	9,487	4,358	1,539
River Grove	8,464	4,839	3,301	484	333
Riverside	9,750	9,153	7,935	2,532	1,551
Robbins	7,511	4,766	1,349	431	—
Robinson	7,226	6,407	4,311	3,375	1,683
Rochelle	7,008	5,449	4,200	3,310	2,073
Rock Falls	10,261	7,983	4,987	2,927	2,176
Rockford	126,706	92,927	84,637	65,651	31,051
Rock Island	51,863	48,710	42,775	35,177	19,493
Rolling Meadows	10,879	—	—	—	—
Round Lake Beach	5,011	1,892	410	—	—
St. Charles	9,269	6,709	5,870	4,099	2,675
Salem	6,165	6,159	7,319	3,457	1,642
Schiller Park	5,687	1,384	804	390	—
Skokie	59,364	14,832‖	7,172	763	529
South Holland	10,412	3,247	2,272	1,247	766
Springfield	83,271	81,628	75,503	59,183	34,159
Spring Valley	5,371	4,916	5,010	6,493	6,214
Steger	6,432	4,358	3,369	2,304	712
Sterling	15,688	12,817	11,363	8,182	6,309
Stickney	6,239	3,317	2,446	550	—
Streator	16,868	16,469	14,930	14,779	14,079
Summit	10,374	8,957	7,043	4,019	547
Sycamore	6,961	5,912	4,702	3,602	3,653
Taylorville	8,801	9,188	8,313	5,806	4,248
Tinley Park	6,392	2,326	1,136	493	300
Urbana	27,294	22,834	14,064	10,244	5,728
Vandalia	5,537	5,471	5,288	3,316	2,665
Venice	5,380	6,226	5,454	3,895	2,450
Villa Park	20,391	8,821	7,236	854	—
Washington	5,919	4,285	2,456	1,643	1,459
Washington Park	6,601	5,840	4,523	1,516	—
Ji'atseka	5,219	4,235	3,744	2,817	2,505
Waukegan	55,719	38,946	34,241	19,226	9,426
Westchester	18,092	4,308	621	—	—
West Chicago	6,854	3,973	3,355	2,594	1,877
Western Springs	10,838	6,364	4,856	1,258	662
West Frankfort	9,027	11,384	12,383	8,478	—
Westmont	5,997	3,402	3,044	—	—
Wheaton	24,312	11,638	7,389	4,137	2,345
Wheeling	7,169	916	550	313	331
Wilmette	28,268	18,162	17,226	7,814	2,300
Winnetka	13,368	12,105	12,430	6,694	1,833
Wood River	11,694	10,190	8,197	3,476	—
Woodstock	8,897	7,192	6,123	5,523	2,502
Worth	8,196	1,472	702	240	—
Zion	11,941	8,950	6,555	5,580	—

*Populations are reported as constituted at date of each census. †Part of Champaign township annexed to Champaign city Jan. 22, 1920. Population of Champaign city, including this annexation, 16,256. ‡Lincolnwood. Name changed from Tessville in 1935. ‖Skokie. Returned in 1940 as Niles Center.

Note: Dash indicates place did not exist during reported census, or data not available.

to suppress treason, war or invasion unless approved by a vote of the people.

POPULATION

In the decade 1950–60, the over-all population of Illinois increased from 8,712,176 to 10,081,158 even though every county south of Springfield, except for counties surrounding the St. Louis, Mo. metropolitan area, and Effingham. Jackson and Massac counties, lost population. These losses were heavily concentrated in the extreme southern end of Illinois; Franklin. Gallatin, Saline, Pope, Hardin. Johnson, Pulaski and Alexander counties all had losses from 20% to 30%. The heaviest growth was in the Chicago suburbs, with Du Page county growing 102 8%, Lake up 64.0%, McHenry up 66.2%, Kendall up 44.8% and Will up 42.6%. A substantial portion of this suburban growth came from the city of Chicago, which lost 3.3% of its population. although as some moved out of Chicago, others moved in; particularly has the influx of southern Negroes been heavy. In that same decade a number of villages. some quite old, incorporated as cities. including Cahokia, Carpentersville, Morton Grove. Mount Prospect, Niles, Oak Lann, Rockdale and Westchester, as did the village of Park Forest (dating from 1940) and the newly established Rolling Meadows (see Table); all but Cahokia were in the Chicago metropolitan area.

The population of Illinois in 1810 was 12,282; in 1850 it was 851,470; in 1900, 4,821,550; in 1950, 8,712.176 and in 1960, 10,081,158. This last figure represents an increase of 16% over the population in 1950.

The population per square mile in 1960 was 178.7. as compared mith 154.5 in 1950, and with 49.7 for the U.S. in 1960. The urban population in 1960 which included. among other places, the thickly settled suburban area. or "urban fringe" adjacent to the 15 cities which had 50,000 inhabitants or more in 1960 amounted to 8,133,282 or 80 7% of the total.

The number of occupied dwelling units (or households) in 1950 was 2,585,691, as compared with 2.192.724 in 1940. The average population per household had declined from 3 6 in 1940 to 3.4 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follons: 83.4% native white; 9.0% foreign-born white; and 7 6% nonwhite, practically all Negro. (Of the foreign-born white population in 1950, 14 2% was born in Poland, 12 3% in Germany and 10.7% in Italy.) There were 98.3 males per 100 females in the 1950 population. as compared nith 100 4 in 1940. Of the population 8.7% was 65 years old or over; and 55.4% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 9.6% were engaged in agriculture, 6.7% in construction, 33 3% in manufacturing, 6.7% in transportation, 19.5% in wholesale and retail trade and 16.6% in service industries, including professional, business and personal services.

EDUCATION

Public education in Illinois had its genesis in the land of the Northwest territory reserved for educational purposes by the ordinance of 1787. The first school law. which provided for state taxation for public schools, was enacted in 1825. Only a few schools were established under this act since the section providing for taxation nas soon repealed. Free schools supported by the sale of land reserved for education and by local taxation were established as early as 1834.

A second state school law enacted in 1855 and providing for a state school tax is the foundation of the present Illinois public school system. The superintendent of public instruction was first elected in 1856. The Illinois constitution of 1870 required the legislature to provide a thorough and efficient system of public schools.

Elementary and High Schools. — The public schools are free to all betneen the ages of 6 and 21 and school attendance is compulsory for all children from 7 to 16 years of age. Between 1949 and 1959 enrollment increased by more than 500.000, to about 1,700,000; this additional school population resulted in nearly a 50% increase in the number of teachers employed.

Of the total public school funds about $\frac{3}{4}$ comes from local sources and about $\frac{1}{4}$ from state funds, exclusive of nonrevenue receipts and items of duplication. Average school expenditure per pupil (including local, state and federal as well as operations and equipment) has been rising steadily; it rose from approximately $375 in 1950 to about $600 in 1960. In the middle part of the 20th century there was an extensive consolidation of public school districts in Illinois. the number being reduced from almost 12.000 in 1945 to about 5,000 in 1950 and to about 1,700 by 1960. This consolidation was encouraged by state legislation authorizing county school surveys and limiting state financial aid to schools which could meet specific standards.

Public Universities. — In addition to the University of Illinois, the state provides for higher education at Southern Illinois university. Carbondale, and at four other state universities situated at Normal, Charleston, De Kalb and Macomb. The University of Illinois was founded in 1867 as the Illinois Industrial university, and received its present name in 1885; since 1870 it has been coeducational. The expansion of the university through the acquisition or organization of new colleges or schools began in 1896 when the Chicago College of Pharmacy became the University of Illinois school of pharmacy. Since that date important changes have been made. The university consists of colleges of agriculture, commerce, education, engineering, fine and applied arts, journalism. law, liberal arts and sciences, physical education, veterinary medicine and a graduate school; the school of social work; the institutes of aviation, government and public affairs. labour and public relations, all at Urbana; the colleges of dentistry, medicine, nursing. pharmacy and a graduate division, all at the Chicago professional campus: and an undergraduate division at Navy pier in Chicago which offers two years of work in commerce. engineering, liberal arts and sciences and physical education.

In the middle part of the 20th century the growth of Southern Illinois university, established in 1869. was rapid; in the fall quarter of 1960 the enrollment was well over 10,000, more than triple the resident student enrollment of 1953. The main campus is at Carbondale; the university also has a campus at Edwardsville and residence centres in Alton and East St. Louis. The professional schools and their date of establishment are agriculture (1955), applied science (1959), business (1956), communications (1955), fine arts (1955) and home economics (1957).

The four universities under the jurisdiction of the teachers college board are Northern Illinois university at De Kalb, established 1895; Western Illinois university at Macomb. established 1899; Eastern Illinois university at Charleston, established 1895; and Illinois State Normal university, at Normal. established 1857. Chicago Teachers college in Chicago (1869) is state supported and municipally controlled.

Private Colleges and Universities. — Illinois also has a number of distinguished private and church-related Institutions of higher learning. Among the privately endowed institutions are The University of Chicago (q.v.); Bradley university at Peoria (1896); George Williams college in Chicago (1884); Illinois Institute of Technology, Chicago. established in 1940 by merger of the Armour Institute of Technology, founded 1892, and Lewis institute, founded 1896; Rnox college at Galesburg (1836); National College of Education, Evanston (1886); Rockford college, Rockford (1847); Roosevelt university. Chicago (1945); School of the Art Institute of Chicago, Chicago (1866); and Wheaton college. Wheaton (1853). Roman Catholic colleges for women include Barat College of the Sacred Heart. Lake Forest (1904); College of St Francis, Joliet (1874); Mundelein. Chicago (1930); Rosary. River Forest (1848); and Saint Xavier. Chicago (1846). Maryknoll seminary at Glen Ellyn (1949) and St. Procopius at Lisle (1887) are Roman Catholic men's colleges; De Paul university (1898) and Loyola university (1870), both in Chicago, and Quincy college at Quincy (1860) are Roman Catholic coeducational institutions.

Institutions affiliated nith the Presbyterian Church are Blackburn college at Carlinville (1857), Illinois college at Jacksonville

(1829) (also affiliated with the Congregational Church), Lake Forest college at Lake Forest (1857). Millikin university at Decatur (1901), Monmouth college at Monmouth (1853) and McCormick Theological seminary in Chicago. Illinois Wesleyan at Bloomington (1850), MacMurray college at Jacksonville (1846) and Northwestern university at Evanston (1851) are hlethodist, as is Garrett Biblical institute, a seminary, at Evanston.

Other church-related institutions include Augustana college at Rock Island (1860), Carthage college at Carthage (1847) and Concordia Teachers college at River Forest (1864), all Lutheran; Aurora college at Aurora (1893), Advent Christian Church; Elmhurst, at Elmhurst (1865). Evangelical and Reformed Church; Greenville, at Greenville (1855), Free Methodist Church; North Central at Naperville (1861), Evangelical United Brethren; Northern Baptist Theological seminary at Chicago (1913), American Baptist convention; Olivet Nazarene at Kankakee (1907); The Principia college at Elsah (1898), for Christian Scientists; and Shimer college at Mount Carroll (1852), Episcopal. See also the various city articles.

Junior Colleges. — In addition to these four-year colleges Illinois in 1960 had 25 recognized junior colleges, 17 publicly controlled (of which 6 mere branches of the Chicago Junior college) and 8 private. Among the latter is Lincoln college, at Lincoln, founded by the Cumberland Presbyterian Church and chartered in 1865, the only college named for Abraham Lincoln in his lifetime.

HEALTH AND WELFARE

The Illinois department of public welfare supervises 26 institutions: 13 state hospitals for the mentally ill. 2 state schools for the mentally retarded, the Chicago Mental Health centre and 10 residential educational institutions. The hospitals for the mentally ill are located at Elgin, Kankakee. Jacksonville. Anna. East Moline, Peoria, Chicago, Alton, Manteno, Galesburg, Tinley Park, the Illinois Security hospital at hfenard and the Illinois State Psychiatric institute at Chicago. The two schools for the mentally retarded are at Lincoln and Dixon. In Jacksonville the state operates the Illinois School for the Deaf and the Illinois Braille and Sight Saving school; among the eight other educational and residential schools are the Illinois Soldiers' and Sailors' home at Quincy. the Soldiers' Widows' Home of Illinois at Wilmington, the Illinois Soldiers' and Sailors' Children's school at Normal and the Illinois Eye and Ear infirmary (in conjunction with the University of Illinois) at Chicago. The department of public welfare also operates 29 mental health clinics; an Institute for Juvenile Research operates 17 child guidance clinics.

The department of public safety administers the penal institutions: branches of the state penitentiary at Joliet-Stateville, Pontiac and Menard, the state farm for misdemeanants at Vandalia and the State Reformatory for Women near Dwight. In addition to these institutions for adult offenders the legislature in 1953 authorized the creation of the Illinois Youth commission to administer the handling of juvenile offenders. The Youth commission administers four institutions: the Illinois State Training School for Boys near St. Charles, the Illinois State Training School for Girls at Geneva, the Illinois Industrial School for Boys at Sheridan and the Reception and Diagnostic Center for Boys at Joliet; the commission also administers nine boys' forestry camps.

THE ECONOMY

Agriculture. — Among the more important changes which took place in Illinois agriculture during the 20 years preceding 1960 were the pronounced increase in size of farms and the accompanying decrease in number of farms. The average farm size reached 185 ac. compared to 147 ac. in 1939. This change required almost complete mechanization and constant increases in capacity of equipment. The number of Illinois farms declined 22% during this period, largely the product of consolidating farms, but due in small degree to moderate reductions in total farm land. Land in farms increased slightly in the late 1930s and early 1940s, but then started a gradual decline amounting to about 4% after 1945. Urban development and new highways took the greater part of this land. Areas adjacent to large metropolitan communities were most affected, as in Cook county where land in farms declined 35% following World War II. The number of tenants on farms increased from about 92,000 in 1930 to more than 100,000 in 1935, but since then has fallen steadily, to fewer than 92,000 in 1940, fewer than 70,000 in 1950 and fewer than 60.000 in 1960.

Cereals are the main crop and corn (maize) is the leading product. The largest corn crop on record up to 1960 was that of 1959, when 673,350,000 bu mere produced from 10.050.000 ac. Illinois is also an important soybean-producing state and produces important quantities of wheat, oats, rye. barley and sweet corn for canning Apples, peaches, strawberries, cherries, plums and other fruits are grown. The state also ranks high in the production of milk, chickens (including commercial broilers), eggs, cows and heifers two years old and over (milk cows) and ranks very high in the number of hogs. Sheep. horses and mules are of minor importance as compared with other states. Thirteen Illinois counties ranked among the 100 leading U.S. counties in the value of all farm products sold in 1954: McLean, De Kalb, La Salle. Iroquois, Livingston, Champaign, Henry, Bureau, Ogle, Kane. Vermilion, Whiteside and Lee.

Industry. — The growth of manufacturing in Illinois, largely because of the development of the state's exceptional transportation facilities, nas the most rapid and remarkable in the industrial history of the United States. In 1850 the state ranked 15th; in 1870. 6th; in 1880, 4th; and by 1900 had become 3rd, but by 1960 had dropped back to 4th behind New York, Ohio and Pennsylvania. In 1904 the value added by process of manufacture was $570,285,000. In 1919, just after World War I, it was $1,929,-125,000; in 1937 it reached $2,319,036,000; in 1947, $6,683,-083.000; and in 1957, $12,363,458.000.

Illinois ranks high in the meat-packing industry, producing about 10% of the U.S. total in 1954. Manufacture of iron and steel products and of products depending on iron and steel as raw material is first in importance among Illinois industries. representing more than 50% of all Illinois manufacturing. The iron for these industries is secured from the Lake Superior region, the limestone and much of the coal from mines within the state. The position of Illinois in the heart of the agricultural section and its easy access to a bountiful supply of iron caused the state to become the chief producer of agricultural implements. The most important industries in terms of value added by manufacturing are machinery, food and kindred products, electrical machinery, fabricated metal products. primary metal industries, printing and publishing, chemical and allied products, transportation equipment, instruments and related products and stone, clay and glass products.

Chicago. with its tributary manufacturing suburbs of Maywood, Harvey, Cicero, Blue Island, Chicago Heights and others in Illinois. and Hammond and Gary in Indiana, is the great manufacturing centre of the state. A lesser manufacturing area grew up in the railway network that centres at East St. Louis, Collinsville, Granite City and Edwardsville; a third centre is formed by Moline, East Moline, Rock Island and Davenport, Ia. Rockford is best known for its furniture manufactures, Kewanee for boilers, Elgin for watches, Decatur for its corn products industry, Moline, Peoria and Springfield for agricultural and road equipment and Peoria for its distilleries.

Mining. — In mining and allied interests Illinois occupies an important place. The state ranks among the top ten both in the number of persons engaged in the mining industries and in the value of products mined. In addition, large quantities of minerals are imported into the state for processing. Coal constitutes the chief mineral product. The Illinois coal field. as a part of the eastern interior field, extends into Indiana and western Kentucky. At least 70% of this field lies in Illinois from the latitude of Rock Island south to the Illinois Ozarks. It covers more than 55 counties and approximately 35,000 sq mi. of the land surface of the state. The number of mines and miners has been declining for nearly 40 years, the quality of the coal and the expansion in the use of other fuels being the basic cause for the decline. The peak year was 1918 nith 89,979,500 short tons being mined. Petroleum, the mineral second in importance, was long known to exist in the state

but was not seriously exploited until 1906, when the annual production reached 4,397,050 bbl. (42 gal.). The peak production year was 1940, a total of 147,647.000 bbl. being produced that year. In the second half of the 20th century annual production was about 80,000,000 bbl. from 32,000 producing wells. The producing area covers about 16,000 sq.mi. in the southern portion of the state. Clay products also are important. Limestone, dolomite, lime. cement, sand, gravel, tripoli, lead and zinc are other leading products. The quarrying industries are well distributed throughout the state and furnish not only stone for construction work but also limestone for agricultural purposes; the state is also a major producer of silica sand. Illinois has ranked as the leading state since 1842 in the production of fluorspar.

Finance.—All general banking laws must be submitted to the people for ratification. Northern Illinois is in the 7th federal reserve district, with headquarters in Chicago, and the southern part in the 8th, with headquarters in St. Louis. Although Chicago is the banking and financial centre of the state the rest of Illinois is well served by a full range of national and state banks and other financial institutions. The system of state banks created by the act of 1887 operated under the supervision of the auditor of public accounts until 1957. In that year state banks, credit unions and similar organizations were placed under the supervision of the newly created department of financial institutions.

Transportation.— Transportation facilities have been an important factor in the economic development of Illinois. The first settlers used the waterways, some coming by way of the Great Lakes while others used the Ohio river. The first improved transportation facilities were the turnpikes and canals, undertaken in whole or in part by the state. The task of connecting Lake Michigan and the Mississippi river was accomplished by the state's building the Illinois and Michigan canal to La Salle, at the head of the navigation on the Illinois river, a work begun in 1836 and completed in 1848. In 1890 the sanitary district of Chicago undertook the construction of a canal between Chicago and Lockport, where the new canal joined the Illinois and Michigan canal. This work was opened in 1900, providing a waterway with a depth of 20 ft. for navigation between the above places; but from Lockport to Utica, on the Illinois river, a distance of 62 mi., there was no adequate means of water transportation. A legislative act of 1919 provided for the issue of bonds to the amount of $20,000,000 for the construction of an 8-ft. channel, the Illinois waterway, connecting the points mentioned. The bond issue was insufficient to complete the waterway, and the federal government in 1930 completed the original Lockport-to-Utica portion and extended the improvement from Ctica to the mouth of the Illinois river. This improved waterway was opened to navigation in 1933. The federal government also had completed in 1907 the Illinois and Mississippi canal from Hennepin to the Mississippi river near Rock Island. Of these waterways, the Illinois and Michigan and the Illinois and Mississippi canals were little used by 1950. The Illinois waterway, however, experienced a substantial increase in tonnage. Fully opened to navigation in 1935, it carried a tonnage of 1,695,120 that year; annual tonnage reached 12,000,000 by 1950 and more than 24,000,000 by 1960. The completion of the St. Lawrence seaway greatly stimulated the expansion of the deep-water port of Chicago (*q.v.*).

Railways are a major means of transportation, although motor bus, truck and airlines have made heavy inroads into this field since 1930. With 11,349 mi. of railroads (steam, diesel and electric), Illinois in 1960 was second only to Texas. The most striking development in rail transportation in the 1940–60 era was the rapid replacement of steam locomotives with diesel electric locomotives. Between 1920 and 1960 little new mainline road was built and about 1,500 mi. of branch lines, including more than 150 mi. of electric railroad, were abandoned.

Civil aviation continued to develop in Illinois: in 1940 there were about 50 airports, 1,300 pilots, less than 1,000 private aircraft; in 1950 there were more than 150 certified airports, almost 10,000 registered pilots, more than 3,500 private aircraft; by 1960, there were about 125 public airports and more than 500 private landing strips, almost 14,000 registered pilots and almost 4,000 private aircraft. Through the department of aeronautics the state assists in developing public airports and conducts extensive air safety programs. Numerous airlines serve Illinois with scheduled service and a dozen Illinois cities are served by one or more airlines. In 1949 helicopter airmail service was inaugurated to suburbs in the Chicago metropolitan area; the Chicago Midway airport annually has had more departing and arriving aircraft than does any other U.S. airport.

The improvement of roads in the state of Illinois has been given marked attention. A state highway commission was created in 1905, and in 1914 state appropriations for hard roads were made from the proceeds of automobile licence fees. Actual construction was begun in 1914. Road building in Illinois is carried on under four distinct systems—the township, the county, the state and the city.

Acts of congress in 1916 and 1919, apportioning federal aid in behalf of roads, allotted Illinois $3,300.000 and $8,700,000, respectively. The question of issuing $60,000,000 in bonds based on automobile licence fees for the construction of 4,800 mi. of hard roads was submitted to the voters of the state in Nov. 1918 and was approved by them. A bond issue of $100,000,000 providing for the continuance of a state-wide system of hard-surface roads was approved by the people at the general election of 1924. In 1960 the state maintained about 14,500 mi. of highways of which about 13,000 were primary highways.

See also Index references under "Illinois" in the Index volume.

BIBLIOGRAPHY.—There is no comprehensive bibliography of the literature which relates to Illinois. Perhaps most useful is *A Handbook of Illinois History* by Paul M. Angle and Richard L. Beyer (1943).

The best general history of the state is the 5 vol. work edited by C. W. Alvord, *The Centennial History of Illinois* (1918–20). This work consists of: vol. i, C. W. Alvord, *The Illinois Country, 1673–1818;* vol. ii, T. C. Pease, *The Frontier State, 1818–1848;* vol. iii, A. C. Cole, *The Era of the Civil War, 1848–1870;* vol. iv, E. L. Bogart and C. Xl. Thompson, *The Industrial State, 1870–1893;* vol. v, E. L. Bogart and J. M. Mathews, *The Modern Commonwealth, 1893–1918.* An introductory volume to this work is Solon J. Buck, *Illinois itz 1818* (1917). Older standard histories which are still valuable are John Moses, *Illinois, Historical and Statistical,* 2 vol., 2nd ed. (1895); A. Davidson and B. Stuve, *Complete History of Illinois from 7673 to 1873* (1871); N. Bateman and P. Selby, *Historical Encyclopedia of Illinois* (1901). The best one-volume history is T. C. Pease, *The Story of Illinois,* rev. ed. (1949) and the Writers' Program, Illinois, *Illinois,* rev. ed. (1917) is also excellent. A picture history is James Monaghan, *This Is Illinois* (1919).

Much basic material about the state may be found in the *Journal of the Illinois State Historical Society* as well as its *Transactions* and *Occasional Publications;* the *Illinois Historical Collections;* and the University oi Illinois, *Studies in the Social Sciences.* The *Blue Book of the State of Illinois,* edited and published by the secretary of state every two years, is the best source of current information about state government and officials.

Information on the following special subjects may be found in the references named: banking: F. M. Huston, *Financing an Empire: History of Banking in Illinois, 4* vol. (1926); geography: D. C. Ridgley, *Geography of Illinois* (1921); constitution and government: E. Anthony, *Constitutional History of Illinois* (1891), N. F. Garvey, *The Government and Administration of Illinois* (1959), S. K. Gove *et al.* (eds.), *State and Local Government in Illinois: a Bibliography* (1953), D. W. Lusk, *Politics and Politicians of Illinois* (1886); labour: E. R. Beckner, *A History of Labor Legislation in Illinois* (1929), E. Staley, *History of the Illinois State Federation of Labor* (1930); slavery: N. D. Harris, *History of Negro Servitude in Illinois* (1904); southern Illinois: P. M. Angle, *Bloody Williamson* (1952), B. Brownell, *The Other Illinois* (1958), C. Colby, *A Pilot Study of Southern Illinois* (1956); transportation: C. J. Corliss, *Trails to Rails, a Story of Transportation Progress in Illinois* (1937), P. W. Gates. *The Illinois Central Railroad and Its Colonization Work,* Harvard Economic Studies, vol. 42 (1934).

Current statistics on production, employment, industry, etc., may be obtained irom the pertinent state departments; the principal figures, together with the current history, are summarized annually in the *Britannica Book of the Year,* American edition. (C. C. W.)

ILLINOIS, UNIVERSITY OF, an institution of higher learning in Urbana, Ill., was chartered as a land-grant college in Feb. 1867. See ILLINOIS: Education.

ILLITERACY. Illiteracy has usually been loosely defined in the past as inability to read and write. Since the discovery of methods of manufacturing paper and the invention of the printing press in the 15th century, illiteracy has declined at a more or

less constantly increasing rate. By the end of the first decade of the 20th century, it had been largely eliminated in most countries of western Europe, in the major part of North America and in a few other areas of the world. but it was still widespread in Asia and Africa.

Extent of **Illiteracy.**—In *World Illiteracy at Mid-Century*. a report covering all areas of the world published in 1957 by the Cnited Nations Educational, Scientific and Cultural organization (UNESCO), an effort was made to determine the extent of illiteracy among individuals 15 years of age and older; a summary of the findings appears in the table. When the data submitted did not cover the age specified. estimates were made through the use of general population data. Unfortunately the percentages reported are not comparable in all cases, due to the use of diverse sources of data and varying standards of lireracy, but the report provides the most comprehensive information available and the findings are highly significant.

Estimated Population and Extent of Illiteracy in the World at Mid-20th Century, by Coatinents and Regions

Continent and region	Estimated population (in 000,000)		Estimated extent of illiteracy	
	Total (all ages)	Adult (15 years old and over)	Per cent of adult illiteracy	Number of adult illiterates (in 000,000)
World total	2,496	1587	43–15	690–720
Africa	198		80–85	9 8 – 1
Northern Africa	65	1	85–90	'34–36
Tropical and Southern Africa	134	80	80–85	61–68
America	330	223	20–21	45–47
Northern America	168	126	3–4	4–5
Middle America	51	30	40–42	12–13
South America	111	67	42–44	28–29
Asia	1,376	830	60–65	510–540
Southwest Asia	62	37	75–80	28–30
South Central Asia	466	287	80–85	230–240
South East Asia	17.1	102	65–70	68–72
East Asia	677	404	45–50	180–200
Europe	393	293	7–9	22–25
Northern and Western Europe	133	102	1–2	1–2
Central Europe	128	96	2–3	2–3
Southern Europe	131	95	20–21	19–20
Oceania	13	9	10–11	1
U.S.S.R.	186	112	5–10	6–1

Frqm *World Illiteracy at Mid-Century*, published by USESCO, Paris (1957): used by permission.

The striking fact revealed, even when minimal standards were generally used, is that from 43% to 45% of the adult population of the world. or approximately 700,000,000 persons, are wholly illiterate. About 75% of the world's illiterate population lives in Asia, about 14% or 15% in Africa, about 6 5% in the Americas and the remaining 4% or 5% in Europe, Oceania and the U.S S.R. The largest number of illiterates are found in south central and east Asia and the highest percentages occur in Africa and in south central and southwest Asia.

According to the UNESCO report, the countries and other areas of the world having the least illiteracy were: 1% to 2%, St. Helena (Africa), Greenland, Austria. Channel Islands, Denmark, Faeroe Island, Finland. Germany, Iceland, Ireland. Isle of Man, Liechtenstein, Netherlands. Norway, Saar. Sweden, Switzerland, United Kingdom. Australia and New Zealand; 2% to 3%, Japan, Czechoslovakia and Canada; 3% to 4%, United States. Bermuda. Belgium and France. The countries having the greatest extent of illiteracy (95% to 99%) were Angola. British Somaliland. Eritrea, Ethiopia. French Equatorial Africa. French Somaliland, French West Africa, Mozambique, Réunion. South-West Africa and Spanish West Africa. Aden Protectorate, Afghanistan, Bhutan, Muscat and Oman, Nepal, Portuguese Timor, Saudi Arabia, Trucial Oman and Yemen

Functional Literacy.— The use of "minimal" standards of literacy—at the lowest end of the scale, mere ability to read and write one's name—served a valuable purpose for many generations. In the course of time, however. it became apparent that limited ability to read and write does not qualify adults to use reading and writing effectively in meeting many of the practical needs of daily life. To designate the higher level of competence required, the term "functional literacy" was proposed and has been used widely since. During its early use a functionally literate person was defined as one who is able to read and write as well as children who have had four full years of schooling.

With the adoption of this concept countries began to discontinue the use of traditional literacy tests when taking censuses and secured instead statements concerning the extent of schooling, a practice begun by the United States in 1940. This plan is supported by research which shows that there is a reasonably close correspondence, on the average, between last school grade attended and reading competence. Estimates of illiteracy are considerably increased when a higher level of reading ability is adopted as a standard. Using the 1950 census as a basis. Ambrose Caliver of the U.S. office of education calculated the percentage of adults in the United States 25 years of age and above nho had received less than five years of schooling. His findings for the country as a whole showed that 11% of the adults in the United States were not functionally literate by that standard. The range of states was from 3.9% in Iowa to 28 7% in Louisiana. By the same standard about 55% of the population of the world 15 years of age and older is functionally illiterate.

Further adjustments in literacy standards may be desirable, for two reasons. First, such groups as army officials, directors of industrial and cominercial organizations and members of national literacy conferences have criticized fourth-grade standards as wholly inadequate to meet contemporary needs; for example, the U.S. census for 1940 showed only 4% of the population to be illiterate, yet during World War II the U.S. Armed Forces institute found it necessary to establish a literacy training program. These groups recommended as a minimum sixth- or eighth-grade, or even higher, standards. On the other hand a uniform level of literacy is not equally appropriate for all areas of the world. Thus a person may be defined as functionally literate "when he has acquired the knowledge and skills in reading and writing which enable him to engage effectively in all those activities in which literacy is normally assumed in his culture or group." (*The Teaching of Reading and Writing: An International Study*, by William S. Gray, page 24. UNESCO. Paris. 1956.)

Reduction of Illiteracy.— In the 20th century. and particularly after World War II, efforts to eliminate illiteracy were greatly accelerated. The movement was stimulated by the urgent need for broader understanding among citizens of newly established nations, particularly those where suffrage was being widely extended. and by the problems posed by technological and economic developments. National literacy campaigns were carried on with great vigour; those in Turkey, the U.S.S.R. and China were particularly notable. In some countries orthographic and other reforms mere introduced (*see*, for example, TURKISH LANGCAGE) and in almost all countries the system of elementary education was enlarged. Paralleling these developments new approaches to literacy training were developed among groups which had previously been deprived of such opportunities. Among the leaders in this effort were James Y. C. Yen of China, Lorenco Filho in Brazil, Jaime Torres Bodet in Mexico and Frank Laubach, an American-born missionary. In addition to its promotional activities, USESCO has conducted certain practical programs in collaboration with its member states. Two important ones are the International training centres: the Arab States Fundamental Education centre (ASFEC) in Egypt, serving the Arab states of the middle east and the Regional Training Centre for Teachers of Fundamental Education (CREFAL) in Mexico, serving all of Latin America.

The influence of the foregoing developments on methods of teaching adults to read has been very significant. Prior to 1950 highly specialized methods of two general types were used widely in achieving the limited goals sought. One type was synthetic in character and began by teaching the sounds of letters nhich were then used in the recognition of new nords. The other type was analytic in character and began by teaching whole words which were later used in identifying the sounds of letters. As the concept of functional literacy emerged. the view spread that good teaching should cultivate a thoughtful reading attitude, a clear grasp of meaning and interest in independent reading as well as the skills of word recognition.

When a world-wide study of methods of teaching adults to read

was made for USESCO between 1952 and 1955 it was found that they still differed nidely in character. They varied from the formal use of synthetic or analytic methods to broadly conceived programs of teaching which emphasized all the interests, attitudes and skills essential on the part of a good reader. A detailed study of the relative merits of the different methods used revealed the following facts: (1) that no single, highly specialized method secures superior results; (2) that the use of a given method promotes growth in whatever aspect of reading it emphasizes, such as skill in word recognition or a clear grasp of meaning: and (3) that best results are assured when the methods used emphasize all essential aspects of reading.

Stimulated by the results of the UNESCO study, and other reports, wide experimentation was undertaken in various parts of the world to develop improved programs of teaching. Resulting trends were well illustrated by the findings of a study of primers printed in 30 languages and used in six countries of the Americas The outstanding finding was not the diversity but the uniformity of methods Almost without exception the primers were eclectic in nature. even though based on different approaches. The essential principles of primer construction, as demonstrated by field testing, are the gradual introduction of new elements and provision for growth in ability to read independently, to understand what is read and to read fluently. Although methods of developing word recognition must of necessity vary nith the nature of the language involved, the foregoing report indicated progress toward the establishment of sound patterns of literacy teaching.

Reference should be made also to experimental use of television as an aid in reducing illiteracy. Beginning about 1958 the Foundation for World Literacy, sponsored by the Memphis (Tenn) Chamber of Commerce began the use of telecasts based on materials prepared by Laubach. Measures of the progress made during a year showed that those who learned with reasonable ease or had previously made some progress in learning to read profited from the instruction thus provided. Those who learned less rapidly were unable to keep up with the work and discontinued their efforts. The experiment showed that the use of television might be of great value in the fight against illiteracy, but much experimentation was needed in order to learn how it might be used most effectively either alone or in co-ordination with other modes of instruction

As the requirements for literacy have expanded, short-term course- nhich nere formerly given to meet "minimal" standards have been greatly modified and enriched Of great importance also is the fact that they are being extended to enable motivated and capable illiterate adults to gain admission to the regularly established educational institutions of a country, thus facilitating upward intellectual and cultural mobility.

See also ADULT EDUCATION; READING

BIBLIOGRAPHY —UNESCO publications include: *World Survey of Education* (1950), *World Illiteracy at Mid-Century* (1957) and *The Teaching of Reading and Writing: An International Survey* (1956) *See,* in *Yearbooks* of the National Society for the Study of Education, "How Well Do Adults Read," *Adult Reading* (1956), "World Literacy Its Status and Problems," *Community Education: Principles and Practices from World-Wide Experiences* (1959), and *Fundamental and Adult Education,* xi, no 2 and no 3 (1959) *See* also *Report on the Situation in America as to Illiteracy,* published by the Committee for Cultural Action of the Inter-.American Council, Pan American Union (1957) (W. S GY.)

ILLUMINATED MANUSCRIPTS. Illumination in art, is a term applied to the embellishment of written or printed text or design with colours or gold and, rarely, with silver. The old form of the verb "to illuminate" was "to enlumine," and 13th-century laymen nho practised the art were called "enlumineurs." While the term should be strictly applied to the brilliant book-ornamentation which was developed in the middle ages, it has been extended. by usage. to the illustration and decoration of early manuscripts in general.

The decisive changes in the history of the book are similarly turning points in the art of illumination. (*See* BOOKS) The production of precious illuminated manuscripts survived the introduction of printing by nearly a century. So far as is known, the art of decorating manuscripts did not create new forms through a development based on writing, but rather it took over pictures and ornaments from other forms of art. The written pages at first were simple and unadorned; even where the parchment was coloured and the writing in silver or gold; then simple enlarged initial letters and calligraphic ornament appeared. In the codices there were richly adorned title pages and brilliant displays of ornament in the canon tables of Gospel manuscripts. The form and position of the pictures vary exceedingly. Sometimes the illustrations are placed haphazard in the picture borders, in the text or as framed pictures in the text. They may also occupy full pages, or they may be in the form of a running band in the codex above or below the text or, in the roll, they may run in a continuous series of pictures from end to end.

Ancient. — The small amount surviving from the first great period in the history of illumination, which lasted until about the 4th century, consists of numerous fragments of papyrus rolls. Such fragments include the ancient Egyptian Book of *the Dead,* in which the illustrations are either dashing drawings or coloured pictures. The only illustrated rolls of the classical period are fragmentary examples found in Egyptian excavations, and knowledge of this period, as a whole, is very slight. The most ancient and important of these are the fragmentary copy of the *Iliad,* on vellum in the Ambrosiana library, Milan, with 58 pictures of various sizes, obviously the remains of a magnificent manuscript; the small Virgil at the Vatican (Lat. 3,22j; 4th century) with pictures set off in a simple frame and inserted in the text, all of which are considered to have been based on Augustan models; and another Virgil at the Vatican (Codex Romanus, Lat. 3,867).

Early Christian. — Christian illumination dates from the times of the few early profane illuminated manuscripts which are still extant. The number of ancient Christian illuminated manuscripts in Greek or in oriental languages is very small. (*See* BIBLE.)

Among illuminated theological or profane manuscripts which survive in the original, the most important is a medical treatise, the Dioscorides (early 6th century), in Vienna. Few of the manuscripts are dated and localized. Many manuscripts important to early Christian art are preserved only in medieval copies; even those actually written in early Christian times may be merely copies. This is why the Vienna Genesis (Vienna State library), made up of various series of illuminations, is closely allied to the Codex Rossanensis (Rossano, Italy) which belongs to another stage in the development of the style. The style was determined mainly by paintings of late antiquity based on Hellenistic models influenced by indigenous art (Coptic. Syrian and others).

Byzantine. — The development in Byzantium cannot be traced clearly until after the iconoclastic controversy. As art flourished again the works of the Byzantine Renaissance. as it is called, began to be produced. To this renaissance belong those codices which hand on works of late antique or early Christian times, partly in accurate copies, partly in free imitations (Joshua Roll, Kosmas Indikopleustes in the Vatican library), Psalters like that at Paris (Bibliothèque Nationale Manuscript Grec. 139). On the other hand, typical middle Byzantine art modeled its style on monumental art.

Although Constantinople decided the trend of artistic production, illumination was also cultivated outside the capital. As practised in the monasteries of Athos, its importance was far-reaching. From the 11th century a school of miniaturists developed in Russia, the works of which are, at first, scarcely to be distinguished from those of Byzantium. The menology at the Vatican is the only Byzantine manuscript in which each miniature is signed by the artist. The style in the later works, and especially in the productions of the monasteries, became dry, but it persisted through the Latin conquest (1204–61), and was capable of a rebirth after the restoration of the empire under the Palaeologues (1261).

Western.—Few early Christian illuminated manuscripts of western origin have survived. A comparison between the Quedlinberg Itala fragment at Berlin (State library) of this period and the Virgil of the Vatican (Lat. 3,225) proves that the scriptoria which produced the latter also executed Christian illuminated manuscripts. The affinity between the two is extraordinary. The style

is clear and simple in character; the pictorial conception gives evidence of naturalness and is without a trace of the Byzantine spirit.

The most important original manuscript is St. Augustine's Gospels at Corpus Christi. Cambridge (Nr. 286), which was probably executed in lower Italy. The Ashburnham Pentateuch at the Bibliothèque Nationale is of a different type; its 19 miniatures are stylistically and iconographically unique and indicate a connection with oriental models. These manuscripts bear witness to a survival of late antique and early Christian art in the vest. By comparison, the mass of the manuscripts produced in the monasteries of the Frank and Lombard kingdoms in the 7th and 8th centuries have quite a different character. Among the large number preserved only a few have figurative representations. Illuminated Bibles or Gospels are scarce. Ornament, in general. is restricted to initials and decorated pages, a method of embellishment based on the art of the scribe, not of the painter. Compared with the simplicity of the text in late antique manuscripts. it is a complete revolution. Part of the material originated in upper Italy and south France, apparently in the early 7th century. Later, the art was transplanted to central and northern France. The majority of the manuscripts, and especially those richest in decoration, came from north France in the latter half of the 8th century, *i.e.*, not until the Irish and Anglo-Saxon arts of illumination were already highly developed.

In Britain two fundamentally different tendencies must be distinguished, the Irish and the English. The development in England was determined by the Roman mission and by the close relations kept up between the Italo-Saxon churches and monasteries and Rome itself. In the 8th century, from which period a series of splendid manuscripts have survived, artists endeavoured to continue the early Christian figurative tradition in stiffly outlined forms, and at the same time displayed rich decorative splendour in the Irish fashion. The most important works of the Canterbury school are St. Augustine's Psalter with a portrait of David (British museum) and the Codex Aureus in Stockholm (Royal Library Manuscript A35).

Irish.—In spite of Ireland's numerous contacts with England, Irish illumination is unique. It is one of the most interesting phenomena in the whole range of medieval art. In the art of illumination it represents, perhaps, a climax never again reached. It is the more remarkable in that it suddenly appears fully developed, without any preliminary stages and with no source to which it can be traced. The three chief Irish works are the Book of Durrow (Dublin, Trinity college, A. 4, 5), the Book of Kells (ibid. A. 1, 6) and the Lindisfarne Gospels (British Museum Cotton. Nero D. IV). The Book of Durrow (c. 700) is pure Irish in style. The Book of Kells (for which the date 700 has been disputed in favour of a later period) shows traces of foreign ornamental ideas. The Lindisfarne Gospels (written soon after 700) have pictures of the evangelists that are not Irish in style, which implies the influence of the Italo-Saxon monasteries. Irish artists did not attempt naturalistic representation but made the figures of a picture as free as if they were calligraphic designs. so that it is often difficult to see what these plaited figures really mean. This antinaturalistic method of representation stands in sharp contrast to the whole range of classical antique art in all its derivations. Irish manuscripts show a richness of decoration unparalleled. so far as is known, up to that time. The various Gospels are preceded by whole pages with carpetlike designs and the initials at the beginning of the text grow and spread until they, too, cover the whole page.

Carolingian.—Simultaneously with the reform of writing, a project of Charlemagne, there arose a number of new schools of painting which aimed at restoring the connection with antique and early Christian art. The chief works probably were not created before the beginning of the 9th century. They include the Gospel book of Ada (?Charlemagne's sister) at Trier (Municipal Library Manuscript 22), after which all these works are called the Ada group; the group was produced at the Palatine school of Aix-la-Chapelle. These manuscripts include rich canon tables, pictures of the evangelists and of their symbols under large arcades, symbolic representations of the church, the fountain of life, etc. Obviously there is an ancient pictorial tradition, which can be traced on one side to Syria and on the other to Italy and England. The colouring is varied and splendid, the figures dramatic in movement, the faces fine and full of expression and the outlines of the figures rich in style. On the whole, the treatment, with its sharp and clear outlining of form, shows more of the spirit of drawing than of painting. All this points to models of high artistic importance.

In decided stylistic contrast to the Ada group are other manuscripts issuing from the Palatine school of Aix-la-Chapelle. Its chief work, the Gospel book of Charlemagne, is preserved among the crown treasures at Vienna. The treatment is altogether pictorial; the colouring is fine, simple and not too varied. The plain style of embellishment, with the greatness of conception in the figures and the soft pictorial treatment, point to early Christian models. This tendency is continued chiefly in the school of Reims, where a Gospel book at Epernay town library was made for Ebbo of Reims (816–35). There are significant changes of style however; the broad pictorial technique has made room for a hatched treatment, which has led to the supposition that the artist was accustomed to using a drawing pen. The style is that of the Utrecht Psalter, which has great affinity with later Anglo-Saxon work, and which subsequently exercised a strong influence on development in England. The Utrecht Psalter (Utrecht University library) is at once the most magnificent and the strangest production of Carolingian art. The composition with landscape like stage scenery is reminiscent of early Christian models. Without a doubt, the Utrecht Psalter has some connection with early Christian art. Nevertheless, it is essentially a creation of Carolingian times. The school of Tours was at its prime toward the middle of the 9th century under the lay abbot Count Vivian. The Gospel book destined for the emperor Lothaire is the most important work (Bibliothèque Nationale Lat. 266). The Tours manuscripts took from early Christian models a large number of Bible illustrations and introduced them into medieval art. A quite distinctive style marks the works of the Franco-Saxon school. It shows, unmistakably, a continuation of the Irish and Hiberno-Saxon school enriched by Carolingian elements. Its strength is based entirely on ornament and it is notable for having spread the art of the initial as developed in England and Ireland.

Anglo-Saxon.—Anglo-Saxon illumination began to flourish once more under King Edgar (c. 960). The new style, based on Carolingian art, suddenly made its appearance completely developed in the works of the Winchester school. It is one of the most original and attractive in the whole range of medieval art. The artist was not satisfied with normal movements of the neck or head, so the line of the neck is unnaturally prolonged and curved; the draperies appear as if driven by a gale of wind, and end in fluttering points; the seams are broken into numberless small folds. From the standpoint of correctness, fault might be found with these figures, but as the expression of immense spiritual force they excite wonder. Anglo-Saxon art, too, reaches its climax when it dispenses with painting in thick colours and contents itself with sketchlike drawings, which may be tinted with various light colours. The chief work of the early period is the Benedictional which Bishop Aethelwold (963–984) caused to be written by the scribe Godeman (British museum).

One of the most important seats of Anglo-Saxon art was at Canterbury. A copy of the Utrecht Psalter (British Museum Harley 603) is supposed to have been executed there. More than three hands worked at it. so it must have been made in a large scriptorium. The Anglo-Saxon style remained full of life until the middle of the 11th century. It was not confined to England; during the 10th century it crossed the channel to France, where the style appears in many works in such freshness and spontaneity that it seems likely that Anglo-Saxon artists had emigrated to there. Of this type is the Evangeliar (Boulogne library, No. 11) written at the Abbey of St. Bertin. In northern France, side by side with the illuminations influenced by the Anglo-Saxons, other manuscripts were created which are independent in style and full of intense expression.

Ottonian.—The Ottonian Renaissance flourished in Germany during the 11th century, about the same time as the Winchester school. Its political background was the renewal of the Holy Roman empire by Otto I. Within a few decades an almost inconceivable abundance of magnificent manuscripts was produced, which can be allotted to a number of different schools. These schools differ exceedingly in character, according to whether the artists used Carolingian or early Christian models. Middle Byzantine art, too, begins to exercise influence at this period. Most pictures in the Ottonian manuscripts spring from these sources. All the schools, however, were very creative in ornament. They used whole page illuminations with purple ground and richly formed initials of golden foliated branch work, similar to those found occasionally in Carolingian times, especially in the Metz school. In all schools of the Ottonian period, painting with thick colours prevails. In the works of the golden age of Ottonian art the intention to approach the illusionistic conception of the late antique is noticeable. But these endeavours were soon frustrated, and at the beginning of the 11th century decline set in. The painting became more medieval in character, the background of the pictures being divided up by ornamental and coloured stripes, for which the Byzantine gold background was occasionally substituted. The most prominent centres of artistic activity were the monasteries of Reichenau, situated on an island in Lake Constance, Trèves, Cologne, Hildesheim, Corvey, Fulda and Ratisbon.

Romanesque.—Illumination at the middle of the 11th century was at a turning point. Anglo-Saxon schools and the German Ottonian Renaissance were dying out, and so the connection with antique painting disappeared. From then onward in the whole of the west the style was based on linear, not pictorially treated, outline drawing, in which colour was used to tint the surfaces in the flat, with only slight modeling of forms. Art abandoned the last reminiscences of the illusionistic manner of the late antique, in which the picture was based on a reality either seen or visualized. The medieval style, which then established itself, dispensed with illusion, and gave the different components of the pictures, *i.e.*, the figures and whatever else was necessary to understand the action, but released them from contact with natural space. Even the background had a chiefly ornamental importance. The gold ground became more and more popular; borders and backgrounds consisting of a system of frames were also used. This manner of representation permitted the artist to pack the most complicated ideas into a picture and create the corresponding frame to hold the conceptions together. This tendency completely dominated the art of illustration. A counter movement was Byzantine art, which never altogether lost contact with the antique, preserving formulas from the illusionistic age. In the 12th and 13th centuries Byzantine influence penetrated farther and farther into Italy and obtained a strong hold in Germany.

In the west of Europe, especially in northern France, in Burgundy and in England, Byzantine influence may also be traced. Stained glass, with all its beauty of colour, is also based on outline drawing. rather than real modeling. It had an extremely strong influence on the method of painting, described above, in which numerous figurative representations were combined within a system of frames. In the 12th and, especially, the 13th centuries, many illuminated manuscripts show traces of having been imitated from stained glass.

Anglo-Norman.—Soon after 1100 Anglo-Norman scriptoria were at the height of their power. Their productions were chiefly enormous Bibles, separate books of the Bible with commentaries and especially the Psalter. The style abandoned the lightness of Anglo-Saxon times. It was based on stiff linear designs filled with opaque pigmepts of harsh colour. The figures mere, especially early in the 12th century, heavy and awkward. A little later the style became more spirited. The initial ornaments were astonishingly rich in invention and design, enlivened with numerous fantastic forms of men and animals in strange colours.

Bury St. Edmunds produced the first of the large Bibles so characteristic of the 12th century. Winchester again became, about the middle of the 12th century, the seat of an important school.

The wave of Byzantine art had reached England also and the deeply agitated style with its singular types was replaced by an almost classical conception of art. The chief work of this tendency is the M'inchester Psalter of the British museum. Well-proportioned forms of measured placidity and solemnity of movement are characteristic of these pictures. Of the greatest importance is the latest copy of the Utrecht Psalter (Bibliothbque Nationale Lat. 8846).

Continental.—Knowledge of the history of miniature in France is altogether much slighter than that of England. The quick rise and decline of an important scriptorium at Cîteaux, the founder of which mas Abbot Stephen Harding, is known. Numerous manuscripts with most peculiar decoration, especially initial letters of quite fantastic formation, emanate from Limoges and western France. The productions of monasteries in Belgium and northern France are extraordinarily numerous. Many of these are dated and indicate the names of the artists. In the eastern part of this territory, a style approaching the Rhenish predominated, while toward the west, where the narrowness of the straits provided a natural connection with England, the Anglo-Norman affinities already mentioned made their appearance.

In these districts, also, the presence of a strong Byzantine influence in the critical period around 1200 can be established.

In Germany the development of art, after the Ottonian Renaissance, varied in the different territories. In the southeast, the Middle Byzantine influence, already perceptible in the early 11th century, became permanent.

In the western and northern districts of Germany, Byzantine influence was not so powerful in the 12th century. One work, however, the famous Hortus Deliciarum of the abbess Merrad of Landsberg in Alsace was unique for the unusual illuminations it contained. (The original perished in 1870.) Pure pen drawing had become prevalent. On the lower Rhine, in north Germany and in Weingarten (Berthold Missal, Pierpont Morgan library, New York city) some miniatures were executed in opaque pigments. These are clear and calm in style, and at times they rise to monumental dignity, *e.g.*, in the Gospel book of Henry the Lion made at Helmarshausen, or the Hildesheim manuscripts of the 12th century (Hildesheim, Ratman Missal, etc.).

With the beginning of the 13th century Byzantine influence extended its power over almost all the country, and its style displays great restlessness. In the latter part of the 13th century the desire to create original forms and to express passionate feeling was so strong that the style was often positively distorted. The Byzantine tendency attains its zenith in the Gospel book of the town hall at Goslar, and the related miniatures in Halberstadt, executed in the first third of the 13th century. Immediately after the middle of the 13th century numerous fine works were produced especially in south Germany, where refined Byzantinesque style, mixed with the court style of Paris, predominated (Psalter, Munich Staatsbibliothek Lat. 3,900 and the Gospels of Aschaffenburg, Staatsbibliothek Manuscript 3).

Gothic.—In the first half of the 13th century there was a complete transformation of the fundamental ideas of book ornamentation. A refined and dainty style was cultivated which resulted in the contrast between miniatures in Gothic manuscripts and the art of monumental painting appearing sharper than ever before. Picture and text were more closely assimilated, and the historiated initial became predominant in Gothic manuscripts. When the miniature remained independent, it bore the character of a small medallion or of a quatrefoil. The initials, however, expanded more and more until they twined themselves all round the pages of text. Figures dispersed at random in the margin, called drolleries, although they represented any sort of conceivable object, introduced a new style of embellishment on which all development to 1500 was founded. Paris is regarded as the birthplace of the new style. Several manuscripts are designated as the property of Queen Blanche or of St. Louis, among them the Psalter of the Arsenal library in Paris. It is the first to show the substitution of medallions for the usual rectangular series of pictures. From other books it is still clearer that the illuminators kept very close to the example of stained glass windows, from

which they borrowed the complicated arrangement of the medallions.

Although a great advance was made by the manuscripts of the *Bible moralisée* and the allied manuscripts, the pure type of Gothic manuscript had not yet been produced. Many other miniatures, however, display a strongly dramatic and restless style, which has a certain affinity with contemporary German work rather than with French Gothic. A number of splendid manuscripts. which are supposed to emanate from Salisbury, are illustrated in this style. Early English examples include the magnificent pictures of the Apocalypse at Trinity college, Cambridge. A great new style. which was to oust all the previous tendencies in France and England, was created under the strong influence of monumental art in Paris about 1240. Its chief works are the Psalters written for St. Louis or other members of the royal family (Bibliothbque Nationale Lat. 10,525), and the liturgical manuscripts executed for the Ste. Chapelle, Paris. These works combine two qualities: first. the greatest simplicity of style, in that they work out the pure Gothic line; second, a marked attention to reality in ornament and in architectonic details, in costume, etc. It is very difficult to distinguish between French and English work of this period. In spite of numerous English traits the Psalter of the municipal library at Niirnberg and the Psalter of Queen Isabella, Edward II's wife, at Munich (Staatsbibliothek) probably originated from Paris. Queen Mary's Psalter at the British museum is, beyond dispute. an early 14th-century English masterpiece. In the work of the East Anglian school can be seen the gradual giving up of Gothic outline drawing for the sake of a broader pictorial treatment. Its most singular characteristic is extravagant richness of ornamentation displayed in the large border frames of the decorated pages, interlaced with figures of every shape and kind. In Parisian illumination the characteristic style of the miniaturists Honoré and Jean Pucelle show the change unmistakably. From this time the development of modern painting can be followed in the miniatures of the manuscripts. The fundamental revolution in style which took place during this period can only be explained on the assumption of Italian influence arising out of the close connection between Italian and French art. based, in its turn, on political and dynastic relations and the transference of the papal court to Xvignon. This may account for the fact that Pucelles' masterpieces, the breviary of Queen Jeanne of Navarre (formerly Tates Thompson collection), and the hours of Jeanne d'Evreur (Cloisters, Metropolitan museum, New York city) contain certain miniatures that can only be understood as imitating Italian pictures of the Trecento.

From the middle of the 14th century onward, the naturalistic tendency became more and more powerful. For this period the phrase. "the naturalism of head and hand," has been coined Its influence is seen most clearly in the dedication pictures, where the elements of portraiture in the persons represented, *e.g.*, Charles V, are unmistakable. In religious pictures, however, Gothic idealism continued until the beginning of the 15th century. The miniatures executed for Charles V are often set in quatrefoil frames, and gray monochrome (grisaille) is preferred to painting in colours. The decisive change in the direction of modernity may best be studied in the manuscripts illuminated for Charles V's brother, the duke of Berry. The name of André Beauneveu of Valenciennes is given for the Psalter at Paris (Bibliothbque Nationale Fr. 13,091), that of Jacquemart de Hèsdin for the prayer books at Paris (Bibliothbque Nationale Lat. 919) and Brussels (Bibliothèque Royale 11,060–61). In these manuscripts there is a change in the borders, the dainty sprays of ivy, which had hitherto sprouted loosely over the margins, now completely fill them up, and new motifs add to the wealth of ornament. In the miniatures the old Gothic tradition can be seen gradually being displaced by the tendencies of Italian art, with a rapid progress in naturalism. The new art reached its climax in the second decade of the 15th century in two manuscripts begun for the duke of Berry, which must be classed, beyond dispute, among the most magnificent illustrated books of all times. The unfinished prayer book at Chantilly (called, according to the inventory, Trks riches Heures du *duc de* Berry), was illuminated by Pol de Limbourg and his brothers. Pictures which are reminiscent of famous Italian mural paintings stand side by side with faithful representations of reality, as, *e.g.*, the calendar pictures with the views of the duke's castles or the genrelike February snow landscape. Another step forward was the prayer book begun for the duke of Berry, but after his death continued for Count William IV of Bavaria-Holland. In the pictures of William IV's time the Italian style has been completely replaced by a style so near to that of the brothers Van Eyck that some of the best pictures have been attributed to them. The miniatures of the two last-named manuscripts are invaluable to the history of painting.

Spanish and Italian. — Spanish and Italian illumination had only a slight share in the Renaissance movement on which Carolingian, Ottonian and Anglo-Saxon art was based. In Spain, as in Italy, tendencies prevailed, during this period, which can best be compared with the Franco-Saxon school. The Spanish manuscripts of the 9th to 11th centuries display a rich, but fantastic decoration in which early Christian and Moorish elements are mixed. The figures are antinaturalistic, reminding one of the Irish style. The most singular Spanish creation is the great series of illustrations to Beatus of Liebana's Commentaries on the Apocalypse which have survived in many copies from the 9th (?) to the 12th centuries (the oldest in the Pierpont Morgan library).

The character of Italian illumination varies extremely in the different Italian territories, according to their relations with east and west. A curious blend of contrasting tendencies is to be seen in the book ornamentation of the Benedictines at Monte Cassino in the 11th and 12th centuries. Here Hiberno-Saxon, Ottonian and Byzantine stylistic elements are intimately combined. Southern Italy made a specialty of Exultet Rolls, as they are called, *i.e* , long illuminated scrolls of parchment, which contained liturgical readings for use at Easter and which were unrolled by the officiant priest over the lectern of the pulpit. Various Italian monasteries produced from the 11th to the 13th centuries gigantic Bibles, some of which show a singular beauty of initial which was afterward imitated in the 15th century. The origin of these Bibles is partly to be sought in Tuscany, where, in the reign of the margravine Matilda, works of a pronounced original character were produced, *e.g.*, the Gospel book which Matilda presented in 1109 to the Abbey of Polirone (Pierpont Morgan library). During the 13th century, Italian illumination in the large university towns of northern Italy developed freely and in a manner quite its own. Legal textbooks. Bibles, etc., were executed and taken by the students all over Europe. Moreover, the 13th century produced a new type of book, the immense choir book, which was everywhere used at church services. In general, large miniatures are rare in Italian illuminated manuscripts. Most have only historiated initials, but these are drawn out to great length and spread out over the margins in branch and leaf work. Drolleries were added very early, so that one feels inclined to assume that they made their way to the north from Italy. All this, however, does not exhaust the importance of Italian miniature. Just as in mural and panel painting, Italy was foremost in diffusing the Byzantine style.

The immediate influence of the Crusades in causing an interpenetration of the western and Byzantine elements must not be overlooked. In the Latin kingdoms of the orient, there were executed for churches and princes magnificent manuscripts in which such a mixture of styles was inevitable, *e.g.*, the Psalter of Queen Melissenda of Jerusalem (British museum), the Missal of the Holy Sepulchre church at Jerusalem (Bibliothilque Nationale Lat. 12056), and many others. Similar works probably emanated from those districts of Italy which were particularly exposed to Byzantine influence. In this class may belong the missal at Madrid. A similar mixture of style is evident, in a much coarser form, in the epistolary, written in 1259 at Padua by Gaibana (cathedral treasure). About 1300 a large number of Byzantinesque illuminations were produced at Bologna, which are distinguished by copious border decoration, with figures in the pseudoclassic style. Splendid works of this kind are the Bibles at Paris (Bibliothbque Nationale Lat. 18) and at the British museum (Add. 18,720).

During the 14th century, throughout Italy's busy scriptoria, as at Naples, where French influence is noticeable, numerous manu-

scripts rich in miniatures were produced (Bible in the Berlin Kupferstich-Kabinett, Manuscript 78E3, once belonging to Leo X). Only rarely can miniatures be connected with the artists who painted on panel.

15th- and 16th-Century. — Ailany illuminated manuscripts of the later 15th and 16th centuries surpass in wealth of pictures and magnificent embellishment, even the works from the time of the duke of Berry. In the 16th century they were eventually supplanted by black and white. The splendid miniatures of the 15th and 16th centuries are, like those of the preceding period, chiefly destined for princes and great courtiers. Three large centres of production were prominent: Flanders (Ghent, Bruges); France (Paris. Tours); Italy (Florence, Ferrara and others). Illumination in this period acknowledged no restriction in its choice of subject. The Books of Hours, indeed, still played an important part. but, besides these, there were profane manuscripts of an incredible variety, among which the chronicles and the romances are prominent.

Flemish. — It can only rarely be proved that painters on panel of the generation after the Van Eycks had a hand in illumination. A number of miniaturists are known from their works or from documents; *e.g.,* Jean le Tavernier, Willem Vrelant, Loyset Lyédet, Philippe de Mazerolles, the Bening family. About the middle of the 16th century the activity of the Flemish scriptoria seems to have died out. It is important to note Simon Marmion, unsurpassed in landscape (Book of Hours, British Jluseum Add. 38.126). A master belonging to the circle of Roger van der Weyden is called, after the Romance of Girart de Roussillon, Jean le Tavernier. nho adorned the Conquêtes de Charlemagne executed for Philip the Good (Vienna Staatsbibliothek 2.539). His second masterpiece, the Chronicle of Hennegau, is at Brussels (Bibliothèque Royale Manuscript 9.066).

French. — The production of French manuscripts during the 1 jth century can best be judged by the *Heures* de Rohan (Bibliothkque Nationale), the *Heures* du *Marichal* de *Boucicaut* (Paris, Musée Jacquemart André), the Bedford Alissal (British museum) and the Salisbury breviary in Paris (Bibliothkque Nationale), nith its numberless miniatures. About the middle of the 15th century Jean Fouquet, the most important personality among the French miniaturists, made his appearance. He died about 1480 at Tours, where he had lived before and after his journey to Rome, between 1443–47. Attested works of his are parts of the *Antiquités Judaïques* at Paris, and the miniatures cut out from the *Heures d'Etienne Chevalier* at Chantilly. Fouquet's art, which otherwise shows affinities with Flemish naturalism, has a touch of the Renaissance.

German.-In Germany in the 15th century, illustration passed a humble existence in monasteries and scriptoria which engaged in large-scale manufacture of manuscripts (Diebold Lauber in Hagenau). In contrast with this mass production, there are the splendid manuscripts of the emperor Maximilian. The finest work is the superb border, executed by Dürer and other great German artists, in a copy of the prayer book printed by Schonsperger (Munich Staatsbibliothek and Besançon).

Italian. — In Italy the renaissance in the manuscripts began with the introduction of the *scrittura umanistica,* which returned to the model of the fine Italian manuscripts of the 11th and 12th centuries, from which was also taken the scroll work design in the frames enclosing the pages of text. Illumination did not really flourish until the middle of the 15th century, when a number of new studios, most of them associated with the luxurious courts, created a new style and new decorative forms. As in Flanders, the artists are seldom those who painted on panel, although. for example, the works of Simone Martini, Giovanni di Paolo and Andrea Mantegna are reflected in miniatures. In northern Italy, Milan and Verona were two of the centres. A masterpiece is the Book of Hours of Bona of Savoy, widow of Galeazzo Maria Sforza, duke of Milan, which afterward came into the possession of Charles V (British Museum Add. 34,924). In the Ferrara school, where a number of miniaturists worked for the ducal family of Este, Taddeo Crivelli takes the first place (Borso d'Este's Bible, 1455–62, Modena). The most important miniaturist under Borso's successor, Ercole I. is Martino da Modena (Ercole I's Breviary at Vienna). Miniature painting in central Italy was chiefly concentrated at Florence; Francesco d'Antonio del Cherico with Attavante degli Attavanti were the two chief miniaturists.

See PAINTING; BYZANTINE ART; BIBLE; PRINTING; PALAEOGRAPHY.

BIBLIOGRAPHY. — H. Omont, *Listes de recueil de facsimile's et de reproductions de nzanuscrits conserve's & la Bibliothèque Nationale,* 2nd ed. **(1912).** Numerous articles of the highest importance are scattered through the scientific periodicals, especially *Scriptorium* **(1946** *et seq.).*

1. *General:* J. **A.** Herbert, *Illuminated Manuscripts* (1911); *A.* Michel, *Histoire de l'art,* contributions from Leprieur, A. Haseloff, Millet, P. Durrieu, Bernath (1905 *et seq.*); A. Boeckler, *Abendlandische Miniaturen* (1930); *A.* Grabar and C. Nordenfalk, *Early Medieval Painting: From the 4th to the 11th Century* (1957), *Romanesque Painting: From the 11th to the 13th Century* (1958) both with an extensive bibliography.

Late Ronzan, Early Christian and Byzantiunz: Codices e Vaticanis selecti, Vergilius Vaticanus (1902), *Vergilius Roinanus* (1943); *C.* Nordenfalk, *Die Spätantiken Kanontafeln* **(1938)**; H. Stern, *Le Calendrier de 354* (1953); *F.* Wormald, *The Miniatures in the Gospels of St. Augustine* (1954); *A.* Grahar, *Evangéliaire de Linope* **(1948)**; H. Gerstinger, *Die Wiener Genesis* (1931); *K.* Weitzmann, *Die Byzantinische Buchmalerei* (1935), *The Joshua Roll* **(1948)**; *A.* Goldschmidt, *Early Manuscripts of the Aesop Fables of Avianus, and Related Manuscripts* (1947); *R.* Bianchi Bandinelli, *Commentary: Hellenistic-Byzantine Miniatures to the Illiad* (1956).

2. *Reproductions:* G. Leidinger, *Meisterwerke der Buchnzalerei aus Mss. der Bayerischen Staats-bibl. München* (1920); G. Warner, *Illuminated Manuscripts in the British Museum* (1899–1903); *British Museum Reproductions of Illuminated Manuscripts* **(1923)**; *Schools of Illumination* (1914–26); *E.* H. Zimmermann, *Vorkarolingische Miniaturen* (1916–18); A. Boinet, *La miniature carolingienne* (1913); *E.* **T.** De Wald, *The Stuttgart Psalter* (1931), *The Illustrations of the Utrecht Psalter* (1932); R. Stettiner, *Prudentius Handschriften* (1905).

Great Britain and Ireland: E. H. Alton and P. Meyer, *Book of Kells* (1950); *J.* Duft and P. Meyer, *Irish Miniatures in the Abbey Lihrary of St. Gall* (1954); *J.* Brown and Bruce-Mitford, *Book of Lindisfarne* **(1957)**; *E.* **G.** Millar, *English Illuminated Manuscripts Fronz the 10th to the 13th Century* (1926), *English Illuminated Manuscripts of the 14th and 15th Century* **(1928)**; *A.* Goldschmidt, *Albani Psalter in Hildesheim* **(1895)**; M. **R.** James, *The Canterbury Psalter* (1934); F. Masai, *Essai sur les origines de la nziniature dite irlandaise* (1947); *M.* Rickert, *Painting in Britain* (1954); F. Wormald, *English Drawings of the 10th and 11th Centuries* (1952); *C.* **R.** Dodwell, *The Canterbury School of Illumination, 1066–1200* (1954); *R.* Mynors, *Durham Cathedral Manuscripts* (1939); W. Oakeshott, *The Artists of the Winchester Bible* (1945).

France: G. Leidinger, *Codex Aureus in München* (1921–25); W. Koehler, *Schule von Tours* (1930–33), *Hofschule Karls d. Gr.* (1958); *H.* Martin, *La Miniature française du 13e au 15e siècle* (1923); S. Schulten, "Buchmalerei des ii. Jahrhunderts in St. Vaast .Arras," *Münchner Jahvbuch* **(1956);** Oursel, *La Miniature du 12" siècle à l'Abbaye de Citeaux* **(1926)**; Graf Vitzthum, *Die Pariser Buchmalerei* (1907); Cockerell. *A Psalter and Hours Executed Before 1270 for a Lady Connected With St. Louis* (1905); Comte **P.** Durrieu, *Les Antiquités Judaïques et le peintre Jean Fouquet* (1908), and *Le Boccace de Munich* (1909); *V.* Leroquais, *Les Sacramentaires et les missels* (1924), *Les bréviares* (1934), *Les Livres d'heures* (1940–41), *Les Pontificeaux* (1937), *Les Psautiers* (1940–41); J. Porcher, *Les manuscrits à peinture en France du 7" au 12e siècle* (1954), *Manuscrits à peinture du 13e au 16e siècle* (1955) both with an extensive bibliography; J. Pacht, "Jean Fouquet," *Journal of the Warburg Library IV* (1940).

Low Countries: A. Bouxéruy, "La Miniature," in E. de Moreau, *Histoire de l'église en Belgique* **(1946)**; *A.* **W.** Byvanck and G. J. Hoogewerff, *Noord-hederlandsche Miniaturen* (1922–25); *A.* **W.** Byvanck. *La Miniature Hollandaise* (1937); Comte P. Durrieu, *La Miniature flamande au temps de la cour de Bourgogne, 1415–1530* (1921), *Les Très riches Heures de Jean de France duc de Berry* (1904), and *Les Heures de Turin* (1902); F. Winkler, *Die flämische Buchnzalerei des XV und XVI Jahrhunderts* (1925); *G.* Hulin de Loo, *Les Heures de Milan* (1911).

Gernzany: A. Goldschmidt, *Die deutsche Buchmalerei* (1928), *Evangeliar im Rathause zu Goslar* (1910); Sauerland u. Haseloff, *Der Psalter Erzbischofs Egberts in Trier* (1901); G. Swarzenski, *Regensburger Buchmalerei des X und XI Jahrhunderts* (1901), and *Salzburger Malerei* (1913); *A.* Merton. *Die Buchnzalerei in St. Gallen* **(1912)**; A. Haseloff, *Eine thiiringisch-sachsische Malerschule* (1897), *Manesse Handschrift* (1926–29); K. Löffler, *Schwäbische Buchrnalerei* **(1928)**; P. Metz, *Goldene Evarzgelienbuch von Echternaclz* **(1956)**; W. Vöge, *Deutsche Malerschule um die Wende des ersten Jahrtausends* (1891); H. Wölfflin, *Bamberger Apocalypse* (1921); *E.* **H.** Zimmermann, "Fuldaer Buchmalerei," *Jahrbuch der K. K. Zentralkommission IV* (1910); **A.** Boeckler, *Stuttgarter Passionale* (1923), *Regensburger-Prüfeninger Buchmalerei* **(1924)**; F. Jansen. *Helmarshausener Buchmalerei* (1933); *A.* Friedl, *Kodex Gigas* (1929); *K.* Löffler, *Landgrafenpsalter* (1925); H. Swarzenski, *Die Lateinischen illuminierten Handschriften des 13 Jahrhunderts* (1936), *The Berthold Missal* (1943); *J.* Walter, *Herrade*

BY COURTESY OF THE PIERPONT MORGAN LIBRARY, NEW YORK.

BLANCHE OF CASTILE AND SAINT LOUIS, KING OF FRANCE

Leaf from a *Bible Moralisée,* showing portraits of Blanche of Castile and her son, Saint Louis, king of France. This reproduction is from the original French manuscript, executed in the first quarter of the 13th century, now in the Pierpont Morgan library, New York

ILLUMINATED MANUSCRIPTS

AFTER A FACSIMILE BY SCHWENKE OF THE PELPLIN COPY OF THE GUTENBERG BIBLE, BY COURTESY OF THE NEW YORK PUBLIC LIBRARY

ILLUMINATED PAGE FROM THE GUTENBERG BIBLE

The Gutenberg Bible, traditionally accepted as the first book printed from movable type, was issued at Mainz, Germany, about 1454. The illustration shows page one of the Proverbs of Solomon. The pages are illuminated to give the effect of a hand-copied manuscript, as desired by the printers, who did not wish their invention discovered. The book was probably printed in 10 sections on 6 presses working simultaneously. Of nearly 300 copies, only 45 are known to be in existence to-day

de Landsberg (1952); M. Molwo, *Wettinger Graduale* (1944); O. Homburger, *Evangelistar des Speyerer Domes* (1930).

Italy: Histories of art by E. Bertaux, Marle, P. Toesca, A. Venturi; P D'Ancona, *La Miniature italienne du 10e au 16" siècle* (1924), *La miniature fiorentina* (1914); P. Toesca, *La pittura e la miniatura nella Lombardia* (1912); Graf Erbach-Furstenau, *Die Manfredbibel* (1910); *M.* Avery, *The Exultet Rolls of South Italy* (1937); E. B. Garrison, *Studies in the History of Mediaeval Italian Painting* (1955); *G.* Ladner, "Italienische Malerei im II. Jahrhundert," *Jahrbuch der kunsthistorischen Sammlungen Wien* (1931); *H.* Buchthal, *Miniature Painting in the Latin Kingdom of Jerusalem* (1957).

Spain: W. h"euss, *Die katalanische Buchmalerei um die Wende des ersten Jahrtausends* (1922), *Apocalypse des hl. Johannes in der alfspanischen Bibel-Illustration* (1951); J. D. Bordona, *Manuscritos con pinturas* (1933), *Spanische Buchmalerei* (1930); *A.* Garcia Fuente, *Miniatura española primitiva* (1936). (A. HF.; H. P. T S)

ILLUMINATI, a short-lived movement of republican free thought founded on May day 1776 by Adam Weishaupt, professor of canon law at Ingolstadt and a former Jesuit. The members of this secret society called themselves "Perfectibilists." Their founder's aim was to replace Christianity by a religion of reason, as later did the revolutionaries of France and the positivist philosopher A. Comte in the 19th century. The order was organized along Jesuit lines and kept internal discipline and a system of mutual surveillance based on that model. It ran the full gamut of fads which are usually linked with secret bodies of this kind, including the assumption of classical names. From 1778 onward they began to make contact with various masonic lodges, where, under the impulse of A. von Knigge (*q.v.*), one of their chief converts, they often managed to gain a commanding position. The total numbers never exceeded 2.000.

The scheme itself had its attractions for literary men like Goethe and Herder, and even for the reigning dukes of Gotha and Weimar. Such notables were claimed as members although not actually so. Secret societies of this kind fitted in with the idea of benevolent despotism as a vehicle for the Enlightenment, as Goethe shows in Wilhelm Meister.

The movement suffered from internal dissension and was ultimately banned by an edict of the Bavarian government in 1785. This undermined other, genuine liberal forces that were now open to reprisals from the unprogressive authorities and the Roman Catholic Church alike.

See P. Tschackert in *A.* Hauck (ed.), *Realenzyklopädie fur protestantische Theologie und Kirche (1901).* (P. FO.)

ILLUSION, the experience and the result of misconstruing or misinterpreting some real sense stimulus or stimuli, as when a wax figure at Madame Tussaud's or similar exhibitions is mistaken for a real policeman, or when a piece of suitably modeled plasticine is mistaken for a sausage. Something is actually there to stimulate the senses, and the sense experience itself is produced in a normal manner, but, because of established habits of rapid association or the temporary "set" of the mind, the observer mistakes the thing for something different.

Many optical and other types of illusions are perfectly normal and can be experienced by large numbers of people at the same time. The familiar "magic" entertainments consisting of juggling and conjuring tricks are examples in which the conjurer employs special equipment and techniques designed to deceive the minds of his audience by directing their attention toward one action while another goes unnoticed (see CONJURING). The apparent bending of a pencil placed in a glass of water is an optical illusion caused by refraction of light as it passes from one medium to another, while many other illusions such as the apparent movement of motion pictures and many animated electric advertising signs are possible because of the physiological phenomenon known as persistence of vision.

The normality and indeed the inevitableness of so many illusions constitute one of the serious problems in any attempt to vindicate the validity of human knoll-ledge.

See HALLUCINATION; KNOWLEDGE. THEORY OF; PERCEPTION; PSYCHOLOGY: Bibliography; PSYCHOLOGY, ABNORMAL.

ILLUSTRATION. To illustrate means to elucidate, and illustration is the placing of informative pictorial material in books, magazines and papers. Though the terms illustration and illumination are not always distinguished clearly and the two words are sometimes used interchangeably, illumination strictly speaking applies to the decorative accompaniment of a text while illustration refers to that pictorial matter which clarifies or demonstrates a point in a text or adds vividness and concreteness to the characters and incidents of a story. (See ILLUMINATED MANUSCRIPTS.)

In most cases the illustrations to a text never become completely identified with it, and over a period of time the same story or treatise may be illustrated by a number of different artists, each contributing a different kind of elucidation. However, sometimes one artist's work will seem to be the definitive illustration of a story, no matter how many others attempt it—an example that comes readily to mind is the work of John Tenniel for Lewis Carroll's Alice's Adventures in Wonderland. Tenniel's illustrations seem far more satisfactory even than those designed by the author of the book.

There are other instances where the author himself was also the designer of illustrations that have become inseparable from the text. Among others that could be mentioned are Edward Lear's drawings for some of his limericks and nonsense verse and William Blake's illustrations for his prophetic books.

Ancient and Medieval Illustrations. — The history of illustration is as old as that of books themselves. Man's desire to have his literature illustrated has expressed itself independently of books. Many paintings, for example, are illustrations in the sense that they take their meaning from a literary text (which, however, is rarely provided for the viewer), and they can be fully understood only by those who are familiar with the literary sources. In the more usual sense of pictures intended to accompany a text not necessarily familiar, the earliest preserved illustrations date from the first known period of book production, the Middle Kingdom of Egypt (21st to 18th centuries B.C.), when large-scale workshops for the writing and illustrating of manuscripts were organized. Egyptian books were written on papyrus in roll form. The illustrations were similar in style to the wall paintings of the period, except that they were much more freely organized in space, usually with a single object or group of objects placed in an area left blank by the writer at the appropriate point in the text. Among the texts so illustrated were religious books, such as the Book of the Dead, scientific and literary works. The oldest surviving illustrated roll, the so-called Ramesseum papyrus (c. 1980 B.C.), is a ceremonial play.

The codex, the book of leaves bound together at one edge which is familiar to the modern world, was invented in the 1st century A.D., and for a time both roll and codex were used. The Greeks and Romans apparently made use of illustrated books. Their scientific texts seem to have been supplied most often with pictorial amplification. However, a number of illustrated epics (such as the Iliad and Odyssey) and plays have survived, and there is evidence that these were sufficiently available and popular to have become the models for wall paintings, vase decorations, metalwork and mosaic designs.

As the codex came into more widespread use, new forms were devised for illustrations. Instead of always being placed in the appropriate spot in the text, interrupting the writing, illustrations often were placed on separate pages left blank for the purpose and arranged so that the pictorial material faced the text to which it applied. Furthermore, many Byzantine, Celtic and western European manuscripts contained borders which surrounded pages of the text, and these borders frequently included illustrative pictures.

The Renaissance. — In the 14th century a new spirit entered book illustration. The monumental dignity of Byzantine manuscripts and the often fantastic storytelling of the middle ages gave way to an attempt to suggest reality. A notable early example is the *Très Riches Heures* of the duc de Berry, in which the occupations of the various seasons are depicted with a wealth of detail, a vivid sense of space and atmosphere and careful attention to the correct representation of man-made and natural objects.

Late medieval and early Renaissance scientific treatises were illustrated with great care and a real attempt was made to portray exactly the objects under consideration, but this was hindered by

the impossibility of accurately multiplying pictures. No matter how carefully an artist might draw a plant or an animal, his work was likely to be distorted beyond recognition by the scores of copyists — each copying drawings rather than drawing from life — who would reproduce the manuscript. Only with the invention of printing in the first half of the 15th century did it become possible for illustrations to be exactly reproduced once they had been rendered to the artist's satisfaction.

The Introduction of Printing. — Early printed books (the first to be illustrated was Ulrich Boner's *Der Edelsfein,* printed in 1461 by Albrecht Pfister in Bamberg, Ger.) used illustrations not so much for the sake of scientific accuracy as to produce books that would be attractive to the larger public that printing made possible. As with most manuscript illustrations, the idea of a picture was more important than the accuracy of its details — the same wood block illustration of a town might be labeled as the city of Ulm on one page of the *Nürnberg Chronicle* (1493) and as Damascus on another.

Of course with biblical and literary texts the illustrations had to match the story more closely, and the efforts of such artists as Albrecht Diirer, Albrecht Altdorfer and Lucas Cranach to produce meaningful, coherent accompaniments to these texts are justly famous.

While the first printed books, both in northern Europe and in Italy, used woodcuts, which could be printed at the same time as the text, it was not long before artists began to make intaglio illustrations, which required a separate printing operation. In spite of this difficulty, engraved and etched illustrations had become more common than woodcuts by the end of the 16th century and they remained in vogue for almost 200 years. The various intaglio techniques permitted a fineness of line and a subtlety of tonal values impossible to achieve in woodcuts, and Rubens, Rembrandt, Tiepolo, Fragonard and scores of other artists used these mediums in their illustrations.

Illustrators of the 16th and 17th centuries were particularly fond of creating fables in pictorial form. The so-called "emblem books" were full of illustrations depicting odd combinations of people, animals and objects whose meaning was explained in didactic poems printed under the pictures. This love of learned allegory was also displayed in the elaborate title page illustrations of the time, in which the meaning of the book or the interests of the author were suggested by a collection of clearly symbolic objects.

The illustrator also came to serve the scholar in the 18th century. In the elaborately illustrated archaeological and topographical studies of the period the large, carefully prepared engravings assumed as much importance as the text. Books of this kind had been published in the 17th century as well, but the earlier treatises were crude indeed compared with the fine 18th-century works.

Woodcut and Lithography. — Toward the end of the 18th century Thomas Bewick, an English engraver, developed a technique of engraving on wood in a finely controlled manner. The blocks he produced were capable of as subtle a range of tonal variation as any intaglio process and they had a distinct technical advantage in that they could be printed at the same time as the text and on the same press. Bewick's discovery gave rise to a school of exceedingly skilful engravers on wood who could reproduce drawings and even paintings with astonishing fidelity. As a result, in the 19th century intaglio illustrations practically ceased to be made.

Another important discovery of the late 18th century was the lithograph. which became particularly popular among painters who wished to be illustrators. Many designers of illustrations were distressed at the transformation of their drawings at the hands of commercial engravers. A few artists, like Bewick or Blake, were fortunate enough to be able to engrave their own designs, but most were at the mercy of such skilled engravers as the Dalziel brothers and John Swaine in England and Timothy Cole in the United States. Through the use of lithography the artist was able to produce a print which closely approximated a drawing in crayon or wash without the intervention of a professional engraver.

At the same time there was a significant increase in the size of the reading public and a concomitant reduction in the cost of books. As publishers sought more purchasers for their books, illustrations became important commercial assets. The first traces of this interest of publishers in popular illustrated editions appeared in the 15th century. By the 17th century it was possible for a successful engraver to amass great wealth and enjoy a considerable reputation. Only after the 1830s, however, were illustrated books generally available to the public at comparatively low prices.

In 1832 the *Penny Magazine* appeared, the first periodical regularly to use large numbers of illustrations designed to appeal to the popular taste. Soon a host of illustrated magazines and pictorial ne spapers were on the market — predecessors of the 20th century's *Life, Du, Paris-Match* and *The London Illustrated Weekly* and of the illustrated daily newspapers.

Photography and Photoengraving. — In 1844 Fox Talbot, the English pioneer photographer, used the newly developed technique to illustrate his book *The Pencil of Nature,* which showed the possibilities of photography for accurately and easily recording what an artist could transcribe only with considerable labour. Photography opened a whole new world, and it affected illustration in many ways. At first, individual photographs printed on paper were simply pasted into printed books. For larger editions, wood engravings or lithographs were made from photographs by commercial engravers and artists, and such copies of photographs were commonly used as illustrations in the 1850s and 1860s. Around 1851 a method was devised of transferring a drawing onto a wood block photographically, thus allowing the engraver to enlarge or reduce the drawing at will and enabling him to keep the original drawing on hand as a guide to his engraving. By the time this technique was in general use, in the 1870s, the technique of reproducing line drawings directly by photochemical means, without the intervention of the engraver's hand, had been perfected. Direct reproduction of photographs on a printing press through the use of halftone blocks, which came into use in the 1880s, made it possible to do away with hand engraving entirely. By World War I the craft of wood engraving was no longer of commercial significance. These developments led directly to the richly illustrated books, newspapers and magazines that became characteristic of the 20th century.

At the same time a significant reaction to these new processes took place. In the 1880s and 1890s a number of artists, led by William Morris in England and Maurice Denis in France: began to feel that the use of reproductive engraving had given rise to books lacking the unity and harmony of true works of art. To them, the finely engraved illustration seemed out of keeping with the weight and colour of the type used to print the text. Furthermore, the illustrations themselves tended to be overly literal and failed to provide an imaginative accompaniment for the text. These men and their followers in England and on the continent of Europe produced books that had a tremendous influence. Through their efforts, side by side with the popular illustrated books and periodicals, a series of privately printed, fine-art editions came into being which convinced a number of artists and publishers that illustrated books could be works of art of a high order.

Many artists, among them Aubrey Beardsley, Howard Pyle and T. T. Heine, used photoengraving to reproduce their drawings and were able to design their illustrations in such a way that the results were highly satisfactory artistically. Other artists — Denis; Pablo Picasso, Pierre Bonnard, Henri Matisse, Aristide Maillol and Georges Rouault, for example — preferred the older techniques of wood engraving; metal engraving, etching and lithography as giving them more control over the finished product.

20th-Century Illustration. — Finely illustrated books of this kind are exceedingly costly, and the culture of the 20th century would certainly have developed differently without the prevalence of cheap, accurate and attractive illustrations in school texts, magazines, newspapers, advertising illustrations: catalogues and books of all kinds. The illustrations in publications such as these are almost all produced (or reproduced) photographically. The photograph itself, in the hands of 20th-century workers, yielded masterpieces equal in importance to all but the finest earlier il-

lustrations. Furthermore, through photographic methods of full-colour reproduction, 20th-century publishers were able for the first time to illustrate books about the visual arts with facsimiles of paintings and drawings that were far less distorted than anything possible earlier.

This great diversity of illustration makes it almost impossible to consider any single style of illustration as the exclusive property of a single age. The artist illustrating a hook on botany or geometry will work very differently than he would if he were dealing with a novel or a play. Furthermore, the intentions of illustrators have changed over the years. The earliest illustrators were concerned with the depiction of an object, action or personage, and rarely attempted to evoke a sense of space or setting in their pictures. The artists of the Renaissance tried to represent space and form in such a way that the illustration on the page seemed to be a replica of nature. This continued to be an important concern of the sophisticated illustrator of the 16th, 17th and 18th centuries, who used it as the basis for the expression of his own imagination and emotional feelings about his subject, or as a tool in the representation of objects of scientific interest. The invention of photography made it possible for the painter-illustrator to concentrate on other aspects of his work, though he did not immediately take advantage of the opportunity. By the 20th century the photograph was seen as a powerful illustrative medium for the depiction of current happenings, for the accurate reproduction of scenes, for vivid portraiture and for the elucidation of scientific investigations. The painter and draftsman were left free to explore the realm of the imagination and the possibilities of new communicative techniques in the graphic arts. From a rare, costly, handmade object, the illustrated text became an essential part of western culture.

See also ENGRAVING, LINE; LITHOGRAPH; WOODCUT AND WOOD ENGRAVING.

BIBLIOGRAPHY.—Harry *G.* Aldis, *The Printed Book,* 2nd ed. (1941); Otto Benesch, *Artistic and Intellectual Trends From Rubens to Daumier, as Shown in Book Illustration* (1943); David Bland, *A History of Book Illustration* (1958); André Blum, *The Origins of Printing and Engraving* (1940); Walter Crane, *Of the Decorative Illustration of Books* (1896); Beaumont Newhall, *The History of Photography* (1949); David T. Pottinger, *The French Book Trade in the Ancien Régime* (1958); S. H. Steinberg, *Five Hundred Years of Printing* (1955); Kurt Weitzmann, *Ancient Book Illumination* (1959).

(A. M. FN.)

ILLYRIA, part of the Balkan peninsula extending along the eastern shore of the Adriatic from Fiume to Durazzo, and inland as far as the Danube and the Serbian Morava. It comprises modem Dalmatia, Bosnia and Hercegovina, and Montenegro, with the southern half of Croatia-Slavonia, part of western Serbia, the sanjak of Novibazar, and the extreme north of Albania. Its landward boundaries were never clearly defined. The name was an ethnological rather than a geographical term; the older Greek historians usually wrote of "the Illyrians" (οἱ Ἰλλύριοι), while the names Illyris (Ἰλλυρίς) or less commonly Illyria (Ἰλλυρία) were subsequently used of the indeterminate area inhabited by the Illyrian tribes, *i.e.,* a region extending eastward from the Adriatic between Liburnia on the north and Epirus on the south. The Latin name Illyricum was not synonymous with Illyria; it was a political name applied to various divisions of the Roman empire, the boundaries of which were frequently changed and often included an area far larger than Illyria properly so called.

Ethnology.— Herodotus and other Greek historians represent the Illyrians as a barbarous people who resembled the ruder tribes of Thrace. Both are described as tattooing their persons and offering human sacrifices to their gods. The women of Illyria seem to have occupied a high position socially and even to have exercised political power. Queens are mentioned among their rulers. Fuller and more trustworthy information can be obtained from archaeological evidence. In Bosnia the lake dwellings at Butmir, the cemeteries of Jezerine and Glasinac and other sites have yielded stone and horn implements, iron and bronze ornaments, weapons, etc., and objects of more recent date fashioned in silver, tin, amber and even glass. These illustrate various stages in the development of primitive Illyrian civilization, from the Neolithic age onward. The Hallstatt and La Tène cultures are especially well represented. Similar discoveries have been made in Dalmatia, as among the tumuli on the Sabbioncello promontory, and in Croatia-Slavonia. In Dalmatia there appears to have been a large Celtic element, and Celtic place names are common. The ancient Illyrian languages fall into two groups, the northern, closely connected with Venetic, and the southern, perhaps allied to Messapian and now probably represented by Albanian. (See ALBANIAN LANGUAGE.)

History.—Greek colonization on the Illyrian seaboard probably began late in the 7th century B.C. or early in the 6th century. The most important settlements were Epidamnus (Durazzo) and Salona (near Spalato). Researches at Salona (*see* SPLIT) have brought to light Greek inscriptions, Greek pottery, etc., dating from 600 B.C. But Greek influence seems never to have penetrated far into the interior, and even on the coast it was rapidly superseded by Latin civilization after the 3rd century B.C. Until then the Illyrian tribes appear to have lived in a state of intermittent warfare with their neighbours and one another. They are said by Herodotus (ix, 43) to have attacked the temple of Delphi. Brasidas with his small army of Spartans was assaulted by them on his march (424 B.C.) across Thessaly and Macedonia to attack the Athenian colonies in Thrace. The earlier history of the Macedonian kings is one constant struggle against the Illyrian tribes. The migrations of the Celts at the beginning of the 4th century disturbed the country between the Danube and the Adriatic. The necessities of defense seem to have united the Illyrians under a chief Bardylis (about 383 B.C.) and his son Clitus, but the great Philip crushed the Illyrians completely and annexed part of their country. During the next century they are heard of as pirates. Issuing from the secluded harbours of the coast, they ravaged the shores of Italy and Greece, and preyed on the commerce of the Adriatic. The Greeks applied to Rome for help. Teuta, the Illyrian queen, rejected the Roman demands for redress, and murdered the ambassadors; but the two Illyrian wars (229 and 219 B.C.) ended in the submission of the Illyrians, a considerable part of their territory being annexed by the conquerors. Illyria, however, remained a powerful kingdom with its capital of Skodra (Scutari in Albania), until 180 B.C., when the Dalmatians declared themselves independent. In 168 the Romans conquered and annexed the country. Dalmatia was invaded by a Roman army under Gaius Marcius Figulus in 156, but Figulus was driven back to the Roman frontier, and in Dalmatia the Illyrians were not finally subdued until 165 years afterward. In 119 L. Caecilius Metellus overran the country and received a triumph and the surname Dalmaticus. But in 51 a Dalmatian raid on Liburnia led to a renewal of hostilities; the Roman armies were often worsted, and though in 39 Asinius Pollio gained some successes it was not until Octavian took the field in person that the Dalmatians submitted in 33. They again revolted in 16 and 11, and in A.D. 6–9 joined the rebel Pannonians. In A.D. 9, however, Tiberius entirely subjugated them, and Dalmatia, Iapydia and Liburnia were united as the province of Illyricum.

Latin civilization spread rapidly, the cultivation of the vine was introduced, gold mining was carried on in Bosnia, and commercial cities arose along the coast. Illyria became one of the best recruiting grounds for the Roman legions; and in troubled times Illyrian soldiers fought their way up from the ranks to the imperial purple. Claudius, Aurelian, Probus, Diocletian and Maximian were all sons of Illyrian peasants. The importance of Illyricum caused its name to be extended to many neighbouring districts; in the 2nd century A.D. Illyricus Limes included Noricum, Pannonia, Moesia, Dacia and Thrace. The Via Egnatia, the great line of road which connected Rome with Constantinople and the east, led across Illyricum from Dyrrachium to Thessalonica. Either Diocletian or Constantine made Illyricum one of the four prefectures, each governed by a *praefectus praetorio,* into which the empire was divided. This prefecture included Pannonia, Noricum, Crete and the entire Balkan peninsula except Thrace, which was attached by Constantine to the prefecture of the east. From the partition of the empire in 285 until 379 Illyricum was included in the western empire, but thenceforward eastern Illyricum was annexed to the eastern empire; its frontier was almost identical with

the line of demarcation between Latin-speaking and Greek-speaking peoples, and roughly corresponded to the boundary which now severs Latin from Greek Christianity in the Balkan peninsula.

In 441 and 447 the country was ravaged by the Huns. In 481 Dalmatia was added to the Ostrogothic kingdom, which already included the more northerly parts of Illyricum. Bands of Slavonic invaders gradually established themselves in Illyria, where, unlike the earlier barbarian conquerors, they formed permanent settlements. Between 600 and 650 the main body of the immigrants (Croats and Serbs) occupied Illyria *(see* SERBIA: *History;* and SLAVS). The Croats settled in the western half of Illyria, the Serbs in the eastern; thus the former came under the influence of Italy and Roman Catholicism, the latter under the influence of Byzantium and the Greek Church Hence the distinction between them became a marked differenceof civilization and creed, which has always tended to keep the Illyrian Slavs politically disunited.

The Croats and Serbs rapidly absorbed most of the Latinized Illyrians. But the wealthy and powerful city-states on the coast were strong enough to maintain their independence and their distinctively Italian character. Other Roman provincials took refuge in the mountains of the interior; some Illyrian tribes remained unconquered among the mountains of Albania and were never Slavonized. With these exceptions Illyria became entirely Serbo-Croatian in population, language and culture. The name of Illyria disappeared from history, but was revived in the "Illyrian Provinces" of 1809 and the "Kingdom of Illyria" of 1816–49. For the political propaganda known as Illyrism, *see* CROATIA-SLAVONIA: *History.*

BIBLIOGRAPHY.—J. Marquardt, *Römische Staatsverwaltung,* i (1881); C. Patsch in Pauly-Wissowa's *Realenzyklopädie,* iv, pt. 2 (1901); Th. Mommsen, *The Provinces of the Roman Empire,* ed. by *F.* Haverfield (1909); J. B. Bury, *Later Roman Empire.* For Ethnology and Language, W. Kadimsky, *Die neolitische Station von Butmir* (1895–98); K. Brugmann, *Grundriss der vergleichenden Grammatik* (1897) with the authorities there quoted; R. Munro, *Bosnia, Herzegovina and Dalmatia* (1900); *W.* Ridgway, *The Early Age of Greece* (1901).

ILLYRIAN LANGUAGE was a language of the centum group of Indo-European languages. spoken in the Balkan peninsula through the early centuries of the Christian era. During the centuries before and after the beginning of the Christian era by far the greater part of western Europe, as well as large sections of the eastern part of the continent, was inhabited by peoples who spoke languages belonging to the great Indo-European family. Knowledge of these languages is derived primarily from their use in inscriptions and in literary texts. However, such evidence is almost completely lacking for the extensive region including modern Yugoslavia, Albania and parts of southeastern Austria and of southwestern Hungary, among others. This area, subject to early and scattered Greek colonization and later to incorporation into the Roman empire accompanied by intensive romanization. as well as to sporadic migrations and raids by the Celts and Germanic tribes, was known in later antiquity as the Roman province of Illyricum. Slavonic-speaking peoples do not appear there before the 7th century A.D.

Practically all that is known of the indigenous tongue of ancient Illyricum has been derived from an intensive study of its place names, and of the names of persons contained in the thousands of Latin inscriptions found there, insofar as these names are clearly not derivable from other identifiable languages. There are very few glosses which are specifically designated by ancient authors as Illyrian, *e.g., snbaia, sabaium* ("a beerlike beverage"). *cf.* Germanic **sapa-,* Eng. *sap;* and only one inscription which can surely be assigned to that language. Found near Scutari in northern Albania, it reads in transcription: *ana oëθë iser.* It is interpreted as being a dedication to a goddess Oethe, whose name is preceded by an epithet *ana* and followed by a word meaning "sacred" *(cf.* Gr. *hierds,* "sacred." from Indo-European **isero-*).

However. ancient tradition and modern scholarship agree in regarding as an Illyrian offshoot the language of the more than 300 inscriptions found in southeastern Italy and called Messapic. The linguistic evidence for this connection consists, first, in an impressive number of place names common to both areas; *e.g., Peuketioi* in both Illyricum and Apulia; and the *Galabrion* of the eastern Adriatic with the *Calabri* to the west; second, in some words occurring only in these two regions (*ana* as a divine epithet is common in Messapic); and. thirdly, in the fact that both areas exhibit a large measure of agreement in their reflexes of Proto-Indo-European phonemes.

From this evidence, meagre as it is, some statements can be made about the historical phonology and the morphology of what appears to have been a distinct Indo-European language. For example, names like *Acrabanis* make it probable that the Indo-European voiced aspirates became voiced stops in Illyrian, and that the Indo-European *ŏ* became *ă;* and *Vesclavesis* shows both that intervocalic *-s-* was preserved and that the language belonged to the centum group. These and other features contrast strongly with the contiguous Greek and Italic, and afford links with the northerly Germanic and Balto-Slavic idioms. Another indication that the Illyrian homeland may have lain in eastern Germany or Poland is afforded by a large number of place names common to both regions, *e.g., Setwia* in both Dalmatia and Silesia.

The little that is known of Illyrian, combined with certain archaeological facts and with the presence throughout western, central and southern Europe of names obviously Indo-European but not clearly attributable to any identifiable branch of the family. led earlier in the century to the hypothesis of a prehistoric diffusion of Illyrian-speaking Indo-Europeans over much of the continent. This theory, which for a time had many adherents, has been largely abandoned; and the term "Illyrian" is now usually restricted to the Balkan peninsula and immediately adjacent areas. *See* also ALBANIAN LANGUAGE; SERBO-CROATIAN LANGUAGE; VENETIC LANGUAGE.

BIBLIOGRAPHY.—Hans Krahe, *Die Sprache der Illyrier,* part i (1955). This work contains exhaustive references to earlier studies. For the Messapic texts *see* J. Whatmough, *Prae-Italic Dialects of Italy,* vol. ii, pp. 258–430 (1933). (M. S. BR.)

ILMENAU, a town and summer resort of Germany, in the district of Suhl, at the north of the Thuringian forest, on the Ilm river, 30 mi. S. of Erfurt by rail. Pop. (1950) 18,538. Formerly a part of the county of Henneberg, Ilmenau came in 1631 into the possession of electoral Saxony, afterward passing to Saxe-Weimar. It was a favourite resort of Goethe, who wrote his *Iphigenie* there. It manufactures glass, porcelain, toys, chemicals, surgical instruments and turnery.

ILMENITE or TITANIC IRON ORE is a black metallic mineral named from the Ilmen mountains, U.S.S.R. Ilmenite is a source of titanium. Most titanium is used as the oxide in making pigments. The metal is used as a structural material in high-speed, long-range aircraft. Ilmenite is not used as an iron ore because of smelting difficulties. Ilmenite is usually in compact or granular masses or in grains as sand. It crystallizes in the hexagonal system and crystals are tabular or rhombohedra1 in habit. The hardness is 5.5 to 6.0 and the specific gravity 4.7; streak is black to bronnish red. The composition is $FeTiO_3$ with iron 36 8%, titanium 31.6%, oxygen 31.6%. The ratio between titanium and iron may vary considerably and magnesium or manganese may replace some of the iron. Ilmenite is often intergrown with magnetite, and associated minerals are hematite, apatite, rutile, sphene, zircon and monazite.

Ilmenite occurs in veins, lenticular bodies. large masses, beds, beach sands and river placers, and as an accessory mineral of igneous and metamorphic rocks. The deposits at Allard lake, Quebec, Tahawus, N Y., and in Norway are associated with anorthosite. norite or gabbro. Beach sands occur in Florida, India, Brazil, Australia and Japan. *See* also TITANIUM. (*A.* F. HR.)

ILOCANO, the third largest ethnolinguistic group in the Philippines, numbering over 2,500,000 in 1951. When discovered by the Spaniards in 1572 they occupied the narrow coastal plain of northwestern Luzon known as the Ilocos region. Their language is Malayo-Polynesian and closely related to that of the neighbouring Tinguian and other pagan peoples of the Mountain province, but their early Christianization and rapid acculturation led to population expansion and colonization of neighbouring provinces, and later to emigration to Mindanao and Hawaii.

The major Ilocano provinces, Ilocos Norte, Ilocos Sur and La Union, are among the most densely populated areas in the Philippines. Rice is the staple crop, grown on small fields and irrigated by rainfall during the rainy season. The great majority of rice fields are less than one hectare, and are mainly worked by their peasant proprietors. Vegetable plots supplement rice, and pigs,

goats and chickens are also raised. Fish provide a limited amount of protein and flavour to the diet.

Tobacco is currently an important cash crop, but many Ilocanos must supplement their agricultural income by wage work or handicraft activities, particularly during the dry season. Ilocano cotton textiles have a reputation throughout the Philippines.

Social status is correlated with ownership of land, and the scarcity of riceland has given it a very high value. The wealthier families reside generally in the provincial capitals or in other centres of population, while the poorer classes live in the barrios and hamlets. Marriages are generally arranged to maintain class lines, the husband's family providing the sabong or dowry of land.

The population is Roman Catholic, except for a strong minority who belong to the Philippine Independent Church, a schismatic group founded by Gregorio Aglipay during the revolt against Spain at the turn of the 20th century.

The Ilocanos have not only moved into new or frontier regions in the Cagayan valley and Mindanao but have also taken over large portions of Pangasinan. Nueva Ecija and Tarlac. In these regions they have been economically successful, so much so that they are sometimes called the "Yankees" of the Philippines. In each area they have also brought and maintained their own language and subculture, so that much of northern Luzon uses Ilocano as a lingua franca and imitates their way of life.

See also PHILIPPINES, REPUBLIC OF THE: The People.

(F. R. E.)

ILOILO, a province and a chartered city, on the southeastern side of Panay Island (*q.v.*), west central Philippines. The province is mountainous in the west, hilly in the northeast, level and fertile in the centre and along coastal areas. Rainfall averages 80 in. with a short spring dry season. Area 2.048 sq.mi. Pop. (1960) 966.145. Iloilo is a major rice-producing province with many areas harvesting two crops a year. Important secondary crops are sugar, tobacco, coconuts, bananas and pineapples Important trading and rice-milling centres are Cabatuan and Janiuay on the main north-south highway; Pototan and Santa Barbara, which are also freight depots, on the Iloilo railroad; and Barotac Nuevo on the coast, northeast of Iloilo. The first Malay landing in Panay occurred in the 13th century near San Joaquin, 40 mi. S.W. of Iloilo city.

ILOILO city, the provincial capital, pop. (1960) 150,976, has a good port, protected by the offshore Guimaras Island and serving both interisland and international shipping. It grew rapidly as the major port for the great sugar exports of Negros but the construction of artificial ports on Negros caused a drop in Iloilo's freight. Passenger traffic remains high as thousands of labourers annually migrate through Iloilo to Negros' sugar plantations, returning with the new farming year. After the burning of the city in 1899, it was completely rebuilt and shows marked Spanish influence. The town is an educational centre with several private colleges in addition to a branch of the University of the Philippines. There are also several famous churches and two hospitals.

(R. E. HE.)

ILORIN, a town and capital of the province of that name in the Northern Region, Nigeria, Africa, lies 1,200 ft. above sea level overlooking the valley of the Niger, 50 mi. to the north, and clear of the forest belt in a region of farms. Pop. (1953) 40,994 (African pop. only). The town is of open plan, with shade trees and single-story red mud houses with thatched roofs, many having the traditional openwork walls. The amir's palace is modern concrete in simplified Moorish style, and before it is the canopied well of Mallam Alimi. There is a hospital, a modern junior secondary school and a modern trade and vocational training centre.

Ilorin stands on the north-south railway and at the junction of the east-west and north-south trunk roads. It has an airstrip used by local services. The town has no electricity or other poner and therefore no major industries. The principal local crafts are pottery, which is done by the women, the skill of throwing pots without a wheel being passed from mother to daughter, and hand weaving. The women use looms up to 22 in. while men work on j-in. looms. Dyeing is done by women, and there are some goldsmiths and ironsmiths. Most of the men are engaged in farming food crops, none of the Nigerian cash crops being grown in the district. The sale of farm produce is a monopoly of the women.

Ilorin has long been the subject of dispute between Northern and Western Nigeria. The bulk of the people are Yoruba, the principal race of the Western Region. and before the 19th century Ilorin was part of the old Yoruba kingdom of Oyo. It rebelled in 1817 and with the aid of Mallam Alimi of Sokoto became independent. A son of Alimi became amir and Ilorin has since formed part of Northern Nigeria. A former governor general, Sir John Macpherson, held that there was no case for alteration of the boundary, but there still persists a desire in the Western Region for the possession of Ilorin. Ilorin province has an area of 17,719 sq.mi. and a population (1953) of 530,723. (W. H. I.)

ILYUSHIN, SERGEI VLADIMIROVICH (1894–), an outstanding Russian aircraft designer. was born at Didyalevo, Vologda province. Russia, in 1894. Mobilized in the Russian army in 1914, he was transferred to the army air arm and received his pilot's certificate in 1917. He joined the Red army in 1919 and two years later was sent to the Moscow Air Force Engineering academy from which he graduated in 1926. He then began to design aircraft. In 1939 he designed the well-known IL-2 ("Shturmovik") armoured attack aircraft. Turning to the design of civil aircraft after World War II, he produced in 1946 the IL-12 twin-engined passenger aircraft and in 1957 the IL-18 ("Moscow") four-engined turboprop transport machine. Ilyushin reached the rank of lieutenant general in the Soviet army engineering technical service. He became a professor at the academy from which he had graduated and which in the meantime was named after N. E. Zhukovski. (D. CR.)

IMAGERY. Modern writers employ the word "image" differently, but a useful psychological definition is that of C. W. Bray. Images are "conscious memories which reproduce a previous perception, in whole or in part. in the absence of the original stimulus to the perception." Possibly every sense can produce its own type of image, the visual being the commonest and the most stirring; though it has been claimed that the organic sensations. including pain, and the muscular or kinesthetic sense may not call up conscious memories but actually, if faintly, reinstate immanent experiences.

It is usually easy to distinguish between a visual image and the actual percept. Failure to do so may involve disorders of conduct obvious to other people. But possibly the organic and kinesthetic senses provide us with actual experiences, which may easily pass into the real thing if the mind dwells upon them. In relatively rare instances in adults (probably not so rare in children) eidetic (visual) images may arise. They are not mistaken for percepts, but are more vivid and detailed than ordinary visual images. Such experiences are described by some portrait painters, and many people have them before falling asleep (hypnagogic). Dream images. too, are often of this type, and the intensity and character of images are both affected by drugs of various kinds.

Individual differences in imagery are so great that hardly any statement about them will not be disbelieved or even denied by some. Probably visual imagery is common and plays a great part in the mental life of ordinary people. Yet since thinking with words is needed for success in many types of written examinations, especially in philosophy, it is possible that study which leads to such success comes easier to the type of mind which turns away from concrete particulars and thinks in abstractions. Hence, since in the past psychologists have usually been recruited from the ranks of philosophy, their views concerning visual imagery are often faintly surprising to a nonpsychologist, who does not recognize his own mind in these descriptions.

Words, however, can come to the mind as images (visual, auditory, auditomotor) though their content is obviously itself more stereotyped; *e.g.*, the word "home" may be imaged in similar ways by thousands of people for nhom the visual image of "home" would be suffused uith intimate personal detail. "Imageless thinking" probably takes place in many professional thinkers. For them, "marginal utility" or "power politics" needs no specific picture. Yet some defenders of visual images hold that the abstract

thinking of the nonvisualizer might often be the better for a regular return to concrete examples, since it is apt to outstrip them. Occasional attempts to give examples of "democracy" might be good for all concerned. Experimental psychologists have worked in this region, but their aim has often been to assess or even to measure the utility, in thinking. of imagery; *i.e.*, its power of rendering the processes of judgment more effective. or of solving problems of a quasi-geometrical kind. Attempts have been made to deprive the experimental subject of the power of using imagery in solving a problem, or to pose one which might seem to offer special facilities to the visualizer. But it is doubtful whether such experiments cast much light except upon the artificial situations they were devised to explore. A visualizer may prefer to solve a geometrical problem in a nonvisual way (*e.g.*, by inner speech) because of the strain which visual imagery might entail, while his use of visual imagery in aesthetic enjoyment of memories or in judging whether he prefers one person, place or thing to another may be constant.

Since speech on the radio was deliberately contrived to call up visual imagery, it played a considerable part in most people's imaginations until the advent of television restored the balance of sight and sound.

It might be noted that one may open a book on, for example, Shakespeare's imagery without knowing if the writer is concerned with the poet's use of figures of speech, his power of suggesting imagery to the reader by descriptive writing. whether figurative or not, or the imagery (visual, auditory, kinesthetic, etc.) which the poet himself experiences.

Auditory imagery is probably much rarer, at least in an intensive form, this visual. Though many people can hear sounds in their "mind's ear," few can call up the full texture of an orchestra, though there are many instances (Beethoven. Mozart, Wagner, Elgar) in which this feat is recorded. Probably there is a great tendency for auditory imagery to arise in conjunction nith the muscular imagery necessary to sing, speak or whistle. It is common for people to assert that they cannot image easily, or at all, sounds (*eg.*, thunder, a waterfall) which they cannot make or at least imitate satisfactorily.

The associative powers of smells are famous, though usually it requires the actual percept of the odour, and not its image, to set off a train of vivid memories. It has been suggested that this special power of odours may be attributable to the fact that they are usually unanalyzable and therefore exist in their own right. If we see 50 Alps in the course of a holiday, their colour, shape and details are analyzed to some extent; but the smell of a wood fire or of melted ski wax may bring up a vivid Swiss memory with startling affective accomganiment.

Associated with this subject is that of synesthesia, uhen, to take a simple example, a percept (*e.g.*, of the sound of a violin) may evoke an image not of the instrument but of a colour or texture So a timbre, a pitch, a voice quality, even a musical key, may bring up images of colour. Alexander Scriabin and Nicolas Rimsky-Korsakov both used colours in composing music. There may also be associations between images of the different senses, or, if the auditory image (say of a voice) cannot be evoked, a visual image (*e.g.*, of gray velvet) may symbolize the voice. The musical criticisms of some modern writers are full of such derived adjectives (*e.g.*, "astringent" for a piano tone, "rich copper" for the sound of strings in a particular part of a symphony) though nothing but the critic's own introspection could decide if he mas working with concrete images, or merely with words which suggested them. While it is impossible to know if Rupert Brooke's "The Great Lover" is a list of the vivid images he enjoyed, Robert Graves in Poetic *Unreason* has given some account of his own imagery.

Imagery has often been described as fleeting and variable; hence, an unsure guide for thinking. Yet number forms, which are common, complicate such a simple belief. Their possessors either visualize numbers, or their positions, in patterns containing clock-faces, plans of malls in a garden or similar other remembered patterns of space. Assertions are not rare that number forms are useless or an obstacle to their possessor when calculating. Yet further investigation shows that while many find them useful others find them useless, and one distinguished mathematician used a number form which symbolized imaginary numbers and went up to 1,000,000,000,000. They are apt to remain relatively unaltered during life in many of their possessors, thus disproving the common generalization that all imagery is shifting and unstable. It is not irrelevant to remark that the use of the word "imagery" for all the "robust contents" of that part of our mental life which we call remembering, thinking and dreaming confuses a large number of discriminable events. Until more distinctions have been drawn between the processes involved in perceiving, imagining, judging, conceiving, thinking and expounding thoughts, many discussions of the uses of imagery are likely to be futile.

The details of creative imagination have been discussed by T. Ribot (*L'Imagination créatrice*) and by June E. Downey *(Creative Imagination)*. There are many connections, as yet not worked out, between creative imagination and the processes of dreaming. In fact, it is possible that Sigmund Freud's theory of the dreamwork could be profitably supplemented by determinations oi the extent to which the condensation, displacement oi emotion and regard for presentability which he describes are also operative in creative thinking. And since it is probably difficult to recall in exact detail any complicated object or scene which resembles another (both having been seen at different times by the same person), the possibility is not excluded that all recalling is in some degree creative.

Experiments upon thinking carried out by the Würzburg school resulted in the establishment of much evidence that one can think without discoverable imagery (imageless thought). "Undiscoverable," however, might mean "so dim as to be difficult to discern except by the trained introspectionist," and the thinking of such an introspectionist, himself a philosopher, when applied to abstract matters, might be far from typical. It seems probable that imageless thought exists, though it should be noted that one of its vehicles may be the conscious attitude (a blend of kinesthetic imagery and visceral sensation)—the last remnant of kinesthesis in a mind which had subsequently developed speech habits.

BIBLIOGRAPHY.—C. W. Bray, chapter in E. G. Boring, H. S. Langfeld and H. P. Weld (eds.), *Psychology* (1935); June E. Downey, *Creative Imagination* (1929); *B.* Edgell, "Images." *Proceedings of the Aristotelian Society,* vol. *31,* pp. *1–24* (1930–31); J. *C.* Flügel, *A Hundred Years of Psychology, 1833–1933* (1940); Robert Graves, *Poetic Unreason,* ch. xiv (1925); *E.* Jaensch, *Eidetic Imagery and Typological Methods of Investigation* (1930); *T. H.* Pear, "The Place of Imagery in Mental Processes," *Bulletin of the John Rylands Library,* vol. 21 (1937), *Remembering and Forgetting* (1922), *Voice and Personality* (1931), *The Psychology of Effective Speaking* (1938), *The Psychology of Conversation* (1939); *H.* Read, *Education Through Art* (1943).

(T. H. P.)

IMAGE WORSHIP: see IDOLATRY.

IMAGINARY NUMBER: see COMPLEX NUMBERS.

IMAGINATION: see IMAGERY; PSYCHOLOGY; *THINKING,* PSYCHOLOGY OF.

IMAM (Arabic, "leader" in the sense of a "pattern whose example is followed"). In the Koran it is used several times of leaders and (ii, 118) of Abraham, "Lo, I make thee a pattern for mankind." Imam thus became the name of the head of the Moslem community. His duty is to be the lieutenant, the caliph of the prophet, to guard the faith and maintain the government of the state. Around the origin and basis of his office all controversies as to the Moslem state centre. The Sunnites hold that it is for men to appoint; the Shi'ites, in general, that the appointment lies with God. through the Prophet or otherwise, and that He always has appointed. The Kharijites recognize no absolute need of an Imam; he is convenient and allowable. Another distinction between the Sunnites and the Shi'ites is that the Sunnites regard the Imam as liable to err, and to be obeyed even though he personally sins. provided he maintains the ordinances of Islam. But the Shi'ites believe that the divinely appointed Imam is also divinely illumined and preserved (*ma'sum*) from sin. The above is called the greater Imamate. The lesser Imamate is the leadership in the Friday prayers. This was originally performed by the Imam in the first sense, who not only led in prayers but delivered a sermon (*khutba*); but with the growth of the Moslem empire and the retirement of the caliph from public life, it was necessarily given over to deputies. who in Turkey were servants of the state, each in charge of his own parish; they performed the rites of circumcision. marriage and burial. In Persia among Shi'ites their position is more purely spiritual, and they are independent of the state. A few of their leaders are called mujtahids; *i.e.*, capable of giving an independent opinion on questions of religion and canon

law. A third use of the term Imam is as an honorary title. It is thus applied to leading theologians, *e.g.*, to Abu Hanifa, ash-Shafi'i, Malik ibn Anas, Ahmad ibn Hanbal (these are called "the four Imams"), Ghazali.

BIBLIOGRAPHY.—Ibn Khaldun, *Prolégomènes,* tr. by McG. de Slane, i, 384 *et seq.*, 402 *et seq.*, 426 *et seq.*, 445; iii, 35, 58 *et seq* (1851); Haarbrucker's trans. of Shahrastani by index; 56 *et seq.*; T. W. Arnold, *The Caliphate* (1924), by index; D. B. MacDonald, *Development of Muslim Theology, Jurisprudence and Constitutional Theory* (1903).
(D. B. M.)

IMBECILE: see MENTAL DEFICIENCY.

IMBREX, in architecture, one of the raised, covering tiles placed over the joints between the flat tiles or pantiles in an ancient Greek or Roman roof. The pantiles were laid with the joints in each course, or row, exactly in line with the joints above and below, so that the imbrex tiles formed continuous ridges. There were two types. in one the tile was approximately semicircular, but in the more commonly used form and in the monumental marble examples the imbrex had vertical sides and an angular top. At the lower end of each row of imbrex tiles aas an antefix (*q.v.*) or decorative terminal. The plural is imbrices.

IMBROS or IMROZ, an island in the Aegean belonging to Turkey, at the southern end of the Thracian Chersonese peninsula. Herodotus (v, 26) mentions it as an abode of the historic Pelasgians (*q.v.*). It was, like Samothrace, a seat of the worship of the Cabeiri (q v.). There is much volcanic rock and parts of the island are very fertile. Wheat, oats, barley, olives and fruit are grown. The island was occupied by Greece during and after World War I. It uas also an important base for the British and Allied operations in the eastern Mediterranean at the same time. It was returned to Turkey by the treaty of Lausanne (1923). Its population is (1955) 6,243 and area 108 sq.mi.

IMHOTEP, a famous physician and sage of ancient Egypt, who afterward became the god of medicine.

Egyptian texts speak of Imhotep as a minister who lived in the reign of the pharaoh Zoser of the third dynasty (*c.* 2980 B.C.). He acquired a great reputation for his wisdom and learning and became first a demigod and, under the Ptolemies, the Egyptian god of medicine. By the Greeks Imhotep was called Imouthes, and by them was identified with Asklepios, the god of healing. Although certain Egyptologists regarded Imhotep as legendary, and doubted that he lived as an actual man in the reign of Zoser, later discoveries converted into certainty what aas ever a probability. There can no longer be the slightest doubt that Imhotep was a historical personage, and that, in common with other Egyptian nobles, he held civil as well as religious offices. He was vizier, architect, chief ritualist, sage and scribe under the ponerful king who built the celebrated "step pyramid" of Sakkara. There is no contemporary evidence that Imhotep was a physician, but his priestly duties were intimately concerned with magic, and in Egypt magic and medicine were inseparably related. Imhotep is referred to in certain literary texts as a sage of great renown, and he was born in the neighbourhood of Memphis, his parents being Kanufer and Khreduonkh. Under the Ptolemaic dynasties he was invested with all the attributes of deity and was regarded as the son of the Memphite god Ptah, ahose name is substituted for that of his earthly father, Kanufer. Imhotep had shrines as well as temples of his own in various parts of Egypt and of Nubia. It was believed that miraculous cures could be effected by his divine intervention, and his temples aere thronged with sufferers, many of whom have left records of their gratitude. Statues and figurines of Imhotep as god of medicine have been found in considerable numbers, and these attest his widespread popularity. The evidence afforded by Egyptian and Greek texts supports the view that Imhotep's reputation was respected in very early times and that he became at least a demigod not long after his death. His prestige increased with the lapse of centuries, and his temples in Greek times were the centres of medical teaching. His posthumous deification is paralleled by that of another Egyptian sage, Amenophis, the son of Hapu, who lived in the 18th dynasty. held civil and religious offices in the reign of Amenophis III and was deified under the Ptolemies and closely associated with Imhotep and aith medicine. (See W. R. Dawson, "Amenophis the Son of Hapu," *Aegyptus,* vol. vii, pp. 113–138 [1926].) Imhotep and Amenophis as deified mortals stand almost alone in Egyptian history, and both, during their lives, must have been men of outstanding merit to have earned such signal posthumous recognition.

BIBLIOGRAPHY.—K. Sethe, *Imhotep, der Asklepios der Aegypter,* Untersuchungen zur Geschichte und Altertumskunde Aegyptens, Bd. ii (1902); J B. Hurry, *Imhotep, the Vizier and Physician of King Zoser and Afterwards the Egyptian God of Medicine,* 2nd ed., with bibliography (1928).
(W. R. D.)

IMITATION is the reproduction or performance of an act the stimulus for which is the observation of a similar act of another animal or person. Essentially it involves a model set by the imitatee to which the attention and response of the imitator are directed. As a descriptive term it covers a wide range of social adaptation. Observers of mammalians in their native habitat report the duplication of the activities of the older by the younger members of the species, or of the young of each other in play. Experiments on like animals in the laboratory, such as having one animal watch another pull a string to release an escape door of a cage, or the performance of some other seemingly simple act, have produced contradictory results. Or if imitation was reported, it was described as of a low order, meaning it involved, at best, duplication of some element of the model, not the whole action. More carefully controlled studies, however, have given evidence for inferential imitation on the part of monkeys (C. J. Warden and T. A. Jackson, 1935).

Among human beings imitation has been used to describe behaviour ranging from ideomotor duplication of the leg reaction of a high jumper and such everyday experiences as yawning when others yawn, running when others run, laughing when others laugh and a whole host of unconsciously and passively learned reproductions of social conduct, to the deliberate and self-conscious adoption of the ideas and habits of others.

Studies of infants show that in the second half of the first year they will imitate the expressive movements of those about them; for example, raising of the arms, smiling and babbling. In the second year they begin imitating other people's reactions to objects. As the child grows up all kinds of models are set before him, most of them determined by his culture: physical posture, language, basic skills, prejudices and pleasures and the moral ideals and taboos. His copying these is determined chiefly by the manner in which his drives are socially and culturally directed and controlled in terms of reward and punishment. The duplication of responses set up by those in positions of authority and prestige are well known. Here suggestion (*q.v.*) as well as imitation is involved.

The facts of imitation, then, are well established. Difficulty ensues, however, when the question of explanation is raised. Uniformity or similarity of thoughts and acts among people does not necessarily mean that these are caused by the same or similar psychological motives or mechanisms. Deviations in the situations, in drives and in the learned ways of adaptation are often too complicated to permit of easy explanation by a descriptive term like imitation.

Many earlier psychologists took it for granted that imitation was caused by an instinct or, at least, by an inherited predisposition—the "pseudoinstinct" of W. McDougall (1908). Later writers have viewed the mechanisms of imitation as those of learning. It is usual, however, to distinguish between imitation caused by simple conditioning, that caused by common trial-and-error learning and that involving the higher thought processes (G. Murphy, L. B. Murphy and T. M. Newcomb, 1937). Almost all agree with the writer who said, "We learn to imitate" rather than "learn by imitation" (C. Bird, 1940). The conditioned-reflex theory of learning so modified as to include drive and final reward or punishment in the total process provides a lead to more careful analysis of the factors operating in various forms of imitation (N. E. Miller and J. Dollard, 1941).

Certainly as it stands, imitation is a descriptive not an explanatory concept. Yet, as such, it has considerable use in social psychology. But any consideration of imitation among human beings must take the following factors into account: (1) there is a common constitutional or organic likeness in drives and learn-

ing capacity which make for similar adult motivations and like responses; (2) there are a great many similar situations in which the developing individual is conditioned, through his nonculturalized but withal social relations as well as by means of culture itself; (3) social facilitation also plays a part, especially in the suggestion-imitation processes of prestige-bearing models and in the crowd-stimulus effect seen in mobs, panics, audiences, fashion and other forms of collective behaviour (*see* PSYCHOLOGY, HISTORY OF: *Social Psychology*); (4) finally, there is so-called conscious or deliberate imitation which rests upon the introjection of others' responses into one's own symbolic system and their reorganization, largely in self-other terms. This makes possible planned, self-conscious duplication of the ideas, attitudes and habits of others.

BIBLIOGRAPHY.—F. H. Allport, *Social Psychology* (1924); W. Bagehot, *Physics and Politics* (1872); C. Bird, *Social Psychology* (1940); E. B. Holt, *Animal Drive and the Learning Process* (1931); W. McDougall, *Social Psychology* (1908); N. E. Miller and J. Dollard, *Social Learning and Imitation* (1941); G. Murphy, L. B. Murphy and T. M. Newcomb, *Experimental Social Psychology*, rev. ed. (1937); C. J. Warden and T. A. Jackson, "Imitative Behavior in the Rhesus Monkey," *Journal of Genetic Psychology*, vol. 46, pp. 103–125 (1935); K. Young, "Imitation," *Encyclopedia of the Social Sciences*, vol. 7, pp. 586–587 (1932). (K. Y.)

IMITATION OF CHRIST, THE (*Imitatio Christi*), the title of a famous mediaeval Christian devotional work, much used still by both Catholics and Protestants and usually ascribed to Thomas à Kempis. The prolonged controversy over the authorship of the work has been narrowed down to the issue, "either Thomas à Kempis, or an unknown author."

The following is a statement of the facts that may be received as certain:

1. It is the verdict of the most competent modern expert opinion that there is no palaeographical reason for suspecting that any known manuscript of the *Imitation* (or any part of it) is earlier than the first quarter of the 15th century. The earliest dated manuscript is of book I only (1424).

2. A Latin letter of a Dutch canon regular named Johann van Schoonhoven exhibits such a close connection with book I that plagiarism on the one side or the other is the only possible explanation. It is capable of demonstration that the author of the *Imitation* was the borrower, and that the opposite hypothesis is inadmissible. This letter can be shown to have been written after 1382. Therefore, book I was beyond controversy written between the years 1382 and 1424.

3. It is not here assumed that the four parts of the work formed a single work, or even that they are all by the same author; the date of the other three books cannot be fixed with the same certainty. But, on the one hand, before the beginning of the 15th century there is no trace whatever of their existence—a strong argument that they did not yet exist; and, on the other hand, after 1424 nearly each year produces its quota of manuscripts and other signs of the existence of these books become frequent. Moreover, as a matter of fact, the four treatises did commonly circulate together. The presumption is strong that books II, III and IV, like book I, were composed shortly before they were put into circulation.

It may then be taken as proved that the *Imitation* was composed between 1380 and 1425, and probably toward the end rather than the beginning of that period. Having ascertained the date, we must consider the birthplace.

4. A number of idioms and turns of expression throughout the book show that its author belonged to some branch of the Teutonic race.

5. Of the 400 manuscripts of the *Imitation*, 340 come from the Teutonic countries—another argument in favour of its Teutonic origin. Again, 100 of them, including the earliest, come from the Netherlands. This number is quite disproportionate to the relative size of the Netherlands, and so points to that country as the one in which the *Imitation* was first most widely circulated and presumably composed.

6 There is a considerable body of early evidence, traceable before 1450, that the author was a canon regular.

7. Several of the manuscripts were written in houses belonging to the Windesheim congregation of canons regular, or in close touch with it. Moreover, there is a specially intimate literary and spiritual relationship between the *Imitation* and writings that emanated from what has been called the "Windesheim circle."

8. There can be no question that in the Windesheim congregation itself there was already, during Thomas à Kempis' lifetime, a fixed tradition that he was the author of the *Imitation*. The most important witness to this tradition is Johann Busch, who passed a great part of his life in Windesheim, only a few miles from Mount St. Agnes, the monastery of which Thomas was an inmate. It would be hard to find a more authentic witness. Another witness is Hermann Rhyd, a German member of the Windesheim congregation, who also had personally known Thomas. Moreover, the tradition existed in Thomas & Kempis' own monastery shortly after his death, for John Mauburne became a canon in Mount St Agnes within a few years of Thomas' death, and he states more than once that Thomas wrote the *Imitation*.

9. The earliest biographer of Thomas à Kempis was an anonymous contemporary; the *Life* was printed in 1494, but it exists in a manuscript of 1488. The biographer says he got his information from the brethren at Mount St. Agnes, and he states in passing that book III was written by Thomas. Moreover, he appends a list of Thomas' writings, 38 in number, and 5–8 are the four books of the *Imitation*.

Internal arguments have been urged against Thomas' authorship. It has been said that his certainly authentic writings are so inferior that the *Imitation* could not have been written by the same author. It may be granted that Thomas was a prolific writer, that his writings vary very much in quality and that the *Imitation* surpasses all the rest, and that some are on a level very far below it; still, when at their best, some of the other works are not unworthy of the author of the *Imitation*.

It has been said that *The Imitation of Christ* has had a wider religious influence than any book except the Bible, and if the statement be limited to Christendom it is probably true. The *Imitation* has been translated into more than 50 languages, and is said to have run through more than 6,000 editions. The other statement, often made, that it sums up all that is best of earlier western mysticism, that in it "was gathered and concentered all that was elevating, passionate, profoundly pious in all the older mystics" (Milman), is an exaggeration. It depreciates unduly the elder mystics and fails to do justice to the originality of the *Imitation*. For its spiritual teaching is different from the mysticism of Augustine in the *Confessions*, or of Bernard in the *Sermons on the Song of Songs;* from the scholastic mysticism of the St. Victors or Bonaventura; and from the mysticism of the German school of J. Eckhart, H. Suso, J. Tauler and J. van Ruysbroek. Again, it is different from the later school of St. Teresa and St. John of the Cross, and from the introspective methods of what may be called the modern school of spirituality. The *Imitation* stands apart, unique, as the principal and most representative utterance of a special phase of religious thought—nonscholastic, non-Platonic, positive and merely religious in its scope—herein reflecting faithfully the spirit of the movement initiated by Gerhard Groot (*q.v.*), and carried forward by the circles in which Thomas à Kempis lived. In contrast with many mystical writings it is of limpid clearness, every sentence being easily understandable by all whose spiritual sense is in any degree awakened. No doubt it owes its universal power to this simplicity, to its freedom from intellectualism and its direct appeal to the religious sense and to the extraordinary religious genius of its author.

BIBLIOGRAPHY.—The best account in English of the controversy is that given by F. R. Cruise in his *Thomas à Kempis* (1887). Works produced before 1880 are in general, with the exception of those of Eusebius Amort, superannuated, and deal in large measure with points no longer of any living interest. A pamphlet by Cruise, *Who was the Author of the Imitation?* (1898), contains sufficient information on the subject for all ordinary needs; it has been translated into French and German, and may be regarded as the standard handbook.

The best Latin edition of the *Imitation* is that of Hirsche (1874), which follows closely the autograph of 1441 and reproduces the rhythmical character of the book. Of English translations the most interesting is that by John Wesley, under the title *The Christian's Pattern* (1735). (E. C. B.; X.)

IMMACULATE CONCEPTION, THE. This dogma of the Roman Catholic Church was defined as "of faith" by Pope Pius IX in the Bull *Ineffabilis Deus* (Dec. 8, 1854) in the following terms: "The doctrine which holds that the Blessed Virgin Mary, from the first instant of her conception, was, by a most singular grace and privilege of Almighty God, in view of the merits of Jesus Christ, the Redeemer of the human race, preserved from all stain of Original Sin, is a doctrine revealed by God, and therefore to be firmly and steadfastly believed by all the faithful." The definition imposed no new doctrine on Catholics but merely declared that what had always been believed by the faithful had its origin in revelation as found in Scripture and tradition. The traditional belief had been thoroughly investigated by a special papal commission, which finally reported that the doctrine could be defined and that the time was opportune. The Immaculate Conception is a privilege over and above that immunity from personal sin conceded to Mary. By it Mary, in view of her dignity

as Mother of God, was *immune* from original sin in which all descendants of Adam are conceived, and from which they are freed by baptism. Sanctifying grace was infused into her soul simultaneously with its creation by God. The testimony of Scripture (especially Genesis iii, 15; Luke i, 28) is only implicit, and the same is true of the fathers, but they make constant reference to Mary's unparalleled holiness and the contrast between her and the first Eve. The testimony of the faithful can be gathered from their devotion to Mary the all-holy and their celebration of a special feast from the early centuries. Some of the Scholastics impugned the feast because of an imperfect understanding of the doctrine, but their private judgment did not reflect the belief of the universal church. The Immaculate Conception should not be confused with the Virginal Conception and Virgin Birth which assert Mary's perpetual virginity.

BIBLIOGRAPHY.—C. Passaglia, *De immaculato Deiparae semper Virginis conceptu commentarius,* 3 vol. (Rome, 1854–55); T. Gousset, *La Croyance générale et constante de l'Église touchant l'immaculte conception* (Paris, 1855); W. B. Ullathorne, *The Immaculate Conception of the Mother of God,* 2nd ed. (London, 1904); X. le Bachelet, *L'Immaculée Conception* (Paris, 1903); J. Pohle and *A.* Preuss, *Mariology,* 6th ed. (1930). *See* also the article "Immaculate Conception" in the *Catholic Encyclopedia,* by *F.* C. Holweck; and that in the *Dictionnaire de Thdologie Catholique,* by *X.* le. Bachelet, vol. vii, col. 845–1218. Numerous references to sources and to periodical articles will be found in *Lexikon fur Theologie und Kirche,* under "Empfangnis Maria."

IMMANENCE, in philosophy and theology a term applied, in contradistinction to "transcendence," to the fact or condition of being entirely within something (from Lat. *in-manere,* to dwell in, remain). Its most important use is for the theological conception of God as existing in and throughout the created world, as opposed, for example, to deism (*q.v.*), which conceives Him as separate from and above the universe. This conception has been expressed in a great variety of forms *(see* PANTHEISM; THEISM).

IMMANUEL BEN SOLOMON (c. 1270–*c.* 1330), Hebrew poet, mas born in Rome, He was a contemporary and friend of Dante, and his verse shows the influence of the "divine poet." Immanuel's fame chiefly rests on his poems, especially the collection (in the manner of Harizi [*q.v.*]) entitled *Mehabberoth,* a series of 27 good-natured satires on Jewish life. Most popular is an additional section numbered 28 (often printed by itself) called *Hell and Paradise (ha-Tophet veha-Eden).*

See J. Chotzner, *Hebrew Humour,* pp. 82–102 (1905).

IMMERMANN, KARL LEBERECHT (1796–1840), German dramatist and novelist, was born on April 24, 1796 at Magdeburg, the son of a government official. His legal studies at Halle were interrupted by the call to arms and by the campaign of 1815, after which he returned to the university. He was *Referendar* in Magdeburg, and in 1819 *Assessor* at Miinster in Westphalia. There he made the acquaintance of Elise von Lützow, countess von Ahlefeldt, wife of the leader of the famous "free corps" *(see* LÜTZOW), and their relationship is reflected in several dramas written about this time. In 1823 Immermann was appointed judge at Magdeburg, and in 1827 was transferred to Dusseldorf. Thither the countess, whose marriage had in the meantime been dissolved, followed him, and shared his home until his marriage in 1839. In 1834 Immermann became manager of the Dusseldorf theatre where he accomplished great things in spite of lack of adequate funds. In 1836 he returned to his official duties. He died at Diisseldorf on Aug. 25, 1840.

Immermann's early plays are imitations, partly of A. von Kotzebue's, partly of the Romantic dramas of J. L. Tieck and A. Müllner, and are now forgotten. In 1826, however, appeared *Cardenio und Celinde,* a love tragedy ridiculed by count von Platen in his wittiest satire, *Der romantische Oedipus.* Between 1827 and 1832 Immermann wrote a series of historical tragedies. *Das Trauerspiel in Tirol,* on Andreas Hofer (1827), *Kaiser Friedrich* 11 (1828) and a trilogy from Russian history, *Alexis* (1832). His masterpiece is the poetic mystery, *Merlin* (1831), which, like its model, *Faust,* deals with the problems of spiritual life. Immermann's important dramaturgic experiments in Dusseldorf are described in detail in *Düsseldorfer Anfänge* (1840). As a novelist he clearly stands on the boundary line between romanticism and modern literature; his *Epigonen* (1836) might be described as one of the last romantic imitations of Goethe's *Wilhelm Meister,* while the satirical picture of contemporary life in his second novel, *Münchhausen* (1838–39), forms a major break with the older literature. In *Miinchhausen* is embedded the admirable story of village life, *Der Oberhof.* His last works were *Memorabilien* (1840–43), critical aesthetic observations, and an unfinished epic, *Tristan und Isolde* (1841).

BIBLIOGRAPHY.—*Gesammelte Schriften,* 14 vol. (Diisseldorf, 1835–43); new edition with biography and introduction by R. Boxberger, 20 vol. (Berlin, 1883); selected works, M Koch (ed.), 4 vol. (Stuttgart. 1887–88); selected works, F. Muncker (ed.), 6 vol. (Stuttgart, 1898); G. zu Putlitz, *Karl Immermann, sein Leben und seine Werke,* 2 vol. (Berlin, 1870); F. Freiligrath, *Karl Immermann, Blätter und Erinnerung an ihn* (Stuttgart, 1842); H. Maync, *Immermann, der Mann und sein Werk* (Munich, 1921).

IMMIGRATION: *see* MIGRATION; **POPULATION.**

IMMINGHAM, a seaport in Lindsey, Lincolnshire, Eng., on the south shore of the Humber estuary, 5 mi. N.W. of Grimsby. Pop. (1951) 2,803. The docks (with the graving dock) have a water area of 45 ac. with 9,097 ft. of quayage and berthage. The port was built there (1906–12) because the deep water (47–43 ft. depth) enables vessels to enter and leave unaided at all states of the tide. In 1953 over 3,000,000 tons of coal were exported. Iron and other ore are imported, largely for Scunthorpe's steel mills. Other cargoes handled include grain, timber, chemicals and oil. There are also passenger facilities and the R.A.F. maintain an air-sea rescue unit. The dockers have a reputation for quick turn-round of ships.

IMMOLATION, the ceremonial rites performed in the preparation of victims for sacrificial purposes. The human sacrifice or *sati* (suttee) of India consists of the immolation of a widow on the funeral pyre of her husband, and the Khond sacrifice of the meriah; the days preceding the sacrifice were devoted to increasing the sanctity of the victim by various processes of anointing and other ceremonies. *(See* SACRIFICE.)

IMMORTALITY. The term "immortal" has been used in a wide general sense for everlasting. as in such statements that the writings of Plato, the plays of Shakespeare, the music of Mozart, are immortal. But in its chief use the term "immortality" has had reference to a continuity of men's spiritual existence after the death of their bodies. This article is limited to that conception.

The earlier anthropologists, as E. B. Tylor and Sir James Frazer, assembled convincing evidence that the belief in a future life was widespread in the regions of primitive culture. Among most peoples the belief has continued through the centuries. But the nature of future existence has been conceived in very different ways. As Tylor showed, in the earliest known times there was little, often no, ethical relation between conduct on earth and the life beyond. M. Jastrow wrote of "the almost complete absence of all ethical considerations in connection with the dead" in ancient Babylonia and Assyria. Motoori, an 18th century Japanese thinker, said that "Hades is a land beneath the earth. whither, when they die, all men go, mean and noble, virtuous and wicked, without distinction." In some regions it came to be declared that warriors who died in battle went to a place of happiness. Later, there was a general development of the ethical idea that the afterlife would be one of rewards and punishments for conduct on earth. So in ancient Egypt at death the individual was represented as coming before judges as to that conduct. The Persian followers of Zarathustra accepted the notion of Chinvat, a bridge to be crossed after death, broad for the righteous, narrow for the wicked who fell from it into hell. In India, the steps upward—or downward—in the series of future incarnated lives have been (and still are) regarded as consequences of conduct and attitudes in the actual present life. The idea of future rewards and punishments dominated many Christians in the middle ages, and is held today by many Christians of all denominations. In contrast many contemporary secular thinkers maintain that the morally good is to be sought for itself, and evil shunned on its own account, irrespective of any belief in a future life.

That the belief in immortality has been widespread through history is no proof of its truth. It may be a superstition that arose

from dreams or other natural experiences. Thus, the question of its validity has been raised philosophically from the earliest times that men came to intelligent reflection. In the Hindu *Katha-Upanishad,* Naciketas says: "This doubt there is about a man departed—some say: He is; some: He does not exist. Of this would I know." The *Upanishads,* the basis of most philosophy in India, are predominantly a discussion of the nature of man and his ultimate destiny. Immortality was one of the chief problems of Plato's thought. With the contention that reality, as such, is fundamentally spiritual. he tried to prove immortality, maintaining that nothing could destroy the soul. Aristotle conceived reason as eternal, but did not defend personal immortality as he thought the soul could not exist disembodied. The Epicureans, from a materialistic standpoint, held that there is no consciousness after death. and thus it is not to be feared. The Stoics mostly considered that it is the rational universe as a whole that persists. Individual men, as Marcus Aurelius wrote, simply have their allotted periods in the drama of existence. However, Cicero *(see* below) finally accepted personal immortality. Augustine, following Neo-Platonism, regarded men's souls as being in essence eternal. The Moslem philosopher Avicenna declared the soul immortal, but his coreligionist, Averroes, keeping closer to Aristotle, accepted the eternity only of universal reason. Albertus Magnus defended immortality on the ground that the soul, in itself a cause, is an independent reality. John Duns Scotus contended that personal immortality cannot be proved or disproved by reason. Spinoza, taking God as ultimate reality as a whole maintained His eternity, but not the immortality of individual persons within Him. Leibniz contended that reality is constituted of spiritual monads. Men, as finite monads, not capable of origination by composition, are created by God. He could also annihilate them. However, in that he has planted in men a striving for spiritual perfection there may be faith that he will ensure their continued existence giving them the possibility to achieve it. Kant, admitting that the soul cannot cease by disintegration suggested that it might end by the loss of its own power. Immortality cannot be demonstrated by pure reason, but it may be believed as a postulate of morality. Holiness, "the perfect accordance of the will with the moral law," demands endless progress "only possible on the supposition of an endless duration of the existence and personality of the same rational being (which is called the immortality of the soul)." Joseph Butler. insisting that probability is the guide to life, urged, on ethical grounds similar to those of Kant, that immortality should be accepted as probable. Hegel's philosophy has been interpreted by one wing of his followers as pointing to a cessation of finite individualities in the absolute, and by another to their persistence as constituents of the absolute. A Schopenhauer conceived ultimate redemption from the misery of life as a lapse from conscious personality into the unconscious universal will. The foregoing illustrates the chief positions held in philosophical treatments. After 1925 there was little philosophical discussion of the problem. There was a widespread impression that no conclusions could be reached concerning it and its consideration might be avoided. William Ernest Hocking challenged this contemporary attitude as an "idleness of mind."

Any form of spiritual continuity has been rejected by some thinkers on the basis of an assumption that all is physical. Few philosophers in the occident or the orient have adopted a definite materialism. It was most widespread at mid-20th century among the adherents to Marxian communism. They find in it a ground for rejection of the belief in immortality, taken to be promulgated by priests and others to exploit the masses of the world. Some contemporary thinkers, discarding the term materialism for naturalism, treated man as part of nature. Though their position was metaphysically indefinite, they endeavoured to describe human psychical life without the admission of a spiritual soul or a spiritual deity. Gilbert Ryle describes the soul as a ghost. Corliss Lamont considers immortality an illusion, probably a delusion. The fundamental difficulty that should be regarded as definitely ruling out materialism and all forms of contemporary naturalism is that it is impossible to describe the difference between truths and errors in terms of physical processes. In dismissing the soul as a ghost, Ryle gives no satisfactory account of himself as the thinker of his own theories. Lamont similarly ignores the being who distinguishes between realities and illusions. The contention that we do not know *how* a spiritual mind and a material body may interact is met by the reply that we do not know *how* one material body may affect another. The ultimate problem in both is that of change. Changes have to be accepted; they cannot be explained in terms of the changeless. From the standpoints of science and philosophy the position in the 1950s was not fundamentally different from what it was for William James in 1905: that the relations of mind and body may be described in terms of the interactions of a spiritual being and a physical organism. But even if the soul is different from the body, they are so intimately related that it is extremely difficult to conceive of the continuance of a bodyless soul. This difficulty has been in part met, especially in the orient by the doctrine of reincarnation, and in the occident among Christians with the belief that the soul will have a spiritual body.

In contrast with materialism and naturalism is the theory that reality is ultimately one universal spirit and individual human beings only transitory manifestations of it. Though the one spirit is called eternal, human beings are not to expect personal immortality. The fundamental difficulty of this theory is that both truths and errors are manifestations of the one spirit, who alone is their ultimate thinker. The spirit, the absolute, is in a condition of self-contradiction. The conflicts of good and evil are within it. There is no escape from the difficulty by calling the contradictions and conflicts mere appearances, for the appearances must be in the absolute as they appear.

Discussions of immortality have frequently been obscured by the contention that what men seek is the "eternal." Rudolph Eucken spoke of immortality as experiencing the eternal "in the midst of time." William Ralph Inge interpreted it as a participation in eternal values, and seemed to have a contempt for the idea of a future life for individual minds. The two conceptions of eternity, (1) that it is a now inclusive of all the past, the present and the future; and (2) that it is something in itself timeless or transcending time, are products of abstract reflection. It cannot be said that men have any experience of either. For those other than the few philosophers and theologians who use these conceptions, immortality normally means temporal personal continuity. But within the now of this life and the future of a next one, the religious mind may have an enduring communion with an ever-living God that may give a satisfaction greater than that in values that may not persist. That may be what is sometimes called, indefinitely, an experience of the eternal.

It has frequently been argued that there is a universal desire for personal immortality—as though instinctive, involving its eventual satisfaction. But Sir William Osler, with wide experience of persons near to death, declared that one minority of them ardently desired a future life, another minority hoped for final extinction, and the majority appeared indifferent. The scientist Ilya Metchnikov, after a critical examination of the philosophical and religious arguments for immortality, argued that the discontent of men is due to their failure to obtain complete satisfaction of their natural impulses. If they could live to a ripe old age and attain that satisfaction they would accept death as the natural end of life. Such longevity and satisfaction may eventually be achieved by science, and then all desire for immortality would cease. But, as Shakespeare suggested in Hamlet's soliloquy, there may be a future life whether we desire it or not.

In some ancient literatures there are stories of reappearances of and communications with the dead. In modern times there have been attempts to investigate scientifically such alleged phenomena. Communications have been supposed to be received by writing on a planchette, by knocks made by a moving table, and through mediums; *i.e.,* persons accredited with special capacities for transmission of communications, usually in states of trance. After World War I, many in Britain who had lost loved ones in the war resorted to persons claiming to be mediums. Some support for this may have been in eminent persons, such as Oliver Lodge and Conan Doyle, avowing their acceptance of the validity of this kind of phenomena. Popular interest soon ceased, however, prob-

ably in the main because the messages supposed received had little, if any. significance The research into the alleged phenomena came to be limited chiefly to a few whose interest is more intellectual than emotional There were no signs of any similar popular interest in such mediums after World War II.

It is seriously doubted whether scientific methods can make human life as satisfactory as I. Metchnikov imagined. According to some scientists changing conditions may lead to the degradation and eventual cessation of terrestrial human life. Most followers of naturalism. like Metchnikov, do not take adequately into account the character of men's ethical aspirations. Some theists would maintain that nature is not intended to give men complete satisfaction. The ethical argument has always been recognized as one of the strongest in justification of belief in personal immortality. It is frustrating that mankind, having developed so far intellectually, aesthetically, morally and religiously, should end entirely nith death. Cicero expressed such a conviction in his *Tusculan Disputations:* "For we are not born or created idly or fortuitously; but doubtless there is some power which takes thought for the race of men. and which was not likely to create and foster what—when it had accomplished all its toils—would sink into everlasting misery in death." So Hastings Rashdall wrote in 1907: "Only if we suppose that the present life of human beings has an end which lies in part beyond the limits of the present natural order, in so far as that order is accessible to present human observation, can we find a rational meaning and explanation for human life as we know it; and by far the most natural and intelligible form of such a world-end is the belief in Immortality for the individual souls who have lived there."

There is a fundamental ethical implication in the belief in' a series of reincarnations—a belief common to all the indigenous religions of India—Hinduism, Jainism, Buddhism, and in part, Sikhism. That belief is inseparably associated with the so-called law of karma which is taken as axiomatic. According to that law, the consequences of one's attitudes and conduct follow as inevitably as effects follow causes in the physical world. The conditions into which an individual is born into this world depend on his conduct in previous lives. He looks forward to a sequence of future lives By his spiritual efforts in them he may progress toward ultimate bliss. Under the influence of philosophical thinkers different conceptions of that final goal have been developed. In popular religion, and in some philosophies like those of Ramanuja and Madhvacharya, the individual is believed to retain what in the occident is called his particular personality. He is to achieve infinity in harmonious relations with God and all others. In other philosophies, as in that of Sankara Acharya, the final goal is conceived as consciousness of complete identity with the One reality: in short. it is pantheistic as previously discussed. It may be asked how belief in reincarnation is justified. It seems to offer an explanation of the inequalities into which men are born. But it is also declared that in states of trance the religious devotee may recall experiences of past lives. It is impossible to discover if such claims are true. What is asserted to be from past lives may be due to a play of imagination with reference to otherwise forgotten or similar experiences in this life. The belief in reincarnation has been held by only a few occidental thinkers. There are suggestions of it in the works of Plato, and it was definitely accepted by the Cambridge philosopher, John MacTaggart Ellis MacTaggart.

The profoundly religious have a faith in immortality which is a firm conviction affecting their outlook on life. Though, in the use of the term *hope*, there may be at times the suggestion of a possible doubt, the faith is more than the acceptance of an intellectual hypothesis. It is a fact of history that the idea of immortality has been sustained within the religions. The one firm basis for the belief has been, and is, in religious experience, in the soul's immediate communion with God. He must know whether men are immortal, and may bring a conviction of it to individuals, *when they are truly ready to receive it.* If God creates selves at the beginning of their terrestrial lives. He may sustain in future lives either (1) all—universal immortality; or (2) only those who merit continuance—conditional immortality. This religious basis for belief in immortality is accepted by most Christian thinkers today, with the admission that adherents to other religions may experience it. However, traditionally orthodox theologians have maintained—and many still maintained in the second half of the 20th century—that certainty of a future life was given to men by Jesus. He promised the robber crucified with Him that he should go to paradise. More important, He manifested a future life by His resurrection and ascension. This view is bound up with doctrines as to Jesus Christ that philosophy can neither prove nor disprove, and with accounts of events as to the truth or falsity of which historians seem unable to give a certain decision It is interesting to note that the philosopher Alfred Edward Taylor accepted the traditional Christian view. He contended that all rests on belief that Jesus was God-incarnate. divine and human. "To whittle away either his divinity or his humanity is to surrender the very ground of all our hopes."

The contemporary neglect of philosophical consideration of human immortality has adverse effects on the philosophy of history. A door must be either open or shut. Those who do not definitely accept the belief in immortality think, act. and write as though they explicitly reject it, even if occasionally they admit doubts. The two attitudes involve important differences for philosophy of history. If there is an open door to future lives for individuals there may be significance in terrestrial history with reference to a nonterrestrial future. The religions maintain that there is. Their implied or expressed philosophies of history are affected by it. With the implication that there is no such open door, the significance of history is treated by many contemporary historians and philosophers as being entirely terrestrial. The Marxist theory of history is of that type. For philosophy of history the problem of human immortality needs to be seriously discussed.

Some modern humanists contend that belief in immortality takes attention from and reduces efforts for the goods of the present life. It did that in some periods in the past, and may still do so for a few individuals. Religious teachers now insist that God has put mankind into this life and the best is to be done for the fulfilment of its duties and the enjoyment of its possibilities. Faith in immortality has given men a wider vision. Some of the greatest sacrifices for mankind have been made by men with that faith.

BIBLIOGRAPHY.—I. Metchnikov, *The Nature of Man* (New York, 1903); W. G. Aston, *Shinto* (New York, 1905); W. Osler, *Science and Immortality* (Boston, 1904); W. Windelband, *History of Philosophy* (New York, 1909); M. Jastrow, *Religion of Babylonia and Assyria* (Cambridge, Mass., 1911); F. von Hügel, *Eternal Life* (London, 1912); A. S. Pringle-Pattison, *The Idea of Immortality* (London, 1922); J. G. Frazer, *Man, God, and Immortality* (New York, 1927); E. B. Tylor, *Primitive Culture* (London, 1929); J. S. Bixler, *Immortality and the Present Mood* (Cambridge, Mass., and London, 1931); J. Baillie, *And the Life Everlasting* (New York, 1933; London, 1934); C. Lamont, *The Illusion of Immortality* (New York, 1935; London, 1936); A. E. Taylor, *The Christian Hope of Immortality* (London, 1938); C. J. Shebbeare, *The Problem of the Future Life* (Oxford, 1939); W. E. Hocking, *The Immortality of Man* (New York, 1945); C. A. Alington, *The Life Everlasting* (Oxford, 1947; New York, 1948); G. Ryle, *The Concept of Mind* (London, 1949; New York, 1950); C. J. Ducasse, *Nature, Mind, and Death* (LaSalle, Ill., 1951); A. G. Widgery, *What is Religion?* (New York, 1953). (A. G. W.)

IMMUNITY. By immunity is understood a state of lessened liability to injury by microorganisms and by certain complex poisons formed by animals and plants. An animal that recovers from a disease caused by a microorganism is at the time of recovery immune; the invading microorganism has been present in the body in force and, though it may not have been destroyed completely, is incapable for the time of doing further harm. Immunity is not, therefore, a constant state of freedom from the risk of disease but a state of defense which may rise to a peak in response to an attack and lapse at other times.

The type of immunity that excites most interest is the long-lasting immunity that follows attacks of certain diseases. It is rare that a person, however much exposed to infection, gets a second attack of those fevers—smallpox, chicken pox, measles, mumps—which are caused by viruses, or of typhoid fever and diphtheria, which are caused by bacteria. This immunity is specific: an attack of measles protects against measles but not against

chicken pox. The methods of this specific protection involve reactions with relatively simple constituents of the microorganisms that resemble reactions used in dealing with other foreign substances. These reactions are called immunity reactions, although they may have nothing to do with protection and the foreign substances involved may be harmless. (See articles on above diseases.)

The physics and chemistry of such reactions have been studied, free from the complicating secondary reactions that occur in a living animal, and the substances taking part can be isolated and measured. The terminology used in discussions of immunity is very largely that developed in the early studies of protection of animals against harmful substances; but the meanings of the words and modes of thought used in discussion of protection are largely derived in turn from these studies of simpler reactions. Without a preliminary study of these simpler reactions the words used in discussion of the specific methods of protection remain words with nothing concrete behind them.

IMMUNITY REACTIONS

The Precipitin Reaction. — The nature of these reactions is best illustrated by an example. If crystalline albumin prepared from hens' eggs is injected into a rabbit, a new or modified globulin begins to appear in the blood serum of the rabbit in about a week. If the injections are repeated the amount of such globulin increases. This globulin is called a "precipitin"; in solution it has the characteristic property of forming a precipitate when mixed with a solution of hen's egg albumin. The most remarkable feature of this reaction is its specificity. A solution of the precipitin forms a precipitate with albumin from the eggs of related birds; the amount of precipitate depends on the closeness of the relation. The amount formed with turkey's egg albumin is only about one-half, and that formed with duck's egg albumin one-sixth, of the amount formed with hen's egg albumin. No precipitate is iormed with other proteins, even with the albumin of a hen's blood serum. Other animals besides rabbits can be used and other proteins will stimulate the formation of precipitins when injected. Thus, injection of albumin from horse blood serum will lead to the iormation of a precipitin that will form a precipitate with horse serum albumin, a considerably smaller precipitate with ox serum albumin but none with any kind of egg albumin. (See SERUM THERAPY.)

Antigens and Antibodies. — These precipitins are typical examples of the substances called "antibodies" (in the strict sense of the word). The proteins that are injected are examples of "antigens"; that is, of foreign substances that, when introduced into the body of an animal, stimulate the formation of antibodies that react in some observable way with the antigen. The animals are said to be "immunized" with the antigen. To call this process immunization involves an extension and misuse of the meaning of the word. For egg albumin is not ab *initio* poisonous to a rabbit, while it may, as will be shown later, become harmful as a direct result of "immunization."

In carrying out reactions between antigen and antibody, the whole serum is used, as a rule, without any attempt to isolate the reacting antibody; a serum containing antibody is called an "antiserum."

Most antigens are proteins or contain proteins as an essential part. Proteins are split up by the digestive enzymes in the intestine into their constituent amino acids and lose all their specific characters. For this reason antigens are, as a rule, relatively ineffective if given by mouth: they must be injected. But in some instances small amounts of partially digested protein may be absorbed and may stimulate the formation of sufficient antibody to be detectable by the more delicate reactions.

The meanings of the words antigen and antibody have been extended to include substances which are not covered by the strict definition. At one time it was thought that no substances other than proteins would give rise to or react with antibodies. M. Heidelberger and O. T. Avery found in 1923 that the serums of animals immunized with pneumococci contained antibody that formed a precipitate with the gum that forms the capsules of pneumococci of the same type. Such gums have been called "partial antigens" because they react with antiserums, but were supposed to be incapable of provoking the formation of antibodies without the co-operation of proteins. It appears, however, that antibodies can be formed by injection of these gums absorbed on collodion particles, although the amount of antibody in the antiserums will be small. Antibodies which react specifically with fatty substances can be formed by injecting these fatty substances together with proteins. These polysaccharides and fatty substances, though poorly antigenic or nonantigenic in the strict sense of the word, are commonly spoken of as antigens in discussions of their reactions with antibodies.

The red blood corpuscles of blood groups A and B contain the specific A and B substances on which reactions of serums of groups B and A, respectively, with these corpuscles depend; these serums contain globulins which react with the red corpuscles, group B serum reacting with group A corpuscles and vice versa. These reactions are exactly comparable to the reactions between sheep's red blood corpuscles and serums obtained by immunizing rabbits with sheep's red corpuscles. The group specific substances of human red corpuscles are not, in normal life, used for immunizing other animals; the reacting globulins in the serums are not produced in response to immunization and are part of the genetic make-up of the individual. But these reacting substances are called group specific antigens and antibodies.

The Mechanism of the Precipitin Reaction. — Shortly after the precipitin reaction was discovered, it was shown that relatively crude chemical changes in a protein would change its specificity. During World War I Karl Landsteiner (*q.v.*) introduced a method of attaching chemical groups to proteins, forming azoproteins. The nature of such attached groups, which are called determinant groups, can be varied almost at will. These azoproteins can be used as antigens for immunizing rabbits. The antiserums obtained will form a precipitate with any protein to which the same chemical groups have been attached; they will also form smaller precipitates with proteins which contain determinant groups, closely resembling those contained in the original antigen in composition and structure; but they will form no precipitate with proteins containing determinant groups that do not closely resemble those of the original antigen. 'Enough is not yet known about the structure of the natural unmodified proteins for their specificity to be correlated with details of composition and structure; but the composition and structure of some of the gumlike antigens of bacteria are known. The capsules of the different types of pneumococci are made of gums of different compositions. Each of these type-specific gums forms a precipitate with the serum of an animal that has been immunized with pneumococci of the type from which the gum was derived. The specificity of these gums depends on the structure and composition of the gums exactly as specificity of the azoproteins depends on the composition and structure of their determinant groups. In some cases the antiserums formed by immunization with pneumococci of one type will form precipitates with gums derived from pneumococci of another type or with unrelated bacteria; these "cross reactions" are caused by common features in the compositions of the gums of the pneumococci used for immunization and of the other gums with which they form precipitates. It may be inferred that the specificity of all antigen-antibody reactions is determined by special composition and structure of certain groups in the antigen.

Specific Combination —By Landsteiner's method it was shown that the remarkable specificity of the reaction between antigen and antibody lies in the combination bet een antibody and the determinant groups of the antigen. For relatively simple substances that contain the determinant group will combine with the corresponding antibody though they will not form a precipitate; these substances which combine without forming a precipitate are called haptenes. This specific combination which is the essential stage depends on the composition and structure of certain groups in the antigen.

Precipitation. — A molecule of antigen may have several determinant groups and a molecule of antibody several combining sites. Large aggregates can be built up in which each molecule of antigen is linked to several molecules of antibody, whereas haptenes

with only one determinant group cannot link two antibody molecules together and therefore cannot build such aggregates. A change in the physical properties that reduces solubility in water follows this aggregation of antigen and antibody; like other insoluble substances the aggregates form precipitates.

More Complex Immunity Reactions.—A series of other specific reactions, which have a more obvious connection with immunity in the ordinary sense of the word, depends on a mechanism that is exactly similar to that of the precipitin reaction.

Agglutination.—In this type of reaction an antiserum causes a suspension of small particles coated with antigen to run together into clumps; this clumping is called agglutination and the reacting antibody is an agglutinin. Antiserums prepared by immunizing with a single substance, egg albumin for example, will agglutinate particles that have this substance on their surfaces. Most commonly the antiserums are produced by immunizing with a suspension of cells, such as bacteria or red blood corpuscles, which are relatively complex structures. In this case the substances that stimulate the formation of antibodies are constituents of the cells injected.

Complement.—Certain constituents of blood serum are grouped together under the name "complement." Until recently complement was known solely by its actions. It is absorbed by the complexes formed by most antigens and antibodies; for example, by the aggregates formed by a protein antigen and the corresponding precipitin or by cells and the corresponding agglutinin.

Lysis.—The complement absorbed has a further action on cells, such as red blood corpuscles and certain bacteria, that have combined with antibodies. The surface membranes of the cells are so changed that substances retained in normal cells can diffuse out and the cells may be broken up. This process is called lysis and the antibodies involved are then lysins.

The substances that act as complement are not specific in their action; the same complement will co-operate with the appropriate antibody in the lysis of bacteria and of the red blood corpuscles of various species of animals. Nor is the amount of complement in serum changed by immunization. The absorption of complement is the basis of such tests as the Wassermann reaction. Complement is absorbed by the compound formed by the syphilitic antibody and Wassermann antigen; the removal of this complement from the solution in which the reaction is carried out is demonstrated by the fact that it is no longer available for the lysis of red blood corpuscles that have been treated with an antiserum to the same red blood corpuscles.

Phagocytosis: Ofsonins.--The polymorphonuclear leucocytes of the blood, which are simple cells, can surround particles with which they come into contact and take them into their protoplasm; this is called phagocytosis. Bacteria and other cells, such as red blood corpuscles, are ingested in the same way but to a variable extent that depends on the nature of their surfaces. Cells that normally resist phagocytosis are ingested much more readily after they have been treated with the serum of an animal that has been immunized with the cells in question. This change is caused by the combination of antibody with antigen on the surface of the cell and by a subsequent change in the physical properties. Bacteria, treated with antiserum, are ingested more rapidly if a nonspecific constituent of serum which resembles complement is present. Sir Almroth Edward Wright (*q.v.*) called these substances, which make bacteria more suitable for ingestion by leucocytes, "opsonins" or "appetizers." The antiserum can be said to "opsonize" bacteria.

Anaphylaxis.—Injection of a small amount of a protein, such as egg albumin, of the order of one milligram or less into a guinea pig has no apparent effect. However, a second injection of the same protein after a latent period of about eight days will be followed within a minute by the first signs of a violent shock, of which the most conspicuous feature is contraction of the muscles that constrict the small air passages of the lungs, similar to that in human asthma. If the shock is sufficiently severe the guinea pig dies in less than half an hour. The amount required to sensitize guinea pigs is remarkably small; the limit is of the order of one ten-thousandth milligram and the amount commonly used is about one milligram. Sensitivity reaches its maximum in about three weeks after the sensitizing dose and remains sufficient for a second dose to produce a fatal shock for about six months; possibly the guinea pig remains somewhat sensitive for its whole life. A guinea pig may survive the shock produced by the second, shocking injection; if it does, then for a period of two weeks or more a further injection of the same protein will not produce another shock; the guinea pig is said to be desensitized.

This condition of hypersensitivity is called anaphylaxis. It can be produced in other animals, although larger doses are needed and the shock may take a different form. The hypersensitiveness is caused by the presence of antibodies, for an animal can be sensitized by injection of antiserum derived from another animal; hypersensitiveness induced in this way is called passive anaphylaxis. However, the shock that follows an injection of antigen into an animal that has been sensitized passively is not caused by reaction between antigen and antibody circulating in the blood. There is a latent period after the injection of the antiserum during which injection of a dose of antigen will not cause a shock; during this period antibodies become fixed to cells of the tissues. After the latent period, organs that have been isolated and freed from blood by transfusion will react by contracting on treatment with the antigen. This reaction, again, is specific: the contraction occurs only on addition of the antigen that was used for preparing the immune serum.

It might well be supposed that the aggregation of antigen and antibody on the surface of cells would be enough to account for anaphylactic shock. However, histamine produces symptoms very similar to those of anaphylactic shock; there is evidence that histamine or a substance resembling it is released from the tissues when antigen and antibody react and that it is this substance which produces reactions, such as the contraction of the muscles of the small air passages.

Neutralization of Toxins—The reactions hitherto considered have not involved protection against a harmful substance. There are, however, in the toxins of bacteria. of snakes and of some plants, examples of harmful agents that can be isolated as single chemical substances. An animal immunized with a toxin forms an antiserum (antitoxin) that will combine with and neutralize this toxin. A mixture of toxin with sufficient antitoxin is not poisonous; if antitoxin is injected into an animal before an injection of toxin, the animal is protected; if antitoxin is injected after toxin, it will to some extent mitigate the effects of the toxin. The action of antitoxin is not limited to combination and neutralization. Antitoxin and toxin when mixed in sufficiently strong concentrations form a precipitate comparable to those formed in precipitin reactions. The precipitate (toxin-antitoxin floccules) contains both toxin and antitoxin; it is nontoxic if the amount of antitoxin added is sufficient. Toxins are not destroyed by antitoxins and can, in some cases, be set free, in toxic form. from their combination with antibody. Diphtheria toxin has been liberated, unintentionally, from toxin-antitoxin floccules by shaking with a disinfectant that destroyed the antitoxin, with disastrous results when the mixture was used for immunizing human beings.

The Common Basis of Immunity Reactions.—All these reactions, like the precipitin reaction, are specific. By Landsteiner's method it has been shown that the specificity of agglutination, of opsonization and of anaphylaxis depends on the composition and structure of antigens used for immunization or sensitization. As in the precipitin reaction the essential stage is specific combination of antigen and antibody; it is followed by secondary manifestations which depend on the nature of the antigen and on its situation (on the surface of a cell or other particle), on the situation of the antibody (in solution on the surface of a particle or, again, on the surface of a tissue cell) and on the presence of co-operating nonspecific substances such as complement.

It is not necessary to postulate a series of different antibodies—precipitins, agglutinins, complement fixers, lysins, opsonins and sensitizing antibodies. Antibodies have been prepared in pure form which will not only precipitate but also agglutinate, fix complement and sensitize guinea pigs.

Antibodies: Properties and Formation.--Not only the

specific ability of antigens to combine with antibodies must be accounted for, but also the specific ability of the antibodies to combine with antigens. It must be supposed that the molecules of antibodies have combining sites specifically suited for combining with the corresponding determinant groups of the antigens.

Antibodies are globulins, and globulins belong to the type of substances called proteins. Proteins are built up of 21 different amino acids; they differ in the proportions of amino acids present in their molecules and in the ways in which these amino acids are arranged. There is nothing to suggest that antibodies have any constituents that are not found in other proteins. They are not distinguished from other serum globulins by special proportions of their constituent amino acids. The specific sites adapted to combine with antigens must be formed by special arrangements of these constituent amino acids.

When an animal is immunized 'the amount of globulin in its serum usually increases and the increase is greater than that which the antibody formed will account for. It seems, therefore, that the antigen stimulates the formation of serum globulin, some of the molecules of which have this special arrangement of their constituent amino acids. It is suggested that antigen is deposited in the cells in which serum proteins are synthesized; that the appropriate free amino acids are attracted by groups in the antigen in the pattern appropriate to make a combining site and are then joined together in this specific pattern. The antigen thus moulds the structure of serum globulins as they are synthesized.

Such hypotheses may explain the formation of antibodies shortly after the injection of antigen, but they do not account for the persistence of immunity, which is one of its most remarkable features. If antibodies derived from one animal are injected into the circulation of another of the same species, they disappear from the circulation in two or three weeks. The individual molecules of globulin, including antibody globulin that an animal itself makes, persist in the circulation for about 80 days. But antibodies may be detected in the serum for years after a disease or a course of immunization has ended. Anaphylaxis may persist for the whole life of a guinea pig. An animal that has once been immunized responds to a fresh injection of antigen by forming antibodies more rapidly and in larger amounts than after the first injection. The synthesis of antibody, or at least a heightened capacity to form antibody, must persist without any fresh introduction of antigen. It is this persistence which makes active immunity produced by inoculations so much more valuable than the passive immunity that follows injection of antiserum from another animal. It is difficult to see how the original antigen can persist in the tissues of the immunized animal and influence the synthesis of serum globulin for such a long time. Even such an inert structure as bone is continually renewed; other more active tissues are changed far more quickly. It might be expected that the whole of the antigen would be eliminated in the process. The whole structure of an animal must be renewed over and over again, while the stamp set by a course of immunization remains.

The Site of Formation. — Particles that are injected into the blood stream are taken up by the scavenger cells; it might be supposed that antibodies are formed here, where the antigens are fixed. It has been found that coloured antigens appear in the scavenger cells and these cells are said to shed protein into the circulation at the time when antibodies appear in the blood. However, the best evidence is in favour of the lymph glands as the main site at which antibodies are formed.

Incomplete Antibodies. — According to the definition given, antibodies should give some observable reaction with antigens. It has been realized for some time that globulins might occur in the serums of immunized animals that combined specifically with antigen, but did not produce the visible reaction that would be expected with the type of antigen used. These incomplete antibodies have come into special prominence because the serums of Rh-negative mothers who have Rh-positive babies may contain Rh antibodies, mainly of this type; these cannot be detected unless special techniques are used. They may pass through the placenta into the circulation of the unborn baby, break down the baby's red blood cells and cause severe anaemia,

DEFENSE

Defense against Invasion. — The entry of microorganisms into the bodies of the higher animals is checked by purely mechanical barriers. The horny layer of the skin has gaps only at the openings of sweat glands and hair follicles. The air breathed is filtered in the nose; a large proportion of the microorganisms it contains are caught in mucus and either passed down into the oesophagus or ejected through the nostrils. Even those that escape and get down into the air passages of the lungs are again caught in mucus on the walls and cleared out in the current set up by the cilia of the epithelium. The lining of the intestine is almost impermeable to microorganisms. In the stomach the concentration of hydrochloric acid is normally high enough to kill some microorganisms and check the growth of others. Bile salts inhibit the growth of some microorganisms in the upper part of the intestine. It is only in the large intestine that bacteria multiply freely.

There are other more subtle outer defenses of the body. Many species of bacteria disappear rapidly when spread on clean skin; typhoid bacilli, for example, cannot be recovered from the skin ten minutes after application. However, other bacteria, in particular staphylococci, which normally live on the skin, do rot disappear in this way. Tears, nasal secretion and many tissues contain a substance, lysozyme, which breaks down a mucinous substance that is an essential part of the structure of some bacteria and thereby kills them. This is not apparently the main agent responsible for the disinfection of the skin, but it may contribute to the protection of the eye.

Course after Invasion. — Cellular *Mechanism.*—When suspensions of particles, such as India ink, and certain dyes are injected into the veins of an animal they are deposited in various organs and may remain there in a recognizable form for weeks. These particles or dyes have been ingested by special scavenger cells which form the reticuloendothelial system. Apart from these cells of the reticuloendothelial system, there are the polymorphonuclear leucocytes of the blood, which do not ingest these dyes but play an important part in dealing with bacteria.

Nonspecific Bactericidal Action of Blood. — Attention has been focused on the two mechanisms of defense, the formation of specific antibodies and the phagocytosis of foreign particles. However, blood contains other substances, besides specific antibodies, that kill bacteria or check their growth. It is a common observation that blood serum "keeps" much better than other solutions of protein, such as egg albumin; that is to say, the growth of putrefactive organisms is checked in serum. The serum of some animals contains a substance, apparently not a specific antibody, that will kill anthrax bacilli. A rather similar substance can be extracted from polymorphonuclear leucocytes. During the early stages of fevers, before specific antibodies appear, this power of killing certain bacteria is much increased. The mechanism of this, which must be one of the most important weapons of defense, has been studied but little.

Weapons of the Invader. — Bacteria do not multiply in the body to such an extent that they interfere with its activities by sheer bulk. The size of such particles is not apparently injurious. The damage, whether local or general, is done by poisons (toxins) formed by the bacteria. It is customary to divide the toxins of bacteria into two classes, exotoxins and endotoxins. The exotoxins appear in the culture medium in which bacteria are grown. Diphtheria toxin, the exotoxin that has been most fully studied, is a protein with a molecular weight approximately equal to that of serum albumin. It is extremely poisonous: the minimal lethal dose for a guinea pig is about one ten-thousandth milligram. On a weight basis the minimal lethal dose for a man would be about one-thirtieth milligram; this may be compared with the fatal dose of aconitine, one of the most poisonous of the alkaloids. which is about one milligram. Animals that are immunized with the exotoxins form large amounts of antibody (antitoxin). The endotoxins include complex compounds of carbohydrates and fatty substances (glycolipides) that have been isolated from typhoid and dysentery bacilli. These endotoxins are very poisonous, but their minimal lethal doses are considerably higher than those of

exotoxins. Some bacteria, particularly *Streptococcus haemolyticus,* form substances called leucocidins which kill polymorphonuclear leucocytes. It appears that the harmful effects of viruses are entirely local and arise from their ability to establish themselves inside the actual cells of the tissues of the host's body. Bacteria have their defenses against the weapons of the host. Resistance to phagocytosis depends on the nature of the surface of bacteria. In the case of pneumococci this resistance is caused by the presence of the capsule. The most virulent strains of typhoid bacilli have a surface constituent, the Vi antigen; strains that have this Vi antigen are less readily ingested by phagocytes than those that have not. Antibodies which agglutinate, lyse or promote phagocytosis combine with the constituents of the surface of bacteria. These constituents, such as the gums that form the capsules of pneumococci, may be produced in excess and cast off into the surrounding fluid where they combine with antibodies and put them out of action. Such substances, though harmless in themselves, have been called "aggressins." Pneumonia is more commonly fatal when the amount of this capsular gum in the patient's blood is more than enough to neutralize all the circulating antibody. The virulence of bacteria may therefore depend on the poisonousness of their toxins, as in the case of the diphtheria bacillus, or on the presence of a defensive capsule and the formation of aggressins, as in the case of pneumococci.

Course after Invasion.— When nonvirulent bacteria are injected into the circulation of a rabbit they disappear rapidly from the blood, as lifeless and inert particles would do. If the bacteria are slightly virulent the number in the blood falls during the first five hours, then may rise for a time, as the bacteria multiply, but will fall to zero in a few days. The bacteria are cleared from the blood by both reticuloendothelial cells and polymorphonuclear leucocytes.

If the bacteria are highly virulent, the numbers in the blood fall at first but then increase rapidly until the rabbit dies. If the rabbit has been immunized or if it has been protected by the injection, beforehand, of serum from an immunized animal, the blood is eventually cleared of virulent bacteria, as it is when slightly virulent bacteria are injected.

The entry of bacteria directly into the blood stream must be a very rare event in normal life. When bacteria enter in other ways the object of the defense is to pin down the invader and fight a local battle. The first effect is the formation in injured tissues of a substance that dilates the local blood capillaries and increases the permeability of their walls. This increased permeability allows the constituents of the blood plasma, including nonspecific protective substances and any antibodies the plasma may contain, to flow out; polymorphonuclear leucocytes also are attracted through the walls of the capillaries, both by the substance that causes the increased permeability and, in the case of certain bacteria, by the substance formed by the bacteria themselves. The leucocytes ingest the bacteria if they can; the products of the breakdown of leucocytes that are killed attract more leucocytes to the spot. The bacteria are killed by the nonspecific bactericidal substances of the blood. In the meantime, the fibrinogen of the plasma that exudes from the capillaries coagulates round the area of invasion and walls it off. Later, other scavenger cells invade the area to carry on the work of the leucocytes. The barrier of fibrin is strengthened by the formation of fibrous tissue. The dilatation of the blood capillaries and the escape of blood plasma and leucocytes into the invaded area constitute inflammation; the killed leucocytes form pus.

If the invasion can be localized until appreciable amounts of antibodies are formed these are poured into the area and coat the bacteria. The bacteria are then agglutinated, immobilized and readily ingested by the phagocytes — polymorphonuclear leucocytes and other scavenger cells. Any pus formed and the remains of dead tissue are discharged or absorbed; the area then heals. If the invasion is not localized until the antibodies are formed, the bacteria spread into the surrounding tissues and into the blood stream and the battle is continued there.

If, however, the invaded animal has already been immunized with bacteria of the same species and type as the invaders, the first escape of plasma brings with it agglutinins and opsonins that assist the fixation and phagocytosis of the bacteria. The amount of antibody in the first plasma that escapes may be small and largely neutralized by the aggressins of the bacteria; but, as the animal has been immunized, it responds to the stimulus of the invasion by producing new antibody much more rapidly and in greater amounts than an animal that has not been immunized would do. The immunized animal maintains a small standing army of specific antibodies, but it can mobilize a large army quickly.

Although the invasion may be defeated, the invading bacteria are not necessarily all destroyed. Some may persist locally or, if the blood was invaded, in the liver and spleen. Some, particularly diphtheria and typhoid bacteria, may not only persist but also multiply and be discharged from the body. Persons with such persistent foci of virulent bacteria, calied carriers, may infect susceptible persons directly or through food and water.

Local Immunity.—After an animal has recovered from erysipelas. produced by a type of streptococcus, injection of streptococci of the same type into the area of skin that was affected will not produce a second attack, although it may produce erysipelas if injected into the skin elsewhere. The animal therefore appears to have a local immunity. It has been suggested that local fixed antibodies may be formed before antibodies appear in the circulation. However, all the evidence indicates that this local resistance springs from a persistent local mobilization of defense. particularly the accumulation of phagocytes. The local immunity is not specific.

A similar immunity follo s inflammation produced by chemical irritants and, after local infection by bacteria, the local resistance to wholly unrelated bacteria is increased.

Immunity to Virus Infections.— The most striking examples of long-lasting and complete immunity to disease are against diseases caused by viruses, and it is against virus diseases that the production of immunity by vaccination has been most successful. Because of difficulties of investigation, less is known about immunity to virus diseases and the mechanisms involved therein than about immunity to diseases caused by bacteria. It is known, however, that the essential manifestations of specific immunity to bacteria are reactions not to the bacteria as organized and living cells but to their constituent proteins, gums or fatty substances which are constituents of all living matter, including viruses; it is also knonn that phagocytosis deals not only with bacteria, virulent or avirulent, but also with inert lifeless particles. It would therefore be expected that these two methods of defense would be used against viruses. The presence of specific antibodies in the serum of immunized animals is shown by the protection of nonimmunized animals given by this serum against injected virus of the same species; the immune serum protects if it is mixed with the virus before injection or is injected into the animal beforehand. These protective antibodies combine with the virus particles. The main difference betaeen immunity to viruses and immunity to bacteria lies in the fact that an essential element in disease caused by a virus is the entry of the virus into susceptible cells; an adequate concentration of the antibody in or near these cells is needed in order to keep the virus out. (*See* also FILTERABLE VIRUSES; VACCINE THERAPY.)

The Importance of Antibodies in Defense.— If these concepts are correct. specific immunity depends on the presence of specific antibodies, their appearance in the circulation and the establishment of the machinery for the rapid formation of a large amount of antibody in response to a fresh stimulus. The most striking examples of the importance of antibodies are seen in newborn animals. They come into the world from sterile surroundings with no experience of even the less virulent organisms that they will encounter as soon as they are born. They have had no occasion to make antibodies to these organisms and it appears that their capacity to make antibodies is relatively undeveloped. They are, however, supplied with antibodies from the serum of their mothers. Antibody proteins similar to those in the plasma of the mother hen are found in the yoik of eggs, and they persist in the egg although other proteins of the yolk are used up to make the tissues of the chick. The placentas of rodents, apes and women allow anti-

bodies to pass from the blood of the mother to that of the foetus in the last stages of pregnancy. However, the placentas of ruminants, mares and pigs do not allow the passage of antibodies. The concentration of antibodies in the first milk of these animals is higher than in the plasma of the mother; these antibodies are not split up in the intestines of the newborn animal as they would be in the intestines of an adult or as other proteins are split in the intestines of the young animal; they are absorbed unchanged into the blood.

The great susceptibility of premature babies to infection is probably a result of the lack of antibodies which should be supplied by the mother during the last weeks of pregnancy. The importance of these antibodies can be shown more clearly in the case of ruminants. Newborn calves and foals have in their blood serum neither antibodies nor the fraction of globulin in which antibodies appear. Within a few hours after they have sucked their first milk both antibodies and the corresponding globulin appear. If the first milk is withheld neither antibodies nor the globulin fraction appear and the calves are very susceptible to common bacteria, particularly to *Bacillus coli.*

In the same way, antibodies appear in the serum of lambs only if they get the first milk, and lambs that do not get this milk are susceptible to lamb dysentery.

Such a transfer to an individual of antibodies made by another individual of the same or of another species is called passive immunization. If all goes well the newborn animal gets its quota of antibodies from its mother before it encounters any infection. To confer this passive immunity on older animals antiserums must be injected; if given by mouth the antibodies are split up in the intestine. Much depends on the relation of the time of injection to the time of attack by microorganisms. If the injection is made shortly beforehand it will, so long as the antibodies persist in the circulation, confer a high degree of immunity against disease. Thus, mice that have received an injection of antiserum against a type of pneumococcus will survive subsequent injection of 1,000,000 times the number of pneumococci of the same type, which would kill mice that had not been protected in this way.

When antiserums are used to treat human beings they are rarely injected before clinical symptoms appear; that is, before the microorganisms have invaded the host and have multiplied. Antiserums, other than those containing antibodies to exotoxins, then have little effect on the course of the disease. Investigations have been made on a large scale into the value of treating pneumonia with antiserums to pneumococci of the type with which the patients are infected. Only in the case of type I pneumonia caused by type I pneumococci was there any significant difference between the death rates of patients who were treated with serum and of those who were not so treated. It is the same with infections with a virus. In experiments on animals antiserum will not prevent disease unless it is injected before or with the virus. In the treatment of contacts of cases of measles by convalescent serums, which contain antibodies to the measles virus, it may be possible to forestall the multiplication of the virus and invasion of the body cells. If the serum is injected early in the incubation period, within four days of exposure to infection, measles does not usually develop. If the injection is delayed until the eighth day after exposure, it rarely prevents an attack but this attack is usually mild. Injections given still later have little or no effect on the course of the disease.

Treatment of diseases such as diphtheria and tetanus, in which the damage is mainly caused by exotoxins, may be successful after the symptoms have appeared. But again the antiserums are much more effective if given before or early in the course of a disease. With passive immunization this difficulty always arises: if the antiserum is given beforehand the antibodies may have disappeared from the circulation when they are needed for defense; if they are injected after a disease is diagnosed they may have little effect on its course.

When a person is immunized actively by an actual attack of a disease or by inoculation with bacteria or viruses, by bacterial toxins or by these agents modified in some way, the formation of antibodies may continue for years; when the amount of antibody circulating in the plasma has fallen to a low level the capacity rapidly to form antibody remains. A fresh infection can be met with antibody before the infective agent has time to multiply. The value of this active formation of antibodies, and of the capacity to form more antibody rapidly, is shown by the protective effects of inoculation with typhoid vaccine and with diphtheria toxin in some modified form.

In the case of diphtheria, the amount of circulating antitoxins and the capacity to respond by producing more is commonly kept up by repeated exposure to infection. But it rarely happens that people are exposed repeatedly to infection with typhoid or smallpox. The immunity that follows antityphoid inoculation and vaccination therefore wanes in the course of years. It is not possible to put a definite term to the duration of immunity. Individuals vary, and for a long time after the remaining antibodies have become insufficient to prevent disease the latent capacity to make fresh antibodies may be awakened early enough in the course of the disease to mitigate it considerably.

Attacks of some diseases, such as smallpox and typhoid, are almost always followed by lifelong protection. We might expect that inoculation with the organisms that give rise to these diseases, killed or attenuated in some way, or inoculation with a cross-reacting organism would confer protection for a considerable time. On the other hand, a person may suffer more than one attack of pneumonia, several attacks of influenza and innumerable colds. It would be surprising if inoculation against these diseases afforded anything more than a very transitory protection. Fuller investigations cast doubt on the claim that the incidence of pneumonia in South African mines was lowered by inoculation; other changes occurred at the same time that might have accounted for the fall in the incidence. In further trials little evidence of protection was found.

Natural Immunity. — Some species of animals are not harmed by toxins that are very poisonous to other animals, although the insusceptible animals have no special protective antibodies. Birds and cold-blooded animals, for example, are not poisoned by tetanus toxin. This insusceptibility appears comparable to the insusceptibility of hedgehogs to strychnine. Probably, because of some peculiarity of the composition of the constituents of the cells of these animals, the toxins are not able to combine them as they do in susceptible animals. But insusceptibility of this type seems to be exceptional.

The antibodies that young animals get from their mothers disappear during the first year of life. But through adult life, when these antibodies have gone, many species are still immune to some diseases and this immunity appears to be due to the presence of antibodies in their serum. Repeated exposure to diphtheria bacilli, without the development of recognizable disease, accounts for the presence of diphtheria antitoxin in the blood of human beings who have never been deliberately immunized with diphtheria toxin or toxoid and have not had diphtheria. But pigs and oxen may frequently have antibodies to typhoid and cholera bacilli, among other organisms, in their serums; and it is unlikely that they have been exposed to these organisms. These antibodies may be formed as a result of exposure to some other organisms that contain antigens identical with or similar to those in these bacilli. There are unquestioned examples of such cross reactions; the immunity to smallpox that follows vaccination is one of them. It is hardly conceivable. though, that such accidents could account for the immunity and for the antibodies in the serum found consistently in some species.

How could it arise that chickens have specific antibodies in their serums for three types of pneumococci? There is no doubt that the presence of the group specific agglutinins in human serums is determined by genetic factors; these agglutinins are not formed in response to the stimulus of foreign substances. It is possible that the presence of other antibodies may be part of the inborn constitution of certain species.

Serum, as already noted. may contain some substances that will break up anthrax bacilli but do not resemble antibodies. It appears that animals that are naturally immune to anthrax have a large amount of this substance in their serum, whereas susceptible ani-

mals have considerably less.

There is another kind of immunity that is familiar in everyday life and in experimental studies of the transmission of disease, but itself has been little studied. In most cases, experimental animals cannot be infected with certain human diseases, particularly the diseases, such as measles, caused by viruses. This immunity is not caused by the presence of antibodies in the serum. Bacteria are better adapted to one environment than another; for example, tubercle bacilli injected into the blood stream will settle down and infect one organ in one animal and another in another. The viruses, which actually enter the cells of the host, may be still more susceptible to the chemical composition of these cells and therefore be able to thrive in the cells of hosts belonging to a few species only.

THE INFLUENCE OF EXTRANEOUS FACTORS

Nutrition. — Malnutrition is commonly associated with a lowered resistance to disease, especially to tuberculosis. With the growth of the new knowledge of nutrition during the 20th century, attempts were made to pin the lowering of resistance to infections on to deficiency of one or other constituents of the diet. A clear distinction must be drawn between diseases (such as pneumonia) caused by infection and those (such as beriberi and rickets) caused by lack of some necessary constituents of the diet. in which there is no element of infection. This loss of resistance to infection has been ascribed to lack of various food constituents, particularly vitamin A. In experimental animals that are deprived of vitamin A the cells that line surfaces, such as those of the air passages, change to form a horny layer like the surface of skin. Such a horny layer has not the cilia which clear mucus and organisms entangled in it out of the air passages. Consequently, harmful 'microorganisms have an opportunity to establish themselves in the air passages: the outer defenses are breached. Because lack of vitamin A increases the risk of infection in this way it has been called the "anti-infective vitamin." It bears, however, no relation to the development of specific immunity; animals deprived of vitamin A can form antibodies as well as normal animals can. The change of surface cells can be seen on the surface of the eye, and it occurs there in human beings when the lack of vitamin A is extreme. But human subjects have been deprived almost completely of vitamin A for two years or more without the appearance of this local change or any evidence of an increased liability to colds, bronchitis or pneumonia. And pathologists are not convinced that the lack of vitamin A produces the change in the cells lining the air passages of human beings.

There is, however, evidence from experiments on human subjects that deprivation of vitamin A does lower the resistance to tuberculosis: in Denmark the supply of vitamin A was very low during the years 1915–1917, when the tuberculosis death rate rose; in 1918, when the death rate fell, the supply was well above the pre-war level.

Antibodies are proteins and must be made, in the end, from the constituent amino acids of the proteins of the food. It might be expected that animals that were not getting enough protein in their food would fail to make antibodies; this has been found by experiment. When an infection begins. in an animal already depleted of protein, a vicious circle is set up; for a diseased animal wastes protein and the depletion therefore becomes more severe.

In consequence, the formation of antibodies is defective; the animal is not able to throw off these infections and wastes more protein.

The effects of folic acid illustrate the importance of leucocytes in defense. The number of leucocytes in the blood of monkeys falls when they are fed on a diet which lacks vitamin M (proved to be folic acid); these monkeys become very susceptible to diseases, particularly to dysentery.

Vitamin C (ascorbic acid) is needed for the proper formation of fibrous tissue. In scurvy, the disease caused by lack of vitamin C, wounds heal slowly or not at all on account of defects in the fibrous tissue which should close them: breaches in the outer defenses remain open to invasion by microorganisms. Apart from this, the barrier of fibrous tissue formed round areas that bacteria have invaded is weak and incomplete; the invasion is not localized as in normal animals.

Several trials have been made of the effects of giving large supplements of vitamins for many months to people eating their usual diets. If the subjects of the experiments were already getting enough of the vitamins in their food, no benefit could be expected from their supplements. But, in most cases, the usual diet of some of the subjects would contain less of one or more of the vitamins than is considered necessary. The only constant difference found between the subjects who received the supplement of vitamin A, or a mixture containing vitamin A, and control subjects, who did not, was a slight reduction in the severity and duration of colds (but not in their frequency).

Cold and Injury. — Resistance may be lowered by cold or injury; the degree of injury needed to turn the scale in favour of the invader may be very slight. When foot-and-mouth virus is injected into the muscle of a guinea pig, blisters appear on the pads of the feet in three or four days. If one foot is protected from pressure by being wrapped in cotton wool, no blisters develop on this foot, although they appear on the unprotected feet. The virus of herpes, which commonly gives rise to blisters on the lips, often causes inflammation of the mouth in young children. The virus appears to lie latent in the tissues after this attack. The latent virus may cause blisters on the lips when resistance is lowered locally, by injuries such as burns, or generally, in association with colds and pneumonia: hence the name fever blisters. The name of the common "cold" may not be a misnomer. Infection with a virus, still virulent but kept in check by the local defenses, gets the upper hand and causes a fresh attack when these local defenses are weakened by cold.

Each cold is not necessarily caused by a fresh infection from another person.

HYPERSENSITIVE STATES OF HUMAN BEINGS

Skin Reactions. — If a small amount of antigen is injected into the skin of a subject who has been immunized with this same antigen, a patch of reddening followed by a weal appears round the point of injection in the course of 24 hr. to 48 hr. Such a response, for example, follows the injection of 0.02 ml. of horse serum into the skin of a person who has received a course of injections of diphtheria toxin-antitoxin floccules. The small amount of horse serum protein, present as antitoxin in the floccules, has immunized against horse serum. The reddening and formation of a weal is typical of all these skin reactions. These reactions can be produced in the skins of persons suffering from certain diseases; the most familiar instance is that produced in tuberculin tests. such as those of C. von Pirquet and C. Mantoux. A small amount of tuberculin, which contains antigenic constituents of tubercle bacilli, is injected into or under the skin; if infection with tubercle bacilli, whether active or dormant, is present, the injection is followed by a typical skin reaction.

With refinements of technique, precipitins can be demonstrated in the serum when the skin reactions are positive; for example, precipitins for tuberculin are found in the serums of persons who respond to the tuberculin test. These responses may therefore be supposed to be caused by reactions between antigen and antibody in the skin.

Reactions of this tuberculin type must be distinguished from those like the Béla Schick and G. F. Dick reactions. In the two latter reactions poisonous substances, the toxins of diphtheria bacillus and streptococcus. produce a response unless they are neutralized by antibody; the reaction appears if antibody is not present in sufficient amount.

Reactions of the tuberculin type are caused by local interaction of antibody and antigen; the reaction does not appear when antibody is not present.

Serum Sickness.—If anaphylaxis comparable to that which occurs in guinea pigs and dogs were at all common in human beings, treatment with serums derived from other species would have been out of the question. Fortunately. anything comparable to anaphylactic shock is extremely rare Serum sickness, which is the common response to a single injection of foreign serum, is

characterized by the onset, after about ten days, of urticaria, fever, pains on the joints and swelling near the site of injection. It is supposed that these symptoms are caused by reaction of antibodies, formed in response to the injections, with proteins of the foreign serum still remaining in the body.

Atopy, Hay Fever. — Certain people suffer from running of the nose and eyes after inhaling pollens of grasses. This "hay fever" is an example of a type of hypersensitivity which is characterized by the appearance of a set of symptoms after contact with some substances or a range of substances. These substances include pollens, horse dander and cutaneous debris of other species of animals, various foods and various drugs. The symptoms include, besides the running eyes and nose of hay fever, asthma, urticaria, gastrointestinal disturbances, eczema and local reactions at the site of application of some substances to the skin. Injection of a small amount of an extract from the substance that excites these symptoms (pollen, dander, etc.) into the skin of a sensitive person is promptly followed by reddening and a weal.

It is natural to regard these general and local reactions as comparable to the anaphylaxis and hypersensitiveness of the skin described earlier, and to attribute them to interaction of antibodies in the serum and antigens in the exciting substances. The serum of these subjects contains some kind of antibody, for if it is injected into the skin of normal persons it will usually sensitize the skin to the corresponding antigen. This hypothetical antibody has been called a reagin. We have seen that the amounts of antigen needed to sensitize an animal may be extremely small. The reagin may be formed in response to minute amounts of antigen absorbed from the intestine or from the respiratory passages.

When either these hypersensitive or normal persons are immunized by a series of injections of the exciting substance, a precipitin appears in the serum; such serums neutralize the sensitizing action of reagin. Two kinds of antibody are therefore formed by hypersensitive persons: the reagin which sensitizes and the normal precipitin which, if sufficient is present, combines with antigen and thereby neutralizes the sensitizing action of reagin. Reagin and normal precipitin differ in structure, for reagin is more readily destroyed by heat.

This hypersensitivity runs in families, although one member of a family may get hay fever when exposed to grass pollen and another get urticaria after eating certain foods. The abnormality of these hypersensitive persons seems to be twofold: they form antibodies in response to exposures to an antigen that would be insufficient to stimulate the formation of antibodies in normal persons; and the antibodies formed differ from normal antibodies. We have still to account for sensitivity to such relatively simple substances as formaldehyde and diphenylamine which, by themselves, would not serve as antigens. There is considerable evidence in favour of the theory that these substances form loose complexes with the proteins of the body and that these complexes serve as antigens and stimulate the production of reagins. (See also BACTERIAL AND INFECTIOUS DISEASES.) (J. R. MAR.)

PROPHYLACTIC PRODUCTION OF ACTIVE IMMUNITY

By means of artificial immunization man has attempted to improve on natural processes of immunization which occur whenever a human or animal population is exposed to certain infections. This natural phenomenon often fails to reach and immunize all of the susceptibles in the population, and unfortunately many of those exposed develop the disease in a severe or fatal form before immunity develops. Through artificial procedures it became increasingly possible to cause people to become immune to a certain disease at a desired time and age and to do so without causing them to be exposed to the hazards of the fully developed illness.

The advent of chemotherapy and the antibiotics did not decrease the importance of active immunization. It was still more important to prevent disease than to employ even a good method of treatment after a person became ill. People still died of infectious diseases in spite of the miracle drugs. The threat of bacteriological warfare which could cause wholesale disability was sufficient reason for continuing to immunize against those diseases for which prophylactic agents were available, and to seek for vaccines not yet available.

Artificial immunization may be brought about by the introduction into man or animals of a variety of agents designated as antigens. These antigens may be living or dead bacteria or other micro-organisms; chemically purified derivative of bacteria; toxins elaborated by bacteria; mixtures of toxin and the specific counteracting immune substance, antitoxin; or toxoids, which are toxins treated in such a manner that they are no longer poisonous, but still capable of stimulating immunity.

Living, unmodified micro-organisms are rarely used to immunize man because of the dangers associated with this practice. Before the discovery of smallpox vaccine in 1796 people were immunized against smallpox by injecting them with material taken from the skin eruption of persons ill with the disease. Some individuals inoculated in this way developed smallpox but, so great was the fear of this disease, many people preferred to take the smaller chance of dying from the inoculated disease rather than develop the more often fatal natural one. Probably, even in this case, there was some weakening of the virus through the handling it received before being injected. The route of inoculation was probably responsible for the lesser virulence of the inoculated material.

Bacteria or viruses which have been weakened or attenuated in some way are more useful as vaccines than fully virulent micro-organisms. A variety of procedures used for this purpose, including growing the organisms under conditions not optimum for their development, exposing them to physical and chemical agents, or adapting them to another animal so thoroughly that they become relatively nonvirulent for man. The latter procedure proved to be especially valuable. Yellow-fever vaccine, for example, was developed through application of this principle. The virus of this disease was first passed through many generations of mice, then through tissue culture and finally propagated in developing chick embryos. The virus by then was so altered that an amount of living virus equivalent to millions of infectious doses of the original, unattenuated virus could be injected into humans without causing yellow fever. Millions of people have been protected against yellow fever with this type of vaccine.

BCG (Bacillus Calmette-Guérin), the vaccine widely used against tuberculosis, is made from attenuated tubercle bacilli. In this case the bovine-type tubercle bacilli, originally virulent for man and animals, were rendered harmless by growing them for many generations on a potato-bile culture medium. It is generally agreed by authorities in the tuberculosis field that BCG is safe and that its use markedly lowers the incidence of infection.

Another type of vaccine, and possibly the most desirable, is one containing killed or inactivated micro-organisms. Vaccination against such diseases as typhoid fever, whooping cough, rabies and influenza is accomplished with killed vaccines. In the inactivation of the micro-organisms a great variety of physical and chemical agents are employed. Moderate heat and low concentrations of formalin and phenol are most commonly used. H. L. Hodes et al. first demonstrated that ultra-violet light is capable of inactivating the virus of rabies with less impairment of its immunogenic capacity than occurs when other physical or chemical agents are employed. An improved procedure, using ultra-violet light as the killing agent, was adopted for commercial production of some types of vaccine, especially antirabic vaccine. According to the Expert Committee on Rabies of the World Health organization, ultra-violet killed antirabic vaccine is superior to all others.

It appeared in the 1950s that future immunization would be carried out increasingly with purified antigens, freed from the extraneous materials which are inactive in the production of immunity but which sometimes may cause 'reactions in persons inoculated. These preparations, usually proteins or complex polysaccharides, are concentrated so as to have their immunizing power enhanced several thousand times as compared with an equivalent volume of the unpurified vaccine. A vaccine of this type, designed to immunize against several of the most prevalent types of pneumococci, the micro-organisms which cause pneumonia, became available for general use.

In some instances it is more important to stimulate protection against the toxin produced by a bacterium than against the organism itself since the symptoms of the disease may be due primarily to the toxin and not to the presence of the bacteria in the body. Inoculation with repeated graduated doses of toxin, beginning with amounts insufficient to cause local or systemic reactions, produces immunity to the toxin. This method was rarely used because it required too many injections and was also likely to give rise to undesirable reactions. However, it has been used in the Dick method of immunization against scarlet fever, because it has not been possible to produce a scarlet-fever toxoid with any degree of immunizing potency.

Mixtures of toxin and antitoxin, prepared in such a manner that there was a very slight excess of toxin, were the first prophylactics to be used in diphtheria immunization. They had the disadvantage, however, of sensitizing against horse serum. Furthermore, they were inferior in immunizing potency to toxoid and were almost entirely replaced by the latter.

Toxoid is usually made by exposing toxin to the action of formalin for several weeks. The resulting product seems to be identical with the original toxin in every respect except for the loss or reduction of its ability to produce poisonous effects in man or animals. Toxoids are widely used in immunization against diphtheria and tetanus and to a lesser extent as prophylactic agents against gas gangrene and staphylococcus infections (boils, carbuncles, septicaemia). Toxoids made from purified toxins are more potent and less likely to give rise to undesirable side reactions than those which were formerly available. In 1946 L. Pillemer and his associates announced that they had been able to produce purified crystalline tetanus toxin, from which it should be possible to produce even better toxoids. It was found possible to purify toxoids by various chemical methods. This is of considerable importance because of the increasing need of immunizing adults in whom undesirable reactions, following the injection of impure toxoids, are more likely to be severe.

Earlier attempts at immunization usually employed a single injection of antigen. In instances where a living vaccine is used; *i.e.,* in smallpox immunization, a single injection suffices because the organisms originally inoculated multiply manyfold. On the other hand, a single injection of vaccine consisting of killed bacteria or inactivated virus is usually only partially effective or offers complete protection for relatively short periods of time. The ideal method mould be to administer the vaccine in a large number of injections spread over a relatively long period of time. Practical considerations usually require that the number of injections for most diseases be limited to something like three or, at most, five.

With the small number of injections ordinarily employed, better immunity can be stimulated if the doses are given at considerable intervals. Originally, doses were spaced not more than seven to ten days apart for fear of encountering undesirable reactions of the anaphylactic type. Experience showed that the vaccines and toxoids in use were not likely to cause these undesirable reactions, and the tendency was to space the injections at greater and greater intervals. Three or four weeks is the usual spacing between injections but even better results can be obtained with intervals of three months or more.

The number of injections used and their spacing is determined to a large extent by whether the antigen contains an adjuvant. Potassium alum has been the most widely used adjuvant but there are others such as protamine aluminum phosphate or calcium phosphate. Perhaps the best adjuvant discovered by the 1950s was lanolin, but this substance could not be used in materials designed for human use. The mode of action of adjuvants is not fully understood but it appears that they may act in at least two mays. Antigens containing adjuvants are absorbed very slowly so that the effect is as if many repeated injections had been given. They also apparently stimulate the mechanism responsible for the production of immunity.

By adding alum to diphtheria toxoid it nas found that the percentage of individuals successfully immunized nith tno doses of this material was as great as when three doses of fluid toxoid (not containing alum) were used. It was claimed by several investigators that it is possible to immunize very young infants with whooping-cough vaccine containing alum whereas the same observers were unable to accomplish this end with vaccine lacking alum. Since about half the deaths from whooping cough occur in children under six months of age, this discovery offered new life-saving possibilities. On the other hand, alum was of no value in enhancing the potency of influenza vaccine. Unfortunately, adjuvants not only potentiate the desirable features of a vaccine or toxoid but may also enhance its capacity to produce undesirable side reactions. Further purification would remove foreign antigenic materials and thus would decrease the already low incidence of allergic reactions.

As stated above, ridding vaccines and toxoids of their potentialities for producing undesirable reactions became of greater importance because of the need of immunizing adolescents and adults. For example, when artificial immunization against diphtheria was first begun, it appeared that one course of injections would lead to lifelong immunity. It was not appreciated at that time that, because there was still a great deal of the disease in the community, the original artificial immunization was being bolstered continuously by the natural immunization process. Parallel with the reduced prevalence of diphtheria was a reduction in the opportunities for natural immunization to occur. Consequently it became recognized that reimmunization is necessary at some time subsequent to the primary immunization. Usually only a single injection is given as a "booster" dose and the amount of antigen used may be much smaller than that considered necessary in the primary immunization. In the U.S. it is believed that primary immunization should be done in early infancy with booster injections at about one year of age, at school entrance and at some later date such as graduation from grammar school.

In order to make it unnecessary for persons, especially children, to be subjected to numerous injections of vaccines and toxoids the practice of combining antigens became more prevalent. Diphtheria toxoid, tetanus toxoid and pertussis vaccine were combined with apparently excellent results. It mas formerly thought that immunization against diphtheria could not be successfully carried out at an earlier age than six months but this was found to be untrue. V. K. Volk's studies reported in 1947 seemed to indicate that there was a definite limit to the number of antigens that could be combined unless some way was found to forestall the high incidence of unwanted reactions that follow the use of combinations of four or five of the folloning antigens: diphtheria toxoid, tetanus toxoid, pertussis vaccine, typhoid vaccine and scarlet-fever toxin. It mas also evident that, unless markedly improved antigens were developed the dilution effect inherent in the combination would place a limit upon the number of component antigens.

Attempts to prevent an undue number of injections also took another course; *i.e.,* introduction of the antigens by some method not requiring its deposition in the tissues. Numerous investigators experimented with intranasal immunization by drops or by spraying the mucosa. Oral immunization was also tried by a number of research workers. G. Bousfield in 1945 suggested that diphtheria toxoid be incorporated in pastilles which could be sucked like hard candy, but indicated that this method could be used only for booster doses. In general, however, the results of studies along these lines were disappointing. It dppeared that the most fruitful course would be to continue attempts at further purification of the several antigens and the devising of techniques for combining them successfully.

Excellent results have been obtained through the use of prophylactics against diphtheria, tetanus, whooping cough, yellow fever and smallpox; good results in typhus. Rocky Mountain spotted fever, equine and Japanese encephalitis and typhoid, and poor or no results in bacillary dysentery, scrub typhus and influenza. In the case of the latter disease the reason for relative failure nas that new types of influenza virus, against which the vaccines mere not effective, kept cropping up every year or tno.

From the earliest work in this field it has been the practice to study immunizing materials extensively in laboratory animals

until adequate proof of their value could be adduced. These laboratory studies were usually followed by careful field studies in human populations, designed to evaluate the products further. Even after they came into general use, the various antigens used in artificial immunization continued to be on trial. Many vaccines and other immunogens failed to survive this rigorous sort of evaluation and sooner or later dropped out of use. Because vaccines and toxoids in use survived this vigorous process of elimination, they are, in general, admirably effective and are in large part responsible for the great reduction in the number of cases and deaths from such diseases as smallpox and diphtheria, diseases which heretofore ravaged so many communities.

BIBLIOGRAPHY.—Harvard symposium by John Everett Gordon and others, *Virus and Rickettsial Diseases With Especial Consideration of Their Public Health Significance* (1940); H. L. Hodes, L. T. Webster and G. I. Lavin, "The Use of Ultra-violet Light in Preparing a Non-Virulent Antirabies Vaccine," *Jour. Exp. Med.*, 72:437–444 (1940); W. C. Boyd, *Fundamentals of Immunology*, 2nd rev. ed. (1947); B. Ratner, *Allergy, Anaphylaxis and Immunotherapy, Basic Principles and Practice* (1943); S. O. Levinson, A. Milzer, H. J. Shaughnessy, J. L. Neal and F. Oppenheimer, "Production of Potent Inactivated Vaccines With Ultra-violet Irradiation," *J.A.M.A.*, 125:531–532 (1944); G. Bousfield, "Restoration of Diphtheria Immunity Without Injections: Pastilles by Mouth," *Brit. M. J.*, 1:833–835 (1945); L. Pillemer, R. Wittler and D. B. Grossberg, "Isolation and Crystallization of Tetanal Toxin," *Science*, 103:615–16 (1946); W. W. C. Topley and G. S. Wilson, *Principles of Bacteriology and Immunity*, 3rd rev. ed. by G. S. Wilson and A. A. Miles (1946); John J. Miller, Jr., "Immunization Procedures in Pediatrics," *J.A.M.A.*, 134:1064–1068 (1947); M. Heidelberger, C. MacLeod, R. G. Hodges, W. G. Bernhard and M. M. Di Lapi, "Antibody Formation in Men Following Injection of Four Type-Specific Polysaccharides of Pneumococcus," *Jour. Exp. Med.*, 85:227–230 (1947); Symposium, "Current Status of Immunization Procedures," *Am. J. Pub. Health*, 38:476–492 (1948); G. Edsall, "Active Immunization," *N. E. Jour. Med.*, 241:18–26, 60–70, 99–107 (1949); Sydney Raffel, "Types of Acquired Immunity Against Infectious Disease," *Am. Rev. of Microbiol.*, vol. iii, pp. 221–264 (1949). (H. J. SY.)

IMMUNITY, in law, a term for exemption from liability, principally used in the legal sense in connection with exterritoriality (*q.v.*).

IMOLA, a town and episcopal see of Emilia, Italy (anc. Forum *Cornelii*), province of Bologna, 21 mi. S.E. of that town by rail, 140 ft. above sea level. Pop. (1951) 24,245. The cathedral of S. Cassiano possesses interesting reliquaries, and contains the tomb of Petrus Chrysologus, archbishop of Ravenna (d. 449), a native of Imola. S. Domenico has a fine Gothic portal and S. Maria in Regola an old campanile. The town also contains some fine palaces. The communal library has some manuscripts, including a psalter with miniatures, that once belonged to Sir Thomas More (1304).

IMPALLA: see PALLA.

IMPATIENS, a genus (family Balsaminaceae) of annual or biennial herbs, sometimes becoming shrubby, comprising about 350 or more species, chiefly natives of the mountains of tropical Asia and Africa, but also found widely distributed in the north temperate zone and in south Africa. The flowers, which are purple, yellow, pink or white and often showy, are spurred and irregular in form and borne in the leaf axils. *Impatiens nolitangere,* touch-me-not, an annual succulent herb with yellow flowers, is probably wild in moist mountainous districts in north Wales, Lancashire and Westmorland. I. *roylei,* a tall hardy succulent annual with rose-purple flowers, a Himalayan species, is common in England as a self-sown garden plant or garden escape. In North America they are often called jewel weed. Two of the commonest, the spotted touch-me-not (I. *biflora*), with orange-yellow flowers, mottled with brown, and the pale touch-me-not (I. *pallida*), with pale yellow flowers, are widely distributed across the continent.

I. *balsamina,* the common balsam of gardens, a well-known annual, is a native of India and China; it is one of the showiest of garden flowers and of comparatively easy cultivation. I. *sultani,* a handsome plant, with scarlet flowers, a native of Zanzibar, is grown in a greenhouse in winter, but used as a summer bedding plant outdoors.

IMPEACHMENT. The U.S. constitution provides that "The House of Representatives.. . shall have the sole Power of Impeachment" (art. i, sec. 2, cl. 5); "The Senate shall have the sole Power to try all Impeachments" (art. i, sec. 3, cl. 6).

"The President, Vice President and all civil Officers . . . shall be removed from Office on Impeachment for, and Conviction of, Treason. Bribery, or other high Crimes and Misdemeanors" (art. ii, sec. 4).

In Great Britain conviction on an impeachment may include fines and imprisonment. The U.S. constitution. however, provides that judgment on an impeachment shall extend no further than removal and disqualification from office. This difference has had a profound effect on the history of impeachment in the U.S.

Impeachment trials held in the United States senate are given below.

1. William Blount, senator from Tennessee, charged (1797) with conspiring and contriving to excite the Creek and Cherokee Indians against the king of Spain. The senate held that a senator was not a civil officer within the meaning of the constitution. The impeachment was dismissed, but Blount was expelled from the senate.

2. John Pickering, judge of the district court of New Hampshire, charged (1804) with drunkenness, tyrannous conduct and disregard for the terms of statutes. Convicted.

3. Samuel Chase, associate justice of the U.S. supreme court, charged (1805) with intemperate, arbitrary and unjudicial conduct in sedition-law trials. Acquitted.

4. James H. Peck, judge of the U.S. for the district of Missouri, charged (1830) with tyrannous treatment of counsel and arbitrary conduct. Acquitted.

5. West H. Humphrevs, judge of the district court of the U.S. for the eastern, middle and western districts of Tennessee, charged (1862) with supporting the secession movement. Convicted.

6. Andrew Johnson (*q.v.*), the only president ever impeached, charged (1868) with the attempted removal of the secretary of war, Edwin M. Stanton, contrary to statute, inducement of a general of the army to violate an act of congress and contempt and reproach of congress. Acquitted by the margin of a single vote.

7. William Belknap, former secretary of war, charged (1876) with accepting profits from his own appointee to an army trading post. The senate voted down Belknap's defense that he could not be impeached since he had already resigned. He was nonetheless acquitted.

8. Charles H. Swayne, judge of the northern district of Florida, charged (1905) with falsifying expense accounts, nonresidence and use of a private car belonging to a railroad in receivership. Acquitted.

9. Robert W. Archbald, judge of the U.S. commerce court, charged (1913) with using his official position for private gain and accepting loans from litigants. Convicted.

10. Harold Louderback, judge of the northern district of California, charged (1932) with favouritism in the appointment of receivers. Acquitted.

11. Halsted L. Ritter, judge of the southern district of Florida, charged (1936) with bankruptcy irregularities and income tax evasion. Convicted.

The principal criticism directed at the impeachment process is that it is cumbersome and anachronistic. An impeachment trial occupies the entire senate for from 16 days to six weeks, fills thousands of pages of testimony and involves conflicting and troublesome political pressures. Repeated attempts in congress to amend the procedure, however, proved uniformly unsuccessful. A partial explanation of the resistance to change is the fact that impeachment is regarded as an integral part of the American system of checks and balances.

Instead: a more practical solution has emerged. The resignation of the officer under inquiry has generally terminated the proceedings (despite the ruling in the Belknap case). For instance, in the case of District Judge George W. English (1926) the senate, after it had received the articles of impeachment from the house and had convened as a trial court, dismissed the impeachment upon notification of his resignation. A later example occurred when the house committee on the judiciary, after noting the removal by resignation of District Judge Albert W. Johnson (1946),

refused to recommend impeachment because a trial would have occupied the senate unduly "when that body is engaged in so many issues vital to the welfare of the nation."

BIBLIOGRAPHY.—Asher C Hinds, *Hinds' Precedents of the House of Representatives of the United States,* vol. iii (1907); Clarence Cannon, *Cannon's Precedents of the House of Representatives of the United States* (1935); Edward Corwin (ed.), *Constitution of the United States of America, Analysis and Interpretation* (Washington, *D.C.,* 1953).

(J. B.)

England. — Impeachment in England is in the form of judicial parliamentary procedure against criminals, in which the house of commons are the prosecutors and the house of lords the judges. It differs from bills of attainder (*q.v.*) in being strictly judicial. When the house of commons has accepted a motion for impeachment, the mover is ordered to proceed to the bar of the house of lords. and there impeach the accused "in the name of the House of Commons, and of all the Commons of the United Kingdom." The charges are formulated in articles, to each of which the accused may deliver a written answer. The commons appoint managers to conduct the prosecution, but the whole house in committee attends the trial. The defendant may appear by counsel. The president of the house of lords is the lord high steward in the case of peers impeached for high treason; in other cases the lord chancellor. The hearing takes place as in an ordinary trial, the defense being allowed to call witnesses if necessary, and the prosecution having a right of reply. At the end of the case the president "puts to each peer, beginning with the junior baron, the questions upon the first article, whether the accused be guilty of the crimes charged therein. Each article is proceeded with separately in the same manner, the lord high steward giving his own opinion the last" (Sir T. E. May's Parliamentary Practice). Should the accused be found guilty, judgment follows if and only if the commons move for it. The commons thus retain the power of pardon in their own hands, and this right they have in several cases expressly claimed by resolution, declaring that it is not parliamentary for their lordships to give judgment "until the same be first demanded by this House." Spiritual peers occupy an anomalous position in the trial of peers, as not being themselves ennobled in blood; it is customary for them to withdraw before judgment is given, entering a protest "saving to themselves and their successors all such rights in judicature as they have by law, and by right ought to have." An impeachment, unlike other parliamentary proceedings, is not interrupted by prorogation, nor even by dissolution. Proceedings in the house of commons preliminary to an impeachment are subject to the ordinary rules, and in the Warren Hastings case an act was passed to prevent the preliminary proceedings from discontinuance by prorogation and dissolution.

A royal pardon cannot be pleaded in bar of an impeachment, though it is within the royal prerogative to pardon after the lords have pronounced judgment. The point was raised in the case of the earl of Danby in 1679, and the rule was finally settled by the Act of Settlement. Persons found guilty on impeachment may be reprieved or pardoned like other convicts. Impeachment will lie against all kinds of crimes and misdemeanours, and against offenders of all ranks. In the case of Simon de Beresford, tried before the house of lords in 1330, the house declared "that the judgment be not drawn into example or consequence in time to come, whereby the said peers may be charged hereafter to judge others than their peers," from which Sir William Blackstone and others have inferred that "a commoner cannot be impeached before the Lords for any capital offence, but only 'for high misdemeanours." In the case of Edward Fitzharris in 1681, the house of commons in answer to a resolution of the Lords suspending the impeachment, declared it to be their undoubted right "to impeach any peer or commoner for treason or any other crime or misdemeanour." And the house of lords has in practice recognized the right of the commons to impeach whomsoever they will. The procedure has, however. been reserved for great political offenders whom the ordinary powers of the law might fail to reach. It fell into desuetude. The last impeachments were those of Warren Hastings (1788–95) and Lord Melville (1806), but an unsuccessful attempt was made by Thomas C. Anstey to impeach Lord Palmerston in 1848.

IMPERIA, a city of Liguria, Italy, the capital of the province of Imperia, on the coast of the Ligurian sea, 46 mi. E. of Nice by rail and 70 mi. S.W. of Genoa, 115 ft. above sea level. Pop. (1957 est.) 32,132 (mun.). It consists of a picturesque old town on the heights and a modern town of villas on the lower slopes. The dome of the principal church, a large structure of 1780, was rebuilt in 1821. About 2 mi. N.E. on the same bay is Oneglia, with a fine church, S. Giovanni Battista (designed by Gaetano Amoretti), a hospital (1785) and a large prison. It suffered considerably from the earthquake of 1887. Both towns have small but safe harbours, and both are embowered amid olive groves. The district is famous for the quality of its oil. During World War II, Imperia's port and industrial section suffered damage.

Imperia, formerly Porto Maurizio, appears as Portus Maurici in the Maritime Itinerary. After being subject to the marquises of Turin (11th century) and of Clavesana, it was sold by Boniface of Clavesana in 1288 to Genoa in return for a yearly payment; in 1354 it became the seat of the Genoese vicar of the western Riviera, and thenceforth shared the fortunes of Genoa.

IMPERIAL CHAMBER (Reichskammergericlzt), the supreme judicial court of the Holy Roman empire, during the period between 1495 and the dissolution of the empire in 1806. From the early middle ages there had been a supreme court of justice for the empire—the Hofgericht, in which the emperor himself presided and a body of assessors found the judgments. The Hofgericht was connected with the person of the emperor; it ceased to act when he was abroad; it died with his death. Upon him it depended for its efficiency; and when, in the 15th century, the emperor ceased to command respect, his court lost the confidence of his subjects. After 1450 it ceased to sit.

Its place was taken by the Kammergericht, which appeared side by side with the Hofgericht from 1415 and after 1450 replaced it altogether. The king (or his deputy) still presided in the Kammergericht and it was still his personal court; but all the members of the new "chamber" were now officials—the consiliariz of the imperial aula (or Kammer, whence the name of the court). It was generally the legal members of the council who sat in the Kammergericht (see XULIC COUNCIL); and as they were generally doctors of civil law, the court which they composed tended to act according to that law, and thus contributed to the "reception" of Roman law into Germany toward the end of the 15th century.

Even the *Kammergericht,* however, fell into disuse in the later years of the reign of Frederick III; and the creation of a new and efficient court became a matter of pressing necessity, and was one of the most urgent of the reforms which were mooted in the reign of Maximilian I.

This new court was eventually created in 1495; and it bore the name of *Reichskammergericht,* or imperial chamber. It was distinguished from the old Kammergericht by the essential fact that it was not the personal court of the emperor but the official court of the empire (or Reich—whence its name). The emperor appointed the president; the empire nominated the assessors or judges. More exactly, the emperor nominated, according to the regular usage of later times, a certain number of the members—partly on his authority as emperor and partly as the sovereign of his hereditary states; the rest of the judges. who formed the majority, were nominated by the empire—partly by the electors and partly by the six ancient circles. There were originally 16 judges (afterward, as a rule. 18): half of these were to be doctors of Roman law, and half were to be knights; but after 1495 it became necessary that the latter should be learned in Roman law, even if they had not actually taken their doctorate. Thus the empire was at last possessed of a court—a court resting on the enactment of the diet and not on the emperor's will; a court paid by the empire and not by the emperor; a court resident in a fixed place (until 1693, Speyer. and afternard. from 1693 to 1806, Wetzlar) and not attached to the emperor's person.

The great result it served to achieve was the final "reception" of Roman law as the common law of Germany. That the imperial chamber should itself administer Roman law was an inevitable result of its composition; and it was equally inevitable that the composition and procedure of the supreme imperial court should be imitated in the various states which composed the empire, and that Roman law should thus become the local, as it was already the central, law of the land.

The province of the imperial chamber, as it came to be gradually defined by statute and use, extended to breaches of the public peace, cases of arbitrary distraint or imprisonment, pleas which concerned the treasury, violations of the emperor's decrees or the laws passed by the diet, disputes about property between imme-

diate tenants of the empire or the subjects of different rulers, and finally suits against immediate tenants of the empire—with the exception of criminal charges and matters relating to imperial fiefs, which went to the aulic council. The court also had cognizance in cases of refusal to do justice, and it acted as a court of appeal from territorial courts in civil, and, to a small extent, in criminal cases; but it had no authority as a court of appeal in all territories which enjoyed a *privilegium de non appellando* (such as, for example, the territories of the electors).

The business of the court, however, was badly done; the delay was interminable, largely a result of want of funds, which prevented the maintenance of the proper number of judges. In all its business it suffered from the competition of the aulic council (*q.v.*); for that body, having lost all executive competence after the 16th century, had also devoted itself exclusively to judicial work. Composed of the personal advisers of the emperor, the aulic council did justice on his behalf (the erection of a court to do justice for the empire having left the emperor still possessed of the right to do justice for himself through his *consiliarii*); and it may thus be said to be the descendant of the old *Kammergericht.*

The competition between the aulic council and the imperial chamber was finally regulated by the treaty of Westphalia, which stipulated that the court which first dealt with a case should alone have competence to pursue it.

See J. N. Harpprecht, *Staatsarchiv des Reichskammergerichts* (1757–85); G. Stobbe, *Reichshofgericht und Reichskammergericht* (Leipzig, 1878); R Schroder, *Lehrbuch der deutschen Rechtsgeschichte* (Leipzig, 1904). (E. B.)

IMPERIAL CHEMICAL INDUSTRIES LIMITED is the largest British chemical manufacturer and one of the largest industrial undertakings in the British Commonwealth. The situation that was to lead to the formation of I.C.I. developed during World War I. Although Great Britain had produced many of the pioneers of the chemical industry, the country lacked facilities at the outbreak of war to make the synthetic nitrate needed in the manufacture of explosives and fertilizers and could not produce many essential dyestuffs. By 1918 many technical deficiencies had been repaired, but the need for a strong chemical industry was clear. After the war, several explosives manufacturers banded together to form an organization which became Nobel Industries, Ltd. At about the same time, the dyestuffs industry was also being re-formed and several of the principal manufacturers had sunk their separate identities in the British Dyestuffs Corporation, Ltd. At the end of 1920, the four outstanding organizations in the British chemical industry were the British Dyestuffs Corporation, Ltd.; Brunner, Mond and Co., Ltd.; Nobel Industries. Ltd.; and the United Alkali Co., Ltd.

In other countries even larger corporations had arisen enjoying the advantages of large-scale enterprise. With their greater financial resources they could support research on the grand scale and maintain large technical service organizations for the benefit of their customers. In the light of such developments, the structure of the British chemical industry called for review. Sir Harry (later Lord) McGowan, the head of Nobel, and Sir Alfred Mond (later Lord Melchett) of the Brunner, Mond enterprise took action to bring together their own companies and the other two large groups, British Dyestuffs and United Alkali. Negotiations began in July 1926 and on Dec. 7, 1926, Imperial Chemical Industries, Ltd., came into being.

In more than 100 factories throughout England, Scotland, Wales and Northern Ireland, I.C.I.'s employees, numbering about 112,000, make about 12,000 products, ranging from heavy chemicals, blasting explosives and fertilizers to paints, plastics and synthetic fibres. Through its metals division, I.C.I. also enters into the nonferrous metals industry. Overseas, I.C.I. has manufacturing or selling organizations in almost every country. (GY. R.)

IMPERIAL CITIES or IMPERIAL TOWNS is the usual English translation of *Reichsstädte,* an expression of frequent occurrence in German history. These were cities and towns subject to no authority except that of the emperor, or German king; in other words, they were immediate. The earliest of them stood on the demesne land of their sovereign, and they often grew up around his palaces.

A distinction was thus made between a *Reichsstadt* and a *Landstadt,* the latter being dependent upon some prince, not upon the emperor direct.

The term *Freie Reichsstadt,* sometimes used in the same sense as *Reichsstadt,* is rightly only applicable to seven cities—Basle, Strasbourg, Speyer, Worms, Mainz, Cologne and Regensburg. Having freed themselves from the domination of their ecclesiastical lords, these called themselves *Freistadte* and in practice their position was indistinguishable from that of the *Reichsstadte.*

In the middle ages many other places won the coveted position of a *Reichsstadt.* Some gained it by gift and others by purchase; some won it by force of arms, others usurped it during times of anarchy, while a number secured it through the extinction of dominant families, like the Hohenstaufen. There were many more free towns in southern than in northern Germany, but their number was continually fluctuating, for their liberties were lost much more quickly than they were gained. Mainz was conquered and subjected to the archbishop in 1462.

Some free towns fell into the hands of various princes of the empire, and others placed themselves voluntarily under such protection. Some, like Donauworth in 1607, were deprived of their privileges by the emperor on account of real, or supposed, offenses, and others were separated from the empire by conquest. In 1648 Besançon passed into the possession of Spain; Basle had already thrown in its lot with the Swiss confederation, while Strasbourg, Colmar, Haguenau and other free towns were seized by Louis XIV.

Meanwhile the free towns had been winning valuable privileges in addition to those which they already possessed, and the more wealthy among them, like Lubeck and Augsburg, were practically *imperia in imperio,* waging war and making peace, and ruling their people without any outside interference. But they had also learned that union is strength. They formed alliances among themselves, both for offense and for defense, and these *Städtebünde* had an important influence on the course of German history in the 14th and 15th centuries. These leagues were frequently at war with the ecclesiastical and secular potentates of their districts and in general they were quite able to hold their own in these quarrels. The right of the free towns to be represented in the imperial diet was formally recognized in 1489 at the diet of Frankfurt, and about the same time they divided themselves into two groups, or benches, the Rhenish and the Swabian. By the peace of Westphalia in 1648 they were formally constituted as the third college of the diet and later as the third estate of the empire. A list drawn up in 1422 mentions 75 free cities and another drawn up in 1521 mentions 84, but at the time of the French Revolution the number had decreased to 51.

At this time there were 14 Rhenish free cities: Cologne, Aachen, Liibeck, Worms, Speyer, Frankfurt-on-Main, Goslar, Bremen, Hamburg, Muhlhausen, Nordhausen, Dortmund, Friedberg, and Wetzlar.

The Swabian free cities were: Regensburg, Augsburg, Nuremberg, Ulm, Esslingen, Reutlingen, Nordlingen, Rothenburg-ob-der-Tauber, Schwabisch-Hall, Rottweil, Uberlingen, Heilbronn, Memmingen, Gmund, Dinkelsbiihl, Lindau, Biberach, Ravensburg, Schweinfurt, Kempten, Windsheim, Kaufbeuren, Weil, Wangen, Isny, Pfullendorf, Offenburg, Leutkirch, Wimpfen, Weissenburg (Wissembourg), Giengen, Gengenbach, Zell, Buchhorn, Aalen, Buchau and Bopfingen. But a large proportion of these free cities, both Rhenish and Swabian, had as little claim to their exceptional positions as the pocket boroughs of Great Britain and Ireland had before the passing of the Reform bill of 1832.

By the peace of Lunéville in 1801 Cologne, Aachen, Worms and Speyer were taken by France, and by the decision of the imperial deputation of 1803 six cities only—Hamburg, Lubeck, Bremen, Augsburg, Frankfurt-on-Main and Nuremberg—were allowed to keep their *Reichsfreiheit,* or in other words to hold directly of the empire. This number was soon further reduced. On the dissolution of the empire in 1806 Augsburg and Nuremburg passed under the sovereignty of Bavaria, and Frankfurt was made the seat of a duchy for Karl Theodor von Dalberg, elector and archbishop of Mainz, who was appointed prince primate of

the Confederation of the Rhine. When the German confederation was established in 1815, Hamburg, Liibeck, Bremen and Frankfurt were recognized as free cities, and the first three continued to hold that position in the later. German empire; but Frankfurt-on-Main, in consequence of the part it took in the war of 1866, lost its independence and was annexed by Prussia.

In the earlier years of their existence the free cities were under the jurisdiction of an imperial officer, who was called the *Reichsvogt* or imperial advocate, or sometimes the *Reichsschultheiss* or imperial procurator. As time went on many of the cities purchased the right of filling these offices with their own nominees; and in several instances the imperial authority fell practically into desuetude except when it was stirred into action by peculiar circumstances.

The internal constitution of the free cities was organized after no common model, although several of them had a constitution drawn up in imitation of that of Cologne, which was one of the first to assert its independence (1288).

See COMMUNE : *Mediaeval.*

IMPERIAL CONFERENCE: ***see*** CONFERENCE.

IMPERIALISM. Imperialism is the policy of a state aiming at establishing control beyond its borders over people unwilling to accept such control. Because of this unwillingness imperialist policy always involves the use of power against its victims. It has therefore often been considered morally reprehensible, and the term has been employed in international propaganda to discredit an opponent's policy. This polemic use is facilitated by the fact that the imperialist nature of a policy is sometimes difficult to discover. For in foreign policy many means and methods can serve either imperialism or other purposes, depending upon the motivation of their user. The manifold and sometimes subtle or hidden political, financial, economic, technical and cultural activities of one state in another may aim at the creation of sympathy, friendship or influence, but they may also be techniques to gain control. Often only the result of a given policy can tell what the intention has been; and many imperialist policies, ending in failure, remain undetected. However, enough have been successful throughout the ages to show that, though the term as here defined dates back to only the last half of the 19th century, the phenomenon it describes is as old as civilization and that ancient and modern imperialism have in common not only the end but many means.

HISTORY

Ancient Times. — In eastern Asia, the Chinese empires of the Chou, Ch'in and Han dynasties (1766?–1123? B.C., 221–206 B.C., 206 B.C.–A.D. 221, respectively) and later the T'ang dynasty (618–906) extended over vast territories in the name of bringing the blessings of Chinese civilization to "barbarians." In northern India the dynasties of the Maurya (320–*c.* 185 B.C.) and later the Gupta (320–480) ruled over large empires without advancing any excuses and claimed suzerainty over tribes far beyond the borders of the empire.

The history of western Asia and the Mediterranean is an unending succession of empires, many building upon the ruins of preceding ones. About 25 centuries before Christ, Lugal-zaggisi united the Sumerians under his rule in Mesopotamia in what might have been the first Sumerian empire. It was followed around 2550 B.C. by the Semitic empire of Sargon of Akkad and thereafter by the second Sumerian empire lasting from the 22nd to the 21st centuries. The Babylonian empire came next. It was dominated by the personality of Hammurabi (*c.* 19th century B.C.) whose influence lasted into the Christian era, long after his empire had succumbed to the invasion of Indo-European tribes from eastern Europe.

The scene then shifted to the Nile where the Pharaohs established their empires from the 16th to the 13th centuries B.C. But in contrast to preceding rulers of empire, the Pharaohs could not expand their empire to coincide with the then known world. Failing to defeat the Hittites in northern Syria, they agreed upon peaceful coexistence, each guaranteeing the integrity of the other's empire.

The heritage of these two empires fell to the tyrannical empire of the Assyrians. It reached its apex around 660 B.C. and was soon thereafter, from the 6th to the 4th centuries, replaced by the Persian empire. Persian rule was in strong contrast to the Assyrian in its liberal treatment of subjected peoples, assuring it long duration.

It eventually gave way to the imperialism emanating from Greece. When Greek imperialism reached an apex under Alexander the Great (356–323 B.C.), a union of the eastern Mediterranean with western Asia was achieved. But the cosmopolis, in which all citizens of the world would live harmoniously together in equality, remained a dream of the great Alexander. It was realized when the Romans built their empire from Britain to Egypt and based it, ideologically, upon the Stoic and Christian concepts of the unity and brotherhood of man.

This idea of empire as a unifying force was never again realized after the fall of Rome. The nations arising from the ashes of the Roman empire in Europe, and in Asia on the common basis of Islamic civilization, pursued their own imperialisms. Imperialism became a divisive force among the peoples of the world.

Modern Times. — Some novel, mostly modern versions of old forces provided the impetus behind these modern imperialisms: nationalism (*q.v.*), industrialization, improved communications, discovery of new territories and even growing humanitarianism. People of all classes became involved in the drives for empire, though they acted on different motivations: merchants and missionaries, militarists and adventurers, nationalists and politicians.

Three periods stand out in the modern era in which competing imperialist policies of the nations led to the creation of vast empires, primarily of the colonial kind. Between the 15th century and the middle of the 18th, England, France, the Netherlands, Portugal and Spain built empires in the Americas, India and the East Indies. For almost a century thereafter relative calm in empire building reigned as the result of a strong reaction against imperialism. Then the decades between the middle of the 19th century and World War I were again characterized by intense imperialistic policies.

Russia, Italy, Germany, the United States and Japan were added as newcomers among the imperialistic states and indirect, especially financial, control became a preferred form of imperialism. For a decade after World War I the great expectations for a better world inspired by the League of Nations put the problem of imperialism once more in abeyance. Then Japan renewed its empire building with an attack in 1931 upon China, and under the leadership of the totalitarian states Japan, Fascist Italy, National-Socialist Germany and Communist Russia, a new period of imperialism was inaugurated.

THEORIES

Ancient Views. — Wherever imperialism existed, men have attempted to find its causes, usually either to denounce or to excuse, if not praise it. The Chinese Mencius, around 300 B.C., condemned imperialism as the result of man's unending greed and acquisitiveness, especially the insatiable ambitions and covetousness of princes, advised by selfish ministers and false counselors. The mass of the people, he felt, want to live in peace and are disturbed and injured by imperialistic wars. The country as a whole, he claimed. suffered because the maintenance of newly acquired territory was a burden and eventually a loss when it fell prey to the competing imperialism of another country. He saw no political, economic or moral justification for imperialism. In contrast to the idea, widely held in China, that admission to the empire was a blessing, Mencius granted that there may be a moral duty to liberate a people from its tyrannical rulers but that, once liberated, every people has a right to choose its own rulers.

In contrast to China, where ideologically war was deprecated and considered unnatural, secular Hindu philosophy in India had extreme views on the warlike nature of man. Life was considered an eternal and ruthless struggle, in which every state was the enemy of every other neighbouring state.

Quite logically, the ancient Hindu writers, Kautilya in his *Arthasastra* prominent among them, advocated the worst imperial-

istic power politics. They suggested that a state must strive for world domination, for only by beating its enemies into subjection can it have peace. A state must therefore be ready for war at all times, though if the aim can be achieved by cheaper means, such as diplomacy, alliances or the threat of force, they, rather than war, should be used.

Among the Persians the idea was widespread that in building their empire they were fulfilling a divine mission. And, perhaps more than most ancient empire builders, they translated this idea into reality by treating the conquered peoples with justice and fairness and granting them a certain degree of autonomy, though not neglecting to draw the greatest possible economic profit from them.

Among the Greeks ideas about empire building differed. In Sparta military prowess and the conquest of neighbouring territories were the ideals. But Sparta was satisfied essentially with military greatness and never became a colonizing power. In Athens political parties existed favouring and deprecating imperialistic wars. Thucydides (jth century B.C.) justified the expansion of Athens under Pericles by pleading security. Pericles himself, in the words of Thucydides, added that "to be within the circle of our influence is not dependence but privilege." To Plato and Aristotle, the self-sufficient city-state was the ideal. Aggressive war, Aristotle wrote, was justified only against people destined "by nature" to be slaves. Otherwise, he condemned the building of empires as endangering the morality of the citizens and also the freedom of the state which cannot remain liberal toward its own people while being tyrannical toward its vassals.

The Stoics, in the latter days of Greek imperialism, developed the ideal of world citizenship on an equalitarian basis and turned it eventually into humanitarianism. This concept never was applied in Greek political practice, but it became the ideological underpinning of the Roman empire where it fitted into the existing political and social reality.

Only later, when Stoic ideals gained a hold over important leaders of the empire did they exert a positive, directive effect upon the affairs of state. They finally fused with the Christian ideology and in the new form had a most fundamental effect deep into modern times.

Modern Views.—Considering the basic similarity in the patterns and the logic of imperialism throughout history, it is not surprising that in the thoughts of the ancients can be found the essence of all theories about the causes and value of imperialism. Modern thinkers have added refinements, elaborations, adaptations to modern conditions. and they have occasionally tried to support their views with evidence rather than dogma. but they have added little new knowledge. In their modern form, arguments about the causes and value of imperialism can be classified into four main groups.

The first group contains economic arguments and often turns around the question, does imperialism pay? Those who argue that it does and consequently advocate imperialist policies, from the English mercantilists to the German. Italian and Japanese totalitarians of the 20th century, point to the human and material resources and the outlets for goods, investment capital and surplus population provided by empire.

Their opponents. among them the physiocrats of France, Adam Smith, David Ricardo. J. A. Hobson, often admit that imperialism may benefit a small, favoured group but never the nation as a whole. Their reasoning ends in the advocacy of rectification of economic maladjustments in national economies and a liberalization of international economic relations so that in fact the benefits might be obtained which imperialism claims to but does not actually provide.

Marxist theoreticians have elaborated the economic aspects of imperialism in great detail. They interpret imperialism as a late stage of capitalism when the national capitalist economy has become monopolistic and is forced to conquer outlets for its overproduction and surplus capital in competition with the monopolistic economies of other capitalist states. This is the view held, for instance, by Nicolai Lenin and N. J. Bukharin to whom capitalism and imperialism are identical. Lenin argued further that the exploitation of "colonial slaves" moderated the oppression of the European workers and delayed their revolt. It would therefore hasten revolution in the developed countries to aid the emancipation of the colonial and semicolonial areas in the name of "nationalism." Marxist theory was thus reconciled with the nationalism of colonial peoples and both were made to serve the imperialist policies of the U S.S.R. Moderate Marxists, such as Karl Kautsky and Rudolf Hilferding, have argued that imperialism is merely a possible, not an inevitable, policy of a capitalist state. One of the chief weaknesses in these arguments is that historical evidence does not support them and that they fail to explain precapitalist imperialism and communist imperialism.

A second group of arguments relates imperialism to the nature of human beings and human groups, such as the state. Such different personalities as Niccolo Machiavelli, Sir Francis Bacon, Ludwig Gumplowicz, Adolf Hitler and Benito Mussolini, reasoning on different grounds, nevertheless arrive at similar conclusions. Imperialism to them is part of the natural struggle for survival. Nature has made men unequal, and those endowed with superior qualities are destined to rule all others. Nations must prove their strength and virility in combat and the subjection of weaker peoples. Like all organisms, states must pass through a period of growth (*i.e.*, expansion).

In Mussolini's words, "Fascism sees in the imperialistic spirit [*i.e.*, the tendency of nations to expand] a manifestation of their vitality." Critics of these viewpoints, for the most part biologists, political scientists and social psychologists, point out that in addition to being illogical in many cases, there is no evidence to support them and that they rest on mysticism rather than demonstrable fact.

The third group of arguments has to do with strategy and security. Nations are urged, proponents of this viewpoint say, to obtain bases. strategic materials, buffer states, "natural" frontiers, control of communication lines for reasons of security or to prevent other states from obtaining them.

Those who deny the value of imperialism for these purposes admit that they have been a motivating factor, but they point out that security is not achieved. On the contrary, expansion of a state's control over territories and peoples beyond its borders is likely to lead to friction, hence insecurity, because the safety belts and spheres of influence of competing nations are bound to overlap sooner or later. Related to the security argument is the argument that nations are imperialistic in the search for po er and prestige for their own sake.

The fourth group of arguments is based on moral grounds, sometimes with strong missionary implications. Imperialism is excused as the means of liberating peoples from tyrannical rule or of bringing them the blessings of a superior civilization. The white man's burden of the English, the civilizatory action of the French, the manifest destiny of the Americans, the greater east Asia coprosperity sphere of the Japanese, the Pan-Slavism of the Russians and the Pan-Germanism of the Germans, and the Liberation movements of the Communist Russians belong in this category.

These arguments have been used increasingly as growing liberalism and popular awareness of the price of imperialism combined with mass participation in the political process have caused a political and moral revulsion against imperialism.

The foes of imperialism have claimed that these moral arguments were merely a disguise to deceive people and gain their support for imperialist policies. But they can hardly deny that, driven by nationalist fervour and convinced of the righteousness of the moral mission, large sections among the population of imperialist states have supported, even demanded imperialist policies for no other gain than the psychological satisfactions they derive from them. The "devil theory" of imperialism, that only ruthless profiteers have engineered imperialism, is not borne out by the facts of history.

On the contrary, historical evidence, such as that assembled by Jacob Viner, Eugene Staley and William L. Langer, and theoretical analysis, such as that by Joseph A. Schumpeter and Lionel

Robbins, indicate that imperialism results from a complex of causes in which in varying degrees economic pressures. human aggressiveness and greed, search for security, drive for power and prestige, nationalist emotions, humanitarianism and many other factors are effective. Hence the difficulty of eliminating imperialism.

In the League of Nations and the United Nations attempts have been made to satisfy by peaceful means the legitimate aspirations of nations and to contain their illegitimate ones. Among the measures for these purposes are the collective security system, the mandate and the trusteeship system for dependent areas, the stimulation of cultural relations between nations, aid to underdeveloped countries and the improvement of health and welfare everywhere.

See also EMPIRE.

BIBLIOGRAPHY.—Parker Thomas Moon, *Imperialism and World Politics* (1926); J. A. Hobson, *Imperialism,* 3rd ed. (1938); J. R. Palanque, *Les Impérialismes antiques* (1948); E. M. Winslow, *The Pattern of Imperialism* (1948); J. A. Schumpeter, *Imperialism and Social Classes,* trans. by Heinz Norden (1951); Lionel Robbins, *The Economic Causes oj War* (1939); Eugene Staley, *War and the Private Investor* (1935); Jacob Viner, "International Finance and Balance of Power Diplomacy, 1880–1914," *South Western Political Science Quarterly,* 9:40 (1929); William L. Langer, *The Diplomacy of Imperialism, 1890–1902,* 2 vol. (1935); Quincy Wright, *A Study of War,* p. 1177 ff. (1942); Liu Shaoch'i, *Internationalism and Nationalism* (1951). (WR. L.)

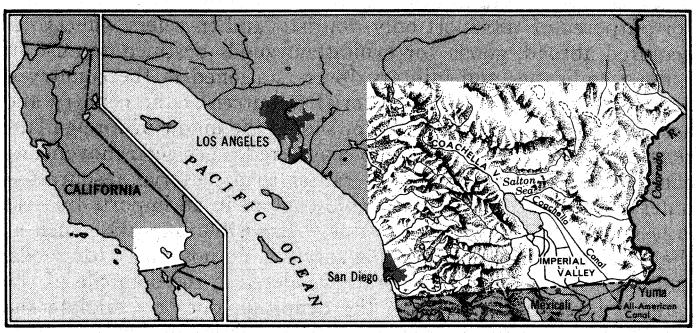
IMPERIAL PREFERENCE, the commercial system that arises when preferential rates (*i.e.,* duties levied at rates below the general level of the tariff, with free entry as a limiting case) are granted to each other by the constituent units of an empire; it may also include other sorts of preference, such as favourable consideration in the allocation of public contracts, indirect subsidies to shipping, preferential access to the capital market, etc.

Preferential arrangements of one kind or another have been enforced in the 20th century by most countries with dependent colonies, but in view of the great relative importance of the foreign trade of the British Commonwealth, the British imperial preference introduced in 1932 may be considered as the most important. The dominions granted preferences to Great Britain and to each other early in the 20th century; and when Great Britain imposed tariffs (*e.g.,* on certain key-industries goods in 1919 and 1921), the dominions were given preferences, which were however only of nominal value to them.

But when by the radical change in tariff policy in 1931 and 1932 Great Britain removed the ban on the taxation of food imports, the way was open for a systematic policy of imperial preference, based on the principle of "home producers first, empire producers second and foreign producers last," to come to a head at the Ottawa conference of 1932. The results were, after much hard bargaining, embodied in a series of bilateral agreements, which were to run for five years in the first instance (though they were allowed to run on after 1937 without formal renewal). These pledged that the United Kingdom was to allow the continued free entry of most empire goods and to impose new tariffs on certain food and metal imports from foreign countries; the dominions were to use their tariffs against United Kingdom produce in order only to protect efficient producers; and both sides were to maintain certain margins of preference. The political reasons for the agreements were strong, but the effect of the great depression and the search for "sheltered markets," as well as the spread of the protectionist spirit, culminating in the Hawley-Smoot Tariff act (1930) in the United States, may have been more important. Intraimperial trade increased after Ottawa, and empire trade as a proportion of an expanding world trade also increased in the 1930s. But other factors contributed to this; *e.g.,* the recovery of the prices of primary products and the existence of the sterling bloc.

During World War II and subsequently, exchange problems, commodity agreements and other factors had more effect than preferential tariffs. Some of the commonwealth suppliers of Great Britain benefited from the preferences, but not all countries achieved through it what they had hoped. Already some of the privileges had been waived to facilitate the signature of the Anglo-American trade agreement of 1938. Eventually the partners of the Ottawa agreements became signatories of the General Agreement on Tariffs and Trade (G.A.T.T.) in 1947, which was based on the most-favoured-nation principle and prohibited the extension of existing preferences. Indeed, in the several annual sessions of tariff negotiations through G.A.T.T. Great Britain and its partners agreed to some reductions of the preferential margins, without however abandoning the system. (L. Rs.)

IMPERIAL VALLEY, an intensively irrigated part of the Colorado desert, is located mainly in Imperial county in southeastern California, U.S., and extends slightly into Mexico. The valley is one portion of a huge trough in the earth's crust that includes, from southeast to northwest, the Gulf of California, the



LEFT. MAP SHOWING POSITION OF IMPERIAL VALLEY IN CALIFORNIA; RIGHT. DETAIL OF THE VALLEY

delta fan of the Colorado river (including the Imperial valley), the Salton sea and the Coachella valley. The Imperial valley extends northward about 50 mi. from just south of the California-Mexico border to the southerly end of the Salton sea. It is flanked on the east and west by slightly higher and gently sloping areas (east mesa and west mesa) which rise to barren hills and mountains.

All of the valley is below sea level—barely below at the Mexican border and 234 ft. below at the edge of the Salton sea. Were it not for the broad, damlike deposits of the delta fan of the Colorado river, the waters of the Gulf of California would invade and drown the Imperial valley, the Salton sea basin and much of the Coachella valley.

The Imperial valley has a hot desert climate, similar in many respects to that of the Sahara in Africa. The average temperature of the hottest month (July) is about 92° F.. and shade temperatures may at times reach 124° F. The coolest month (January) averages about 53° F., although cool-season temperatures may drop as low as 20° F. for a few hours in some years. Four months of the year average above 80° F., seven above 70° F. and only three average below 60° F. Rainfall is very meagre and uncertain from year to year; the average annual rainfall is about 3.5 in. The combination of high temperatures. abundant sunshine and numerous strong and drying winds makes the scant rainfall extremely ineffective.

Before 1900 the Imperial valley was a virtually uninhabited waste. The change from desert waste to green fields was accomplished by diverting water from the Colorado river to the deep, rich soils of the desert plain. This began nith the opening of the Imperial canal (about 50 mi. of which curved through Mexico) in May 1901. Disaster struck in 1905 and 1906 when Colorado river floodwaters destroyed diversion controls and the flow of the river poured northward into the Salton depression to create the Salton sea. Not until early 1907 nas control re-established. The area continued to face the possibility of new breaks. and not until the completion of Hoover dam (*q.v.*) in 1935 did major flood threat cease. In 1940 the All-American canal was completed and the valley became independent of the old Imperial canal. Chief products of the valley are beef cattle, sheep, lettuce, tomatoes, carrots, melons. sugar beets, alfalfa, barley, flax, cotton and dairy products. The chief cities and commercial centres are El Centro (*q.v.*) and Brawley.

By 1907 the Salton sea was about 40 mi. long and 13 mi. wide, covered over 500 sq.mi and had a surface 195 ft below sea level. Although it mas predicted that the sea, because of evaporation, would disappear by 1920, it continued to exist because of irrigation drainage water fed into it from the Imperial and Coachella valleys. In the middle part of the 20th century the greatly increased supply of drainage water caused the sea to rise again until in the early 1960s it covered nearly 300 sq.mi. and had a surface 234 ft. below sea level.

See also COLORADO RIVER. (R. M. GL.)

IMPORT DUTIES: see **TARIFFS.**

IMPORTING, the converse of exporting, is the process of bringing goods from abroad into one's own country for domestic consumption or transformation; it adds to the material resources of a country. Goods in direct transit that move through a country for purposes of transport only, tourists' and travelers' effects not acquired abroad, goods for exhibition, goods destined for use of foreign embassies and military forces stationed in the country—all these do not add to the material resources of the country and are not regarded as imports. Nor should the inflow of foreign currencies, securities and gold be so considered, since their movements change monetary and financial rather than material resources—unless, in the case of gold, the gold content in an imported object is less than 80% of its total value. ('Invisible imports," such as the purchase of foreign shipping services, do not deal with goods, and because services are generally rendered in the domicile of the caterer, their exclusion from the definition does not violate the reality as it would in the case of domestic marketing. This definition follows closely the concept underlying the standard international trade classification adopted by the United Nations. Importing, therefore, is part of the general process of marketing.

Importing Channels.— The import market structure is composed of three categories. In the first are import merchants, who buy from abroad on their own account, assume entire merchandising risks, carry goods in stock, engage in sorting, grading, cleaning, mixing and blending and do the physical importing. They generally specialize insofar as products and regions of supply are concerned. Indent houses belong to this group, but they buy from abroad only on orders from domestic customers. The second category comprises import agents, including import commission houses, commission merchants and resident agents or sales offices representing foreign supply. They sell to the domestic market on a commission basis for foreign exporters, usually with exclusive rights; they often attend to customs and details of shipments. Finally there are import brokers who, because of the need for knowledge of markets, grades, quality and trade practices, specialize in one or only a very few staples produced in many countries and by many individual producers (coffee, rubber, sugar, cocoa beans). They collaborate closely with export brokers abroad and normally act as intermediaries in bringing many domestic buyers (themselves not final consumers) and many foreign sellers together on specific lots either on the spot, already afloat or to be shipped from abroad. Unlike import agents, they are not at all associated with physical movements of goods or customs clearance.

This classification is made for analytical purposes only, for in actual practice the functions of the operators in these three categories greatly overlap and many of them carry on exporting as well as importing activities. Their relative importance varies according to product. International staples are handled in the first instance by import brokers and sometimes by import merchants who. together with import agents, generally deal with semi-manufactures and finished products. Some imports, consumer goods in particular, may even bypass the market structure through the use of correspondence, samples or catalogues and reach the final user by parcel post.

In underdeveloped countries where imports consist mainly of consumer goods, foreign firms traditionally have dominated the importing structure and will probably continue to play an important role as more and more capital goods are imported for national development. In industrialized countries the import agencies, generally operated by nationals, serve a good part of the domestic market well. They have to see to it that the foreign sources of supply are reliable as to design, quality, delivery dates and prompt delivery on reorder of identical products.

However, their services are not always satisfactory to large concerns in retailing, wholesaling and manufacturing. Modern merchandising methods require product differentiation and close co-ordination between production. sales promotion activity, inventory and changing consumer tastes in style, colour and pattern. Thus many large department stores and wholesalers establish purchasing agents abroad or send out traveling buyers in order to look after proper designing and uniform quality, to assure continuity of supply and to keep abreast of changes occurring constantly in foreign production. Other retail stores buy direct either through resident buying offices abroad that are under their own management or under indigenous management (commissionaires) or through branch offices or co-operative offices supported by groups of stores.

In some trades, manufacturing in particular, the problem of availability of supply (not to mention continuous supply at stable prices and in uniform quality) looms very large and has led many big corporations to acquire, develop and maintain full authority over foreign sources of supply (mining, rubber, bananas) with the express purpose of bringing the products back to their own country for processing or consumption. The same type of consideration underlies the "bulk purchase agreements" between national governments, such as that entered into by Great Britain from 1946 to 1951 to buy the exportable surpluses of various New Zealand and Australian farm products at prices negotiated annually.

In a socialist economy the market structure differs considerably. Importers, wholesalers and retailers there are, but they are part of the state trading machinery. Foreign trade is a state monopoly and importing as well as exporting may be as much a weapon of economic warfare as it is a method of trade development.

Importing Procedure.— Every important trading country has its omn laws governing imports with respect to documentation, packing, labeling, marking and customs clearance. (A separate set of regulations applies to personal baggage of nonresidents and returned residents.) The legal requirements are precise and deviation map result in financial losses, heavy penalties and in some cases even imprisonment. The most complicated among them is customs clearance, which consists of customs entry, appraisement and liquidation. For example, effective in the United States are 22 types of entry, each serving a particular purpose, and as many as five different bases of customs valuation (foreign value, export value. U.S. value, constructed value and American selling price). Procedures in other major trading countries are no less elaborate. Both the basis of valuation and the classification of the imported article for tariff purposes affect the amount of duty to be assessed. While the work of clearing import shipments may be relegated. as it is by many importers, to licensed customs brokers at reasonable costs, the uncertainty as to the amount of duty to be paid (especially on new products, novelties and specialties) remains and this partly explains the high margin in import pricing. Often appraisement entails delay in releasing the goods, and the delay might be prolonged if the importer appeals the decision of the appraiser to the customs court. Free ports, free-trade zones and foreign-trade zones help consignment and re-export trade; but when the goods landed there proceed to the hinterland, the same customs clearance procedure applies.

Complicated administrative regulations and procedures, costly to importers and consumers. may be regarded as an "invisible tariff," affecting, however, both duty-free and dutiable imports.

Importing and National Policy.—All trading nations have government boards, bureaus or ministries charged with the responsibility of assisting their own importers as well as exporters. In the United States, for example, the bureau of foreign and domestic commerce, with the help of the department of state foreign service personnel, provides importers with statistical aid relating to actual imports, reports on foreign producers as reliable sources of supply, indirect aid by means of information given to foreign producers and exporters, and surveys and analyses of domestic markets for imports. An import advisory committee to help importers functions in the office of international trade. And the Export-Import bank, a federal agency originally organized in 1934 to finance trade with the Soviet Union, has the task of assisting exporters and importers when adequate financing is not available to them from commercial banks and other private sources.

As profit-seeking businesses, importing firms strive to secure goods in domestic demand from the cheapest source in terms of total outlay for purchase price and transfer cost. In actual practice this freedom is variously prescribed in different countries. Some imports are banned for reasons of public health (certain food and drugs), public morals (obscene literature), public taste

(advertising matter) and fair trade practices (dumping, goods with infringing trade-marks). Although by no means uniform among countries, this type of embargo list is designed to protect public interests and tends to remain substantially unchanged in a country over long periods of time.

There is. however, great variation among countries in respect of a large group of control measures, each designed to attain a definite national policy objective and subject to modification as policy changes. The objective may be to raise revenue for the national treasury, to protect certain domestic industries, to give preference to products from certain areas, to restore equilibrium in the over-all balance of international payments, to maintain the international current account balanced with each particular trading partner, to reduce purchases that require "hard" or scarce currencies, to promote the import of essential producer and consumer goods against nonessential items, to safeguard state monopolies or to give effect to a domestic price- or income-support program which is susceptible to the depressing influences of imports.

Among the various instruments of control, the import tariff is the most widely used. either primarily for revenue or for protection purposes. A national tariff schedule is generally divided into the dutiable and the free list. Goods on the duty-free list are usually those that the country does not produce or prefers to import for political reasons (*e.g.,* Philippine sugar to the United States from 1916 to 1955). The dutiable list specifies three different levels of duty for all or some commodities: the highest is applicable to imports from countries that do not enjoy the most favoured nation treatment; the next. to those that do; and the lowest, to those accorded preferential treatment (the British imperial preference system). The duty rates are either ad valorem (*i.e* , a fixed percentage of the imported value to be determined) or specific amounts of money per unit of quantity or weight (gross, legal or net) or a combination of the two. In some countries, certain imports are also subject to excise taxes after they have been cleared through customs. Heavy duties and taxes, however, do not necessarily bar importation completely as long as the domestic market is willing to pay high enough prices for the goods in question.

Import quotas, import licensing and foreign exchange allocation are measures of quantitative restriction. There are many types of quotas relating to imports. The tariff rate quota provides for the entry of a specified quantity of the quota product at a reduced rate of duty during a given period and unlimited quantity above the quota at higher rates; the so-called mixed quota requires domestic manufacturers to use a minimum proportion of domestic materials in combination with imported materials. In contrast, the absolute quota fixes the quantity of total imports of the quota product during a given period. It may be global nith no discrimination against any one of the exporting countries or allocated to each one of them by unilateral action or by bilateral negotiation. Import licensing restricts importation of all or specified products by permit. and is often used in conjunction with allocated quotas or when the quotas are not publicly announced. Foreign exchange control usually accompanies foreign trade control; import restriction is exercised through allocation of exchange at official rates for certain imports and through limitation of the amount of exchange to be sold in the officially controlled "free" market.

Most of these measures, including the tariff, tend to favour certain producers and commercial firms at the consumers' expense, or to discriminate among the trading countries or both. Import control thus stands in contrast to public regulation of domestic marketing activities, which frequently takes consumers' interests as the point of departure.

BIBLIOGRAPHY —F R Eldridge *et al., Export and Import Practice* (1938), Harold J Heck, *Foreign Commerce* (1953); Charles N Henning, *International Finance* (1958); Don D. Humphrey, *American Imports* (1955); *R F* Mikesell and J N Behrman, *Financing Free World Trade with the Sino-Soviet Bloc* (1958); *E.* E Pratt, *Foreign Trade Handbook* (1948); Morris S. Rosenthal, *Techniques of International Trade* (1950); *Standard International Trade Classification,* United Nations Statistical Papers, "Series M." no. 10, available in English, French, Spanish (1953); U S. Department of Commerce, *Selling the United States Market* (1954); *U.S.* Treasury Department, Bureau of Customs, *Exporting to the United States* (1959). (CH.-M. L.)

IMPORTS. A term used to describe the commodities brought into a country by the operations of commerce. Considered economically, the imports into a country represent payments to the importing country for (1) exportation of goods; (2) services, such as the services of ships, or commercial or financial commissions; (3) interest and principal repayments on capital previously exported by the importing country; or (4) movements of gold and silver. After World War I. another source of imports arose out of the payment of indemnities, Germany being compelled to export to the Allies and thus causing them to receive imports. The repayment of the interallied debts set up a cause of imports, consisting of exports made by one ally to another.

The difference between the imports and exports of a country, as recorded by its customs houses, is called the balance of trade (see INTERNATIONAL PAYMENTS). The records made at the custom house can refer, of course, only to material commodities, but a country may at any time be importing services, the value of which cannot and is not recorded in the trade returns. To such imported services the term invisible imports is sometimes applied. The values at which imports are officially recorded by customs houses varies with different nations; in the case of the United Kingdom the imports are entered at what are called c.i f. values, that is, values representing the cost, insurance and freight; or when goods are consigned to the United Kingdom for sale, at the latest sale value of such goods. See also EXPORTS; TRADE, INTERNATIONAL.

IMPOSITION, in ecclesiastical usage, the "laying on" of hands by a bishop at the services of confirmation and ordination as a sign of a spiritual gift or conferring special service (Lat. *imponere,* to place or lay upon). The word also means the levying of a burdensome or unfair tax or duty. and of a penalty; also a trick or deception. In the printing trade the term is used for the arrangement of pages of type in the form.

IMPOST, a tax or tribute. and particularly a duty levied on imported or exported merchandise. In architecture, a molding, series of moldings, projecting band, carved ornament or projecting block, marking the spring of an arch. and placed at the top of the pier or section of wall that carries the arch. In Byzantine work the block sometimes placed between the capital of a column and the arches which it carries is known as an impost block. See DOSSERET.

IMPRESARIO, the contractor or promoter of an enterprise (from the Ital., *impresa,* an undertaking). specifically of concert and operatic ventures. The impresario was a person of musical judgment who negotiated tours of musicians. often abroad, when wider international fields were opened up at the end of the 19th century. Gabriel Astruc in Paris, Harold Holt in London and Arthur Judson in the United States were impresarios responsible for tours of this kind. With the 20th-century mechanical diffusion of music and its partial control by municipal or state organizations the impresario's role nas gradually taken over by the agent.

IMPRESSIONISM. The term impressionism, first used. derisively, by a journalist, was taken from Claude Monet's canvas representing the effect of the sun rising over the sea and entitled "Impression." The painting was shown at an exhibition (April–May 1874) organized by a group of young painters whose work had been rejected by the official Salon The word later spread throughout the entire world to refer to the first revolutionary movement of modern painting, of which the chief exponents were Manet, Degas, Monet, Pissarro, Sisley, Cézanne. Guillaumin and Berthe Morisot (*qq.v.*). Two periods are distinguishable in its development: a preparatory phase (1862–71), which. led by Manet, was hastened by the influence of two forerunners of Impressionism, Eugène Boudin and J. B. Jongkind (*qq.v.*), and by the introduction of Japanese prints to western attention; and, after Monet's and Pissarro's stay in England (1870–71), a phase of development. also called the Argenteuil phase because it centred around Monet uho was then living in that charming village on the outskirts of Paris. From 1880 onward the movement broke up and the last and eighth exhibition of the group, in 1886. confirmed its disintegration. Each of its founders developed his own individual technique, and other trends emerged.

Freed from academic fetters and artistic conventions, at one and the same time reacting against the romanticism of literary inspiration and the social tension of realism, Impressionism inaugurated independent painting based on the pure colours of the prism and the splitting-up of "tone" into its component colours. An expression of outdoor modern life, its chosen subjects were Paris and urban scenes, the coasts of the English channel and the North sea or the little village resorts on the banks of the Seine and Oise, made accessible by the railway. Influenced by what is spontaneously perceived, the Impressionists tried to convey the changing rhythm of appearances under the universal vibration of light, the rendering of which was the principal characteristic of their style. See also PAINTING: *France: 19th Century.*

BIBLIOGRAPHY.—T. Duret, *Les peintres impressionnistes* (1878); *W*. Dewhurst, *Impressionist Painting* (1904); *P*. Francastel, *L'Impressionnisme* (1937); *L*. Venturi, *Les Archives de l'Impressionnisme,* 2 vol. (1939); J. Rewald, *History of Impressionism* (1946); *G*. Bazin, *L'Époque Impressionniste* (1947); *F*. Novotny, *Die grossen französischen Impressionisten* (1953); B. Taylor (ed.), *The Impressionists aizd Their World* (1953); *J*. Leymarie, *L'Impressionnisme* (1955).

(JN. LE.)

IMPRESSIONISM, MUSICAL. The word impressionism, borrowed from painting, was principally applied as a musical term to the music of Claude Debussy and later adopted to describe music of French associations of the post-Wagnerian period. An early use occurred in a letter of Renoir of Jan. 14, 1882, in which, referring to a conversation with Wagner, he wrote, "We spoke of the Impressionists of music." In 1887 the *Journal Officiel* criticized the "vague impressionism" of Debussy's *Printemps.* The term was used in a laudatory sense by Belgian critics in 1894 in reference to Debussy's String Quartet, which was played in the hall of an exhibition in Brussels of paintings by Renoir, Pissarro, Sisley, Gauguin and others. On the same occasion, Maurice Kufferath spoke of Debussy's "musical pointillism" and stated that his music suggested "the neo-Japanese canvases painted in Montmartre." The term mas later used by Jean d'Udine to describe the subtle orchestration of Debussy's *Nocturnes* and by Romain Rolland in writing of *Pelléas et Mélisande.* Though Debussy himself compared the original form of his *Nocturnes* to "a study in grey in painting" and frequently sought the musical equivalent of a visual image, so that his work shows a strong aesthetic affinity with that of contemporary painters, there was no conscious imitation of Impressionist methods in his music, nor in that of Emmanuel Chabrier, who possessed an important collection of Impressionist paintings.

Comparisons in technique, such as that between the broken chords in Debussy's *Reflets dans l'eau* and the reflection of clouds in water in Monet's "La Grenouillère" or between a bold use of solo instruments in the orchestration of Chabrier and the use of primary colours by the Impressionist painters, were therefore conjectural. In the first quarter of the 20th century the term was applied in a general sense to the works of many other composers (not all of them French) including Ravel, Delius, Scriabin and Stravinsky. Since an affinity with the aesthetic of the Impressionist painters in the work of such composers was remote) impressionism acquired a period sense, comparable to the use of the terms classical and romantic, and was used loosely to describe a variety of trends in post-Wagnerian music. (E. LR.)

IMPRESSMENT, the exercise of the authority of the state to "press" or compel the service of the subject for the defense of the realm.

In England impressment may be looked upon as an erratic, and often oppressive, way of enforcing the common obligation to serve in "the host" or in the *posse comitatus* (power of the county). In Scotland, where the feudal organization was very complete in the lowlands, and the tribal organization no less complete in the highlands, and where the state was weak, impressment was originally little known. After the union of the two parliaments in 1707, no distinction was made between the two divisions of Great Britain. In England the kings of the Plantagenet dynasty caused Welshmen to be pressed by the lords marchers and Irish kerns to be pressed by the lords deputy for their wars in France. Complaints were made by parliament of the oppressive use of this power as early as the reign of Edward III, but it continued to be exercised. A small sum called imprest money or coat and conduct money was given to the men when pressed to enable them to reach the appointed rendezvous. Soldiers were secured in this nay by Queen Elizabeth I, by Charles I and by the parliament itself in the Civil War. The famous new model army of Cromwell was largely raised by impressment. Parliament ordered the various county committees to select recruits of "years meet for their employment and well clothed." After the revolution of 1688 parliament occasionally made use of this resource. In 1779 a general press of all rogues and vagabonds in London to be drafted into the regiments was ordered. It is said that all who were not too lame to run away or too destitute to bribe the parish constable were swept into the net. As they were encouraged to desert by the undisguised connivance of the officers and men who were disgusted with their company, no further attempt to use the press for the army was made.

Armies on the continent were also made up in large part of men who had been impressed. They had been taken from jails, snatched from taverns while drunk or kidnapped in dark streets or alleys. "Press gangs," as the military or naval parties that impressed men were known, were as common in France and Prussia as they were in England. The fighting qualities of troops obtained in this manner were usually incredibly poor.

The impressment of sailors for the Royal Navy was regarded as a prerogative of the crown. From an act of Philip and Mary (1556) it appears that the watermen of the Thames claimed exemption from the press as a privileged body. They were declared liable, and the liability was clearly meant to extend to service as a soldier on shore. In the reign of Elizabeth I, an act was passed (1563) to define the liability of the sailors. It is known as "an act touching politick considerations for the maintenance of the navy." By its term all fishermen and mariners were protected from being compelled "to serve as any soldiers upon the land or upon the sea, otherwise than as a mariner, except it shall be to serve under any captain of some ship or vessel, for landing to do some special exploit which mariners have been used to do." The operation of the act was limited to ten years, but it was renewed repeatedly, and was at last indefinitely prolonged in the reign of Charles I (1631).

The justices of the peace in the coast districts, who were often themselves concerned in the shipping trade, were not always zealous in enforcing the press. The pressed sailors often deserted with the "imprest money" given them. Loud complaints were made by the naval officers of the bad quality of the men sent up to serve in the king's ships. On the other hand. the press gangs were accused of extorting money, and of making illegal arrests. In the reign of Queen Anne (1703) an act gave parish authorities power to apprentice boys to the sea and exempted such apprentices from the press for three years, and until the age of 18. It especially reaffirmed the part of the Vagrancy act of 1597 which left rogues and vagabonds subject to be pressed for the sea service. By an act of 1740, all men over 55 were exempted from the press, together with lads under 18, foreigners serving in British ships and landsmen who had gone to sea during their first two years. The act for "the better supplying of the cities of London and Westminster with fish" gave exemption to all masters of fishing boats, to four apprentices and one mariner to each boat and all landsmen for two years, except in case of actual invasion.

Subject to such limitations as these, all seafaring men and watermen on rivers, were liable to be pressed between the ages of 18 and 55, and might be pressed repeatedly for so long as their liability lasted. The rogue and vagabond element were at the mercy of the justices of the peace. The frightful epidemics that desolated the British navy till late in the 18th century were caused largely by infections brought by the prisoners drafted from the ill-kept jails of the time. Even merchant ships were stopped at sea and the sailors taken from them. On one occasion, in 1802, an East Indiaman on her way home was deprived of so many of her crew by a man-of-war in the Bay of Biscay that she was unable to resist a small French privateer and was carried off as a prize with a valuable cargo. In 1795 it was found necessary to impose on the

counties the obligation to provide a quota of men, at their own expense. The local authorities provided the recruits by offering high bounties. often to debtors confined in the prisons.

The impressment of seamen from United States vessels during the Napoleonic wars was one of the causes, though probably not the primary cause, of the War of 1812. The trouble stemmed from the British government's adherence to the generally accepted doctrine of inalienable allegiance: once a British subject always a British subject. The U S. government advanced a new, revolutionary concept that every man was free to change his allegiance at will Between 1790 and 1812 thousands of British seamen, some deserters from the Royal Navy, signed up on ships of the thriving U S merchant marine and claimed U S. citizenship. To cope with this problem the British insisted upon the right to board neutral ships on the high seas in search of deserters and British subjects liable to impressment. Because of the common language of the two countries and the abuses that grew up around the issuance and illegal sale of U S. citizenship papers. the difficulty of determining a man's citizenship was great Desperate for men to continue the fight against Napoleon, British boarding parties sometimes impressed bona fide U.S citizens.

After the conclusion of the Napoleonic wars in 1815, the power of the press was not again exercised. In 1835 an act was passed during Sir James Graham's tenure of office as first lord of the admiralty, by which men who had once been pressed and had served for a period of five years were to be exempt from future impressments. Sir James, however. emphatically reaffirmed the right of the crown to impress seamen. The introduction of engagements for a term of five years and then of long service produced a large body of voluntary recruits. With better pay and working conditions, service in the navy became so popular that the question had no longer any interest save a historical one In the 20th century compulsory service, both in the navy and army, once more became necessary, but it was then referred to by such terms as conscription, national service or selective service.

See CONSCRIPTION.

BIBLIOGRAPHY—John Masefield, *Sea Life in Nelson's Time* (1905); J. R. Hutchinson, *The Press-Gang Afloat and Ashore* (1913); J F. Zimmerman, *Impressment of American Seamen* (1925); S F. Bemis, *A Diplomatic History of the United States* (1953). (D. H; X)

IMPROMPTU, a name used in the 19th century as the descriptive title of pieces for the piano, from the French, *impromptu,* unpremeditated or improvised. The style of the music is similar to that of other compositions of this period, nith such titles as fantaisie. caprice and bagatelle. In England, from the 16th century onward, music improvised by a performer, generally at the harpsichord or organ, in the form of a prelude to another composition. was known as a voluntary. The name impromptu first appeared in 1822 as the title of piano pieces by Jan Hugo Voříšek and Heinrich Marschner. In 1824 Liszt wrote an "Impromptu on Themes of Rossini and Spontini." These, and the impromptus by Chopin, Schumann and others, may have been intended to convey the impression of improvised pieces, but since they first appeared in their published form they were not actually extempore norks. This also applies to the first set of impromptus by Schubert, so called by his publisher. An improvised impromptu of this period is the 13-bar "Allegretto quasi andante" dedicated by Beethoven to a granddaughter of Charles Burney. No definite form is prescribed for the impromptu. which may resemble a prelude a set of variations or be freely conceived in the form of a fantasy. Among the impromptus of a later period are those of Gabriel Fauré and Alexander Scriabin.

IMPROVISATION (EXTEMPORIZATION) in music means composing and performing simultaneously; *i.e.,* literally making it up as you go along. Music originated as improvisation and is still extensively improvised in eastern traditions and in the modern western tradition of jazz (but this is an offshoot of African music nith a higher proportion of genuinely primitive inspiration than is usually realized).

In antiquity and in many eastern schools nith ancient traditions, elaborate modes (*i.e.,* forms of scale) developed for codifying melodic and rhythmic patterns. Different subjects, different emotions and even different localities are associated with different modes, between which any possibility of confusion is rigorously resisted. Knowing their modes well and preserving them jealously, musicians can improvise long compositions within the boundaries thus set. Important examples of this method of improvisation are encountered in the early history of European church music, including the Byzantine school of the so-called dark ages (*see* BYZANTINE MUSIC) and the astonishing Notre Dame school of music in medieval Paris. There the foundation was written down as plain chant and maintained according to strict and conservative rules; yet it nas the originally improvised additions to it which led to a written art of flexible melody subtly combined into "horizontal" harmony by counterpoint; *e.g.,* the Renaissance polyphony of Josquin, Byrd or Palestrina. (See also COUNTERPOINT; HARMONY; PLAINSONG.)

Outside this central tradition in western music, full "vertical" harmony was already being improvised within conservatively established modes (orally transmitted) by Welsh and other harpers of the Celtic fringe. The nearest surviving equivalent (though it is melodic rather than harmonic) is the highly developed and sophisticated Hindu tradition. Another and vast field in which improvisation has always played a vital part is folk music.

The delight taken by Renaissance organists, harpsichordists, lutanists, viol players and other instrumentalists in adapting plain vocal compositions to the idiosyncracies of their instruments by insinuating the most elaborate variations impromptu did more than anything else to develop the specifically instrumental idioms which have been the glory of western music since the 16th and 17th centuries.

Certain types of composition came into being through the same Spontaneous outpouring of invention. The prelude and the toccata ("touch-piece") were at first informal improvisations to loosen the fingers, check the tuning (*e.g.,* of a lute), establish the tonality and put both performer and audience at their ease. The chorale prelude started as improvisations on a hymn tune by church organists at suitable interludes in the service. The theme and variations grew out of that most sophisticated of early parlour games: improvising contrapuntal descants on a given plain chant, or free variations on a ground bass (divisions on a ground) or the like. A favourite 18th-century development of this, continued frequently in the 19th century and occasionally (*e.g.,* by French virtuoso organists) in the 20th, was improvising not merely variations but a formal fugue on a theme handed up by a member of the audience—not necessarily an accomplice of the performer. The art was quite genuine; and there were listeners who put it on record that the improvisations of John Bull and Frescobaldi, of Bach and Handel, of Mozart and Beethoven, of Liszt and Busoni impressed them as being almost as highly organized as, and in some ways even more moving than, the written-out compositions of these composers.

That impression may have been in part due to the excitement of hearing great music spontaneously shaped and no sooner shaped than lost again. Some allowance must also be made for the composer's bringing memory to the aid of invention in the spirit of that "offhand discourse which (all nature, no art)" Browning tells us in his poem "Englishman in Italy" that "the Dominican brother, these three weeks, was getting by heart." No one can genuinely improvise outside an existing tradition with which he is intimately familiar. But this is a condition which applies almost as strictly to composition in its ordinary, written form. A composer can only modify the existing tradition because he has the indispensable advantage of having gronn up inside it. The primary patterns out of which music is built up are archetypal in the sense that everyone inherits a predisposition to produce them and to understand them when other musicians produce them. It is because these archetypes not only well up from within the musician's consciousness, but, to a certain extent, organize themselves by their own autonomous nature that genuine improvisation can happen. (R. DO.)

IMPROVISATORE (Ital. *improvvisatore*), a word for a poet who recites verses which he composes on the spur of the moment. It became recognized as an English word in the middle of the 18th century and is used by Tobias Smollett in his Travels

(1766). The feminine form is *improvisatrice.* (*G. W. A.*)

IMRU'-AL-QAYS (AMRU-'L-KAIS; 6th century A.D.) Arabian poet and author of one of the Mu'allaqat (*q.v.*), nas regarded by Mohammed and others as the most distinguished poet of pre-Islamic times. He was of the kingly family of Kinda, and his mother was of the tribe of Taghlib. While he was still young, his father was killed by the Bani Asad (a rebel Bedouin tribe) and his life was devoted to the attempt to avenge his father's death. He wandered from tribe to tribe to gain assistance, but his attempts were always foiled by the persistent following of the messengers of Mundhir, king of Hira. By means of Harith of Ghassan he procured an introduction to the Byzantine emperor Justinian. After a long stay in Constantinople he was named phylarch of Palestine, and received a body of troops from Justin II. With these he started on his way to Arabia. The story that he was charged before the emperor with the seduction of a princess and that Justin sent him a poisoned cloak, which caused his death at Ancyra (Ankara), is generally regarded as legendary.

BIBLIOGRAPHY.—His poems mere published in W. Ahlmardt's *The Divans of the Six Ancient Arabic Poets* (1870) and in McG. de Slane's *Le Diwan d'Amro'lkais* (1837). *See* also G. Olinder, *The Kings of Kinda* (1927); R. A. Nicholson, *A Literary History of the Arabs* (1953).

INBREEDING is the mating of relatives. The consequences of inbreeding are slight unless the relationship is close. Hence the matings are not usually called inbreeding unless the mates are related at least as closely as half brother and sister or as individual and grandparent, although usage varies in this respect. In man, for example. matings of first cousins are often called inbreeding. and the term is even applied occasionally to the mating of second cousins.

Among species of plants which customarily reproduce by self-fertilization are some hardy and widespread ones like wheat, beans, barley. oats. cotton and the sorghums. Other species (*e.g.,* beets, alfalfa and many clovers) are equipped with special mechanisms to prevent self-fertilization and to insure cross-pollination. In still other species pollination is mainly by the wind and there is no special device either to favour or to hinder self-pollination. hlaize and many of the forest trees are examples (see POLLISATION). In the higher animals self-fertilization is impossible because the two sexes are not combined in the same individual. But among the lower animals, as among the plants, are many functional hermaphrodites (*q.v.*). In a few of these (*e.g.,* some tapeworms) self-fertilization is the rule. Many others (*e.g.,* oysters) have structures or devices to prevent self-fertilization or at least to make it rare.

Most breeders of farm animals regard inbreeding as dangerous, especially for the inexperienced, but a few have dared to inbreed when they thought their own animals were unusually good. Some of these have had conspicuous successes. From at least as far back as Bakewell's time, inbreeding has generally been considered the most effective way to "fix" type and to isolate "pure" (homozygous) lines.

consequences of **Inbreeding.**—The primary effect of inbreeding is to increase genetic purity; *i.e.,* to make the offspring homozygous for more pairs of genes than if the parents had been unrelated. Inbreeding does not create defective offspring. It is not harmful in itself; however, the increase in homozygosity permits more recessive genes to show their effects. These are generally less desirable than the effects of dominant genes. Therefore inbreeding usually increases the proportion of defective, weak, slow-growing or otherwise undesirable individuals. Yet inbred individuals vary much from this general rule and many of them are highly meritorious. The fundamental units of inheritance, the genes, are not themselves changed by inbreeding but are merely brought together in combinations which would be rarer under outbreeding (matings between nonrelatives). Families become more distinct from each other as the inbreeding proceeds. The members of an inbred family resemble each other genetically much more closely and outwardly somewhat more closely than members of an ordinary family do. The inbreeding permits them not only to be alike because they can inherit the same things from their sire or from their dam but also because one member can inherit from the sire the exactly same gene groupings as another inherits from the dam.

Measures of Inbreeding. — In ordinary speech inbreeding is measured only by describing verbally the relationship between the mates. In civil and canon law, inbreeding is measured in degrees by counting the number of generations intervening between the individuals which marry and the ancestor through which they are related. Since 1921 Wright's coefficienthas been available for expressing inbreeding intensity as a fraction of the initial heterozygosity ("mixture" of genes) which is expected to have been lost because of the inbreeding. Approximate values of this fraction in some of the more intense systems of inbreeding are as follows:

System of mating or relationship of mates	Inbred generation			Fraction of remaining heterozygosis lost per generation
	First	Second	Third	
Self-fertilization	.50	.75	.88	.50
Full brother-sister or parent-offspring	.2j	.38	.50	.19
Male and many half sisters (one-sire closed herd)	.12	.22	.30	.11
Two males and many females (two-sire closed herd)	.06	.12	.18	.06

Clearly, self fertilization is the most effective means of removing heterozygosity and creating a pure line.

Practical Uses of Inbreeding.—Inbreeding helps in purging a breed or other population from its recessive defects by bringing these to light in larger numbers. If the possessors of these defects can be culled, the population is freed from that undesirable heredity more rapidly than could be done without inbreeding.

Inbreeding makes family selection more effective. This it does in three ways. First, it makes the families drift apart, so that their averages become increasingly different. Second, it makes members of the same family more like each other genetically, so that what is true of the family average is more likely to be true of each member. Third, it permits increasing the family in numbers without mixing it with other families. In this way the family is still intact when it has declared its merit clearly. Probably much of the usefulness of inbreeding in the production of "hybrid corn" consists in its thus increasing the effectiveness of family selection.

Inbreeding is often used by livestock breeders to preserve the merits of a highly admired ancestor long after that ancestor is dead. This is generally called "line breeding." When the descendants of animal X are bred to each other the offspring tend to resemble X about as much as their parents did, whereas if they were mated to individuals unrelated to X their offspring would resemble him only about half as closely. Since all inbreeding except that necessary to hold high the relationship to the admired ancestor is avoided, line breeding is generally somewhat less intense than the inbreeding done when the primary intention is to make families distinct or to purge a stock of its defects.

Some inbreeding is done merely because the breeder thinks there are no animals as good as his, and that to mate his animals with unrelated stock would contaminate and dilute some inheritance which is especially meritorious. This was influential in originating many of the pure breeds.

Inbreeding in Nature. — Even among wild species which must cross-fertilize, some inbreeding may occur because of subdivision into small groups which rarely interchange breeding stock. Random mating within such isolated groups is inbreeding with respect to the whole species, since sooner or later all members of a subgroup become related to each other. This relationship continues to increase except as it is cancelled by immigration of individuals from other groups. Besides isolation by geographical barriers and by distance itself, there can be some isolation by having breeding seasons at different times of the year, by genes for partial sterility, and by other mechanisms. Some inbreeding due to isolation and to widely unequal reproductive rates between individuals certainly occurs in nature but whether it is an important factor in evolution, through permitting natural selection to operate on a family basis, is still uncertain (see HYBRIDISM; EVOLUTION, ORGANIC).

Inbreeding in man, except for a few striking cases such as among royalty in ancient Egypt, has generally been prohibited

(as incest) among civilized peoples and among primitive peoples was often prohibited by taboos. In civilized societies individuals more closely related than first cousins have generally been forbidden to marry. The marriage of first cousins has sometimes been forbidden, sometimes permitted freely, and sometimes permitted only on special dispensation. Biologically the last arrangement seems the most desirable, provided the dispensation is granted when the common ancestors were meritorious. The arguments against inbreeding have more validity in man than in animals because a few defectives occurring among domestic animals can be discarded without serious economic loss, whereas the production of even a few completely incompetent human beings may be a serious burden on a society which does not permit the deliberate elimination of such individuals. (See also EUGENICS; ANIMAL BREEDING; PLANT BREEDING.

BIBLIOGRAPHY.—E. M. East and D. F. Jones, *Inbreeding and Outbreeding* (1919); J. L. Lush, *Animal Breeding Plans* (1943); S. Wright, "Systems of Mating," *Genetics*, vol. 6, pp. 111–176 (1921) and "Breeding Structure of Populations in Relation to Speciation," *Amer. Naturalist*, vol. 74, pp. 232–248 (1940); N. Freire-Maia, "Inbreeding Levels in Different Countries," *Eugenics Quarterly*, 4:127–138 (1957).
(J. L. LH.)

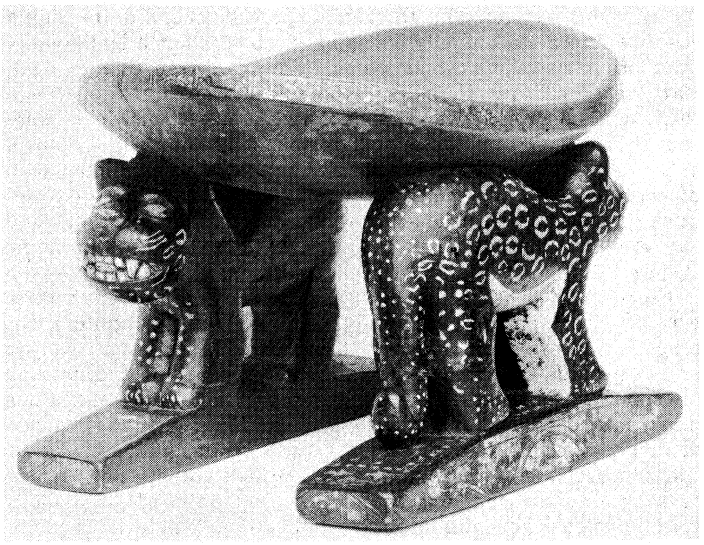
INCA, a Peruvian tribe, speaking the Quichua dialect, who. at the time of the Spanish expedition under Francisco Pizarro in 1533, exercised paramount rule over a region extending west of the Atlantic slope of South America between Quito in Ecuador and the Maule river in Chile. They were a highland people and organized a renaissance of the earlier "civilization." characterized by megalithic, polygonal structures of stone, which appears to have prevailed in the uplands of Bolivia and Peru at an anterior date (known as the Tiahuanaco period). The earliest traditional records of the people are mythological. The ancestors of the tribe are supposed to have emerged from certain caverns in a hill (*Tamputocco*, "House of Windows"), in a region known as *Paccari-tampu* ("House of the Dawn"), under the leadership of four brothers, all bearing the title of *Ayar*. The chief was the eldest brother, named Manco, who was the high priest of the tribal god, the sun, whose emblem was a fetish in the form of a bird, kept concealed in a basket. This fetish possessed oracular powers and directed the migrations of its votaries. The other brothers were named Cachi ("Salt"), Uchu ("Pepper") and Auca ("Pleasure"). Their sister-wives, who bore the title of Mama ("Mother"), were named respectively, Occlo, Huaco, Cura and Raua.

BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

INCA REPLICA OF A LLAMA WITH COPPER BODY AND HEAD AND NECK OF GOLD FOUND AT HUANACAURI HILL NEAR CUZCO, PERU

Under the direction of an oracle. these leaders conducted the tribe northward in search of empire. The leader, Manco, was equipped with a golden rod which, according to the prophecy, would sink into the ground when the predestined home was attained. In the course of the migration, the three younger brothers perished. Cachi was persuaded to return for certain fetishes which had been left behind in a sacred cave; but when he had entered the sanctuary his escort rolled a great rock against the entrance. Uchu, in the attempt to seize a mysterious stone statue encountered on the journey, was himself turned to stone. Auca, who was winged, was asked by Manco to fly to the top of a distant hill (afterward the site of the great sun temple in Cuzco), but he, on completing the feat, was transformed to stone. Nevertheless the tribe followed, the test of the golden rod was applied and Cuzco, the seat of the later Inca empire, was founded.

Most traditions give Manco's immediate successor as Sinchi Roca. It is probable that Manco is in the main a legendary character, dating back possibly to the Tiahuanaco period. Roca appears to have been the first ruler bearing the royal title of *Sapa Inca* ("Only Inca"), and it is probable that his accession heralded the epoch associated nith Inca domination. In fact he may be regarded as the first Inca "historical" ruler. The evolution of the Inca tribe into a ruling caste has brought about a certain confusion in the use of the word "Inca." Originally tribal. it became a term of rank, as applied to the members of the official hierarchy. At the same time, the phrase "the Inca" is used in connection with the supreme ruler, regarded as a god on earth and descendant of the old tribal god, the sun. *See* SOUTH AMERICA: *Archaeology; see* also Index references under "Inca" in vol. 24. (T. A. J.)



BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

WOODEN SEAT FOUND NEAR CUZCO

INCANTATION: *see* MAGIC.

INCENDIARPSM: *see* ARSON.

INCENDIARY MIXTURES are used to start fires, generally for military purposes but occasionally for arson or sabotage. They may be made from a variety of ingredients. Some mixtures ignite spontaneously when exposed to air; others take fire when the ingredients are brought together; still others require a fuse or first-fire mixture to heat them to the temperature where they will begin to burn. Many incendiary mixtures may be extinguished if smothered with sand or dirt.

Greek Fire.—Simple incendiary mixtures have been known since ancient times. The Romans made mixtures of pitch, sulfur and other flammables, poured them into pots and threw them, burning, upon enemy buildings and ships. The most famous of the early incendiary mixtures was Greek fire (*q.v.*) invented by Callinicus around 670 A.D., and used by the Byzantines to defeat an Arab fleet. The composition of Callinicus' mixture is not known for certain, because attempts were made to keep it secret and also because later writers applied the term Greek fire to many different kinds of incendiary mixtures and thus brought about unravelable confusion. Generally. the Greek fire of the middle ages contained petroleum and other flammables such as gums, resins and sulfur. The assertion that Greek fire contained quicklime that reacted with water and generated heat to ignite the petroleum is certainly incorrect because quicklime does not give off any flame when it is quenched.

Whatever the composition of the original Greek fire may have been, the name persisted down to the middle of the 19th century. During the American Civil War, Confederate agents burned Union transports on the Mississippi by throwing into the holds bottles containing a spontaneously flammable mixture which they called Greek fire; they set fire to buildings in New York city by similar means. Northern artillery upon occasion fired so-called Greek fire shells in attempts to burn Confederate positions and towns.

Thickened Gasoline.—An important advance in incendiary mixtures during the 20th century occurred when gasoline was thickened or solidified by the addition of materials such as rubber,

plastics and soaps. The thickening process changed the liquid gasoline into a sticky, jellylike solid which was much less volatile than ordinary gasoline and which burned with an intense heat. Early in World War II several countries used natural rubber as a thickener. As supplies of rubber gave out other thickeners were found. The U.S. army chemical corps made use of a plastic known as isobutyl methacrylate, and of napalm (*q.v.*), an aluminum soap of naphthenic and coconut fatty acids. The U.S. army used millions of pounds of thickened gasoline during World War II and the Korean War in incendiary bombs, fire bombs and flame throwers (*q.v.*). *See* also AIR WARFARE: *The B-29 Campaign.*

Phosphorus. — One of the oldest incendiary mixtures is a solution of phosphorus. The ability of phosphorus to ignite spontaneously in air was discovered coincidentally with the isolation of phosphorus in 1669. After substances capable of dissolving phosphorus were found, it was natural that phosphorus solutions be suggested as incendiary agents. A common solvent is carbon disulfide which evaporates rapidly and leaves behind a residue of spontaneously ignitable phosphorus. British patents were issued to John Macintosh in 1855 and to John Norton in 1863 for shells containing solutions of phosphorus and carbon disulfide. The U.S. army chemical corps standardized a mixture of phosphorus, carbon disulfide and rubber as a filling for glass grenades in World War II.

The German air force used a filling of phosphorus, benzene and rubber in incendiary bombs dropped on England. One of the most effective and most widely used types of artillery ammunition in World War II and the Korean War was the white phosphorus shell.

Metallic Incendiaries. — Thermit type mixtures contain a metal and an oxide of another metal. A number of combinations may be made using various metals and oxides. One of the most common is a mixture of powdered iron oxide and powdered or granulated aluminum, similar to thermit (*q.v.*) used in welding. This mixture is inert at ordinary temperatures but when heated to a certain point by means of a first-fire charge, the ingredients react, forming iron and aluminum oxide. Intense heat then develops, raising the temperature of the mass to more than 2,000° C., hot enough to melt iron to a liquid. Iron–aluminum oxide mixtures with their burning characteristics modified by addition of other materials have been used in incendiary bombs, grenades and artillery shells. In World War II the magnesium bomb was a metallic incendiary used in great quantities. It consisted of an aluminum–magnesium body filled with a compressed thermit mixture.

Other Types.—The above classes of incendiary mixtures are those that are most important from the viewpoint of history or because of the large quantities used in warfare. Many other mixtures are known. Sulfuric acid and potassium chlorate react vigorously when they come in contact, a property that has been applied in constructing delayed action sabotage devices. Potassium and sodium react violently with water, generating hydrogen which then takes fire from the heat of reaction. This fact has led to the development of sodium–oil and potassium–oil mixtures that burn on the surface of water. The reaction between chromic anhydride and alcohol has been used to ignite gasoline in glass grenades. In the final analysis, the range of incendiary mixtures is limited only by the ingenuity of chemists.

See also CHEMICAL WARFARE. (W. D. Ms.)

INCENSE, the perfume (fumigation) arising from certain resins and gum resins, barks, woods, dried flowers, fruits and seeds when burned, and also the substances so burned. In its literal meaning the word incense is one with the word perfume, the aroma given off with the smoke *(per fumum)* of any odoriferous substance when burned. But, in use, while the meaning of the word perfume has been extended so as to include everything sweet in smell. from smoking incense to the invisible fresh fragrance of fruits and exquisite scent of flowers, that of the word incense, in all the languages of modern Europe in which it occurs, has, by an opposite process of limitation, been gradually restricted almost exclusively to frankincense. *'(See* FRANKINCENSE.)

Probably nowhere can the actual historical progress from the primitive use of animal sacrifices to the later refinement of burning incense be more clearly traced than in the pages of the Old Testament; but in the monuments of ancient Egypt the authentic traces of the use of incense that still exist carry us back to a much earlier date. From Meroë to Memphis the commonest subject carved or painted in the interiors of the temples is that of some contemporary *phrah* or Pharaoh worshipping the presiding deity with oblations of gold and silver vessels, rich vestments. gems, the firstlings of the flock and herd, cakes, fruits, flowers, wine, anointing oil and incense. One of the best known of these representations is that carved on the memorial stone placed by Tuthmosis (Thothmes) IV (1533 B.C.) on the breast of the sphinx at Gizeh. The tablet represents Tuthmosis before his guardian deity, the sun-god Ra, pouring a libation of wine on one side and offering incense on the other. The ancient Egyptians used various substances as incense.

They worshipped Ra at sunrise with resin, at midday with myrrh and at sunset with an elaborate confection called *kuphi,* compounded of no fewer than 16 ingredients, among which were honey, wine, raisins, resin, myrrh and sweet calamus. While it was being mixed, holy writings were read to those engaged in the operation. According to Plutarch, apart from its mystic virtues arising from the magical combination of four times four, its sweet odour had a benign physiological effect on those who offered it *(De Iside et Osiride,* c, 52). The censer used was a hemispherical cup or bowl of bronze, supported by a long handle, fashioned at one end like an open hand, in which the bowl was, as it were, held, while the other end within which the pastils of incense were kept was shaped into the hawk's head crowned with a disk, as the symbol of Ra. In embalming their dead the Egyptians filled the cavity of the belly with every sort of spicery except frankincense (Herodotus, ii, 86), for it was regarded as specially consecrated to the worship of the gods. In the burnt offerings of male kine to Isis, the carcass of the steer, after evisceration, was filled with fine bread, honey, raisins, figs, frankincense, myrrh and other aromatics, and thus stuffed was roasted, being basted all the while by pouring over it large quantities of sweet oil, and then eaten with great festivity.

How important the consumption of frankincense in the worship of the gods became in Egypt is shown by two of its monuments, both of the greatest interest and value for the light they throw on the early history of the commerce of the Indian ocean. One is an inscription in the rocky valley of Hammamat, through which the desert road from the Red sea to the valley of Egypt opens on the green fields and palm groves of the Nile river near Coptos. It was cut on the rocks by an Egyptian nobleman named Hannu, who states that he was sent by Pharaoh Seankhkare, Mentuhotep IV, with a force gathered out of the Thebaid, from Coptos to the Red sea, there to take command of a naval expedition to the holy land of Punt (Puoni) "to bring back odoriferous gums." Punt is identified with the Somali country, later known to be the native country of the trees that yielded the bulk of the frankincense of commerce. The other bears the record of a second expedition to the same land of Punt, undertaken by the command of Queen Hatshepsut, 1600 B.C. It was preserved in the vividly chiselled and richly coloured decorations portraying the history of the reign of this famous Pharaoh on the walls of the "Stage temple" at Thebes. The temple was later ruined, but the entire series of gorgeous pictures recording the expedition to "the balsam land of Punt," from its leaving to its returning to Thebes, remained intact and undefaced.

These were the only authenticated instances of the export of incense trees from the Somali country until Col. Robert Playfair, then political agent at Aden. in 1860–62 collected and sent to Bombay the specimens from which Sir George Birdwood prepared his descriptions of them for the Linnean society in 1868. King Antigonus is said to have had a branch of the true frankincense tree sent to him.

Homer tells us that the Egyptians of his time were emphatically a nation of druggists *(Odyssey,* iv, 229, 230). This characteristic, in which, as in many others, they so remarkably resembled the

Hindus. the Egyptians maintained to modern times, and, though they changed their religion, the use of incense among them continued to be as familiar and formal as ever. The kohl or black powder, with which the modern. like the ancient, Egyptian ladies painted their eyelids, was nothing but the smeeth of charred frankincense, or other odoriferous resin brought with frankincense, and phials of water, from the well of Zem-zem, by the pilgrims returning from Mecca. They also melted frankincense as a depilatory and smeared their hands with a paste into the composition of which frankincense entered, for the purpose of communicating to them an attractive perfume. Herodotus (iv, 75) describes a similar artifice as practised by the women of Scythia (compare also Judith x, 3, 4). In cold weather the Egyptians warm their rooms by placing in them a brazier, chafing dish or standing dish filled with charcoal, whereon incense is burned; and in hot weather they refresh the rooms by occasionally swinging a hand censer by a chain through them — frankincense, benzoin and aloe wood being chiefly used for the purpose.

In the authorized version of the Bible, the word "incense" translates two wholly distinct Hebrew words. In various passages in the latter portion of Isaiah (xl–lxvi), in Jeremiah and in Chronicles it represents the Hebrew *lebōnah,* more usually rendered "frankincense"; elsewhere the original word is ketoreth (Exodus xxx, 8. 9; Leviticus x, 1; Numbers vii. 14, etc.), a derivative of the verb kitter (Pi.) or hiktir (Hiph.), which verb is used, not only in Exodus xxx, 7, but also in Leviticus i, 9, iii, 11, ix, 13, and many other passages to denote the process by which the "savour of satisfaction" in any burnt offering, whether of flesh or of incense, is produced. Sometimes in the authorized version (as in I Kings iii, 3; I Samuel ii, 28) it is incorrectly made to mean the burning of incense. The expression "incense (ketoreth) of rams" in Psalms lxvi, 15, and the allusion in Psalms cxli, 2, ought both to be understood, most probably, of ordinary burnt offerings. The "incense" (ketoreth)! or "incense of sweet scents" (ketoreth sammim), called, in Exodus xxx, 3j, "a confection after the art of the apothecary," or rather "a perfume after the art of the perfumer," which was to be regarded as most holy, and the imitation of which was prohibited under the severest penalties, was compounded of four "sweet scents" (sammim), namely stacte (*nataph*), onycha (sheheleth), galbanum (helbenah) and "pure" or "fine" frankincense (*lebōnah zaccah*), pounded together in equal proportions, with (perhaps) an admixture of salt (memullah). It was then to be "put before the testimony" in the "tent of meeting" (a transference of late ceremonial back to the years of sojourn in "the wilderness"). It was burned on the altar of incense by the priest every morning when the lamps were trimmed in the holy place, and every evening when they were lighted or "set up" (Exodus xxx, 7, 8). A handful of it was also burned once a pear in the holy of holies by the high priest on a pan of burning coals taken from the altar of burnt offering (Leviticus xvi, 12. 13). Pure frankincense (*lebōnah*) formed part of the meat offering (Leviticus ii, 16, vi, 1j), and was also presented along with the shew bread (Leviticus xxiv, 7) every Sabbath day (probably on two golden saucers; see Josh., Ant., iii, 10, 7). The religious significance of the use of incense, or at least of its use in the holy of holies. is distinctly set forth in Leviticus xvi. 12, 13.

The introduction of incense took place late in the history of the Jewish ritual (see J. Wellhausen, Geschichte *Israels,* i, 75 et seq. [1878]); but evidently the idea that the odour of a burnt offering (cf. the κνίσης ἡδὺς ἀϋτμή of Od., xii, 369) is pleasing to the deity, being at least the vehicle by which the sacrifice can be successfully conveyed to its destination, was a survival of a very early belief and underlies the biblical phrase "a savour of satisfaction" (Genesis viii, 21; Leviticus i, 9, and elsewhere; cf. Ephesians v, 2). It is probable that the development of a sensuous appreciation of pleasant perfumes, and knowledge of the sources from which these could be derived, expressed itself not only in domestic habits, sanitation, etc., but also in religious ceremonial: so that the custom of adding some kind of incense to animal sacrifices naturally arose. The final stage (not reached in the Levitical ritual) was the offering of incense pure and simple.

The "marbles" of Nineveh furnish frequent examples of the offering of incense to the sun-god and his consort (II Kings xxiii, 5). The kings of Assyria united in themselves the royal and priestly offices, and on the monuments they erected they are generally represented as offering incense and pouring out wine to the tree of life. According to Herodotus (i, 183), frankincense to the amount of 1,000 talents' weight was offered every year, during the feast of Bel, on the great altar of his temple in Babylon.

The monuments of Persepolis and the coins of the Sassanians show that the religious use of incense was as common in ancient Persia as in Babylonia and Assyria. Five times a day the priests of the Persians (Zoroastrians) burned incense on their sacred fire altars. Herodotus (iii, 97) states that the Arabs brought every year to Darius as tribute 1,000 talents of frankincense. The Parsees still preserve in western India the pure tradition of the ritual of incense as followed by their race from probably the most ancient times.

The Ramayana and *Mahabharata* afford evidence of the employment of incense by the Hindus. in the worship of the gods and the burning of the dead, from the remotest antiquity Its use was obviously continued by the Buddhists during the prevalence of their religion in India, for it is still used by them in Nepal, Tibet. Ceylon. Burma, China and Japan. These countries all received Buddhism from India. and a large proportion of the porcelain and earthenware articles imported from China and Japan into Europe consists of innumerable forms of censers. Jains all over India burn sticks of incense before their Jina. The commonest incense in ancient India was probably frankincense. The Indian frankincense tree is found chiefly where the Buddhist religion prevailed in ancient times. in Bihar and along the foot of the Himalayas and in western India. where it particularly flourishes in the neighbourhood of the Buddhist caves at Ajanta. Now, however, the incense in commonest use in India is benzoin. But the consumption of all manner of odoriferous resins, gum resins, roots, woods, dried leaves. flowers. fruits and seeds in India, in social as well as religious observances, is enormous. The incense sticks and pastils made at the Mohammedan city of Bijapur in the Maratha country are celebrated all over western India.

The Indian Moslems use incense at the ceremonies of circumcision, *bismillah* (teaching the child "the name of God"), virginity and marriage. At marriage they burn benzoin with nim seeds to keep off evil spirits, and prepare the bridecakes by putting a quantity of benzoin between layers of wheaten dough. closed all round, and frying them in clarified butter. For days the bride is fed on little else. In their funeral ceremonies, the moment the spirit has fled incense is burned before the corpse until it is carried out to be buried. The begging fakirs also go about with a lighted stick of incense in one hand, and holding out with the other an incense holder (literally, "incense chariot"), into which the coins of the pious are thrown. Large "incense trees" resembling the Christmas trees of the western world, formed of incense sticks and pastils and osselets and alight all over. are borne by the Shi'ah Moslems in the yearly procession of the Mohurrum, in commemoration of the martyrdom of the sons of Ali.

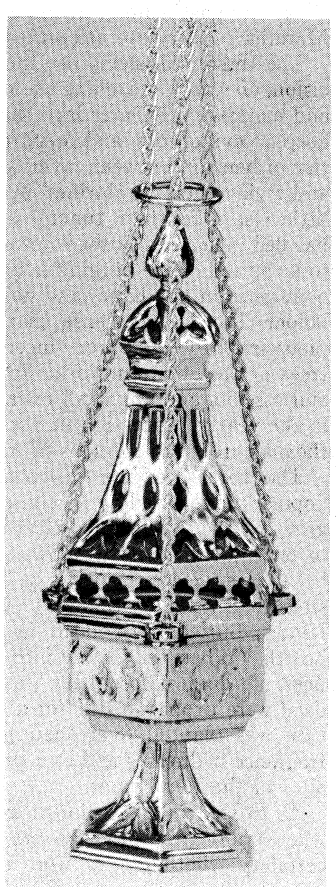
The worship of the *tulsi* plant, or holy basil, by the Hindus is popularly explained by its consecration to Vishnu and Krishna. It grows on the four-horned altar before the house, or in a pot placed in one of the front windows, and is worshipped every morning by all the female members of every Hindu household. It is possible that its adoration has survived from the times when the Hindus buried their dead in their houses, beneath the family hearth. When they came into a hot climate the fire of the sacrifices and domestic cookery was removed from the house; but the dead were probably still for a while buried in or near it, and the *tulsi* was planted over their graves. at once for the salubrious fragrance it diffuses and to represent the burning of incense of the altar of the family Lar.

As to the θύεα mentioned in Homer (Iliad, ix, 499, and elsewhere) and in Hesiod (Works *and* Days, 338), there is some uncertainty whether they were incense offerings at all, and if so, whether they were ever offered alone, and not always in conjunction with animal sacrifices. That the domestic use, however. of the fragrant wood θύον (arborvitae) was known in the Homeric

age is shown by the case of Calypso (Odyssey, v, 60), and the very similarity of the word θύον to θύος may be taken as almost conclusively proving that by that time the same wood was also employed for religious purposes. It is not probable that the sweet-smelling gums and resins of the countries of the Indian ocean began to be introduced into Greece before the 8th or 7th century B.C., and doubtless λίβανος or λιβανωτός first became an article of extensive commerce only after the Mediterranean trade with the east had been opened up by the Egyptian king Psammetichus (*c.* 663–609 B.C.). The new oriental word is frequently employed by Herodotus, and there are abundant references to the use of the thing among the writers of the golden age of Attic literature (see, for example, Aristophanes, *Plut.,* 1.114; Frogs, 871, 888; Clouds, 426; *Wasps,* 96, 861). Frankincense, however, though the most common, never became the only kind of incense offered to the gods among the Greeks. Thus the Orphic hymns are careful to specify, in connection with the several deities celebrated. a great variety of substances appropriate to the service of each; in the case of many of these the selection seems to have been determined not at all by their fragrance but by some occult considerations which it is now difficult to divine.

Among the Romans the use of religious fumigations long preceded the introduction of foreign substances for the purpose (see, for example. Ovid, Fast., i, 337 et seq., Et non *exiguo laurus adusta sono*). Later the use of frankincense (*mascula thura,* Virgil. Eclogues, viii, 6j) became very prevalent, not only in religious ceremonials, but also on various state occasions; such as in triumphs (Ovid, *Tristia,* iv, 2, 4), and also in connection with certain occurrences of domestic life. In private it was daily offered by the devout to the *Lar* familiaris (Plautus, *Aulularia,* prol. 23); and in public sacrifices it was not only sprinkled on the head of the victim by the pontifex before its slaughter, and afterward mingled with its blood, but was also thrown upon the flames over which it was roasted.

No perfectly satisfactory traces can be found of the use of incense in the ritual of the Christian church during the first four centuries. (Cf. L. M. O. Duchesne. Christian Worship [Eng. trans., 1904], ch. ii, "The Mass in the East," v, "The Books of the Latin Rite," and xii, "The Dedication of Churches.") Its use was foreign to synagogue services on which the worship of the primitive Christians is known to have been originally modeled; and its associations with heathen solemnities, and with the evil repute of those who were known as "thurificati." would still further militate against its employment. Various authors of the ante-Nicene period have expressed themselves as distinctly unfavourable to its religious, though not, of course, to its domestic, use. Thus Tertullian, while (De Cor. *Mil.,* 10) ready to acknowledge its utility in counteracting unpleasant smells ("si me odor alicujus loci offenderit, Arabiae aliquid incendo"). is careful to say that he scorns to offer it as an accompaniment to his heartfelt prayers (*Apol.,* 30; cf. 42). Athenagoras also (*Legat.,* 13) gives distinct expression to his sense of the needlessness of any such ritual ("the Creator and Father of the universe does not require blood, nor smoke, nor even the sweet smell of flowers and incense"); and Arnobius (*Adv. Gent.,* vii, 26) seeks to justify the Christian neglect of it by the fact, for nhich he vouches, that among the Romans themselves incense was unknown in the time of Numa, while the Etruscans had always continued to be strangers to it.



BY COURTESY OF JOHN P DALEIDEN CO.

INCENSE CENSER USED IN THE ROMAN CATHOLIC CHURCH

St. Cyril of Jerusalem, St. Augustine and the Apostolic Constitutions make no reference to any such feature either in the public or private worship of the Christians of that time. But in the Apostolic Canons (can. 3) the θυμίαμα is spoken of as one of the requisites of the eucharistic service. It is easy to perceive how it should inevitably have come in along with the whole circle of ideas involved in such words as "temple," "altar," "priest," which about this time came to be so generally applied in ecclesiastical connections. At a later date Roman Catholic theologians treated it as symbolically typifying the prayers of the faithful and the virtues of the saints. Ultimately the word incense was sometimes used symbolically of prayer; a usage anticipated in Revelation v, 8, viii, 3, 4 (cf. Origen. Contra *Celsum,* viii, 17, 20).

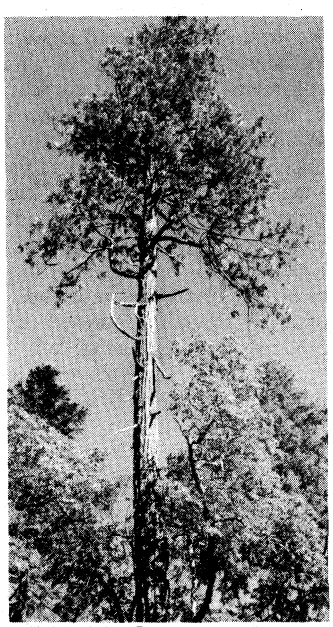
Incense in the **Church** of England. — The missal of the Roman Church, however, enjoins incensation before the introit, at the gospel and again at the offertory, and at the elevation. in every high mass; the use of incense also occurs at the exposition of the sacrament. at consecrations of churches and the like, in processions. in the office for the burial of the dead and at the exhibition of relics. On high festivals the altar is censed at vespers and lauds. There is reason to believe that. notwithstanding the order for the use of incense at every celebration, it was used in British churches only on high festivals. and then only in rich churches down to the period of the Reformation, and that the ritual of the mass remained unchanged until the death of Henry VIII (Jan. 28, 1547). On Whitsunday 1549 the first prayer book of Edward VI came into use under the first Act of Uniformity (2 and 3 Ed. VI, ch. 1), which required its exclusive use in public worship so as to supersede all other forms of service. Another act (3 and 4 Ed. VI, ch. 10) required the old service books to be delivered up to be destroyed. The first prayer book does not contain any direction to use or any mention of incense. It is a controverted question whether incense did or did not continue to be in ceremonial use under the first prayer book or during the rest of Edward VI's reign. No evidence has hitherto been discovered which justifies us in answering this question in the affirmative. The second prayer book of Edward VI (1552), published under the authority of the second Act of Uniformity (5 and 6 Ed. VI, ch. 1), contains no reference to incense. Edward VI died July 6, 1553. Queen Mary by statute (1 Mary, sess. 2, ch. 2) abolished the prayer book. repealed the Acts of Uniformity and restored "divine service and administration of sacraments as were most commonly used in England in the last year of Henry VIII." The ceremonial use of incense thus became again an undoubted part of the communion service in the Church of England. A proclamation issued (Dec. 6, 1553) directed the church wardens to obtain the proper ornaments for the churches; and the bishops in their visitations inquired whether censers had been furnished for use. Mary died Nov. 17, 1558. On June 24, 1559, the second prayer book of Edward VI (with a few alterations having no reference to incense) was again established, under the authority of the third Act of Uniformity (1 Eliz., ch. 2), as the exclusive service book for public service. There is no evidence of the ceremonial use of incense under Elizabeth's prayer book, or under the present prayer book of 1662 (established by the fourth Act of Uniformity. 13 and 14 Charles II. ch. 4) until the middle of the 19th century; and there is no doubt that as a ceremony of divine worship. whether at the Holy Communion or at other services, it was entirely disused. There are a good many instances recorded of what has been called a fumigatory use of frankincense in churches, but this use of incense — which was utilitarian and not symbolical — must be carefully distinguished from its ceremonial use. In the general revival of church ceremonial which accompanied and followed the Oxford movement incense was not forgotten, and its ceremonial use in the pre-Reformation method was adopted in a number of churches after 1850. Its use has been condemned as an illegal ceremony by the

ecclesiastical courts. In 1868 Sir Robert Phillimore (dean of the arches) pronounced the ceremonial use of incense to be illegal in the suit of *Martin* v. *Mackonochie* (2 A. and E.L.R. 116). The case was carried to the privy council on appeal, but there was no appeal on the question of incense. Again, in 1870, the ceremonial use of incense was condemned by Sir Robert Phillimore in the suit of *Sumner* v. *Wix* (3 A. and E.L.R. 58).

Notwithstanding these decisions, it was insisted by those who defended the revival of the ceremonial use of incense that it was a legal custom of the Church of England. The question was once more elaborately argued in May 1899 before an informal tribunal consisting of the archbishop of Canterbury (Frederick Temple) and the archbishop of York (William Maclagan), at Lambeth palace. On July 31, 1899, the archbishops decided that the liturgical use of incense was illegal. The Lambeth "opinion." as it was called, failed to convince the clergy against whom it was directed any better than the judgments of the ecclesiastical courts, but at first a considerable degree of obedience to the archbishops' view was shown. Various expedients were adopted, as, *e.g.*, the use of incense just before the beginning of service, by which it was sought to retain incense without infringing the law as laid down by the archbishops. There remained, nevertheless. a tendency on the part of the clergy who used incense, or desired to do so, to revert to the position they occupied before the Lambeth hearing—that is, to insist on the ceremonial use of incense as a part of the Catholic practice of the Church of England which it is the duty of the clergy to maintain. notwithstanding the decisions of ecclesiastical judges or the opinions of archbishops to the contrary.

BIBLIOGRAPHY.—"Incense" in *Encyclopaedia Biblica;* P. Morrisroe, "Incense" in the *Catholic Encyclopaedia* (from the modern Roman Catholic point of view); J. A. MacCulloch, "Incense" in J. Hastings, *Encyclopaedia of Religion and Ethics* (with many refs.); E. G. Atchley, *History of the Use of Incense in Divine Worship* (1909). *See* also PERFUMES.

INCENSE CEDAR *(Libocedrus decurrens)* is a handsome North American tree of the cypress family (Cupressaceae), native to high mountains from Oregon and Nevada to Lower California. It is a valuable timber tree, with cinnamon-red bark, frequently attaining a height of 150 ft., and sometimes a trunk diameter of 7 ft. The slender branches, with much-flattened branchlets and lustrous, cypresslike leaves, form a beautiful crown. The soft, durable, straight-grained, fragrant, resinous wood is utilized for pencil slats, fence posts, telephone poles and lumber.



RUTHERFORD PLATT

THE INCENSE CEDAR (LIBOCEDRUS DECURRENS)

The incense cedar is planted for ornament, as is. also the smaller South American species *(L. chilensis)*. Besides the foregoing, six other species of incense cedar are found, one each in Chile, New Caledonia, China and Japan and two in New Zealand. Of these. L. *uvifera* of Chile and *L. plumosa* of New Zealand are valuable timber trees.

INCEST, sexual intercourse between persons so related by kindred or affinity that legal marriage cannot take place between them *(see* MARRIAGE, LAW OF, especially the section *Canon Law).*

In England incest formerly was not generally treated as a crime. although, along with other offenses against morals. it was made punishable by death in 1650. After the Restoration it was. to use W. Blackstone's phrase, left to the "feeble coercion of the spiritual courts," but bills to make it a criminal offensewere at various times unsuccessfully introduced in parliament. In 1908, however, an act (the Punishment of Incest act, 1908) was passed under which sexual intercourse of a male with his granddaughter, daughter. sister or mother is made punishable with penal servitude for not less than three or more than seven years, or with imprisonment for not more than two years with or without hard labour. It is immaterial that the sexual intercourse was had with the consent of the female; indeed, by s. 2 a female who consents is on conviction liable to the same punishment as the male. The act also makes an attempt to commit the offense of incest a misdemeanor, punishable by imprisonment for not more than two years with or without hard labour. The terms "brother" and "sister" include half brother and half sister, whether the relationship is or is not traced through lawful wedlock. Formerly all proceedings under the act were held in *camera* (s. 5), but this provision was repealed by the Criminal Law Amendnient act, 1922. In *Rex* v. *Ball* (22 Cx. C.C. 366) it was held by the house of lords that evidence of previous intercourse was admissible to establish guilty passion and rebut innocent association. In the law of Scotland, it was, until the Criminal Procedure (Scotland) act, 1887, a crime nominally punishable with death, but the penalty usually inflicted was penal servitude for life. This sentence was actuallv pronounced on a man in 1855.

In the United States incest, though not an indictable offense at common law, has, generally speaking, been made a felony by statute and punishable by fine or imprisonment or both. It is also a punishable offense in some European countries, notably Germany, Austria and Italy. (W. DE B. H.)

INCH: *see* WEIGHTS AND MEASURES.

INCHBALD, ELIZABETH (1753–1821), English novelist, playwright and actress whose novel *A Simple Story* may have inspired Charlotte Brontë in writing *Jane Eyre,* was born at Standingfield, Suffolk, Oct. 15, 1753, the daughter of Joseph Simpson. At 18 she ran away to London to seek her fortune on the stage. Two months later she married Joseph Inchbald. an actor, and made her debut at Bristol as Cordelia to his Lear. They toured the provinces until his sudden death in 1779, after which she continued to act for ten years, also writing adaptations of plays and some original farces and comedies, the most successful being *I'll Tell You What* (1785). She was never a great actress, but her beauty, vivacity and blameless personal life won her great admiration. Her fame rests upon her two novels, *A Simple Story* (1791) and *Nature and Art* (1796); they are among the earliest examples of the novel of passion and enjoyed immediate success.

Mrs. Inchbald died at Kensington on Xug. 1, 1821.

BIBLIOGRAPHY.—J. Boaden, *Memoirs of Mrs. Inchbald,* 2 vol. (1833); Fanny Kemble, *Records of a Girlhood* (1878); W. Bell Scott, preface to *A Simple Story* (1880); S. R. Littlewood, *Elizabeth Inchbald aad her Circle* (1921).

INCHCAPE, JAMES LYLE MACKAY, 1ST EARL (1852–1932), British shipowner, was born at Arbroath. Forfarshire, on Sept. 11, 1852, and educated there and at Elgin. In 1874 he went to India to join the firm of Mackinnon, hfackenzie and company, Calcutta, of which he ultimately became senior partner; he was a member of the legislative council of the viceroy (1891–93) and a member of the Council of India from 1897 to 1911.

In 1902, consequent upon the Boxer rebellion: Mackay negotiated a commercial treaty with China. In 1911 he was raised to the peerage as Baron Inchcape of Strathnaver. As a representative of the shipping industry Inchcape took a leading part in all its affairs both during World War I and after, being president of the Chamber of Shipping of the United Kingdom (1893, 1918, 1919) and president of the Shipping federation (1926). He served on most of the government commissions of inquiry both in India and England. He was a member of the Geddes committee on national expenditure (1921) and chairman of the Indian retrenchment committee (1922). In 1924 he was created viscount and grand commander of the order of the Star of India. The positions of chairman of the P. and O. Steam Navigation company and director of the National Provincial bank and Suez Canal company were other important positions which he occupied. In 1928 Lord Inchcape lost his daughter, Elsie Mackay, in an attempted transatlantic flight. He was created an earl June 3, 1929. He died at Monaco, May 23, 1932.

INCHIQUIN, MURROUGH O'BRIEN, 1ST EARL OF (c. 1614–1674), Irish soldier and statesman, was the son of Dermod O'Brien, 5th Baron Inchiquin (d. 1624). He belonged to a great family which traced its descent to Brian Boroimhe, king of Ireland, and which was always to the forefront in Irish public life. The first baron of Inchiquin was another Murrough O'Brien (d. 1551) who, after having made his submission to Henry VIII, was created baron of Inchiquin and earl of Thomond in 1543. When Murrough died in Nov. 1551 his earldom passed to his nephew Donogh, son of Conor O'Brien (d. 1539), the last independent prince of Thomond (see THOMOND, EARL AND MARQUESS OF), leaving only his barony to be inherited by his son Dermod (d. 1557), the ancestor of the later barons of Inchiquin.

Murrough O'Brien, who became 6th baron of Inchiquin in 1624, took an active part in suppressing the Irish rebellion which broke out in 1643, and during the Civil War the English parliament made him president of Munster. Early in 1648, however, he declared for Charles I, and for about two years he sought to uphold the royalist cause in Ireland. He then emigrated. In 1654 Charles II made him an earl. He died on Sept. 9, 1674.

His son WILLIAM, 2ND EARL OF INCHIQUIN (c. 1638–1692), served under his father in France and Spain, and for six years was governor of Tangier. He was a partisan of William III in Ireland, and in 1690 he became governor of Jamaica, where he died in Jan. 1692. In 1800 his descendant Murrough, the 5th earl (d. 1808), was created marquess of Thomond, but on the death of James, the 3rd marquess, in July 1855 both the marquessate and the earldom became extinct.

INCIDENTAL MUSIC, a type of music so called because it is incidental or subservient to the action of a play, film, radio or television program, being intended to reflect or enhance a dramatic situation, rather than to form an integral part of it. The best of such music, originally written to form part of a dramatic performance, has acquired a life of its own, and can be played and heard without reference to the work for which it was intended, although it is, in a sense, "programme music" (*q.v.*), *i.e.*, music written to express a literary idea, rather than a purely musical one.

The place of music in drama is closely bound up with the origins of both drama and opera (*qq.v.*). It is not really possible to describe the music in Greek drama or in oriental drama, with its ritual associations, as "incidental," although the songs in Menander's comedies seem to have been forerunners, as do the flute accompaniments to speeches in Roman plays. In any case, our knowledge of this music can only be inferred from stage directions and it is difficult to determine how far it was regarded as essential, or whether it always took the same form. The gradual emergence of drama from the liturgy of the church in the late middle ages was marked by a development of a more truly "incidental" music. But it was not until the 16th century that the use of music in the theatre began to approximate to modern practice. In Italy attention was concentrated on opera and oratorio, and in England on the spoken drama: thus it was in England that incidental music developed. It took the form of songs within the plays themselves, interludes between acts and instrumental music accompanying the interpolated dumb shows or masques or even off-stage (indicated by the frequent stage direction "music within") as a means of heightening dramatic effect. Early examples of such music are the comic songs in Nicholas Udall's *Ralph* Roister Doister (c. 1553), the dumbshom music in Gorboduc (1562) and the music between the acts in *Gammer Gurton's* Needle (c. 1559).

Incidental music was used in a variety of ways by Shakespeare. The use of songs serves many dramatic purposes and instrumental music not only forms an accompaniment to the masque scenes (as in *Timon* of Athens, *Much* Ado about Nothing and Tlze *Tempest*), and to the dances which sometimes ended the plays, but also heightens the dramatic tension (as in the casket scene in the *Merchant* of Venice), and introduces supernatural characters (as in *Cymbe*line, *Pericles* and As You Like It). Knowledge of this music is derived both from Shakespeare's own stage directions (*e.g.*, "Music! ho") and from the inventories of Elizabethan theatres, which show the types and number of instruments used and make possible a reconstruction of the manner of performance. Settings of Shakespeare's songs were made by such contemporary composers as Robert Johnson, Thomas Morley and John Wilson.

In the Restoration theatre elaborate scores of incidental music were written by Purcell for adaptations of A *Midsummer Night's* Dream and *The* Tempest, for John Dryden's King Arthur and for The Indian Queen by Dryden and Robert Howard. Purcell also wrote incidental music for about 40 other plays, by Thomas Durfey, Beaumont and Fletcher, John Dryden, Thomas Shadwell, William Congreve and others.

In France Lully, in association with Molière, wrote a series of *comédies-ballets,* forming interludes in the plays for the *Plaisirs* du Roi (Louis XIV). The king and princes of the blood themselves took part in the performances of these ballets which fell into two categories: majestic ballets such as that in Les *Amants magnifiques* and comic ballets such as those in Monsieur de Pourceaugnac and Le Bourgeois *Gentilhomme*. Since vocal items were introduced into these ballet interludes the former was held to have anticipated the French opera and the latter the *opéra-comique*.

In the 18th century there was relatively little incidental music, though Handel wrote music for Ben Jonson's *The* Alchemist (1732) and Mozart for T. P. von Gebler's *Thamos,* Konig in *Aegypten* (1779). Where opera and drama were performed in the same subsidized theatre, as at the 19th-century German and Austrian courts, the orchestra was also available for dramatic productions with the result that incidental music was written by Beethoven for Goethe's *Egmont* (1810), by hfendelssohn for A *Midsummer* Night's Dream (1843) and by Schumann for Byron's *Manfred* (1852). These scores, like those by Bizet for Daudet's *L'Arlésienne,* Grieg for Ibsen's Peer Gynt and Fauré for Maeterlinck's *Pelléas* et *Mélisande,* were later played independently of the plays for which they were written and which they sometimes outlived.

Among later associations of playwrights and composers of incidental music are those of Paul Claudel and Darius Milhaud, Virgil Thomson and Ernest Hemingway and Benjamin Britten and W. H. Auden.

Toward the middle of the 20th century developments in motion-picture productions and in radio and television programs created an enormous demand for incidental music. Much of it was ephemeral, but some of the scores by composers who experimented with new forms of film and broadcast music, among them T'aughan Williams and Prokofiev, survived in their own right. These new opportunities in film and radio for incidental music increasingly supplied the main sources of income for many composers. Motion pictures and radio also made use of experiments with electronic music in Germany, Italy and France. These types of incidental music branched out in two directions. They either tended to become more accurate and telling in expression, as when films or radio programs represented the joint efforts of composer and producer; or they tended to become debased, as when background music was selected from libraries of recorded music, written not so much to be heard during the performance as to be overheard.

(E. LR.)

INCINERATOR, a term which came into use during the first half of the 20th century, replacing "destructor" in England and "crematory" in the United States, to describe a plant designed to burn solid wastes (refuse). An incinerator is comprised of a furnace into which the refuse is charged and ignited, a secondary combustion chamber in which burning at a high temperature is continued to complete the combustion process, flues to convey the gases of combustion to a chimney and thence to the atmosphere. Incinerator plants also include facilities for unloading and storing the refuse for short periods to permit uniform charging of the furnaces, and a building, if necessary, to house the incinerator appurtenances. Incineration of community refuse is not a complete disposal process as the remaining ash (about 10% by volume) must be disposed of (see REFUSE DISPOSAL).

The growth of large cities was primarily responsible for the development of refuse incinerators since it was not practical from nuisance, public health and aesthetic viewpoints to permit refuse dumps in their midst. The burning of refuse provided an efficient means of inoffensively reducing the bulk of refuse to a readily

transportable and often usable ash. To accomplish the burning in a sanitary and effective manner it was necessary to develop specialized furnaces and other equipment as well as buildings laid out to facilitate delivery, storage, handling and salvage of the refuse and ash.

Although many refinements of equipment have been developed during the 20th century the basic components of a municipal incinerator remain the same.

Incineration Costs.—Incineration has always been costly as compared with other methods of disposal, so it is usually resorted to as a final choice dictated by necessity. In the United States, capital costs for pit-and-crane incinerators have been found to range from $3,000 to $4.500 per ton of rated capacity. Of a complete municipal incinerator, about 40% of the cost is for the furnaces and their appurtenances and about 60% for the access roads and ramps, storage bins, building and chimney. Operating costs range from $3 to $6 per ton of refuse burned.

Nature of Refuse.—Town or community refuse is considered the useless, unused or unwanted solid wastes resulting from the normal course of community activity. It consists primarily of food wastes (garbage), rubbish (paper, wood, glass, metal, leather, plastic, etc.) and ashes.

The composition of refuse received at an incinerator plant may vary widely with the season of the year and with local conditions, such as the presence of various industries: Pre-World War II analysis of English refuse indicated its composition to average 48% noncombustibles (including fine dust) and 52% combustibles, such as rags, garbage, paper and cinders. Later analyses on a limited basis showed a higher vegetable content. The average over-all yield of town refuse in England is about 1,800–1,900 lb. per 1,000 population per day. In the United States, an analysis of refuse in a city where natural gas was used extensively could be expected to show 80% by weight of combustible material (paper, rags, wood, garbage), 13% of noncombustibles (metals, glass) and only 7% ash. Normally, community incinerators in the United States and Canada are designed to handle 2.500 lb. of refuse per 1,000 population per day. A higher design figure is needed where a heavy industrial refuse contribution is encountered.

For plant design purposes the combustible component of refuse may be considered the same as cellulose ($C_6H_{10}O_5$). Actually, refuse contains a small percentage of carbohydrates and fats but these do not influence the design significantly. The calorific or heat value of refuse has been found to vary from 3,000 to 5,000 B.T.U. per pound in England.

Incinerators constructed by the city of New York utilized a calorific design value of 4,000 B.T.U. per pound (7,000 to 9,000 B.T.U. per pound of dry combustible solids).

Engineering Design.—The combustion equipment in an incinerator plant is similar to the furnace system in a power plant, except that it must be designed to receive a heterogeneous fuel rather than a uniform fuel such as coal or oil. In order to determine the amount of air and, if necessary, auxiliary fuel needed to consume the combustible refuse and evaporate the water present, it is necessary to compare the heat value of the refuse with the heat required to maintain the proper combustion temperature. Through use of the basic combustion formula (cellulose + oxygen → carbon dioxide + water) and the molecular weights of the combustible refuse, the amount of oxygen and thus the air required to sustain combustion is found. The total moisture in the refuse and in the combustion air, the water formed during the combustion process and heat losses through furnace doors and refractories are calculated to determine minimum heat requirements to raise the gases of combustion to at least 1,300° F. The heat available from the refuse is then calculated to determine the excess heat value available or additional heat required for proper combustion.

Facilities for Receiving Refuse.—Refuse is usually delivered to an incinerator in trucks. It may then be fed directly into a furnace or undergo a separation process to remove salvable material before the remainder is incinerated. In England, the relative economics of direct salvage of components of the refuse v. the production of steam from burning it was an issue for many years. Successful plants of both systems were built, the controlling feature being local conditions. However, subsequent to World War II, very few plants in Great Britain were designed on the direct incineration principle. In the Cnited States, because of the high cost of separating refuse and the poor market potential for salvage, direct incineration is practiced almost exclusively.

Incinerator plants are referred to as "floor dump" plants or "pit-and-crane" plants depending on whether the refuse is dumped on the charging floor and pushed into the charging opening to the furnace or dumped into a pit first for storage and subsequently fed into the furnace with a bucket crane. Smaller plants operated eight hours a day are usually of the floor dump type since the storage area required for the refuse received is not great; such plants require smaller capital outlay and can be operated more economically on a limited basis. Cities of more than 100,000 population almost always build pit-and-crane plants since it is more economical for such plants to operate on a 16- to 24-hr. basis.

The refuse is collected and delivered to the plant during the eight-hour working day. The storage pits of a modern plant are usually designed to hold 70% to 100% of the plant's 24-hr. burning capacity.

Furnaces.—The furnace chamber of an incinerator, sometimes called the primary or ignition chamber, must be designed to promote the rapid desiccation of the raw refuse, leaving only volatile gases to be burned in the secondary chamber and ashes to fall into the ash pit.

A mixing chamber, placed immediately following the combustion chamber and equipped with baffles or restricted passageways, promotes mixing and burning of volatile gases to prevent odours. The gases in the mixing chambers should be at a temperature of at least 1,300° F., and usually the temperature is from 1,600° to 1,800° in modern incinerators. A secondary combustion or expansion chamber is provided to permit expansion of the combustion gases, complete the burning process and permit particulate matter (fly ash) to settle out.

The sizes of these chambers are governed by the volume of the gas produced in the combustion process. After the amount of refuse that must be burned per hour is established, grate areas, chamber volumes and size and placement of air ports are determined. U.S. designs which take into account air pollution requirements employ a grate loading factor of about 50 lb. per square foot per hour.

Similarly, a furnace volume of 12.5 cu.ft. per ton of rated capacity is deemed reasonable and a combined volume of the secondary combustion chambers and flues of 80 cu.ft. per ton of rated capacity is indicated for municipal plants (rated capacity of a plant is the amount of refuse in tons that can be burned over a 24-hr. period).

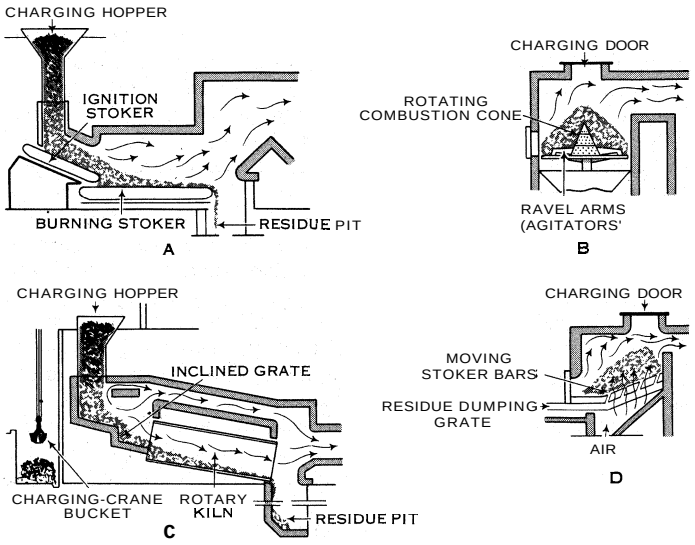
Grates.—The function of a grate is to support the refuse without leakage of the combustibles and to provide a free flow of air to support combustion. The design of furnace grates has undergone considerable change because community refuse no longer consists primarily of garbage with its high moisture content and because high labour costs have necessitated automation.

Prior to World War II practically all incinerators constructed in the United States were hand stoked. Within a few years after the war, automatic and semiautomatic mechanical grates were being installed in practically all new plants. Mechanical grates developed during this period were of four basic types: rectangular, cylindrical, traveling grate and rotary kiln.

The rectangular type (fig. [D]) is provided with alternately moving stoker bars that agitate the burning refuse and keep noncombustible materials moving toward the front of the furnace, where they pass through a dumping grate.

In the cylindrical incinerator (fig. [B]), refuse is dropped onto a circular grate over a rotating perforated cone through which cdmbustion air is passed. Ravel arms, attached to the cone, stir the burning mixture and move unburned material toward dumping grates at the outer edges.

Higher production rates can be achieved in incinerators equipped with traveling grate stokers (fig. [A]), for these permit continuous charging of refuse and removal of residue. In this type, the more inflammable refuse is largely consumed on the ignition



FROM "INCINERATOR ENCLOSURES' (1956); REPRODUCED BY PERMISSION OF M. H. DETRICK CO.

BASIC INCINERATOR DESIGNS

(A) Traveling grate: (B) cylindrical; (C) rotary kiln; (D) rectangular

stoker; the remainder then drops onto the burning stoker, which runs about 25% faster than the ignition stoker so as to spread the less inflammable materials thinner over the grate surface.

Continuous charging and residue removal also is possible in the rotary kiln incinerator (fig. [C]), in which refuse is dumped onto an inclined grate and thence into a rotary kiln, which provides greater agitation and more intimate mixing with combustion air.

Flues.—A flue is the connection between the secondary combustion chamber and the chimney. In large plants, when more than one furnace is employed, the flues are interconnected so that one chimney can serve two or more units. Flues are designed to facilitate removal of particulate matter from the combustion gases as they flow to the chimney.

Chimneys.—The chimneys (or stacks, as they are usually referred to in the United States and Canada) are the means of conveying the gases of combustion to the atmosphere. Their dimensions must be chosen so as to obtain proper draft for the incinerator and to dispense the gases over a wide area. A large municipal plant may have a chimney as high as 200 ft., depending on the velocity and volume of flue gases, the height of nearby buildings and the nature of the terrain.

Preheaters.—If an incinerator handles a large percentage of refuse of high moisture content, a recuperative type of preheater is placed before the flues to furnish preheated air to the forced draft fan supplying air to the stoker. In the United States, community refuse is composed primarily of readily burnable material and preheaters are not used in many incinerators. Auxiliary oil or gas burners in the furnace may be provided in lieu of preheaters in order to maintain combustion chamber temperatures for short periods when the refuse contains a high percentage of moisture.

Draft Facilities.—The air needed for combustion is provided by forced, by induced or by natural draft. The first two require fans; the third requires a chimney of adequate height and cross-sectional area. The quantity of air required varies from 4 lb. per pound of mixed refuse with 54% moisture to more than 10 lb. per pound of highly combustible rubbish having a moisture content of 15%. In the latter instance almost half of the air requirement is needed to cool gaseous products of combustion to prevent thermal damage to the furnace refractories. Dampers to regulate furnace draft are usually placed between the combustion chamber and the secondary chamber or between the secondary chamber and the flues.

Ash Hoppers.—The ash hoppers are designed to receive the residue or ash from the furnace grate. Hoppers usually are of steel construction and lined with vitrified paving brick. Usually the ash is cooled by water quenching in the hoppers and dumped directly into a truck or transported through a water bath on an endless belt conveyor to an ash storage hopper or to an ash truck.

Instruments.—The instruments necessary for operation of the plant usually include recording pyrometers connected to thermocouples placed in the combustion chamber and chimney, gauges to record draft at the base of the chimney and forced draft pressure beneath the grates, a recording meter for wind direction and a smoke density meter mounted in the chimney. A carbon dioxide recorder for determining the percentage of CO_2 in the flue gases is also recommended. The instruments usually are mounted on the stoking floor for easy observation by the operator.

Fly Ash Control.—The problem of controlling particulate matter (fly ash) in the combustion gases to prevent a nuisance condition from the plant chimney discharge in the vicinity of the incinerator has continued to plague designers. The expense of installing. maintaining and operating the necessary fly ash control equipment has been the principal deterrent to achieving desired standards. Two basic methods of fly ash control are used in modern incinerators: entrapment with water sprays (or baffles) and gravity settlement. Fly ash emission was effectively controlled in one type of incinerator by utilizing extremely large flues along with a series of wall baffles to settle out and trap the fly ash under natural draft conditions. Another incinerator design accomplished fly ash removal by using forced draft to force the flue gases through stainless steel baffles equipped with water sprays; the water trapped the particulate matter in the gases and carried it via drains to a lagoon where the ash was allowed to settle out.

Waste Heat Utilization.—Much attention has been paid to the possible utilization of the heat generated by the incineration process for steam or power production. In Great Britain many such plants were built in the early half of the 20th century. It was found in the Birmingham plants, for example, that 2 lb. of steam were obtained from each 1 lb. of refuse burned. Glasgow had a successful scheme of power production wherein the electrical authority purchased excess power from the incinerating plant to help meet demand periods during the week. The incinerating plant ran for 5½ days each week and thus its power production fitted in with the demand for electricity, which fell off on Saturday afternoon and Sunday.

Generation of steam for heating or other purposes is also found profitable in certain locations. The Miami, Fla., plant is designed to provide steam for a nearby hospital. Generally, in the United States and Canada heat produced from the refuse is wasted to the atmosphere because it has been found that the equipment required to produce steam and electricity cannot be installed and operated economically in competition with regular power supply sources.

Institutional and Household Incinerators.—On-site disposal of combustible refuse is an economical method for many industries, multiple apartment dwellings and many large retail commercial establishtnents as well as, in certain instances, for householders. There are thousands of such plants in the larger cities and they usually form an important part of the over-all disposal system. The basic furnace design for such units is similar to that required for their larger municipal counterparts.

There is usually incorporated in the design of apartment house incinerators special charging features for the convenience of their users. Such units are often "flue fed"—that is, a chute extends to the upper story of the building and rubbish placed into an opening in the chute drops directly into the furnace. These units have often been the source of nuisances, however, where insufficient attention is given their operation.

Because such units have been found to be a significant source of air pollution, much attention has been given to improvement of their design.

Household incinerator units are not recommended by refuse disposal authorities in lieu of use of a community-wide collection system, but have found application in rural areas. When garbage is included in the refuse burned, some odour can be detected in the gases discharged into the flue when a single-cell unit is used. Such units usually are equipped with a gas burner to assist in the combustion of refuse such as garbage.

It has been the practice in many communities to encourage the burning of refuse in "backyard incinerators." These are some-

times specially built single-cell burning units, but usually are converted oil drums or wire baskets. To call them incinerators is a misnomer. Usually such practice is necessitated by inadequate or incomplete refuse collection systems.

In Los Angeles, Calif., for example, the collection of combustible rubbish was instituted in 1957 because it was shown that the practice of burning combustible rubbish by householders was a significant contributing factor to that city's severe air pollution problem. At the time the municipal collection system was instituted and backyard burning banned, there were 1,500,000 household rubbish burners in the city. (Lo. W.)

INCLEDON, CHARLES BENJAMIN (1763–1826), English singer, son of a doctor in Cornwall. was the principal English tenor of his day. He sang both in opera and in oratorio, but his chief popularity lay in his delivery of ballads. such as "Sally in Our Alley," "Black-Eyed Susan," "The Arethusa" and others of a similarly bold and manly type. On retiring in 1822 from the operatic stage, he travelled through the provinces with an entertainment called "The Wandering Melodist." He died at Worcester on Feb. 11, 1826.

INCLINOMETER. Two classes of instruments are used for measuring the dip or inclination of the earth's magnetic field to the horizontal, the dip circle (*q.v.*) and the induction inclinometer or earth inductor. The principle on which induction inclinometers depend is that if a coil of insulated wire is spun about a diameter there will be an alternating current induced in the coil, unless the axis about which it turns is parallel to the lines of force of the earth's field. Hence, if the axis about which such a coil spins is adjusted until a sensitive galvanometer connected to the coil through a commutator, by which the alternating current is converted into a direct current, is'undeflected: then the axis must be parallel to the lines of force of the earth's field, and hence the inclination of the axis to the horizontal is the dip.

INCLOSURE or ENCLOSURE: *see* COMMONS.

IN COENA DOMINI, a papal bull, so called from its opening words. first issued in 1363 and republished annually about Eastertide. It was a statement of ecclesiastical censure against heresies, schisms. sacrilege, infringement of papal and ecclesiastical privileges, attacks on person and property, piracy, forgery and other crimes. Because of the opposition of the sovereigns of Europe, both Protestant and Catholic, who regarded the bull as an infringement of their rights, its publication was discontinued by Pope Clement XIV in 1770. It is considered to have been formally abrogated by Pius IX in the constitution *Apostolicae Sedis.* It received its final form from Pope Crban VIII in 162;.

See J. Prior, "In Coena Domini" in the *Catholic Encyclopaedia;* M. O'Riordan, "Apostolicae Sedis," *ibid.*

INCOME: ECONOMIC DEFINITION. Income has been defined as: (1) "the wealth measured in money which is at the disposal of an individual or a community, per year or other unit of time"; (2) "the inflow of satisfactions from economic goods, estimated in money" (Seligman); (3) "those incomings which are in the form of money. including 'payments in kind.'"

These definitions have some ambiguity. In general, the term is confined to those "satisfactions a-hich are capable of being parted with, or are usually parted with. for money." For example. the satisfaction or economic value derived from living in one's on-n house is commonly expressible as an annual rental. and this is usually included in income, but an analogous satisfaction from contemplating one's pictures or using one's furniture is not. Again. periodicity is essential. and a year is the common basis, though the flow may be quite uneven. in fact. and even accruing unevenly over the year. Services performed for oneself which, if performed for others. would bring in an income are not usually included; *e.g.,* painting one's own house. or a wife's domestic services. This is extended to exclude other mutual services within a group; *e.g.,* a club or co-operative society. There is a field of difficult distinction from capital; *e.g.,* a series of profits from transactions which, taken singly. are regarded as capital transactions (sales of houses, lands or securities) may constitute an income in certain circumstances. And "net income" involves considerations of long-period wastage in the producing agent—a coal mine, or 99 years' lease or a building. The term "national income" is subject to numerous special conventions.

BIBLIOGRAPHY.—Lord Stamp, *British Incomes and Property* (1916), *Principles of Taxation (1936);* A. Marshall. *Principles of Economics,* book ii, ch. iv, 8th ed. (New York, 1920); A. L. Bowley, "Definition of National Income," *Economic Journal* (1922); *E.* R. A. Seligman, *Studies in Public Finance,* ch. v (New York, 1925); G. Armitage Smith, *Principles and Methods of Taxation* (London, 1933). (J. S.)

INCOME BONDS, bonds bearing a stipulated interest rate but upon which no interest is paid unless there is sufficient income for this purpose after all other fixed charges have been met. The nonpayment of interest on an income bond when the earnings are not sufficient for this purpose does not constitute a default and does not give the bondholder the right to sue. Income bonds are almost invariably brought about during reorganizations of businesses, whereupon they may be accepted by holders of old defaulted bonds or offered for sale to the general public to raise cash.

Income bonds may be secured as to principal by a mortgage, in which case the mortgage would be junior to the others; or by collateral: or may be strictly of the debenture type. The interest may be either cumulative or noncumulative. It is usually the practice to use available income to pay a portion of the interest if there is not enough to pay the full rate. Because of the uncertainty of interest payments income bonds generally rank very low as investments and are usually regarded as just above the preferred stock of the corporation.

They are often bought at a low price by unprincipled persons and sold at par or above to uninformed buyers upon the false representation that the name "income bonds" means bonds upon which an income is guaranteed, than which nothing could be further from the truth.

INCOME TAX. An income tax, under usual terminology, is a tax imposed upon net incomes, that is. on total incomes less expenses incurred in earning them. An income tax may apply to individuals (personal income tax), corporations (corporation income tax) or both. The personal income tax typically applies only to income in excess of a certain figure. and thus low-income groups are freed from the tax. Income tax rates may be proportional at all income levels, but are more commonly progressive, the rate rising as the size of the income rises. Progression is particularly common with personal income taxes. An income tax may be applied in blanket fashion to all income (or to all except certain specially treated items), as in the United States, or it may consist of a series of schedules applying to various forms of income, as in Great Britain and some countries of continental Europe.

An income tax in the typical form is distinguished from a gross income tax. which applies to the entire gross income of individuals, corporations or both, without deduction of expenses of gaining the income, or other items.

After World War I, the income tax became the most important source of tax revenue in many countries, particularly the Gnited States. Great Britain and most nations of the British Commonwealth and the countries of northern Europe. In the 1953 fiscal year. Great Britain obtained about 50% of its total revenue from the various income taxes: the United States. 78% (personal 47%, corporate 31%); Canada, 60%; Australia, 60%; and New Zealand, 35%. In western Europe the percentage was highest in Luxembourg, 66%; the Netherlands, 52%; and Sweden, 50%; other figures include west Germany (federal and *Länder*), 36%; Finland, 26%; Belgium, 42%; Norway, 32%; Denmark, 43%; Switzerland (federal and cantons), 48%; France, 29%; Italy, 15%; Austria. 33%; Portugal. 31%; Spain: 43%.

This article is divided into three sections, as follows: *Historical Development of Income Taxation; Practical Aspects of Income Tuxation;* and *Economics.*

HISTORICAL DEVELOPMENT OF INCOME TAXATION

Income taxation developed slowly, with many reverses. The merits of income taxation were recognized centuries ago, but fear that administration would be difficult or impossible—a fear supported by evidence in many instances in which the tax was tried—

delayed its widespread use. But the development of democratic government gave important impetus to the income tax movement. as did increased awareness of the disadvantages of other forms of taxation in terms of accepted standards of society and the growing need for revenue as government expenditures increased. Introduction of the tax was facilitated by increased importance of exchange and the earning of money incomes, more adequate record keeping and use of banking facilities and improved standards of tax administration. The income tax can effectively constitute a major source of government revenue only in a society with a high state of economic and political development and education.

Great Britain. — Credit for the establishment of the first major successful income tax in the world is usually given to Great Britain. The British tax was first introduced in 1799 by William Pitt, to aid in the financing of the war against France. Exemptions and progressive rates were provided, with a standard rate of 10%. The tax was repealed in 1802, but reimposed in 1803 when war resumed. This tax, which involved the use of income schedules and deduction at source, was repealed in 1816 after the battle of Waterloo. In 1842 the tax was revived by Sir Robert Peel. initially for a three-year period. The levy was extended a number of times, and became accepted as' a more or less permanent tax in 1860, when tariff reductions made its revenue essential. The tax was gradually reduced from the 1 shilling 4 pence in the pound figure of 1860, but was raised during the South African War of 1899–1902 to 1*s*.3*d*.

These earlier taxes, with minor exceptions, had been levied with proportional rates. In 1909, however. graduated rates were permanently established, through the introduction of the surtax. The standard rate reached 6s. during World R a r I. was reduced during the 1920s and raised to a level of 10*s*. during World War II. The figure was cut to 9s. in 1946, raised to 9*s*.6*d*. during the Korean war and cut to 8*s*.6*d*. in 1955. The exemptions were reduced somewhat during World War II and raised after 1945. A separate tax on profits, primarily on those distributed as dividends, was introduced for the first time in 1937, largely replaced by an excess-profits tax during World War II and reinstated, at relatively high rates. in 1946. The profits tax was increased in 1955 and 1956 as a part of an anti-inflationary and exchange-control program.

United States. — Limited attempts to use income taxes were made by four states early in the 19th century. But administration was weak, and the yield was very low. While additional states attempted to use the tax prior to 1900, the first successful state use came with the Wisconsin tax in 1911. Other states then followed. Expansion of state use, however, was retarded after 1940 by the high federal tax.

The first federal income tax was imposed in 1862, to meet Civil War expenditures. The rate. at first 3%, was later raised. made progressive for a time and then returned to a proportional 10% figure in 1865. Exemptions were provided. Despite the lack of adequate enforcement machinery. the tax yielded substantial revenue. But complaints of evasion and the dislike of many groups for the principle of the tax led congress to allow it to expire in 1872.

During the succeeding decades the tax remained a political issue, support coming primarily from farm and labour groups. Finally, in 1894, a proportional 2% tax was imposed, in part to offset revenue losses from tariff reductions In a reversal of the Civil War tax decision. the 1894 tax mas held to be unconstitutional by the supreme court on the grounds that certain portions of it were direct taxes, and therefore were invalid because the tax was not apportioned according to population as required by the constitution. An immediate attempt was made to sanction income taxation by constitutional amendment; this culminated in the 16th amendment. which became effective in 1913. Meanwhile, in 1909, a levy had been successfully imposed upon corporation profits in the technical form of an excise tax.

In 1913, immediately after the 16th amendment became effective, congress enacted a personal income tax, with a normal rate of 1% on incomes in excess of $3,000 for a single person and $4,000 for a married person, and surtax rates on taxable incomes in excess of $20,000 ranged from 1% to 6%. The corporate rate was 1%.

The development of the tax after 1913 can be summarized briefly, in terms of the following major trends:

1. Sharp increases during World War I. In 1918 the normal rate was made progressive, with a range from 6% to 12%, and the progression of the surtax greatly sharpened. the rate rising from 1% to 65%. The combined normal and surtax rate on income in excess of $1,000,000 was 77%, the highest rate used in any country to that date. Exemptions were also lowered.

2. Gradual reductions in rate and increases in exemptions during the 1920s. The exemption reached $1,500 for single persons and $3,500 for married persons, with $400 for other dependents, by 1925. The normal tax was lowered to a range of from ½% to 4%, and the top surtax rate to 20%.

3. Increases during the 1930s. In an effort to reduce budget deficits, the exemption for married couples was lowered to $2,500, and the basic rate raised to 4% in 1932; progression was sharply increased in an effort to place more of the burden on the higher income groups. Later in the period the surtax rates were raised to a maximum of 75%.

4. Drastic increases during World War II. At the beginning of World War II, the tax was converted almost overnight from a "rich man's tax" to one which reached down to the great majority of workers. The exemption, after several reductions, was set at a flat $500 per person, including the taxpayer, and the surtax rate made to apply to all taxable income, the initial tax rate reaching 23%. The maximum combined normal and surtax rate reached 94%. The normal and surtax rates were eventually consolidated into a single rate. The number of returns, which had been 6,000,000 in 1937, reached 50,000,000 in 1945, or 38% of the population.

In 1943 a significant change was made in methods of collection by the establishment of the withholding system on wages and salaries.

5. Modifications, 1945–56. In the postwar period, continuing high expenditures prevented sharp reductions in income tax, and the general level, while fluctuating somewhat, remained much closer to the wartime figures than to those of the 1930s. Several modifications were made, however, in the structure of the tax.

Rates were reduced in 1946, to a basic figure of 19% and a maximum of 86.45%. In 1948 the exemption figure was raised to $600, rates were reduced again (basic, to 16.6%) and the splitting of income between husband and wife was universally permitted. This rule greatly reduced the operation of progression for married couples. After 1950, as a result of the Korean war, rates were raised again, to a high of 22.2% basic and 92% maximum. In 1953 the rate increase was eliminated and the basic rate table, with rates ranging from 20% to 91%, restored. In 1954 a number of other modifications were made, primarily in the direction of easing the, severity of various rules relating to dependents, to working wives, to depreciation and other questions. A step was also taken to reduce double taxation of dividend income.

The corporation income tax followed a pattern somewhat similar to the personal tax. The rate, originally 1%, reached a high level of 13.5% in 1926, was reduced to 12% in 1928 and raised again in the 1930s. During the latter period limited rate progression was introduced, primarily to lessen the adverse effects of the tax on the growth of small businesses. In 1936, for example, the beginning rate was 8%, the maximum rate 15%. The subjecting of dividend income of individuals to both the normal and surtax rates of the income tax in 1936 established double taxation of corporate dividend income; a proposal to apply the corporate tax only to undistributed profits was rejected by congress in favour of a supplementary tax on such profits in addition to the regular levy. This tax led to great protests and was abandoned in 1937.

During World War II the corporate income tax was raised drastically, the maximum rate figure reaching 40%. The structure of the tax was greatly simplified in 1936 with the establishment of a two-rate structure, a 23% rate applying to all corporate income and a surtax rate of 19% on income in excess of $25,000. The basic rate was raised to 28% in 1951 and to 30% in 1952, the maximum effective rate becoming 52%. These rate increases were extended several times by congress.

While expanded state use of income taxes was restricted after 1940 by the high federal tax, there was a tendency toward greater

use of income taxes (restricted usually to wages and salaries) by the cities, especially in Pennsylvania and Ohio.

Canada. — In Canada income taxation commenced at the municipal level. with substantial development of such taxes at the time of confederation (1867). First provincial use came in 1876, although only two provinces levied the' tax prior to 1923. Five others followed during the 1920s and 1930s, but all provinces temporarily surrendered their right to impose this tax in 1941 in exchange for federal tax rental payments.

Quebec did not renew its tax rental agreement after World War II and imposed its own personal income tax beginning in 1954. Other provinces continued under the rental system. Municipal income taxation also came to an end in 1941.

The first dominion income tax was introduced in 1917, to aid in the financing of World War I, and increased after the war, in contrast with the usual pattern, to eliminate continuing deficits. After 1925 rates were reduced on several occasions and there was some belief that the tax would be repealed. However, after 1932, deficits led to increases in the tax. World War II brought drastic increases in rates and reductions in exemptions. After the end of the war the tax was reduced sharply, the prewar exemptions being re-established (in contrast with United States policy). In 1947 a tax credit for dividend income was granted. Rates were raised in 1952 because of the increased defense spending, and subsequently reduced again.

Corporation income taxation was introduced in 1916 in the form of a special war tax on excess profits; this was supplemented by a tax on all corporate profits in 1917. The rate was raised immediately after the end of the war, reduced during the late 1920s, raised during the depression and very sharply during World War II. Rates were lowered after the end of the war, but' increased somewhat after 1950.

Other Countries. — In the countries of continental Europe, the income tax developed slowly during the 19th century. Income taxes of limited significance were imposed in Belgium as early as 1828, and a general income tax was levied by the Swiss canton of Basle-Stadt in 1840. Austria imposed a general income tax in 1849, and Italy in 1864. Germany entered the field in 1894. Spain imposed an income tax of limited significance in 1900. France was one of the last major countries to enter the field, imposing the tax in 1914. Most of the Swiss cantons did not impose income taxes until the World War I period, and the confederation levied the tax only in 1940. The general trend in most countries has been toward a gradual strengthening of the income tax, the rate levels, however, being greatly increased in periods of war and often not falling back after the end of the wars to prewar levels.

BIBLIOGRAPHY. — E. R. A. Seligman, *The Income Tax,* 2nd ed. (New York, 1914); S. Ratner, *American Taxation* (New York, 1942); F. Shehab, *Progressive Taxation* (London, New York, 1953); J. H. Perry, *Taxes, Tariffs and Subsidies* (Toronto, 1955).

PRACTICAL ASPECTS OF INCOME TAXATION

UNITED STATES

In 1956 the United States applied a single income tax to all taxable personal income, with a corporation income tax imposed upon the entire net profit of corporations.

Returns. — Personal income tax returns were required to be filed by all residents whose gross income exceeded $600, and by nonresidents in certain instances.

There were two primary return forms: 1040A, on which the tax liability was figured by the internal revenue service, was available only to those with wage income subject to withholding of under $5,000 per year (including not over $100 of other specified incomes). Form 1040 required calculation of tax liability by the taxpayer. either by the use of a table (permissive only if the income was under $5,000), or by application of the actual tax rates. Normal filing date was April 1 j.

Married couples might file separate or joint returns, but the latter was almost always preferable because it provided automatic splitting of income between the two persons.

Gross Income. — The law did not define income, but the regulations indicated the types of items which had to be included in gross income. These included all incomes in the usual sense, including gross receipts of operators of business firms, professional men and farmers. Receipts which involved merely a change in the form of nealth with no increase in value did not constitute income. Increases in the value of property were taxed only when realized through sale of the property and received special treatment.

Items of income specifically excluded include certain armed forces pay, most veterans' benefits, social security benefits, gifts and inheritances. casualty insurance benefits received, life insurance benefits upon death and interest on state and municipal bonds. Partial exclusion was permitted for sick leave pay, annuity income (under a complicated formula) and corporate dividends (the first $50 received).

Business Deductions and Adjusted Gross Income. — In general. various expenses of gaining the income, known as business deductions. could be subtracted from gross income to determine adjusted gross income. These were of primary importance for operators of business firms, professional men operating their own practices, farmers, etc. All business and trade expenses, in the usual sense of the term, were deductible, including depreciation on capital equipment and interest on borrowed money. Depreciation deductions had to conform with regulations relating to length of life of the property and allocation formulas.

For an employee, business deductions were restricted to expenses of travel (including meals and lodging while away from home) in the services of the employer. Expenses of going to and from work were not deductible.

Nonbusiness Deductions. — From adjusted gross income the taxpayer could deduct certain personal expenses, which were designated as nonbusiness deductions. These included:

1. Contributions to religious, charitable. educational and similar organizations, up to 20% of adjusted gross income, with an additional 10% for certain types of contributions.
2. All state and local taxes paid (including sales taxes separately quoted by the vendor) with minor exceptions, such as special assessment levies. No federal taxes were deductible as nonbusiness deductions.
3. Casualty and theft losses in excess of insurance compensation.
4. Medical and dental expenses in excess of 3% of adjusted gross income, subject to certain maximums ($10,000 for a married couple. for example).
5. Interest payments, with minor exceptions.
6. Expenses for the care of children, by a woman or widower, when necessary to permit employment of the person.
7. Certain expenses related to employment, such as union dues. and expenses of certain tools, supplies, special clothing, professional journals, etc.

The taxpayer bad the option of taking the standard deduction, equal to 10% of adjusted gross income up to a maximum of $1,000, in place of itemizing deductions. About 75% of all taxpayers used this option.

Exemptions. — A taxpayer was allowed a $600 exemption for himself, for his spouse and for each dependent, as defined by law. To qualify as a dependent. the person had to have received more than half of his support from the taxpayer (with special rules when several persons provide joint support of a dependent), have received less than $600 per year gross income (except for students and persons under 19) and be related, as defined.

Tax Rates. — The tax liability was determined by applying the tax rates to the sum of taxable income, or by using the tax tables (in the case of incomes under $5,000 only). Separate rate tables were applicable to single persons, married taxpayers and unmarried heads of households, the latter receiving partial benefit of the income-splitting provisions.

As of 1956 the basic rate was 20%, applying to the first $2,000 of taxable income for a single person, and the first $4,000 for a married couple. The rate rose to 227, for the portion of income in excess of $4,000 (married couple) up to $8,000; to 26% in the third income bracket: and ultimately to 91% on the excess over $400,000. The effective rate on the entire amount of a particular taxable income was much lower than the marginal rate, which applied only to the excess of income over the previous bracket figure.

Dividend and Other Credits.—The taxpayer was entitled to a credit against the figure of tax due, of an amount equal to 4% of corporate dividends received in excess of the $50 exclusion, and for certain tax payments to foreign countries.

Withholding.—With minor exceptions, all employers were required to withhold tax on a current basis from employees' pay cheques and transmit the sums to the government. Thus when the taxpayer filed his return at the end of the year he merely paid the difference due, or received a refund if overpayment had been made. Withholding was not applied to other incomes.

Persons not covered by withholding and those subject to withholding but earning in excess of a certain sum were required to file declarations of estimated income and pay tax on a quarterly basis during the current year.

Capital Gains and Losses.—Capital gains from the sale of property held more than six months were taxable either at a flat rate of 25% or through inclusion of one-half of the gain with other income, at the option of the taxpayer. Gains on property held less than six months were fully taxable. Special provisions were made for owner-occupied residences, which in effect exempted the gain from the sale of a home if one of equivalent or greater value was purchased or built within a given time interval. Capital losses could be deducted only from capital gains or from other income in limited amounts.

The Corporation Income Tax.—The corporation income tax applied to the net profit of corporations, calculated in the usual accounting manner, apart from certain special rules relating to depreciation. Bond interest was fully deductible. Contributions to charity were deductible up to 5% of net income. No exemption was provided for small businesses. As with the personal income tax, losses incurred in one year might be carried back two years and forward five years against earnings of those years. The rate structure, as of 1956, contained a basic rate of 30%, applying to all taxable income, and a surtax of 22% on income in excess of $25,000.

Administration.— The tax is administered by the internal revenue service. Returns are filed with the office of the district director of internal revenue. All returns are subject to routine office audit, and larger returns, plus all about which there is any doubt. receive more thorough field audit. Except in cases of fraud, examination of returns is subject to a three-year statute of limitations.

General regulations are issued by the internal revenue service in amplification of the code, and rulings are issued on specific cases arising; these are summarized in the semimonthly Internal *Revenue Bulletin.* Appeals from the rulings may be taken by the taxpayer to the tax court.

State Income Taxes.—Thirty-one states imposed personal income taxes in 1956. The rates were low by comparison with the federal rates, exceeding 7% only in four states, with a top figure of 15%. Progression was usually limited, and terminated at a low figure. Business and personal deductions were similar to those of the federal tax, but exemptions were typically higher. Some of the taxes applied only to income of residents of the state, and others only to income earned in the state regardless of residence. Most states, however, combined the two bases, taxing residents on all income and nonresidents on income earned in the state. The amount of double taxation was lessened, however, by reciprocal provisions in the laws of most states.

Thirty-one states imposed corporation income taxes, as of 1956. The rates ranged from 1% to 8%, with limited progression in a few instances. Formulas have been established for the allocation of interstate income.

GREAT BRITAIN

The British income tax system in 1957 consisted of three distinct but co-ordinated elements: (1) the income tax, levied at a standard rate; (2) the surtax, applied only to incomes in excess of a certain figure; and (3) the profits tax. imposed primarily on distributed profits. In the fiscal year ending in 1955, the income tax yielded £1,893,000,000; the surtax, £135,000,000; and the profits tax, £249,000,000.

The Income Tax.—The income tax was applied not only to the income of individuals, but also, in effect. to undistributed profits of corporations. Husband and wife had to aggregate their income for tax purposes. Exclusions from income included capital gains (defined more narrowly than in the United States); benefits in kind which are not convertible into money income, as for example lodging for a servant; interest on National Savings certificates; certain armed forces benefits; and benefits under the national insurance scheme (for unemployment, sickness, etc.).

The tax was levied under five different schedules (but at uniform rates):

Schedule A: income from the ownership of real property, including the rental value of owner-occupied homes. The tax was assessed on the "net annual value," the amount at which the property is or could be rented, less repairs and other expenses. By the mid-1950s the net annual value figures had not been completely reassessed since 1936, the figures of that year generally remaining in use. Actual rentals in excess of the assessed figure are included in Schedule D income.

Schedule B: income from certain types of land, now of minor importance.

Schedule C: interest from certain government securities, collected at the source.

Schedule D: profits of trades, businesses, professions and farming; and interest. Normal accounting rules were employed in determining net income, except with respect to depreciation. Specific schedules of depreciation allowances for tax purposes were established, with, in many instances, a high allowance in the initial year, partly to compensate for rising cost of capital equipment, partly to give a direct stimulus to investment. From 1954 to 1956 the initial allowances, termed investment allowances, were granted in addition to the depreciation allowed over the subsequent years of life of the equipment, which was equal to original cost.

Schedule E: wages and salaries. Deduction of certain expenses of employees in the performance of their duties was permitted. The tax on wages and salaries was subject to the PAYE (pay-as-you-earn) system, involving current collection from the employer and deduction from the pay cheques. The system of determining the an-fount deductible was much more complicated than in the U.S. as it was designed to ensure that the exactly correct amount, instead of an approximate amount, would have been deducted by the end of the year.

Withholding was applied to other incomes where possible.

The system of personal deductions and exemptions differed substantially from that of the U.S. and Canada:

1. Relief was given for earned income (labour income) by allowing deduction of $\frac{2}{9}$ of such income, up to a maximum figure, in 1957, of £4,005, and of $\frac{1}{9}$, up to £9,945.

2. Personal allowances (exemptions), as of 1956, were: £140 for a single person. £240 for a married couple, and amounts for each child dependent on age: under 11, £100; 11–16. £125; and over 16, £150. Special rules are provided for other dependents.

3. A portion of amounts paid as life insurance premiums were deductible. No other items were deductible.

The standard rate, as of 1957, was 8*s*.6*d*. on the pound. Progression was introduced in two ways:

1. Lower incomes were taxed at rates reduced below the standard figure; as of 1956, 2*s*.3*d*. rate on the first £60, 4*s*.9*d*. on the next £1 jo and 6*s*.9*d*. on the next £150. Standard rate was applied only to the excess.

2. The surtax, technically a separate tax, applied to all income in excess of £2,000. The combined normal and surtax rates reached, in 1956, the maximum figure of 18*s*.6*d*. on income in excess of 615,000.

With relatively low exemptions and a standard rate of nearly 50%, the tax burden on the typical wage earner was very much heavier than that in the United States. While the maximum rates were not fundamentally different from those in the U.S., they were reached at a much lower income level, and were thus much more significant.

Corporations were subject to the standard income tax rate on their entire income, but the portion on dividends paid was sub-

tracted from the dividend and was treated by the stockholder as prepayment or withholding of tax on the dividend, in the same manner as withholding of tax on wages. There mas. therefore, no double taxation of dividend income by the income tax.

Profits Tax. — Distinct from the income tax was the profits tax, applied only to corporations. The tax was applied to net profit, after deduction of bond interest, in the same manner as the income tax. Companies with incomes of less than £2,000 a year were exempt, and a reduction in tax was provided for those with income between £2,000 and £12,000. The standard rate was 27½% on distributed profits and 2½% on undistributed profits (the latter being taxed at the low figure because it was subject to the income tax). The profits tax created an element of double taxation of dividend income.

CANADA

The Canadian income tax system has been influenced by both the U.S. and British taxes, although in general structure it resembles the former more than the latter.

The Personal Income **Tax.**—The tax in 1956 was applied to income from all sources, excluding capital gains (more narrowly defined than in the U.S.), armed forces pay (subject to separate assessment), most veterans' benefits, gifts and bequests, life insurance proceeds at death, casualty insurance proceeds, unemployment benefits, family allowances and. in part, annuities.

Net income was determined by deducting the expenses of gaining the income: for business firms and the professions, usual business expenses, including depreciation on a prescribed basis (the diminishing balance system); for employees, expenses involved in travel away from home in connection with employment, and union dues. Contributions by both employees and employers into approved pension systems were deductible.

Taxable income was obtained by subtracting from net income the following deductions: contributions (up to 10% of net income); medical expenses (in excess of 3% of net income); personal exemptions of $1,000 each for taxpayer and for spouse. $400 for each dependent over 16 and $150 for each dependent under 16 (the lower figure offsetting the exclusion of family allowances from taxable income).

Joint returns might be filed if the wife earned less than $1,000; if she earned more, she was required to file a separate return. No splitting of income for tax purposes was permitted.

The rate on the first $1,000 of taxable income in 1956 was 13%, and on the second $1,000, 15%. The marginal rate reached 33% at $10,000, 52% at $30,000 and a maximum of 78% on income in excess of $400,000. An additional 4% tax was applied to investment income in excess of $2,500 and an additional 2% tax on all income up to $3,000 for social security purposes.

A credit of 20% of the amount of the dividends received from Canadian corporations was deductible in determining tax due. and thus double taxation of dividend income was greatly reduced.

Tax on wage and salary income was collected through a withholding system.

Corporation Income Tax. — The dominion corporation income tax was very similar to the United States tax, applying to the entire net profit of the corporation whether distributed or not. The basic rate in 1956 was 20% on the first $20,000 of net income, with a combined rate of 49% (including 2% for social security purposes) applying to the portion in excess of $20,000.

OTHER COUNTRIES

Australia. — Income taxation in Australia was employed only by the commonwealth government. The concept of income was basically the same as in the U.S., except that capital gains were not taxable. Usual business deductions were permitted, as well as certain personal expenses, including those for medical care, gifts to charities but not churches. insurance premiums and tuition fees. Special deductions were permitted for persons living in high cost areas. These as well as deductions for dependents, took the form of deductions from tax rather than from income, and thus did not reduce the tax rate class into which the income fell. The allowance in 1956 was £A130 for a married couple, LA78 for the first child under 16 and LA52 for subsequent children. No income splitting was permitted. Property income was taxed more severely than other income.

The rate structure was highly progressive, by a formula system which eliminated wide brackets. The initial rate was only 1*d* in the pound. but the maximum rate of 13*s*.4*d*. was reached at the income level of £A16,000. Collection by withholding was employed.

Corporate income was subject to a tax on net profit, with a slight degree of progression; the principal rate was 35%. Small corporations were taxed as though they were partnerships. There was no mitigation of double taxation of dividends.

New Zealand. — The New Zealand income tax applied to income defined in the usual manner, excluding capital gains and excluding dividends, which were, however, taken into consideration in determining the tax rate applicable. Dividends themselves were taxed only at the corporate level. Usual business deductions were permitted, but personal deductions were limited to a very few items. Exemptions of £N.Z.375 for a single person, £N.Z.500 for a married couple and £N.Z.75 for other dependents were allowed in 1956. Rates were progressive; in 1956 they commenced at 3*s*. on the first £N.Z.100 of taxable income and rose to 12*s*. on income in excess of £N.Z.4,000. In some years flat rebates independent of the amount of tax paid, where the amount equaled the rebate, were given. Corporations were taxed on their entire incomes, at somewhat progressive rates.

South Africa. — The Union income tax was a two-stage tax, with a normal tax rate which commenced at 6¼% and a supertax at 10%, both rates being progressive. The rate was higher for unmarried persons, commencing at 7¼% instead of 6¼%. Incomes of husband and wife were aggregated. **A** system of rebates from calculated normal tax was provided, with a greater sum for married than for single persons. and a figure for each minor child (whether supported or not) four times that for other dependents.

The provinces also levied income taxes, in the form of percentage additions to the Union tax.

France. — The personal income tax system was twofold. A uniform 18% tax applied to all types of income (replacing a schedular tax applied at different rates to various forms of income. imposed prior to 1948). and a surtax with progressive rates applied to higher incomes (to only about 2,000,000 taxpayers out of 30,000,000). With both taxes, low incomes were excluded, and exemptions were allowed for dependents. Earned income and income of farmers, craftsmen and some other groups received special treatment. From 1948 the proportional tax on workers' income was payable by the employer (as a flat 5% of his payroll) and not deductible from wages. A vanishing exemption (applicable only to income below a certain figure) was provided, and the tax itself reduced according to the number of children. Income splitting was provided not only between husband and wife, but between parents and children as well. Small business firms and farmers were, in effect. taxed upon an estimated profit figure rather than a calculated figure of profits.

The corporation income tax, introduced in 1948, applied to all corporate profits; the rate in 1956 was 38%. A partnership had the option of being treated as a corporation.

Italy. — The Italian income tax system consisted of two parts, a proportional schedular tax on various forms of income, and a progressive tax on total income. The schedular tax was imposed at different rates on various forms of income. Three flat-rate taxes applied, respectively, to income from land, from buildings and from other sources. The third group was classified into three categories. investment income, profits from operation of business and wage and salary income. The wage income mas treated most leniently, from the standpoint of both rates and exemptions. These taxes applied to both individuals and corporations.

In addition to these proportional taxes, a complementary personal income tax was imposed at progressive rates. Personal exemptions were provided. The yield of this tax was limited.

Only after 1951 were all taxpayers required to file a return on an annual basis; prior to that time tax was paid primarily on the basis of estimates.

West Germany.— Technically the income taxes in nest Germany were imposed by the *Lander,* although the federal government shared in the revenue, and the taxes were uniform throughout the republic. The personal income tax resembled that of the United States. being imposed on all income regardless of source. the rate being the same on all types of income. The tax rate was sharply progressive, to a maximum figure of 95%. Exemptions were provided for dependents.

A corporation income tax was imposed on the net profit of all corporations, at a proportional rate (50% to 60% after 1950). Reduced rates mere applied to certain types of businesses.

Others.—Belgium imposed schedular taxes on various types of income, at different rates. There were three such levies: on income from land and buildings; on interest and dividends; and on labour income. There were two supplementary taxes, the first on both individuals and corporations, at a progressive rate, nith exemptions similar to those of the tax on labour income; the second a steeply graduated tax on personal incomes only.

In the Netherlands, special income taxes were imposed on wages and dividend payments, which constituted credits against basic income tax liability, and thus constituted a form of withholding. A basic tax at progressive rates applied to all income. Exemptions were provided for dependents. An income tax on all business establishments was imposed for local tax purposes. and a corporation income tax was applied to all corporate profits.

Personal and corporate income taxes were major revenue sources in the Scandinavian countries. In some instances local income taxes were levied as supplements to the national tax. In Snitzerland the primary income tax was that imposed by the cantons, but from 1940 the confederation imposed a tax, at progressive rates, uniform on all types of personal Income.

BIBLIOGRAPHY.—United States Internal Revenue Service, *Your Federal Income Tax* (annual), J. P Crockett, *The Federal Tax System of the United States* (New York, London, 1955); Prentice-Hall, Inc., *Federal Tax Service* (annual); Commerce Clearing House, *Federal Taxes* (annual).

Great Britain: Central Office of Information, *The British System of Taxation* (1956); Reports of the Royal Commission on the Taxation of Profits and Income, i (1953), ii (1954), iii (1955); Ronald Staples *"Taxation" Key to Income Tax and Surtax* (annual).

Canada: J. H. Perry, *Taxation in Canada,* 2nd ed. (Toronto, London, 1954); CCH Canadian, Ltd., *Canadian Master Tax Guide* (annual). Australia and New Zealand: F. R. Irwin, "Prrsonal Income Tas—Australia and New Zealand," *Canadian Tax Journal* (1953); J. A. L. Gunn and R. E. O'Neill, *Guide to Commonwealth Income Tax,* 7th ed. (Sydney, 1955); C. A. Staples, *A Guide to New Zealand Income Tax Practice* (annual). Other countries: Sweden: K. G. A. Sandstrom, *A Survey of Swedish Taxes on Income and Capital* (1954); Germany: F. W. Neumark, *Theorie und Praxis der modernen Einkommenbesteuerung* (1948); France: H. Laufenberger, *Economie du système fiscal français national et local* (1954); Belgium: *Banque de la Société Générale de Belgique, Impôts Directs* (1952).

The volumes published periodically by the French Ministry of Finance (Ministère des Finances), entitled *Statistiques et Etudes Financières,* contain surveys of the income taxes of a number of countries. The 1951 issue includes west Germany, Belgium and Switzerland; 1952, Italy and the Netherlands; and 1953, France and Spain.

ECONOMICS

THE ROLE OF THE INCOME TAX IN THE TAX STRUCTURE

The role of the income tax in the tax structure and the effects which it has upon the economy have become questions of major significance, as the tax has grown in importance.

Income taxes have been introduced primarily to raise revenue in a manner which conforms most closely with the ability-to-pay doctrine of taxation. Typically in the literature of public finance, and in less explicit form in popular thinking and discussions of legislative bodies. the principle that persons should pay tax on the basis of their ability is widely accepted. In turn, net income. after certain adjustments, is regarded as the best measure of ability, since it is the principal determinant of a person's economic well-being—the level of consumption and savings which he can enjoy. Adjustments can be made in net income in determining taxable income to reflect certain circumstances, such as size of the family, which influence the standard of living which the family can enjoy from a given net income.

The importance of income taxation is also due in part to the fact that the burden of such taxes can be made progressive relative to income. There is wide acceptance of the principle that taxpaying ability rises faster than income, and thus that persons with high incomes should pay not merely more taxes, but a higher percentage of their income in taxes, than persons with lower incomes. Only by a direct tax on income can this result be accomplished readily. Closely related has been the goal of lessening inequality of real income. Under the philosophy that income distribution tends to be excessively unequal relative to the standards regarded by society as desirable, the income tax has been regarded as an effective instrument of producing greater equality.

The willingness of countries to employ the income tax has been greatly increased by its high revenue yield (under favourable circumstances) and by the belief that such a tax does not seriously affect economic behaviour and thus does not significantly reduce total national product or alter its composition to the detriment of the welfare of society. This belief is not necessarily entirely valid, as noted in a subsequent section.

Objections to Income Taxation.— Acceptance of the principle of income taxation is by no means universal. Most of the attack upon the tax centres upon the use of progressive rates, rather than upon the principle of taxation of income as such. It is charged that there can be no possible scientific standards for determining the desirable degree of progression. Thus, progression tends to become excessive and seriously weakens the incentives of persons to work, to take more responsible positions, to develop and expand businesses. to invest in securities. etc.

In part, however, the attack is made against the income basis itself. It is maintained that administration of an income tax is inherently difficult because of the impossibility of checking reported figures of earnings and deductions. As a consequence, it is charged, substantial evasion results and great incentive is given for dishonesty. This argument receives particular emphasis in countries in which record keeping, accounting methods and standards of administration are not highly developed, and has been a major factor discouraging such countries from using income taxes of any magnitude.

The income basis is also condemned on the grounds that its use results in double taxation of the portion of income saved, since both the savings and the earnings from them are taxed, to the detriment of capital formation and economic development. This argument is regarded as spurious by defenders of the tax.

Finally, it is charged that excessive reliance on income taxation tends to penalize persons who have not yet accumulated wealth, compared with those who have.

PROBLEMS RELATING TO THE STRUCTURE OF AN INCOME TAX

If a particular income tax is to meet the threefold requirements, under generally accepted standards, of (1) equity relative to ability to pay, (2) avoidance of adverse effects on the economy and (3) administrative feasibility, certain problems must be solved in the establishment of the tax. These can be summarized briefly:

Definition of Income.— In principle, income, as a measure of economic well-being, can most appropriately be defined as the sum of (1) the person's consumption during the period, plus (2) the net increase in the person's wealth. The second item may, of course, be a negative figure. It is this sum which constitutes the gain obtained by the person from economic activity during the period. But the difficulties of calculating these two magnitudes and of taxing persons on unrealized increases in wealth have led in practice to a different approach to the definition. Income is usually defined or described, therefore, in terms of the flow of wealth to the person during the period.

There are two important consequences of the use of the flow definition. In the first place, in the U.S. persons are usually not taxed on the value of income arising in cases in which no market transaction is involved, as, for example, the gain from the use of durable consumption goods previously acquired, the rental value of their own homes: etc. As a consequence, persons are given some artificial tax incentives to buy homes instead of renting them,

to perform tasks for themselves instead of working for money income and paying others for the work, etc.

In the second place. the definition of income as flow during the period results in the taxation of capital gains — increases in the value of assets held--only when the gains are realized when the property is sold, instead of uhen they accrue. Since taxation at progressive rates in the year of realization of the gain would, in some instances, be inequitable, special favourable treatment is usually provided for capital gains, compared with that given other income. The recurrent flow concept of income has led Great Britain and most British Commonwealth nations to exclude capital gains from taxable income completely. In countries in which the gains are partially taxable there has been constant demand for complete exemption, partly on the basis of the argument that such a policy would stimulate investment.

The favourable treatment or complete exemption of capital gains has provided great incentive to taxpayers to convert other income into the form of capital gains whenever possible; this in turn has led to progressive narrowing of the definition of such gains for tax purposes.

Specific Exclusion of Certain Types of Income. — There is a strong presumption in favour of taxing all income regardless of the source, to avoid inequities and administrative problems in delineating various types of income. But arguments can be advanced for excluding certain types on grounds of general economic or social policy, or to avoid administrative complications. Bequests and gifts, for example, are universally excluded, because of their irregularity and consequent tax penalty under progressive rates, and the significance for taxpaying ability of the relationship of the donee to the donor. Small gifts are difficult to check. Pay to persons in the armed forces and veterans' benefits are often excluded on grounds of general governmental policy. Incomes from some types of economic activity may be excluded in order to stimulate the conduct of such activity.

Business v. Personal Expenses. — If an income tax is to rest upon net income, provision must be made for deduction of those expenses involved in gaining the income, generally known as business expenses. But even as a matter of principle it is difficult to distinguish precisely betueen such expenses and those for personal consumption purposes, and it is even more difficult to ensure correct application of the rules which are established. The greatest problems of principle arise in cases in which purchases are made for both business and consumption use (purchase of a car by a farmer or doctor) and with expenditures for education. Typically income tax laws have not recognized the latter as expenses of gaining the income, to the possible detriment of the maintenance of the supply of labour in fields requiring extensive training. Apart from the matter of principle is the very serious problem of preventing taxpayers from listing personal expenses as business expenses.

Time-Period Problems. — Income is essentially a more or less continuous stream through the years in which a person is earning a livelihood. But for tax purposes the stream must be segmented into periods, usually annual ones. Thus rules must be established to control the allocation of income and expenditures to particular periods. The item which has given rise to greatest time-period assignment difficulties has been depreciation charges on capital equipment. Typically, businesses are not permitted to charge capital purchases as current expenses for tax purposes. but are permitted to depreciate the purchase price over a period of time. Governments have set up rather arbitrary rules relating to such allocation. with consequent problems of interpretation and complaints from business firms.

The depreciation question has been complicated in the mid-20th century by the sharp rise in the cost of capital equipment for replacement purposes. Demands that depreciation be permitted on the basis of replacement cost rather than the original cost of the equipment have been denied in most instances, although some countries have made special provisions to ease the problem for the firms created by higher replacement cost.

Because of the use of exemptions and progressive rates. the segmentation of the income stream results in an inequitable burden on those persons whose incomes fluctuate sharply from year to year. Over a ten-year period a person who earns a uniform $10,000 per year will pay much less tax than a person who earns $100,000 in one year and nothing in the other nine years. This penalty can be avoided by a system which allows the averaging of income over a period of years. But except in limited instances, as, for example, with capital gains, with business losses (which typically may be carried forward or backward against business profits of other years) and with incomes of certain specified occupations (farmers and fishermen in Canada, for example), governments have been reluctant to permit averaging because of the added administrative complications.

Personal Deductions and Exemptions. — It is generally recognized that the suitability of income as a measure of taxpaying capacity can be improved by adjusting the figure in terms of certain circumstances nhich affect the standard of living which can be attained with a given money income.

The most important adjustment permitted is that for dependents, including the taxpayer himself. This allowance serves two primary functions: families with very low incomes are excluded completely from the tax; and the height of the tax on other families is adjusted in terms of the family size.

The exemption may be a flat amount per dependent, or adjusted according to the dependent's status, a larger sum often being given for the taxpayer and spouse than for others. In theory the amount of the exemption should be based upon an estimate of the sum necessary for a minimum living standard, but in practice it has been dictated by revenue expediency.

It is obvious that certain types of expenditures, such as those for medical care, directly reduce tax capacity, and many countries have authorized deductions for items of this type, as noted in previous sections. But the fear of eroding the tax base and opening avenues for evasion has tended to minimize the granting of such deductions.

The Taxpaying Unit. — A question of major importance is that of the taxpaying unit. The unit may be each individual separately, the husband and wife, or the entire family, including children. The treatment of each individual as a separate taxpayer ignores the basic nature of the family as a spending unit. In practice, husband and wife are usually permitted or required to file joint returns. A requirement for pooling of the income of the husband and wife has the unfortunate effect of causing marriage to increase total tax liability if both partners are earning substantial incomes.

An alternative. of allowing the division of income between husband and wife for tax purposes regardless of who earns it, as permitted in the United States, is the most equitable in many ways, but it does place a heavy tax premium on marriage. The usual practice of treating children merely as dependents encourages the splitting of property income with the children; only France has sought to meet this problem by treating children as partial partners in the entire family income.

The Problem of Corporation Income. — One of the most controversial aspects of developing a satisfactory income tax structure is the treatment of income earned by corporations. If only individual persons are subject to tax, the portion of corporate income not paid out as dividends is not subject to current income tax. To prevent this, special levies on corporations are typically employed. In some instances. particularly in Great Britain in the past, these have been regarded purely and simply as devices to reach the undistributed profits. But in many countries, and particularly in the U.S., the taxes on corporation income have gone far beyond merely reaching the undistributed profits, and have applied to all corporation net income, uhether held or distributed. The effect is to place a double burden on corporate income paid out as dividends, so long as the initial tax burden rests on the corporations and is not passed on to their customers in the form of higher prices. This policy has been in part based upon the idea that the corporation as such, as a separate legal entity, is a suitable object for taxation, independently of any tax on the stockholders, and in part on the fact that such a tax raises a large amount of revenue with relatively little complaint and is

perhaps less objectionable than most alternative sources. Since 1945, however. several countries. including the U.S. and Canada, have taken partial steps in the direction of lessening the double burden on dividends, typically by reducing the net impact of the personal income tax on dividends. An alternate approach. under which the corporate tax would be limited to the portion of profits held in the company. has not met with favour, although it has important merits.

ECONOMIC SIGNIFICANCE

There are three primary aspects of the economic significance of the income tax: the incidence. or pattern of distribution of burden; the effects on economic development; and the significance of the tax for fiscal policy.

The Distribution of the Income Tax Burden. — It has been traditionally assumed that the burden of an income tax rests upon the persons upon whom it is levied. So far as wages and other individual incomes are concerned, it is argued that the tax does not enable the persons to obtain higher incomes than they would otherwise receive, because the tax does not affect the supply of or demand for the particular goods or services used in production. With respect to business firms, it is assumed that the tax will not lead to a change in supply or price, since the reduction of the net earnings by a given percentage will not alter the levels of output and price which allow the firm to make the most profit.

In the mid-20th century these assumptions have been questioned. When labour unions develop in an industry, the income tax may be a factor leading them to demand and obtain higher wages than otherwise. and thus a portion of the tax burden will be shifted off of their members. Likewise. particularly in view of the fact that the income tax applies to all net profit and not merely to excess profit, business firms may in fact shift at least a portion of the income tax imposed upon them. Especially in nonpurely competitive markets, the tax may serve as a stimulus to movement closer to the price which mould allow the maximum profits for the firms as a group, but was not previously obtainable, given the relationships among the firms. Others have argued that the tax will reduce the volume of investment and thus the output of goods by lowering the net return on capital, and cause shifting of the burden.

The state of knowledge in the mid-1950s did not permit any exact statement of the extent of the shifting, but it was obvious that the traditional assumptions were too restricted. To the extent that shifting of the tax does occur, obviously the distribution of burden of the tax will differ from that which is intended.

The Effects on Economic Development. — Particular emphasis was given after 1940 to the possible adverse effects of the income tax on the level of national product and the rate of economic development. There are several aspects of this question:

1. Effect on the supply of labour. It has commonly been charged, especially during and after World War II, that the income tax tends to reduce the total supply of labour-hours available and, particularly, the supply of highly trained executives, professional men. etc. It is argued that the tax lessens persons' willingness to work because the government takes an increasing percentage of their incomes as they earn more. The tax may discourage overtime work: and encourage absenteeism and the taking of longer vacations. The tax may make persons unwilling to undertake the training necessary for more skilled jobs and to accept more responsible positions, by reducing the net financial gain.

While isolated illustrations can be found to demonstrate these effects, and wartime tax rates apparently had a noticeable effect on overtime work and absenteeism in some instances, there was little evidence in the mid-1950s that income taxes were significantly reducing the labour supply, even at the higher income levels. Increased income taxes will cause some persons to work more rather than less to maintain old levels of living, particularly if the basic rate, rather than the marginal rates, is raised. Other motives besides purely financial gain obviously play a major role in encouraging persons to take more responsible jobs.

2. Effects upon investment and economic development. The income tax has been charged with retarding business development and investment. The tax lessens the supply of money capital in the hands of individuals and may reduce their willingness to invest in business; it curtails the amounts of money which the firms themselves have for expansion and their willingness to undertake the risks of loss.

Despite many complaints about these effects. business expansion progressed at an extremely rapid rate in most countries after 1945; the deterring effects of the taxes were much less obvious than might be expected. In part, the taxes merely operated in the same manner as restrictive credit policy, holding expansion down to levels permitted by availability of resources. In part, as demonstrated by several studies of the question, the favourable tax treatment of capital gains reduced the adverse effects of the high tax rates by shifting some investors from other outlets to those involving the financing of business expansion by purchase of common stock. However, over a period of time, the restrictive effect of high personal and corporate taxes on investment might become much more marked.

The Income Tax and Fiscal Policy. — From the standpoint of fiscal policy, that is, the attempt to gain greater economic stability by adjustment of government revenues and expenditures, the income tax has an important advantage. Because of its exemptions and progressive rates, its yield tends to fall drastically in depressions and rise more rapidly than the national income in inflationary periods. Thus, it cushions the fall of purchasing power and spending in depressions and curtails them in inflationary periods. This instability in yield, however, appears as a definite disadvantage to those persons who believe that any use of fiscal policy is unwise and that the budget should be balanced at all times. It is also a disadvantage to subordinate units of government, such as states and cities, which often have limited borrowing capacities and are not in a position to conduct deliberate fiscal policy. If the income tax does seriously retard investment, it would aggravate the problem of maintaining long-range full employment.

BIBLIOGRAPHY. — O.H. Brownlee and E. D. Allen, *Econonzics of Public Finance,* 2nd ed. (New York, 1954); William Vickrey, *Agenda for Progressive Taxation* (New York, 1947); H. C. Simons. *Personal Income Taxation* (Chicago, Cambridge! 1938); N. Kaldor, *An Expenditure Tax* (London, 195j; New York, 1956); Richard Goode, *The Corporation Income Tan:* (Kew York, London, 1951); D. Black, *The Incidence of Income Taxes* (London, 1939; Kew York, 1940); J. K. Butters, L. E. Thompson and L. L. Bollinger, *Effects of Taxation: Investment by Individuals* (Boston, London, 1953); L. H. Seltzer, *The Nature and Tax Treatnzent of Capital Gains* (New York, 1951). (J. F. D.)

INCONVERTIBLE PAPER CURRENCY: *see* BANKING; MONEY.

INCORPORATION, in law, the embodying or formation of a legal corporation, brought about either by a general rule contained in such laws (*e.g.,* as the Companies acts) or by a special act of sovereign power (*e.g.,* an incorporating statute or charter). The word is used also in the sense of uniting; *e.g.,* a mill may incorporate by reference other papers, which may be then taken as part of the will as much as if they were set out at length in it. This term is used similarly in the U.S. and Great Britain.

INCREASING RETURNS. In economics, a term used to describe a condition of production in which the application to land of additional capital and labour produces a greater proportionate return. This phenomenon is especially common in the fields of transportation, mining, manufacturing and electrical generation. For example, the investment of $5,000 in capital and labour to develop a power site at a waterfall might result in a net loss to the investor; a $50,000 investment might bring in revenue sufficient to cover costs but yield no net profit; while an investment of $500,000 might yield a net return of 10% per year.

In agriculture, the tendency for returns per unit of investment to grow as investment per acre increases disappears as cultivation grows intensive. (See DIMINISHING RETURNS; ECONOMICS.)

INCREMENT VALUE DUTY. A duty called by this name was first imposed by the parliament of the United Kingdom in 1910, the tax being one of the highly controversial measures contained in the Finance act, 1909–10. The rate of duty was £1 for every complete £5 of the "increment value" of any land accruing (a) on a sale, or on a lease (other than a mining lease, and other

than a lease for a term not exceeding 14 years); (b) on a succession on the death of the owner; (c) on a valuation made every 1 jth year in the case of land held by permanent corporations. Increment value was defined as the amount by which the site value of the land as defined in the act should exceed the original site value as ascertained under the provisions of the act as to valuation. The administration of the tax was entrusted to the commissioners of inland revenue, who were directed "as soon as may be after the passing of the act" to cause a valuation to be made of all land in the United Kingdom, showing (a) the "site value," and (b) the total value of the land. The "site value" was to be the value of the land exclusive of buildings and other improvements, which were taken into account in estimating the total value. The "original site value" was the value of the land without improvements on April **30,** 1909. The duty was not imposed in respect to agricultural land while the land had no higher value than its market value for agricultural purposes; or in respect to houses of a limited annual value when occupied by the owner; or in the case of agricultural land not exceeding 50 ac. in area and £75 per acre in value, when cultivated by the owner. One-half of the proceeds of the duty was appropriated for the benefit of local authorities in the United Kingdom in such manner as parliament might determine. The increment value duty did not fulfil the hopes of the promoters of the legislation, and was, together with the other land values duties, *i.e.*, the reversion duty and the undeveloped land duty, repealed by section 57 of the Finance act, 1920.

(See also LAND TAXES; UNEARNED INCREMENT.)

(J. S. S.)

INCUBATORS. Boxes or rooms of special construction designed for the maintenance of a constant internal temperature. usually blood heat or above room temperature. Common uses of such contrivances are in bacteriology, in the poultry industry and for the rearing of prematurely-born infants.

BACTERIOLOGICAL INCUBATORS

An incubator uhich will remain with 0.5° C. (.9° F.) of the adjusted temperature gives sufficiently accurate heat regulation for all ordinary bacteriological purposes. Bacteriological incubators, unlike bird incubators, do not require a continuous circulation of air, nor is it necessary to provide any arrangement to moisten the contained air. The type in ordinary use is in the form of a rectangular box fitted with a double door in front and surrounded on all the other sides by insulated walls; one or more shelves are fitted for the accommodation of flasks, racks of tubes, culture dishes, etc.

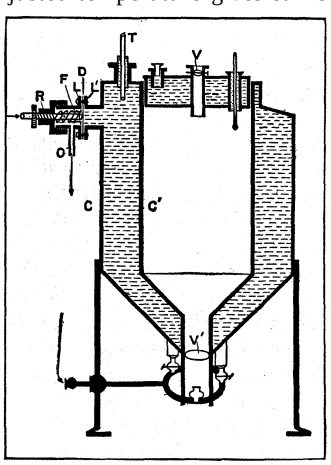
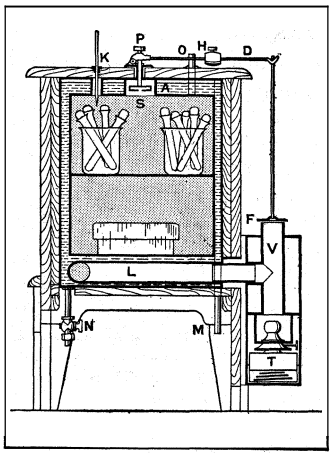


FIG. 1.— D'ARSONVAL INCUBATOR

D'Arsonval Incubator.— Some of the older incubatorswere cylindrical in form, that of Arsène d'Arsonval being the best known. This apparatus (fig. 1) consisted essentially of a cylindrical water jacketed chamber c. The water jacket was heated by gas and there was a gas regulator controlled by the expansion of the water in the jacket. The water expanding by heat rose in the tube T; this increased head of pressure acted upon a rubber diaphragm D which was forced outward thus obstructing the gas flow into the regulator. A great disadvantage of the cylindrical incubator was its inconvenient shape; there was also difficulty of access to the contents as compared with the modern types.

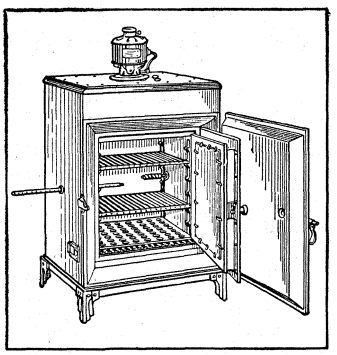
Hearson Incubators.— In the models heated by an oil lamp, or by gas, the incubation chamber is surrounded by a water tank (fig. 2, A) and the lowest part of this is traversed by an in-going (L) and an out-going flue. The mode of regulation of the temperature is by means of a thermostatic capsule which operates the movements of a cap (F) over the main flue (V), and it is identical in its chief features with the method employed in the chicken incubator. The capsule (S) is situated in the upper part of the incubation chamber. When gas is used for heating the incubator, the regulator controls the flow of gas to the burner rather than the heated air.

Electricity replaced these forms of heat early in the 20th century, except in rural regions lacking a power station. With electricity there is less fire hazard, the controlling mechanism is less elaborate and the variation in temperature within the incubator may be held within narrow limits. The electric incubators (fig. *3*) usually have no water tanks in the walls, but have improved insulation.



BY COURTESY OF HEARSON & CO.

FIG. 2.— HEARSON'S BACTERIOLOGICAL INCUBATOR (HEATED BY A PETROLEUM LAMP)



COURTESY OF CENTRAL SCIENTIFIC CO.

FIG. 3.— DEKHOTINSKY INCUBATOR (WITH AIR CIRCULATION AND HEATED BY ELECTRICITY)

An inner glass door permits examining the contents of the incubator without opening the chamber, and the outer door is double and insulated like the walls. An electric motor placed on top of the incubator drives a fan for circulating the air within the incubator and prevents variation of the temperature at different parts of the chamber.

Pathogenic, or disease producing bacteria are usually kept at blood heat (37° C.; 98.6" *F.).* Fungi and protozoa may be grown at temperatures from 18° to 30° C. (62° to 86° F.). In many parts of the world the temperature of the hot season exceeds these values and means must be provided for cooling the incubator in order to maintain a constant temperature.

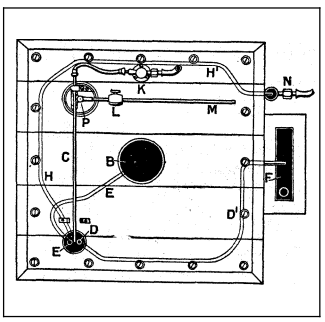


FIG. 4.— HEARSON'S COOL BIOLOGICAL INCUBATOR

Hearson, however, constructed a "cool biological incubator," in which by an ingenious device the expansion or contraction of the thermostatic capsule deflects a horizontal pipe (C) on the roof (fig. 4), through which runs cold water from an ordinary tap, in one of two directions. If it is deflected so as to open into the tube (D), the cold water passes into the tank (F), where it is warmed by a gas flame, and thence it passes into the water jacket of the incubator. If it is deflected so as to open into the pipe (E), it then runs through the ice tank (B), containing broken ice, before passing through the water jacket of the incubator. If it pours into neither of these pipes it then simply passes out through the pipe (H) to the waste pipe (N). By this device the temperature of the incubator can be kept constant at any desired point, even though it may be about 30° to 40° C. (54° to 72° F.) below that of the external air. A refrigerating unit may be used in place of ice for cooling the circulating fluids, or coils containing the refrigerant may be built into the walls of the incubator.

Incubator **Rooms.**—When large numbers of cultures must be used, it is often preferable to insulate the walls of a small room, or suite of rooms, and maintain the entire room and its contents

at a given temperature. Shelves or racks are used to support the cultures. The heat may be supplied by electric heaters, steam or hot water. In warm climates the room may also have pipes for circulating cold water, or other refrigerant, to hold the desired temperature when the outside temperature may be higher. Means to provide a constant humidity, by evaporating or absorbing water vapour in the room may also be provided.

INFANT INCUBATORS

Tarnier's Incubator. — The first incubator for rearing children who are too weak to survive under normal conditions, or who are prematurely born, was that of Dr. E. S. Tarnier. It was constructed in 1880 and was first used at the Paris Maternity Hospital. Its form is that of a rectangular box measuring 6 j × 30 × 50 centimetres (fig. 5). It is divided into an upper and lower chamber; the former contains the infant, while the latter serves as a heating chamber, and in reality is simply a modified water tank. The partition (P) which divides the incubator into two chambers does not extend the whole length of it, so that the upper and lower chambers are in communication with each other at one end of the apparatus. It is through this passage that the heated air from the lower chamber passes into the upper one containing the infant. The narrow bottom chamber (C) serves to prevent loss of heat from the base of the water bottles. The outside air is admitted into the lower chamber at the opposite end, through an aperture (A). and passing over a series of bottles (B) containing warm water, becomes heated. The air is rendered adequately moist by means of a wetted sponge (S) which is placed at the entrance of the lower chamber into the upper. The warmed and moistened air is determined in its direction by the position of the outlet aperture (0), which is situated above and just behind the head of the infant. It contains a helix valve (H) and the rotation of this is an indication that the air is circulating within the incubator.

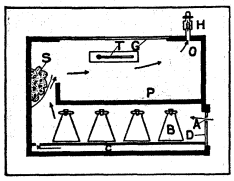


FIG. 5.—TARNIER'S INCUBATOR

The child is kept under observation by means of a sliding glass door (G) situated in the upper or roof wall of the incubator. Immediately beneath this, and attached to one of the side walls, is a thermometer (T) which records the temperature of the air in the infant chamber; the temperature to be determined by the condition of the child; the smaller and weaker it is, the higher the temperature must be.

Hearson's Thermostatic Nurse. — This consists fundamentally of an application of the arrangements for heating and moistening the air and for regulating the temperature of Hearson's chick incubator to Dr. Tarnier's human incubator. As in this latter form, there are two chambers (fig. 6), an upper (A) and a lower (B), connected with each other in the same way as in Tarnier's apparatus The upper chamber contains the infant, but the lomer is not a heating but a moistening chamber. The external air- passes through apertures in the bottom chamber (M), through the inner cylinder of the water tray (O) and through a sheet of wet canvas to the chamber proper. A basket with perforated walls rests on supports (D). The infant is placed in the basket and may be observed through a glass door in the top of the incubator.

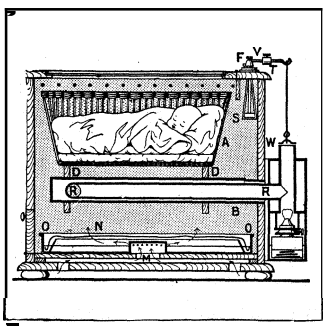


FIG. SONS "THERMOSTATIC

As in bacteriological incubators, electricity has displaced other forms of heat and in addition the humidity is regulated automatically by a humidistat which may be preset to any desired humidity. This is important, as very premature infants require a higher relative humidity than do those born nearly at term. It is desirable to reduce the humidity gradually to that of the nursery before the infant is removed from the incubator. Premature infants of six and one-half months have been reared successfully in the Humidicrib (fig. 7). Such infants usually are kept in the incubator for two to three months at 27° to 37° C. (80° to 98° F.).

The top of the Humidicrib may be raised when the infant is put in the incubator. The sliding panels permit access for ordinary care. An opening is provided in the left side to admit oxygen should the condition of the infant require it. A switch provides light for temporary observation. The main switch and controls for temperature and relative humidity are located on the right end, as well as a door to give access to the automatic heating and humidifying equipment. Air filters at the lower front and in back, provide fresh air and are removable for cleaning. The crib is entirely automatic except for filling the water reservoir.

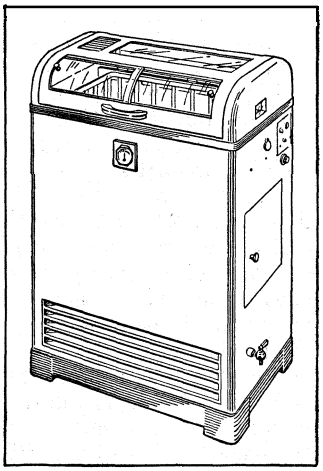


FIG. 7.—HUMIDICRIB WITH AUTOMATICALLY CONTROLLED HUMIDITY AND TEMPERATURE

FUNDAMENTALS OF DESIGN

While many organisms that require a constant temperature environment are kept in bacteriological incubators, experiments to determine the effect of changing temperature on the rate of life processes, such as growth, must be made with more exact and flexible control of the temperature.

Types.—Incubators in general use are water or air baths. The temperature of a large water bath is disturbed less when the cultures are changed, because of the high latent heat capacity of the water. The culture containers may be placed directly in the bath, or in an air chamber near the centre of the bath. Some form of water circulator, or stirrer. is essential.

Most incubators are air baths (fig. 3). When a variation of one or two degrees within the different parts of the incubator is unimportant, no circulation of air is needed. Better uniformity may be obtained with a gravity air circulation by means of adjustable openings at the top and bottom of the incubator. Circulating the air with an electric fan establishes a more uniform temperature in the incubator. Water jacketed incubators (fig. 1) are, in a sense, intermediate between the air and water bath types. When made in the more convenient rectangular shape, the temperature is held well and any cooling from opening the box is quickly replaced by the heat in the walls The water evaporation must be replaced, and the boxes are heavy. Improved wall construction has largely displaced this type of incubator.

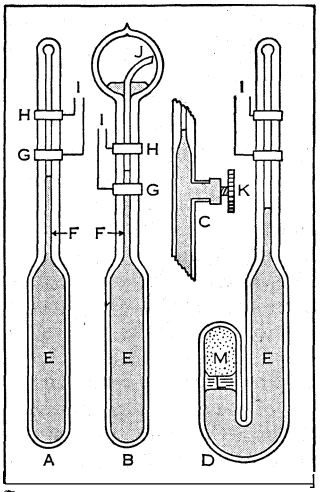


FIG. 8.—MERCURY THERMOREGULATORS

Insulating Materials. — The most elementary incubators are made with a single wall of wood, fibreboard or hardened asbestos board. The high rate of heat flow through the walls precludes close control of the temperature. To obtain better insulation the wall and door usually have an air space between two supports and the air space may be filled with cork, asbestos or glass fibre, glass foam or other insulating material.

Thermal Exchange. — An object warmer than its surroundings looses heat at a rate depending on the extent of the difference. To keep the incubator at a constant temperature above its surroundings, heat must be added to the incubator. Or. if the box is to be kept cooler than the room, heat must be taken away from

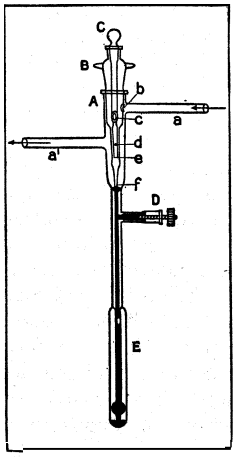
It as fast as it becomes heated from the warmer room. The amount transferred may be determined experimentally, or calculated from the size of the box and the thermal conductivities of the materials used in making the incubator. (See HEAT; THERMOMETRY.)

Fluctuations in room temperature require heating or cooling mechanisms with sufficient capacity and a sensitive controlling element. When large changes must be met, it is better to use several heating units separately controlled. rather than one large one. Otherwise the warming may lag behind, or overshoot the proper temperature. A satisfactory method is to use a continuous heater to keep the incubator almost up to temperature and to use a smaller intermittent heater to maintain the temperature. If the surrounding room does not remain moderately constant, it may not be possible to hold the incubator within a small variation.

Heat may be removed from the box by running cold water, or by some form of refrigeration (*q.v.*). The cooling coil may be placed near or within the incubator. Or, the refrigerator may cool a tank of brine or other refrigerant which is circulated through coils in the walls of the incubator. The natural flow of heat may be utilized by building a row of incubator chambers with common walls, heating one end and cooling the other end. Those in-between will have intermediate temperatures. The group should be placed in a basement room not subject to rapid temperature fluctuations.

Gas, gasoline, kerosene or electricity are used to supply heat. The hot combustion gases from gas or kerosene may be led around, or through the walls of the box. The flame may be regulated by controlling the fuel supply; the flow of the heated air may be regulated with a damper or louvers, or both means may be combined. Electric heating coils are placed in the lower part of the chamber, or in the walls.

The precision of the incubator depends on how nearly the loss or gain in heat is balanced by adding or removing heat. Good design is necessary. For the usual care of bactekial cultures a variation of a degree may not be important, but incubators for physiological experiments may need to be held to at least a tenth of a degree. The smaller the variation to be tolerated, the better must be the insulation and the controlling thermoregulator.



BY COURTESY OF GREINER & FRIEDRICHS

FIG. 9.—NOVY'S THERMOREGULATOR

THERMOREGULATORS

Most materials expand with heat and this change in size is used to regulate the flow of heat by operating a switch or valve. Expanding capsules (fig. 2, S) were used first. They tended to wear out, or leak and have been supplanted by mercury or bimetallic thermoregulators. Mercury has a large thermal expansion and is a convenient liquid to use. Since it corrodes most metals, it is used in glass containers.

Mercury Regulators. — A considerable volume of mercury is placed in a bulb (E, fig. 8) connected with a capillary tube (F). A small change in temperature expands or contracts the mercury slightly and causes a proportionately larger movement of the mercury in the narrow capillary. Control to a tenth of a degree is possible.

When the incubator is to be used at a fixed temperature, two electrical contacts (G, H) are sealed into the capillary. As the mercury rises contact is made with (G), on reaching (H) the circuit is completed and current applied to the mires (I) will flow through the connecting mercury. As the regulator cools the mercury recedes, the current is interrupted and the heating cycle restarted. The setting is made by adding enough mercury to reach the contact (H) when at the desired temperature and the tube is then sealed. An adjustable regulator is left open so that the mercury may be added or removed, or the mercury volume changed by a screw plunger (K, fig. 8; D, fig. 9). Possible loss from spilling is prevented in the sealed, adjustable regulator (fig. 8). A bulb is fused onto the top of the regulator and the capillary is extended toward the side of the bulb (J). The device is adjusted by heating until the excess mercury spills over into the bulb. To set to a lower temperature, the bulb is tilted until the tip of the capillary dips into the mercury; the regulator is warmed until the mercury in the capillary reaches that in the bulb and allowed to cool and draw mercury into the larger bulb.

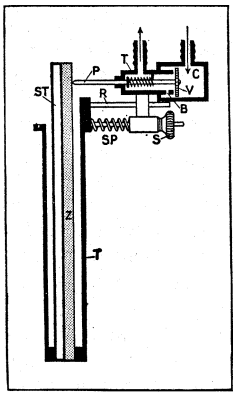
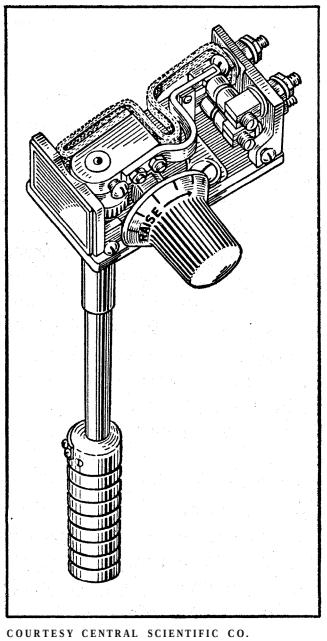


FIG. 10.— DR. ROUX'S THERMOSTAT (STRAIGHT BAR)

Mercury is heavy and expensive and the use of large amounts is avoided sometimes by partly filling the bulb with toluene or some other liquid with a high thermal expansion. Another modification (fig. 8) has a turned up bulb with a layer of liquid (L) over the mercury. Vapour (M) from the liquid fills the remaining space. The liquid, with a boiling point somewhat above the operating temperature, vaporizes, and as the volume of the vapour changes more rapidly with temperature than the liquid, the system is more sensitive. The liquid-vapour systems usually are used only with water bath incubators.

The expanding mercury may control the flow of gas as in Novy's thermoregulator (fig. 9), which consists of a toluene-mercury bulb (E), a volume regulating screw (D), gas ports (a, a') and two ground-glass stoppers (B, C). By turning the glass stoppers the sizes of the openings (b, c, d) may be changed to regulate the gas flow from a to a'.

The early mercury thermoregulators were used to control the current to the heaters, and breaking such large amounts of current soon fouled the mercury surface. This sparking and fouling was lessened by sealing some inert gas above the mercury, or by putting an insulating oil on the mercury. This lessened the oxidation but only prolonged the intervals between cleaning and replacing the mercury. The solution of this difficulty occurred when relays and electronic switches were developed that required very small amounts of current. In the meantime metallic thermoregulators were improved.



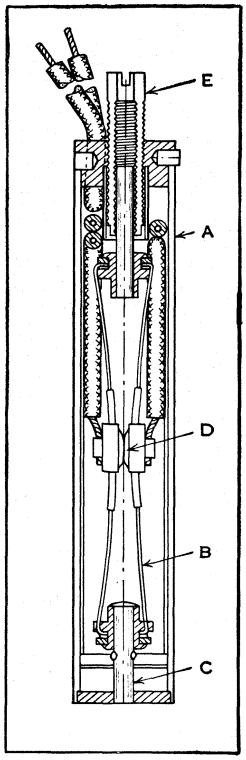
COURTESY CENTRAL SCIENTIFIC CO.

FIG. 11.—DE KHOTINSKY'S SPIRAL BIMETALLIC THERMOREGULATOR

Bimetallic Regulators. — If two strips of metals with different thermal expansions are riveted or welded together, the combination when heated will curve toward the side of the metal with the lesser expansion. As used in a regulator, (fig. 10) one end (T) is fixed and the other end may move a valve (V) and pin (P) to control the gas flow from (C). When used with electricity, one wire is connected to the case and the other to an adjustable contact in place of the pin. The regulators are set by moving the valve unit by a screw (S) nearer toward, or farther from the end of the moving bar. Many metals may be used. Steel (ST) has a very low coefficient of expansion and zinc (Z) a high one, which makes a useful combination. Wilhelm Roux obtained more movement by making the bimetallic pair in the shape of a U.

Arcing or sparking occurs as the contacts open unless the current is small. This pits the contacts and reduces the sensitivity of the regulator. The best contacts are of silver, platinum or their alloys. Placing a condenser of suitable capacity across the contacts greatly reduces damage to the contacts.

De Khotinsky Thermostat. — By bending the welded strip of metals into the form of a spiral (fig. 11) Capt. A. de Khotinsky (1850–1933) obtained greater movement and increased sensitivity. One end of the spiral is fixed to the setting mechanism on the frame and the other end is fastened to a rod which extends back through the spiral and the housing and turns the switch bar. One or two pairs of contacts are used. As the temperature changes the difference in expansion between the two metals causes the spiral to revolve, which turns the rod and opens or closes the switch. The regulator is set to the desired temperature by turning the knob which rotates the spiral to correspond with its position at that temperature. Control at the spiral is possible within about one-quarter of a degree. (*Cf.* fig. 3.)



COURTESY FENWAL, INC.

FIG. 12.—FENWAL CARTRIDGE THERMOSWITCH

Fenwal Cartridge. — The wall of this thermoswitch (fig. 12) consists of a material with a high coefficient of expansion (A). A nonexpanding member (B) is anchored to it at (C). With increased heat (A) slowly elongates and pulls apart the contacts (D) to break the electrical circuit. It is set by turning the screa (E). It will control loads of one kilowatt and is stated to be sensitive to one-tenth degree F.

Thermocouple **Regulators.**—When a junction of suitable dissimilar metals is heated, an electrical current is generated in the thermocouple. (*See* THERMOMETRY.) The current can be measured with a voltmeter or potentiometer calibrated to read in temperature. When a small metal disk is put on the pointer of the meter and two coils mounted on a movable lever which may be set on the scale, then as the disk moves between the coils the frequency of an oscillating current from an electronic tube is changed. the tube draws less current and operates a solenoid switch to control the heater current. The electronic control is sensitive to Iess than a degree. (*See* ELECTRON TUBE; MAGSETISM.)

Controls.—With small currents in the thermoregulator circuits the contacts are not damaged, even over long periods. Direct current is preferable and is obtained by using a transformer (*q.v.*) to reduce the supply voltage to about 6 volts, which is then changed into direct current, often by a built-in rectifier. Sensitive relays are available which operate on about 10 milliamperes. The relay is provided with a mercury tube or heavy contact switch for the control of the heater current. With steam heat, hot or cold water the relay operates a shutoff valve in the pipe line.

A nonmechanical sensitive controlling method uses the small current in the thermoregulator circuit to monitor an electronic tube of the *Thyratron* type so that the heater current passes through the tube in proportion to the control current.

BIBLIOGRAPHY.—J. H. Barlow, *The Art and Method of Hatching and Rearing All Kinds of Domestic Poultry and Game Birds by Steam* (London, *1827*); J. H. Sutcliffe, *Incubators and Their Management* (London, *1896*); Am. Inst. Physics, *Temperature, its Measurement and Control in Science and Industry* (New York, 1941); E. Janisch, "Über die Methoden zur Konstanthaltung von Temperatur und Luftfeuchtigkeit im biologischen Laboratorium," *Abderhalden's Hdb. biol. Arbeitsmeth.* (Berlin, 1933). The catalogues of American Instrument Co., Silver Springs, Md.; Eimer & Amend, New York; Wilmot Castle Co., Rochester, N.Y.; Central Scientific Co., Chicago; and the A. H. Thomas Co., Philadelphia. are illustrated and give further details. British sources are: Baird & Tatlock, Ltd., and A. Gallenkamp & Co., Ltd., both of London, England. (G. P. M.; S. L. B.; O. W. Rs.)

INCUNABULA, a Latin neuter-plural meaning "swaddling-clothes," a "cradle," "birthplace," and so the beginning of anything, now curiously specialized to denote books printed in the 15th century. Its use in this sense may have originated with the title of the first separately published list of 15th century books, Cornelius a Beughem's *Incunabula typographiae* (Amsterdam, 1688). The word is generally recognized all over Europe and has produced vernacular forms such as the French *incunables*, German *Inkunabeln* (Wiegendrucke), Italian *incunaboli*, and the anglicized form incunables is now frequently used. Despite the rapid development of printing in some centres as compared with others, the attractions of a round date have caused the word to be applied to all books produced before the close of the year 1500 and to these alone. The earliest important catalogues of them were (i.) Panzer's *Annales typographici ab artzs inventae origine ad annum MD.*, printed in five volumes at Nuremberg in 1793 and subsequently in 1803 carried on to 1536 in six additional volumes; (ii) Hain's *Repertorium bibliographicum in quo libri omnes ab arte typographica inventa usque ad annum MD. typis expressi ordine alphabetico vel simpliciter enumerantur vel adcuratius, recensentur* (Stuttgart, 1826–38). In Panzer's *Annales* the first principle of division is that of the alphabetical order of the Latin names of towns in which incunabula were printed, the books being arranged under the towns by the years of publication. In Hain's *Repertorium* the books are arranged under their authors' names, and in 1891 an invaluable index of printers was added by Konrad Burger. In 1898 Robert Proctor published an *Index to the Early Printed Books in the British Museum: from the invention of printing to the year MD., with notes of those in the Bodlezan Library.* In this work the books were arranged as far as possible chronologically under their printers, the printers chronologically under the towns in which they worked, and the towns and countries chronologically in the order in which printing was introduced into them, the total number of books registered being nearly 10,000 After Proctor's premature death in 1903, the trustees of the British Museum ordered a full dress catalogue of its incunabula to be prepared, and of this five volumes have been issued, comprising Germany (including Austria and German speaking Switzerland), Rome and Venice. In France Mlle. Pellechet in 1897 began a *Catalogue général des incunables des bibliothkques publiques de France,* which was continued by M Louis Polain but stopped in the middle of G. In Germany after 21 years of preparation the first volume of a *Gesamtkatalog der Wiegendrucke* was published in 192j.

In any attempt to estimate the extent to which the incunabula still in existence represent the total output of the 15th century presses a sharp distinction must be drawn between the weightier and the more ephemeral literature Owing to the great religious and intellectual upheaval in the 16th century much of the literature previously current went out of date, while the cumbrous early editions of books still read were superseded by handier ones. Before this happened the heavier works had found their way into countless libraries and here they reposed peacefully, only sharing the fate of the libraries themselves when these were pillaged, or, by a happier fortune, amalgamated with other collections in a larger library. The considerable number of copies of many books for whose preservation no special reason can be found encourages a belief that the proportion of serious works now completely lost is remarkably low, except in the case of books of devotion whose honourable destiny was to be worn to pieces by devout fingers On the other hand, of the lighter literature in book-form, the cheap romances and catchpenny literature of all kinds, the destruction has been very great. Most of the broadsides and single sheets generally which have escaped have done so only by virtue of the 16th century custom of using waste of this kind as a substitute for wooden boards to stiffen bindings. Excluding these broadsides, etc.. the total output of the 15th century presses in book form is not likely to have exceeded 40.000 editions. As to the size of the editions we know that the earliest printers at Rome favoured 22j copies, those at Venice 300. By the end of the century these numbers had increased, but the soft metal in use then for types probably wore badly enough to keep down the size of editions, and an average of 500 copies. giving a possible total of 20 million books put on the European market during the 15th century, is probably as near an estimate as can be made.

Types as Evidence — Very many incunabula contain no information as to when, where or by whom they were printed, but the individuality of most of the early types as compared with modern ones has enabled typographical detectives (of whom Robert Proctor, who died in 1903, was by far the greatest) to track most of them down. To facilitate this work many volumes of facsimiles have been published, the most important being K. Burger's *Monumenta Germaniae* et Italiae *Typographica* (1892, etc.). J. W. Holtrop's Monuments *typographiques* des Pays-Bas (1868), O. Thierry-Poux's Premiers *monuments* de *l'imprimerie* en France au *XVe* sibcle (1890), K. Haebler's *Typographie ibérique* du *quinzième* sibcle (1901) and Gordon Duff's Early English Printing (1896), the publications of the Type Facsimile Society (1700, etc.) and the *Woolley* Facsimiles, a collection of 500 photographs, privately printed by George Dunn.

In his Index to the Early Printed Books at the British Museum Proctor enumerated and described all the known types used by each printer, and his descriptions have been usefully extended and made more precise by Dr. Haebler in his Typenrepertorium der Wiegendrucke (1905, etc.). With the aid of these descriptions and of the facsimiles already mentioned it is usually possible to assign a newly discovered book with some certainty to the press from which it was issued and to fix within narrow limits the date at which it was finished.

The total number still extant of incunabula printed in England is about 360, of which Caxton produced nearly 100. Of the 10,000 different incunabula which the British Museum and Bodleian Library owned between them in 1898, about 4,100 are Italian, 3,400 German, 1,000 French, 700 from the Netherlands, 400 from Switzerland, 150 from Spain and Portugal, 50 from other parts of the continent of Europe and 200 English, the proportion of these last to the total known being about doubled by the special zeal for collecting them. The celebration in 1640 of the second centenary (as it was considered) of the invention of printing may be taken as the date from which incunabula began to be collected for their own sake. apart from their literary interest, and the publication of Beughem's Incunabula typographiae in 1688 marks the increased attention paid to them. But up to the end of the 17th century Caxton's could still be bought for a few shillings. The third centenary of the invention of printing in 1740 again stimulated enthusiasm, and by the end of the 18th century the really early books were eagerly competed for. Interest in books of the last 10 or 15 years of the century is a much more modern development, but with the considerable literature which has grown up round the subject is not likely to be easily checked.

The chief collections of incunabula are those of the Bibliothèque Nationale at Paris; Royal library, Munich; and British museum, London. Other important collections are at the University library, Cambridge; the John Rylands library, Manchester; the Pierpont Morgan library, New York; the Annmary Brown Memorial, Providence. R.I.; the Henry E. Huntington library. San Marino, Calif.; and the Library of Congress at Washington. See also BOOK COLLECTING. (A. W. P.)

INDENTURE, a law term for a special form of deed executed between two or more parties, and having counterparts or copies equal to the number of parties. These copies were all drawn on one piece of vellum or paper divided by a toothed or "indented" line. The copies when separated along this waved line could then be identified as "tallies" when brought together. Deeds executed by one party only had a smooth or "polled" edge, whence the name "deed poll." By the Real Property act, 1845, s. 5, all deeds purporting to be "indentures" have the effect of an "indenture." even though the indented line be absent. The name "chirograph" was also early applied to such a form of deed, and the word itself was often written along the indented line (see further DEED). The term "indenture" is now used generally of any sealed agreement between two or more parties, and specifically of a contract of apprenticeship, whence the phrase "to take up one's indentures," on completion of the term, and also of a contract by labourers to serve in a foreign country or colony (see CONTRACT LABOUR). In the United States indenture is used generally as a term meaning a conveyance.

INDEPENDENCE, a city of Missouri, U.S., 10 mi. E. of Kansas City (*q.v.*) and 3 mi. S. of the Missouri river; the county seat of Jackson county. Independence is within the Kansas City standard metropolitan statistical area and co-operates with Kansas City in area planning. Pop. (1960) 62.328; for comparative population figures see table in MISSOURI: *Population.*

Best known since his presidency as the home of Harry S. Truman, Independence was once the only city of consequence west of the Mississippi. It was settled in 1827; Mormon settlers arrived in 1831 and were driven out in 1833 (see LATTER-DAY SAINTS, CHURCH OF JESUS CHRIST OF: History). From the early 1820s until 1848, Independence was the starting and outfitting point for the Santa Fe trail (q *v.*) and the Oregon and California trails. It was chartered as a city in 1849.

The Harry S. Truman library, a research centre on the presidency, including a museum was dedicated in 1957. A colonial-style courthouse. rebuilt in 1932 when Truman was presiding judge, is on the square in the centre of the city. The restored log courthouse (1827) houses the welfare office; the old jail, built in 1859, is a museum and county historical society headquarters. World headquarters of the Reorganized Church of Jesus Christ of Latter Day Saints are in Independence; and in 1907 the Mormons of Salt Lake City moved their central states mission there. More than 60 industries make a variety of products. Independence is also a residential suburb of Kansas City. (S. C. G.)

INDEPENDENCE, DECLARATION OF: *see* DECLARATION OF INDEPENDENCE.

INDEPENDENCE DAY, U.S., or Fourth of July. the anniversary of the adoption by the Continental congress, July 4, 1776, of the Declaration of Independence, proclaiming the severance of the allegiance of the American colonies to Great Britain, is the greatest secular holiday of the United States, observed in all the states, territories and dependencies.

The congressional delegates from Virginia introduced in the Continental congress, June 7, 1776, a resolution that "that . . . body declare the United Colonies free and independent States, absolved from allegiance to or dependence on the Crown or Parliament of Great Britain. . . ." On June 10 a committee of five, headed by Thomas Jefferson, was appointed to prepare a declaration suitable to the occasion in the event that the Virginia resolution w s adopted.

Congress approved the resolution July 2; the declaration composed by Jefferson and amended by his committee was adopted July 4 and was publicly read in the yard of the state house July 8.

The first anniversary of the declaration was observed only in Philadelphia, Pa., by the adjournment of congress, a ceremonial dinner, bonfires, the ringing of bells and fireworks. In 1788, after the requisite number of states had adopted the constitution, Philadelphia celebrated July 4 by elaborate festivities, including a grand procession which incorporated five symbolic groups: independence; French alliance; definitive treaty of peace; convention of the states; and constitution.

Boston, Mass., first observed the day in 1783, and thereafter this celebration replaced that of the Boston Massacre, March 5. The custom spread to other cities and states, where the day was marked by parades. patriotic oratory, military displays and fireworks. As the toll of deaths and injuries mounted annually, many communities in the 20th century passed laws prohibiting the sale of fireworks. Civic minded groups worked to link the ideals of democracy and citizenship to the patriotic spirit of the day. Games and athletic contests, picnics, patriotic programs and pageants, and community fireworks displayed by experts became characteristic of the day. (J. K. So.)

INDEPENDENCIA, a small province in southwestern Dominican Republic. Area, 719 sq.mi.; pop. (1960) 27,475. It largely comprises the arid basin between the Sierra de Neiba to the north and the Sierra de Bahoruco on the south. Lake Enriquillo, a large salt lake near the centre where flamingos and alligators breed, lies 144 ft. below sea level. The province produces small amounts of irrigated sugar cane, rice and bananas. It was created from the western section of Bahoruco province in 1948 as part of a plan to develop the area bordering Haiti. The provincial capital,

Jimani, founded 1949 on the west shore of the lake, is a small frontier town. (D. R. D.)

INDETERMINATE EQUATIONS: *see* DIOPHANTINE EQUATIONS.

INDEX, a list of the matter discussed in a book or set of books, showing the pages where each subject is to be found; or, in a more general sense, an indicator of the position of information on any given subject. Such a list may contain the names of persons, places, specific subjects or ideas discussed. An alphabetical arrangement of an index is usually found to be more convenient for consultation than one divided into several parts under large subjects.

Indexes are a valuable key to the material they are concerned with, and for many books they are essential. They have been found in volumes printed as early as the 15th century; the growth of indexing from a short table of contents to an extensive subject index is traced in H. B. Wheatley's *What Is an Index?* (1878). In modern books the table of contents and the index are distinguished, the table of contents being printed at the beginning of the book and the index at the back. Indexes to sets of books, such as the complete works of an author or an encyclopaedia, may be printed in separate volumes. The Index to *Encyclopædia Britannica* is an example; the introduction to it sets forth some principles that apply to other indexes as well.

Periodical Indexes.—Almost a~~periodicals have an index covering the entire volume, issued with the last number. A useful type of periodical index is for many volumes of a set, especially when the publication has not been analyzed in one of the indexing mediums. *Gentlemen's Magazine,* for example, has a *General Index* in 2 volumes covering the years from 1731 to 1818; *Poole's Index to Periodicals* did not begin indexing the *Gentleman's Magazine* until 1868. Daniel C. Haskell has compiled a *Check List of Cumulative Indexes to Individual Periodicals in the New York Public Library* (1942) that lists about 4,500 different indexes.

In 1848 William F. Poole published the first index to English periodicals, *An Alphabetical Index to Subjects Treated in the Reviews and Other Periodicals to Which No Indexes Have Been Published.* In 1876 Poole proposed a co-operative plan for indexing current periodicals. This resulted in the publication in 1891 of the first two volumes of *Poole's Index to Periodicals,* covering 1802–81. This was followed by five supplements, each covering five years.

The H. W. Wilson Co. has published indexes for many years, beginning in 1900 with the *Readers' Guide to Periodical Literature,* which analyzes over 100 of the popular current periodicals. This was followed in 1913 by the *International Index to Periodicals,* now indexing about 175 of the more scholarly journals too specialized for inclusion in the *Readers' Guide.* Readers asked for more specialized indexes, with the result that the *Industrial Arts Index* was begun in 1913, the *Agricultural Index* in 1916, the *Education Index* in 1929, the *Art Index* in 1930, *Library Literature* in 1936, and the *Bibliographic Index* in 1938.

Other **Indexes.**—Newspaper indexes are valuable, but few have been compiled because of the magnitude of the work. The best-known ones are the Palmer's *Index to the London Times* from 1790 to 1906. followed by the *Official Index to the Times* (begun in 1906), and the *New York Times Index* (begun in 1913). An index to one newspaper can serve as an index to other papers, since general news items appear in all the papers of the country at about the same time.

The *Great Books of the Western World,* edited by Robert Maynard Hutchins and published in 1952 in 54 volumes, contains 443 works of 74 authors. In volumes 2 and 3, entitled *The Great Ideas, a Syntopicon,* are 163,000 references arranged under 3,000 topics contained in the *Great Books.* It is the greatest index ever made of ideas found in the classics.

See also BIBLIOGRAPHY: *Enumerative (or Systematic) Bibliography.*

Making an Index.—The making of an index is an art that requires certain skills, such as accuracy, keenness in acquiring the point of view of the author. good judgment and conciseness, as well as knowledge of certain accepted rules for compiling such an index. For a brief discussion of basic considerations and procedures see *A Manual of Style,* published by The University of Chicago Press.

The rapid increase in the volume and complexity of the literature to be indexed has forced a serious consideration of the contribution that automation can make to indexing operations. "Mechanized indexing" is a generic term that includes a wide variety of mechanical and electronic devices and the indexing systems which they use.

Hand-sorted marginal-punched cards. the Peek-a-Boo system developed at the U.S. bureau of standards and Calvin Mooers' Zatocoding are effective for small files of material. Much experimentation has been conducted in adapting standard computer equipment, the IBM series, the Remington Rand UNIVAC, and similar machines, to the indexing of large collections of material. The most efficient devices. however, are those designed specifically for indexing operations such as the Minicard system of the Eastman Kodak Co., and the Filmorex developed in France by Jacques Semain, both of which employ microfilm as the storage medium. The Searching Selector developed at the school of library science of Western Reserve university is the most flexible yet devised and can use punched cards, microfilm or magnetic tape.

The advantages of mechanization are the ability to index large volumes of material so that it can be searched at extremely high speeds, the ability of the machine to correlate a great number of characteristics of the literature to be searched in a variety of complex ways and the capacity to perform other repetitive indexing operations that a machine can do more efficiently than man.

See also Robert L. Collison, *Indexes and Indexing* (1959); Martha T. Wheeler, *Indexing* (jth ed. rev., 1957), which is a pamphlet published by the New York State Library and an excellent brief treatment. (W. V. N.)

INDEX LIBRORUM PROHIBITORUM, the official list of books authoritatively forbidden to members of the Roman Catholic Church, together with the general rules of canon law which declare certain classes of books forbidden *ipso jure; i.e.,* without specific mention. The exact origin of this legislation cannot be assigned with certainty. The apostle Paul approved the burning of bad books by the newly converted Christians of Ephesus (Acts xix, 19). Early ecclesiastical condemnations of books are the *Muratorian Canon* (2nd century), giving the canon of the New Testament and condemning apocryphal books, the condemnation of Arius and his book, *Thalia,* by the Council of Nicaea (325) and the *Decretum Gelasii* promulgated by Pope Gelasius in 496. Though vigilance against the contamination of faith and morals through bad books had been constant throughout the earlier centuries, it became still more necessary after the invention of printing. The principal later editions of the *Index* are those of 1559, 1564, 1596, 1664, 1670, 1681, 1752, 1758, 1819, 1835, 1877, 1881, 1900, 1917, 1922, 1929, 1930, 1938 and 1940. For the historical development, consult the works listed in the bibliography.

The *Index* includes the rules of the code of canon law on forbidden books, but not those which prescribe previous censorship of certain books as a requisite for their licit publication. Books published without this previous examination and approval are not necessarily forbidden, though some of them will fall under the fifth classification given below. Books which are forbidden *ipso jure* are:

(1) Editions of the original text and of ancient Catholic versions of Sacred Scripture, published by non-Catholics; also all translations of Sacred Scripture into any language, made or published by non-Catholics; this prohibition does not apply to persons who are studying theology or Sacred Scripture; (2) books which deiend heresy or schism, or which in any way attempt to subvert the very foundations of religion; ancient and obsolete heresies are not embraced in this prohibition; (3) books which purposely attack religion or sound morals; (4) books by non-Catholics which treat professedly of religion, unless it is certain that they contain nothing against the Catholic faith; (5) books of Sacred Scripture or annotations and commentaries thereof, and books and booklets of prayer, devotion or instruction which tell of new apparitions, revelations, visions. prophecies, miracles, or which introduce new devotions, if any of these were published without observing the special requirements of canon law; (6) books which attack or ridicule any of the Catholic dogmas. which deiend errors proscribed by the Holy See, which disparage divine worship. or strive to overthrow ecclesiastical discipline, or purposely insult the ecclesiastical hierarchy or the clerical or religious state; (7) books which teach or approve of any sort of superstition, fortunetelling,

divination, magic, spiritism or other such practices; (8) books which hold duelling, suicide or divorce licit, or which, treating of Masonic sects and other such societies, contend that they are useful and not harmful to the church and civil society; (9) books which purposely treat of, narrate or teach lascivious or obscene matter; scientific books, written with a serious purpose, are not considered obscene; (10) editions of liturgical books approved by the Holy See, in which anything has been changed so that they do not agree with the authentic editions; (11) books containing indulgences which are spurious or which have been proscribed or revoked; (12) pictures of Christ, His Mother or angels and saints if they are foreign to the mind and decrees of the church.

In 1949 the Holy Office declared that all books, papers, etc., which champion the doctrine or action of Communists, are equally forbidden, without special mention, under the terms of the existing law.

The procedure prescribed by Benedict XIV in 1753 remained unchanged when, in 1917, the Holy Office took over the entire charge of the prohibition of books from the congregation of the *Index*. Books are first examined by one of the *qualificatores* or by one of the consultors, then discussed and voted on by all the consultors; the verdict is given by the cardinals of the Holy Office and then submitted to the pope, who makes the final decision. Individual bishops can forbid a book only for their own territory, subject to recourse to the Holy See. condemnations apply to future editions and translations into any language and forbid the reading, keeping, sale, translation or communication of the book. Cardinals, bishops and ordinaries are exempt from the law. Other persons must obtain permission from the Holy See, or, with certain restrictions, from the ordinary. The law is subject to a rather liberal rule of interpretation in accordance with the general principle that laws which restrict liberty are to be narrowed rather than enlarged in their application (canon 19). The penalty of excommunication *ipso facto* is incurred only in a few strictly limited cases (canon 2318).

The *Index* of 1940 (pp. xxiv + 508) contained: a preface by Cardinal Merry del Val reproduced from the 1929 edition, the canons of the code of canon law (effective May 19, 1918) on the prohibition of books, a decree of the Holy Office (May 3, 1927) on sensual and sensual-mystic literature, a page of *Praenotanda* or prenotes and the authentic list of forbidden books. These are listed alphabetically by author and title, usually with the date and source of the condemnation. An asterisk designates a book which was condemned *donec corrigatur; i.e.*, only until it be satisfactorily amended; a cross (†) distinguishes those condemned by apostolic letter from those condemned only by a decree of a Roman congregation.

BIBLIOGRAPHY.—*Codex Iuris Canonici,* canons 1384–1405 (1918); Joseph Hilgers, *Der Index der verbotenen Bucher* (1904) and articles "Index of Prohibited Books" and "Censorship of Books" in the *Catholic Encyclopedia;* Arthur Vermeersch, *De prohibitione et censura librorum* (1906); A. Boudinhon, *La Nouvelle législation de l'Index* (2nd ed., 1926); Joseph M. Pernicone, *The Ecclesiastical Prohibition of Books* (1932); Edwin F. Healy, *Moral Guidance* (1942). (*T. L.* B.)

INDEX NUMBERS. The phrase index number is sometimes applied to any series in which a chosen term is written as 100 and the other terms expressed as percentages of it. The earlier and more general use is, however, consonant with the following definitions: "An index number [is] a number adapted by its variations to indicate the increase or decrease of a magnitude not susceptible of accurate measurement" (Edgeworth, *Economic Journal,* 1923, p. 379); "index numbers are used to measure the change in some quantity which we cannot observe directly, which we know to have a definite influence on many other quantities which we can so observe, tending to increase all or diminish all, while this influence is concealed by the action of many causes affecting the separate quantities in different ways" (Bowley, *Elements of Statistics,* 1920, p. 196). Thus index numbers are applied to the measurement of the *general* movement of prices, cost of living, wages, production, consumption, employment, etc.

The data from which index numbers are formed consist of records of particular quantities at two or more dates or places and information about the relative importance of these quantities in a general measurement. In constructing an index number to measure the movement of any defined magnitude it is necessary to decide on the choice of the separate quantities, on their relative importance, on the period or place to be taken as base, and on the formula of compilation. Thus, in the *Statist* index number the objective is the measurement of the change of wholesale prices in the United Kingdom; 45 commodities are selected and regarded as of equal importance, the period 1867–77 is taken as base, the average price in that period of each commodity is equated to 100, the terms in each series of prices are expressed as percentages of that average ("price-relatives"), and the simple average of the 45 relatives in any year forms the index number for that year.

A distinction is drawn, but not by all writers, between two classes of index numbers: (a) where, as in the definitions quoted above, the object is to measure the movements of a magnitude without specific reference to any pre-determined application, *e.g.*, the purchasing power of money in general ("indice monétaire") as conceived by Jevons, *The Variation of Prices and the Value of Currency since 1782* (1865); (*b*) where the measurement is to be applied to a defined group, *e.g.*, the changes in the cost of a quantitative standard, such as is used in a cost of living index ("indice budgétaire"). Many index numbers, however, are intermediate between these classes, and much of the analysis of the form and content of the numbers is appropriate to both. Thus, in all cases of price measurement, only those commodities can be included which are measurable in a defined and unchanged unit, and for which the price can be ascertained, and (unless the geometric mean is used) a base period in which each price is equated to 100 must always be selected.

PURCHASING POWER

(*a*) In the measurement of the purchasing power of money in general it is argued that the prices of all commodities, not subject to regulation or monopoly, are equally significant. Theoretically the problem is one of pure sampling, and the precision of the result in any year is directly proportional to the square root of the number of independent terms included and inversely proportional to the mean dispersion of these terms from their average in that year. In practice, the terms are not completely independent, for the prices of related commodities influence one another, and the precision is thus reduced. Also, the greater the interval from the base year, the greater tends to be the dispersion and the smaller the precision. In periods when prices are changing rapidly, as in the years 1914 to 1923, the dispersion is usually considerable and the measurement loses accuracy.

There are three types of averages applicable to price-relatives: their arithmetic mean as described above for the *Statist* index number; the geometric mean of the same numbers, that is the nth root of their product if there are n commodities; and the harmonic mean, which is the reciprocal of the arithmetic mean of the reciprocals. Thus, for two commodities whose prices were 6d. and 10d. in the base year, and 1s. and 2s. 1d. in any other year, the price-relatives are 200 and 250, their A.M. is 225, their G.M. is $\sqrt{(200\times250)}=223{\cdot}6$, their H.M. is $1\div\frac{1}{2}(\frac{1}{200}+\frac{1}{250})=222.2$. If the latter year is taken as 100, the relatives in the original base year are 50 and 40, the A.M. is 45, and $45:100=100:222{\cdot}2$. The H.M. of the "forward" relatives gives the same measurement as the A.M. of the "backward" relatives; or, if the comparison is between two places the H.M. of the relatives when the first is taken as base gives the same measurement as the A.M. when the second is so taken.

A general change in the relation of currency to its use tends to affect all prices in the same proportion, and "if other disturbing causes may be considered proportional to the ratio of change of price they produce in one or more commodities, then all the individual variations of prices will be correctly balanced off against each other in the Geometric Mean" (Jevons, *Investigations in Currency and Finance,* 1884, pp. 121–122; *see* also Bowley, *Economic Journal,* 1921, p. 202). The Geometric Mean is therefore considered appropriate to this problem. It has the advantage that it gives less importance to extreme measurements than does the Arithmetic Mean. It has the further advantage that the comparison by its use of any two years is independent of the choice of the base year (*see* below).

CHANGE IN A FIXED AGGREGATE

(b) The method generally used in the more objective problem of measuring the change of cost of a fixed aggregate of goods is as follows: the quantities of defined commodities which are produced or consumed in a year, or exported or imported, or are purchased in a week by a family, are estimated and the prices per unit are

ascertained in a base year or period and also in the year to which the measurement is to refer. This budget of quantities is valued at the base year prices and again at the prices of the year in question; the latter total expressed as a percentage of the first gives the required index number. The computation is often effected by writing down the relative expenditure (quantity × price) on each commodity in the base year, applying to each the percentage that its price in the second year forms of that in the first, and adding the products. This sum (divided by the total of the base year's relative expenditures) gives the same index number as before. Cost of living index numbers are computed by this method. In this form the index number appears as a "weighted average," where the weights are the relative expenditures and the things weighted are the price-relatives. From the theory of weighted averages it is known that considerable roughness in the weights has little effect on the result. It may also be regarded as an average of price-relatives which form a sample of a larger group than that included, and therefore—as under (a)—its precision depends on the square root of the number of independent relatives and, inversely, on their dispersion about their average.

The weakness of this method is that, when we make a comparison between two years or two places, the relative expenditures generally differ and each scheme of expenditure appears to have an equal claim to be included. This difficulty may be met theoretically by computing the index twice, first with the expenditures in year or place A and then with those in B and averaging the result. For comparison between places this method is applied; but it is seldom that the necessary "weights" can be obtained for more than one year, and till there is a further census of production or a new collection of working class budgets the double computation cannot be made. Further, if the weights are available for three years or places, A, B and C, the index for B in reference to A multiplied by that for C in reference to B does not by any weighted average formula give that for C in reference to A (÷100), as it should. This so-called "condition transitive" is not satisfied by any formula that is symmetrical with regard to weights. The algebra of the method is as follows:—

Write ${}_aQ_1$, ${}_aQ_2$ . . . and ${}_aP_1$, ${}_aP_2$ . . . for quantities and prices in **A,** and ${}_bQ_1$, ${}_bQ_2$. . . , ${}_bP_1$, ${}_bP_2$ . . . in B. The "forward" index number is $I_a = 100\Sigma_aQ_1 \cdot {}_bP_1 \div \Sigma_aQ_1 \cdot {}_aP_1$ and the "backward" index number is $I_b = 100\Sigma_bQ_1 \cdot {}_bP_1 \div \Sigma_bQ_1 \cdot {}_aP_1$. The Geometric Mean $\sqrt{I_a \times I_b}$ is Prof. Irving Fisher's "Ideal index number" (The Making of Index *Numbers,* 1922, p. 220). The arithmetic average, $\frac{1}{2}(I_a + I_b)$ and the form $I_2 = 100\Sigma\frac{1}{2}({}_aQ_1 + {}_bQ_1) \cdot {}_bP_1 \div \Sigma\frac{1}{2}({}_aQ_1 + {}_bQ_1) \cdot {}_aP_1$, may be conveniently used. The three forms of average may be expected to give nearly identical results. I_2, in which the quantities at the two dstes are averaged, is perhaps the simplest in idea. Each average lies between I_a and I_b, and is greater than I_a if an increase of prices of a commodity above the general increase from year A to a later year B is correlated with a relative decrease of the quantity purchased, as may be expected if there is a possibility of substitution of one commodity for another without any general change of standard (Bowley, Statistical *Journal,* 1919, pp. 343 *seq.*).

In their measurement of the change of import or export index prices from year A to the consecutive year B, the Board of Trade uses the formula I_b and for comparison with the next year C the formula $100 \times \frac{\Sigma_bQ_1 \cdot {}_bP_1}{\Sigma_bQ_1 \cdot {}_aP_1} \times \frac{\Sigma_cQ_1 \cdot {}_cP_1}{\Sigma_cQ_1 \cdot {}_bP_1}$ which does not- equal $100\,\frac{\Sigma_cQ_1 \cdot {}_cP_1}{\Sigma_cQ_1 \cdot {}_aP_1}$ obtained by direct re-valuation of the C quantities by the A prices and, if there is a very rapid change of quantities and prices, may differ considerably from it. This is an example of the "step-by-step" or "chain" method of index numbers. Note that from A to B, $100\,\frac{\Sigma_bQ_1 \cdot {}_aP_1}{\Sigma_aQ_1 \cdot {}_aP_1}$ is an index number of quantity of trade (prices constant), and $100\,\frac{\Sigma_bQ_1 \cdot {}_bP_1}{\Sigma_aQ_1 \cdot {}_aP_1}$ is the index number of value of trade. The product of these measurements of price and quantity is the index of value (×100).

Since no form of index number satisfies all the conditions which can properly be laid down (see *e.g.,* Gini, in Metron, 1924, pp. 81 and 134), we must select in each case the form most suited for the particular purpose in hand (regard being had to the data available) and it follows that we can only expect precision when different relevant forms give approximately the same result, for which the conditions are that the dispersion of prices from their average should be small and the number of constituent elements should be considerable. See COST OF LIVING; PRICES, STATISTICS OF. (A. L. B.)

INDEX SYSTEM: see OFFICE MACHINES AND APPLIANCES.

INDIA, a great subcontinent of Asia, with an area of 1,127,345 sq.mi. and a population (1951) of 436,424,429, of the same order of magnitude in area and population as the whole of Europe without the U.S.S.R. and inhabited by many different races speaking about 200 distinct languages. (The figures include India, Pakistan, Kashmir, Nepal. Bhutan and the Portuguese and former French possessions in India.) India was for many years under British rule (*see* below, History); but the transfer of power on Aug. 15, 1947, created two new dominions of the British Commonwealth, the larger retaining the name India with its capital at New Delhi (capital of undivided India since 1912), the latter becoming Pakistan (*q.v.;* capital Rawalpindi). On Jan. 26, 1950, the Dominion (or Union) of India became an independent sovereign republic which, as a full member of the Commonwealth of Nations. recognized the king of England as the head of that commonwealth but not as emperor of India and replaced his governor-general with a president elected by the Indian parliament; Bharat was taken as the official Hindi name of India.

The Indians can scarcely be said to have a word of their own by which to express their common country. In Sanskrit it would be called Bharata-varsha, from Bharata, a legendary monarch of the Lunar line; but Sanskrit is no more the vernacular of India than Latin is of Europe. The name Hindustan, which was at one time adopted by European geographers, applies properly only to that portion of the peninsula lying north of the Vindhya mountains, or yet more strictly to the upper basin of the Ganges, where Hindi is the spoken language. India, a word derived through the Greeks from the Persicized form of the Sanskrit *sindhu,* "river," pre-eminently the Indus, became familiar only after the British connection. To the establishment by the British of a single administration and to the adoption of English as the only common language of educated Indians was due the emergence of the conception of India as a political unit, not, like Europe, a mere geographic term.

The basis of the transfer of power could not be found in this unity; so, when British control went, partition was inevitable. In dealing with India it is impossible at this stage fully to separate earlier data, stalistical or general, according to the subsequent division. Where confusion might otherwise occur it will be necessary to use either "undivided India" or "the Indian subcontinent" in referring to the territory of the former Indian empire; and "India" for the newly created republic, the population of which. according to the 1951 census, was 357,241,494 over an area of 1,177,061 sq.mi. (excluding Jammu and Kashmir, but including the former French possessions.)

GEOGRAPHY

The Indian subcontinent is the middle of the three irregularly shaped peninsulas which jut out southward from the mainland of Asia. Its form is that of a great triangle, with its base resting upon the Himalayan range and its apex running far into the ocean. It extends from the 8th to the 37th degree of north latitude; that is to say, from the hottest tropical regions to far within the temperate zone. The length of India from north to south and its greatest breadth from east to west are both about 1,900 mi.; but the triangle tapers with a pear-shaped curve to a point at Cape Comorin, its southern extremity.

Burma (*q.v.*), which by British conquest formed part of India after 1885, was in 1937 separated from India. The island of Ceylon (*q.v.*), lying at the foot of India, came under British rule in 1795. Thenceforward it was first administered by the government of Madras until 1798, when its control was transferred to

the governor-general of India; but in 1802 it became a crown colony under the sole authority of the British colonial office. On Feb. 4, 1948, it attained to full self-government as a member of the Commonwealth of Nations. Aden (*q.v.*), at the mouth of the Red sea, with Perim and protectorates over the adjacent mainland and the island of Sokotra, was included within the British Indian empire until April 1, 1937, when it became a crown colony. The Andaman and Nicobar Islands in the Bay of Bengal and the Laccadives in the Arabian sea are administered from India.

On the coast of the peninsula itself, small Portuguese settlements break the continuous line of Indian territory. Similar French territories (see PONDICHERRY) were ceded to India in 1954. The subcontinent is shut off from the rest of Asia on the north by a vast mountainous region, known in the aggregate as the Himalaya, amid which lie the kingdom of Nepal and the Indian-protected principalities of Sikkim and Bhutan, with the great tableland of Tibet behind. From the rest of the world it is severed by tropical oceans. The territory included within these boundaries is rich in varieties of scenery and climate, from the highest mountains in the world to vast river deltas raised only a few inches above the level of the sea. India as a subcontinent is divided into three well-defined tracts.

Himalaya. — The first of the three regions is the Himalaya mountains and their offshoots to the southward, comprising a system of stupendous ranges, the loftiest in the uorld. They extend in the shape of a scimitar, with its edge facing southward, for a distance of 1,500 mi. along the northern frontiers of West Pakistan and India. At the northeastern angle the Dihang river, the connecting link between the Tsanpo of Tibet and the Brahmaputra of Assam, bursts through the main range. At the opposite or northwestern angle the Indus in like manner pierces the Himalaya and turns southward through the Punjab. Ancient trade routes exist, by means of which merchandise from the Punjab finds its way over heights of 18.000 ft. into Sinkiang and Tibet. The Muztagh (Snowy mountain), the Karakoram (Black mountain) and the Changchenmo are the most famous of these passes.

The Himalaya not only form a double wall north of the subcontinent but at their eastern and western extremities send out ranges to the south, which protect its northeastern and northwestern frontiers. On the northeast, those offshoots form a barrier between Assam and the tribal areas of upper Burma. On the opposite or northwestern frontier the mountains run down the entire length of the Afghan border from the Himalaya to the sea. As they proceed southward, their best-marked ranges are in turn known as the Safed Koh, the Sulaiman and the Hala mountains. These massive barriers have peaks of great height, culminating in the Takht-i-Sulaiman, or Throne of Solomon, 11,290 ft. above the level of the sea. But the mountain wall is pierced at the corner where it strikes southward from the Himalaya by an opening through which the Kabul river flous. An adjacent opening, the Khyber pass, the Peiwar (Kurram) pass to the south of it, the Gomal pass near Dera Ismail Khan, the Tochi pass between the two last-named and the Bolan pass via Quetta still farther south furnish the gateways from Afghanistan. The Hala, Brahui and Pab mountains, forming the southern offshoots in western Baluchistan, have a much smaller elevation.

River Plains. — The wide plains watered by the Himalayan rivers form the second of the three regions. They extend from the Bay of Bengal on the east to the Afghan frontier and the Arabian sea on the west, and they contain India's richest and most densely populated areas. The vast level tract which thus covers northern India is watered by three distinct river systems. One of these systems takes its rise in the hollow trough beyond the Himalaya and issues through their western ranges upon the Punjab as the Sutlej and Indus. The second of the three river systems also takes its rise beyond the double wall of the Himalaya, not very far from the sources of the Indus and the Sutlej. It turns, however, almost due east instead of west, enters India at the eastern extremity of the Himalaya and becomes the Brahmaputra. These rivers collect the drainage of the northern slopes of the Himalaya and convey it, by long and tortuous although opposite routes, into India. The third river system of northern India receives the drainage of their southern slopes and eventually unites into the mighty stream of the Ganges.

Southern Tableland. — The third division of India comprises the Deccan (*q.v.*), the three-sided tableland which covers the southern or more strictly peninsular portion of India. This tract comprises Madhya Pradesh (formerly Central Provinces and Berar). Madras. Bombay, Hyderabad, Mysore and others.

Vindhyas.—The northern side of this tableland rests on confused ranges, running with a general direction of east to west and known in the aggregate as the Vindhya mountains. Guarding the flanks of this tumbled mass stand two peaks sacred to the mysteries of the Jain religion. Mt. Abu on the extreme west and Mt. Parasnath on the extreme east, with a succession of ranges stretching 800 mi. between. The various ranges of the Vindhyas, from 1,500 to more than 4.000 ft. high, form, as it were, the northern wall and buttresses which support the central tableland. Though pierced by road and railway, they stood in former times as a barrier of mountain and jungle between northern and southern India and formed one of the main obstructions to welding the whole into an empire.

Ghats. — The other two sides of the elevated southern triangle are known as the Eastern and Western Ghats. These start southward from the extremities of the Vindhya system and run along the eastern and western coasts of India. The Eastern Ghats stretch in fragmentary spurs and ranges down the Madras and Andhra coasts, here and there receding inland and leaving broad level tracts between their base and the coast. The Western Ghats form the great sea wall of the Bombay state, with only a narrow strip between them and the shore. The Eastern Ghats have an average elevation of 1,500 ft. The Western Ghats ascend more abruptly from the sea to an average height of about 3,000 ft. with peaks up to 4,700 along the Bombay coast, rising to 7,000 and even 8,640 (Dodabetta peak) in the upheaved angle which they unite with the Eastern Ghats to form toward their southern extremity. The inner triangular plateau thus enclosed lies from 1,000 to 3.000 ft. above the level of the sea. But it is dotted with peaks and seamed with ranges exceeding 4.000 ft. in height. Its best-known hills are the Nilgiris, with the summer resort of Madras, Ootacamund, 7,000 ft above the sea.

On the eastern side of India, the Ghats are traversed by a number of broad and easy passages from the Madras and Andhra coasts. Through these openings the rainfall of the southern half of the inner plateau reaches the sea. The drainage from the northern, or Vindhyan, edge of the three-sided tableland falls into the Ganges. The Narbada and Tapti carry the rainfall of the southern slopes of the Vindhyas and of the Satpura hills, in almost parallel lines, into the Gulf of Cambay. But from Surat to the farthest south, the Western Ghats form a lofty unbroken barrier between the waters of the central plateau and the Indian ocean. The drainage has therefore to make its way across India to the eastward, now turning sharply round projecting ranges, now tumbling down ravines or rushing along the valleys, until it finally falls into the Bay of Bengal. In this way the three great rivers of the Andhra-hladras region (viz., the Godavari, the Kistna and the Cauvery) rise in the mountains overhanging the western coast and traverse the whole breadth of the central tableland before they reach the sea on the eastern shores of India.

Of the three regions thus briefly surveyed, the first, or the Himalaya, lies for the most part beyond the political frontier, but a knouledge of it supplies the key to the ethnology and history of India. The second region, or the great river plains in the north, formed the theatre of the ancient race movements which shaped the civilization and the political destinies of the whole Indian peninsula. The third region, or the triangular tableland in the south, differs markedly in its population, languages and traditions from either of the other two divisions. (ME.; E. HD.)

GEOLOGY

Geologically, also, the Indian subcontinent consists of three elements — the Himalaya, the Indo-Gangetic plain and the Deccan peninsula. The relations of the Himalaya to the peninsula and the essential differences between them are dealt with in the article

ASIA, and a more detailed description of the geology of the Himalaya is given there. The following account deals only with the Indo-Gangetic plain and the peninsula.

Indo-Gangetic Plain. — The Indo-Gangetic depression is the foredeep of the Himalaya, lying between the folded belt which forms the mountain range and the rigid foreland constituted by the peninsula. It bears the same relation to the Himalaya as the Pacific deeps bear to the island arcs near which they lie, but in those the level is lower and both foreland and foredeep lie beneath the sea. There can be no doubt, however, that the Himalayan foredeep itself extends far below sea level, though since its formation it has been filled up by deposit. In the eastern section of the plain the deposit is chiefly alluvial material brought down from the hills; in the western section wind-blown material plays an important part. Everywhere, except in the neighbourhood of the hills, the deposit is fine-grained, consisting of sands and muds, though kunkur concretions may sometimes give a pebbly appearance.

No boring has ever reached the base of the alluvium or has even shown any downward increase in the coarseness of the material. In a boring at Calcutta a bed of peat with wood, about 360 ft. below sea level, clearly points to subsidence. A boring at Lucknow reached nearly 1,000 ft. below sea level without any indication of an approach to the bottom of the deposit. Sir Sidney Burrard found that the deflections of the plumb line and anomalies of gravity suggest that the loose material filling the Indo-Gangetic depression extends to a depth of 40,000 ft. He thought so great a depth scarcely probable. But the foredeeps of much less massive mountain arcs reach 20,000 ft. and more, and in comparison with these Sir Sidney's estimate seems not improbable for the Himalayan foredeep.

Peninsular India. — The geological history of the Indian peninsula has been so different from that of Europe that the classification of the strata which is natural in Europe cannot be used in India, and an almost entirely different terminology becomes necessary. The grouping, originally proposed by Sir Thomas Holland and later commonlv adopted, is as follows:

Aryan group	Tertiary and recent Cretaceous and Deccan trap Gondwana system
Dravidian group	(absent in the peninsula)
Purana group	Vindhyan system Cuddapah system
Vedic, or Archaean, group	Dharwar system Gneisses and granites

The term Archaean is here used in the restricted sense in which it is often employed, denoting only the crystalline and schistose rocks of pre-Cambrian age. The Purana group consists of normal sedimentary deposits which rest unconformably upon the Archaean but which, from the total absence of fossils, are believed to be pre-Cambrian also, like the Algonkian of North America or the Torridonian of Scotland. The Dravidian group, which is absent in the peninsula but present in the Himalaya, corresponds approximately with the Palaeozoic up to the Upper Carboniferous. The Gondwana system includes the oldest fossiliferous beds of the peninsula and ranges from the Upper Carboniferous to the Upper Jurassic.

The pre-Gondwana rocks (Archaean and Purana groups) form the foundation of the whole peninsula. Southeast of a line drawn from Goa to Allahabad they occupy most of the surface, the areas covered by the later beds being relatively small. Northwest of this line they are concealed over a wide space by the great outflows of the Deccan trap, but they reappear at the surface in Bandelkhand and Gujarat. In southern India appearances suggest that there was an ancient gneissic series, including granitic and other intrusive masses, into which has been infolded a later series of sedimentary and volcanic beds, now for the most part converted into schists. The schistose series is the Dharwar system, nhich runs in long narrow bands through the gneiss from south-southeast to north-northwest. There has certainly been strong folding in this direction, but the Mysore geologists think that the Dharwar system is the older and that the gneissic rocks have been intruded into it.' Farther north, however, where the Dharwar rocks have been less altered and retain their original bedding, they seem to be later than the main body of the gneiss, though intrusions of later date penetrate both. The gneissic series is in fact a complex of various ages. and it has not yet been possible to separate it completely into its several parts.

Rocks of Dharwar type and probably of Dharwar age occur also in the Aravalli hills, in Madhya Pradesh and in western Bengal. The famous "marble rocks" of Jubbulpore, for example, are referred to this system. It is interesting to note that while in southern India the trend of the Dharwar folds is from south-southeast to north-northwest, in the Aravalli hills it is from southwest to northeast.

The Dharwar rocks form the most highly metalliferous system in India. In southern India all the most productive gold-bearing quartz veins, including those of the Kolar gold field. lie within it; while in Madhya Pradesh and Bengal it includes valuable manganiferous deposits. Iron ore of high quality also occurs at several localities but is usually too distant from the coal fields to be profitably worked.

The rocks of the Purana group have not been subjected to the intense folding which has affected the Dharwar system and have suffered little from metamorphism. They are mostly sedimentary deposits, such as sandstones, shales and limestones, and rest quite unconformably and often horizontally upon the older rocks. But in spite of their unaltered condition no fossils have been found in them and for this reason they are supposed to be pre-Cambrian in age. In southern India the group occurs in the Cuddapah basin and between Belgaum and Kaladgi. It covers a wide area in Madhya Pradesh and it forms most of the northern border of the peninsular massif overlooking the Indo-Gangetic plain. Some failure to conform has been recognized in the group and various local subdivisions have been made; but in the absence of fossils the correlation of rocks in widely separated areas is necessarily open to doubt. Two points of general interest may be noted. In the first place, although both the Cuddapah and the Vindhyan systems are often undisturbed, yet in places the former has been strongly folded: along the eastern margin of the Cuddapah basin, for example, the Cuddapah beds show strong overfolding and overthrusting toward the east, the trend of the folds being from north to south. If these beds are correctly referred to the pre-Cambrian there were certainly two great periods of mountain building in pre-Cambrian times, separated by a long interval, the first one being post-Dharwar and pre-Cuddapah and the second post-Cuddapah and pre-Vindhyan.

The second point of general interest is that all the most famous diamond deposits, such as those of Karnul in southern India and of Pannah in Bandelkhand, belong to the upper Vindhyan system. The diamonds usually occur in sandstone or conglomerate and have evidently been carried by water in the same way as other pebbles. No diamond-bearing igneous rock like that of Kimberley has been found, and the original source from which the diamonds have been derived is unknown, though certain igneous rocks have been suspected.

The Gondwana System. — The Gondwana system is the most important and interesting set of beds in India. Outside the peninsula, for example in Assam, coal is found chiefly in the Eocene, but in the peninsula all the principal coal seams lie in the Lower Gondwana series. The Gondwana beds occur in strips which are let into the foundation of older rock by faults. These strips, which may be continuous or broken, show a close connection with the lines of existing rivers and probably by their comparative softness determined the courses which the rivers took. There is, for example, a series of Gondwana patches along the Damodar and a more continuous strip roughly parallel to the Mahanadi. These two strips unite into a broad triangular area traversed by the Son. Another strip is associated with the Godavari.

The Gondwana system consists chiefly of sandstones, shales and clays, with seams of coal in the lower division. For the most part the deposits are entirely of terrestrial origin, but in Cutch and at several places along the Coromandel coast marine beds are interstratified toward the top. The fossils found in these marine

bands are of Upper Jurassic age. In general, however, plants are the predominant fossils. with reptiles! crustacea and freshwater fish locally. The Lower Gondwana is characterized by ferns of the *Glossopteris* type and by Equisetaceae, the Upper Gondwana by the prevalence of Cycadaceae. The lowest subdivision of the Gondwana system is known as the Talcher series and near its base is a remarkable clay with striated boulders) now universally admitted to be of glacial origin. In its lithology, fauna and flora the Gondwana system of India is remarkably like the Karroo system of South Africa, and it was this resemblance that led Eduard Suess and Georg von Neumayr to the conception of "Gondwanaland." It should, however: be pointed out in passing that the *Glossopteris* flora has a much wider distribution than was originally supposed and extends into northern Asia and the U.S.S.R.

The chief interest of the Indian Cretaceous lies in the evidence that it affoids for a former connection between India and South Africa. The marine Cretaceous of the Indian peninsula belongs entirely to the Upper division of the system. A number of detached outcrops occur along the valley of the Sarbada from the town of Bagh in Madhya Bharat, past Baroda, to Wadhwan in Saurashtra. In the south of India there is a Cretaceous area of zoo or 300 sq.mi. in Trichinopoly district and smaller patches near Pondicherry and Viruddhachalam. By far the greater number of species which have been obtained from the Narbada Cretaceous occur also in Europe, but only about a third of them have been found in southern India. On the other hand: only about a sixth of the numerous species which have been found in the south Indian Cretaceous occur in Europe. Moreover, there are Cretaceous beds in Assam and nearly all the species found there are southern Indian forms. Finally, many of the Assam and south Indian species occur also in South Africa. Hence it has been concluded. that in Upper Cretaceous times the Narbada area lay in a northern sea which stretched into Europe, while Assam and the southeast border of India lay in a southern sea which extended to South Africa. Between these seas a land mass stretched from Africa to India.

The Deccan Trap.—The Deccan trap is an extensive series of basaltic laval flows, with a total thickness of several thousand feet, which covers an area of about 250,000 sq.mi. in the northwestern quadrant of the peninsula. Along the west coast it reaches the sea without any diminution in thickness from about 21° N. to 16° N., and since the lavas are certainly subaerial it is clear that at the time of their eruption the land must have extended much farther to the west than it does now. The flat-topped hills and deep-cut valleys characteristic of the Deccan trap area are well shown on the route to Bombay, either from Calcutta or Madras. In spite of the great extent of these lavas there is very little indication of volcanoes, and it is believed that the eruptions took place from fissures, with little explosive action. The duration of the eruptions cannot be determined with certainty. Probably they began during the later part of the Cretaceous period but may have continued into the Eocene.

The Tertiary beds of the peninsula are insignificant. Near the west coast there are a few small outcrops in Travancore. Gujarat and the Kathiawar peninsula (Saurashtra) and a more complete sequence in Cutch. On the east coast the Cuddalore series, ranging in age from Eocene to Pliocene, occurs in patches from Orissa to the southern extremity of the peninsula.

The most interesting of the recent deposits in India is laterite (*q.v.*), which caps many of the hills and plateaus of the Deccan trap area and is also found extensively at a lower level both upon the western and the eastern border of the peninsula. It is a surface formation caused by the weathering characteristic of regions where temperature and humidity are high enough.

Laterite owes its prominence to the fact that, though comparatively soft when first quarried, it hardens on exposure and after hardening often resists erosion more strongly than the rocks on which it rests.

(P. LA.)

BIBLIOGRAPHY.—The official *Manual of the Geology of India* (Calcutta) is useful. *See* also T. *H*. Holland, *Geology*, vol. i of the *Imperial Gazetteer of India* (Calcutta, 1907); D. N. Wadia, *Geology of India, for Students*, 3rd ed. (London, New York, 1953). A general geological map of India, scale 1 in. = 32 mi., is published by the Geological Survey.

CLIMATE

Regional Climate.—The subcontinent of India, with its lofty mountain ranges behind and its extensive seaboard exposed to the violence of the winds of two oceans, forms an exceptionally valuable field for the study of meteorological phenomena.

From the gorge of the Indus to that of the Brahmaputra, a distance of 1,400 mi., the Himalaya form an unbroken watershed. The average elevation of the Himalaya crest may be taken at not less than 19,000 ft. and therefore equal to the height of the lower half of the atmosphere; and indeed few of the passes are below 16,000 or 17,000 ft.

Across this mountain barrier there appears to be a constant flow of air, more active in the daytime than at night, northward to the arid plateau of Tibet.

At the foot of the great mountain barrier, which it separates from the more ancient land that now forms the highlands of the peninsula, a broad plain, for the most part alluvial, stretches from sea to sea. In the midwest of this plain is a dry region occupied partly by the alluvial deposits of the Indus and its tributaries and the saline swamps of Cutch. partly by the rolling sands and rocky surface of the desert of western Rajasthan and the more fertile tracts to the eastward watered by the Luni. Over the greater part of this region rain is of rare occurrence; and not infrequently more than a year passes without a drop falling on the parched surface. On its eastern margin, however, in the neiphbourhood of the Aravalli hills, and again in the northern Punjab, rain is more frequent, occurring both in the southwest monsoon and also at the opposite season in the cold weather.

The alluvial plain which lies north of the desert area and is traversed by the Indus and its tributaries passes into that of the Gangetic valley without visible interruption. Up or down this plain, at opposite seasons, sweep the rain-bearing monsoon winds, in a direction at right angles to that of their nominal course. Nearly the whole surface of the Gangetic plain is under cultivation, and it ranks among the most productive as well as the most densely populated regions of the world. The rainfall diminishes from 100 in. in its southeast corner to less than 30 in. at Agra and Delhi, and there is an average difference of from 15 to 25 in. between the northern and southern borders of the plain.

From the Bengal delta at its eastern extremity, two alluvial plains stretch up between the hills which connect the Himalayan system with that of Burma. The first, or the valley of Assam and the Brahmaputra, is long and narrow, bordered on the north by the Himalaya, on the south by the lower plateau of the Garo, Khasi and Naga hills. The other, short and broad and in great part occupied by swamps, separates the Garo, Khasi and Naga hills from those of Tripura and the Lushai country. The climate of these plains is damp and equable, and the rainfall is prolonged and generally heavy, especially on the southern slopes of the hills.

The peninsula area of India, cut off from the encircling ranges by the broad Indo-Gangetic plain, is divided into two unequal parts by the Vindhyas, an amalgam of several hill systems running almost continuously across the country from west by south to east by north, just south of the Tropic of Cancer. The waters to the north of this watershed drain chiefly into the Narbada and the Ganges, those to the south into the Tapti, the Mahanadi, the Godavari and some smaller streams. Together with the two parallel valleys of the Narbada and Tapti, which drain the flanks of its western half, this mass of hills gives, at opposite seasons of the year, a decided easterly and westerly direction to the winds of that part of India and condenses a tolerably copious rainfull during the southwest monsoon.

The peninsula south of the Vindhyas consists chiefly of the triangular plateau of the Deccan, terminating abruptly on the west in the Sahyadri range (Western Ghats) and shelving to the east (Eastern Ghats). This plateau is swept by the southwest monsoon, but not until it has surmounted the western barrier of the Ghats; and hence the rainfall is, as a rule, light at Poona and places similarly situated under the lee of the range and but moderate over the more easterly parts of the plateau. The rains, however, are prolonged about three or four weeks later than in tracts to the north of the Vindhyas, since they are also brought by the easterly

winds which blow from the Bay of Bengal in October and the early part of November, when the recurved southerly mind ceases to blow up the Gangetic valley and sets toward the southeast coast.

At the junction of the Eastern and Western Ghats rises the bold triangular plateau of the Nilgiris, and to the south of them come the Anamalais, the Palnis and the hills of Travancore. These ranges are separated from the Nilgiris by a broad depression or pass known as the Palghat gap, about 25 mi. wide, the highest point of which is only 1,500 ft. above the sea. This gap affords a passage to the winds which elsewhere are barred by the hills of the Ghat chain. The country to the east of the gap receives the rainfall of the southwest monsoon. In the strip of low country that fringes the peninsula below the Ghats the rainfall is heavy.

The Seasons.—Within the Indian subcontinent almost any extreme of climate that is known to the tropics or the temperate zone can be found. It is influenced from outside by two adjoining areas. On the north the Himalaya range and the plateau of Afghanistan give it a continental climate; on the south the ocean gives it an oceanic climate. The continental type of weather prevails over almost the whole of India from December to May, and the oceanic type from June to November, thus giving rise to the two great divisions of the year, the dry season, of northeast monsoon, and the rainy season, or southwest monsoon. India thus becomes the type of a tropical monsoon climate.

The Indian year may be divided into four seasons: (1) the cold season, including the months of January and February; (2) the hot season, comprising the months of March, April and May; (3) the southwest monsoon period, including the months of June, July, August, September and October. and (4) the retreating monsoon period, including the months of November and December. The temperature is nearly constant in southern India the whole year round, but in northern India the variation is very large.

In the cold season the mean temperature averages about 30° F. lower in the Punjab than in southern India. In the Punjab, the Uttar Pradesh and northern India generally the climate from November to February resembles that of the Riviera, with a brilliant cloudless sky and cool dry weather. The hot season begins about the middle of March, when there is a steady rise in temperature, until the break of the rains in June. In May the highest temperatures are found in the East Punjab, Delhi and Rajasthan.

The southwest monsoon currents usually set in during the first fortnight of June on the Bombay and Bengal coasts (though they linger on their way upcountry) and give more or less general rain in every part of India during the next three months. But the distribution of the rainfall is very uneven. Overlooking the Bay of Bengal, where the mountains catch the masses of vapour as it rises off the sea, the rainfall is enormous At Cherrapunji in the Khasi hills the rainfall averages 428 in. a year. The Bombay monsoon leaves with very little rain a strip 100 to 200 mi. in width in the western Deccan parallel with the Ghats, and it is this part of the Deccan, together with the Mysore tableland and the Carnatic, that is most subject to drought. Similarly the Bengal monsoon passes by the Coromandel coast and the Carnatic with an occasional shower, taking a larger volume inland and abundant rain to Assam and Cachar. The same current also supplies with rain the broad band across India, which includes the Vindhyas, Chota Nagpur, the greater part of Madhya Pradesh and central India, Orissa and Bengal. Rainfall rapidly diminishes to the northwest from that belt. A branch of the Bombay current blows pretty steadily through Rajasthan to the Punjab, carrying some rain to that area now divided between Pakistan and India. But the greater part of the northwest (which lies in Pakistan) is served as a rule by cyclonic storms between the two currents. In September the force of the monsoon begins rapidly to decline, and in its rear springs up the gentle steady northeast monsoon, which gradually extends over the Bay of Bengal. A wind similar in character, but rather more easterly in direction, simultaneously takes possession of the Arabian sea. The most unhealthful season immediately follows the rains, when malaria is prevalent, especially in the north. Later the sharp contrast between day and night temperatures at the outset and end of the cold weather in the north, encourages pulmonary diseases. (ME.; X.)

See W G Kendrew, *Climates of the Continents*, 4th ed. (London, New York, 1953); H F Blanford, *The Climate and Weather of India, Ceylon and Burmah* (London, 1889).

FLORA

The Indian subcontinent has no botanical features peculiar to itself; its flora is compounded out of those of the adjoining countries. In the mountainous region in the extreme northwest many European and Siberian forms occur. while the northeast displays the influence of western China. The south of the peninsula and Ceylon show distinct affinity with Malaya and to a certain extent with east Africa. Burma, while akin to India, has a strong Malayan bias. The nhole area is divisible into three primary botanical sections: (1) Himalayan, (2) western and (3) eastern. These, however, are by no means homologous and are susceptible of further subdivision. They are best considered under the following six main botanical regions.

The Western Himalayan Region.—The region consists of the western portion of the Himalaya from Chitral to Kumaon and covers a vast depth from north to south, embracing a series of parallel snow-clad ranges. Toward the south the vallevs are narrow and tortuous; northward they are more open and tend to form elevated tablelands which merge into the great Tibetan plateau. The predominant families are Gramineae. Leguminosae, Cyperaceae, Labiatae. Ranunculaceae, Orchidaceae. Cruciferae, Rosaceae and Scrophulariaceae, showing a definite western influence, more especially at the higher levels. In the south subtropical trees and shrubs intrude, such as *Boswellia* and *Holoptelea*. The oaks are few and among them is the European holm oak (*Quercus ilex*). Of conifers are found the *Cedrus deodara, Pinus longifolia, Pinus excelsa, Abies pindrow, Cupressus torulosa, Juniperus macropoda* and in the drier localities *Pinus geradiana*

The Eastern Himalayan **Region.**—The remainder of the Himalayan range falls into the next region, which is narrower from north to south and has a lower average level. Tropical forms there are more numerous and there is a definite Chinese influence The dominating families are Orchidaceae, Gramineae, Leguminosae, Compositae, Cyperaceae, Urticaceae (in the wide sense). Scrophulnriaceae, Rosaceae, Rubiaceae and Euphorbiaceae A number of oaks and *Castanopsis* and a large number of rhododendrons characterize the region as do also many species of *Prmula* and *Meconopsis*. The deodar hardly occurs at all and few of the conifers of the last region; they are replaced by *Abies webbiana, Picea morinda, Larix griffithii, Tsuga brunoniana* and two species of *Juniperus*. Tree magnolias are conspicuous and the tropical influence is emphasized by the presence of numerous species of *Impatiens* and orchids.

The Indus Plain Region.—The Punjab, Sind, Rajasthan west of the Aravalli hills, Cutch and northern Gujarat make up the region Over the greater part arid conditions prevail with a very low rainfall and a scanty vegetation which approaches extinction in the Indian desert. Tree growth is comparatively rare and stunted; the vegetation is mainly herbaceous and is burnt or dried up in the hot season Thorny species are conspicuously numerous. The dominant families are Gramineae. Leguminosae, Compositae, Cyperaceae Scrophulariaceae, Labiatae, Boraginaceae, Malvaceae, Euphorbiaceae and Convolvulaceae. Characteristic among the shrubs and undershrubs are *Fagonza arebica,* thorny species of *Capparis* and *Zizyphus* and *Calotropis*. There are two indigenous palms, *Phoenix sylvestris* and *Nannorrhops ritchieana,* and one bamboo, *Dendrocalamus strictus*.

The Gangetic Plain Region.—Extending from the Aravalli hills eastward to the Bay of Bengal, the region comprises all the tract from the Himalayan foothills to the low country of Orissa. There are considerable variations in the vegetation of its different parts, all of nhich are far more humid than the last region. The dominant families are Graminae, Leguminosae, Cyperaceae, Compositae, Scrophulariaceae, Malvaceae. Xcanthaceae, Euphorbiaceae, Convolvulaceae and Labiatae. The deltas of the Ganges and the Brahmaputra consist of a number of islands uhich support a dense evergreen forest of trees and shrubs in which the mangroves predominate. A valuable timber tree, the sal *(Shorea robustu),*

is almost confined to that region.

The **Malabar** Region. — The region occupies a wet zone of mountainous country with a narrow strip of low land between it and the west coast running from Gujarat to Travancore. Its highest peaks attain to a little short of 9,000 ft. in elevation. The vegetation generally is very luxuriant and mainly evergreen and approaches the Malayan type. Dense evergreen forests with thick cane *(Calamus)* brakes and bamboo thickets are characteristic. On the higher hills are found wide expanses of grassy downs dotted with patches of evergreen woods, the remnants of former extensive forests left clinging to the sides of ravines and depressions. In the moderately wet areas below 2,000 ft., the teak, *Tectona grandis,* attains to very large dimensions, growing mixed with a number of other large and valuable timber trees—*Dalbergia, Pterocarpus, Terminalia, Lagerstroemia*—and with *Bambusa arundinacea.* In the wetter forests at moderate elevations Anonaceae, *Garcinia,* Dipterocarpaceae, *Mesua ferrea, Calophyllum, Cullenia,* many Rubiaceous trees, shrubs and herbs, Euphorbiaceae. *Ficus, Artocarpus* and Zingiberaceae occur as does also a single conifer, *Podocarpus latifolius,* and a number of palms and numerous ferns. In the low-lying swampy localities *Pandanus* and several Araceae are noticeable. At higher elevations many Acanthaceous shrubs: particularly of the genus *Strobilanthes,* are prominent and among the trees species of *Elaeocarpus,* many *Eugenias* and a tree Composite — Vernonia *monosis.* Epiphytic orchids are fairly numerous and tree ferns appear here and there. Among the grasses of the downs at elevations of more than 6,000 ft. are numerous herbs and undershrubs of *Impatiens,* Leguminosae, Umbelliferae, Rubiaceae, Compositae, terrestrial orchids, Liliaceae. Commelinaceae and patches of the bracken fern.

The Deccan Region. — The whole of the peninsula south of the Ganges valley and east of the Western Ghats is comprised in the region. With the exception of a belt of dry-evergreen, low jungle along part of the east coast? characterized by species of *Capparis, Pterospermum, Eugenia, Ixora, Mimusops, Diospyros* and *Strychnos,* the vegetation is mainly deciduous and much of it is thorny. Leguminosae occupy a conspicuous place; other prominent families, besides the ubiquitous Gramineae, are Tiliaceae, Rhamnaceae, Rubiaceae, Asclepiadaceae, Convolvulaceae and Euphorbiaceae, with large areas occupied almost exclusively by one or other of the two common bamboos, *Bambusa arundinacea* and *Dendrocalamus strictus.* On dry rocky hillocks *Givotia rottleriformis, Sterculia urens, Gyrocarpus jacquinii, Cochlospermum gossypium, Cassia fistula* and *Euphorbia antiquorum* claim attention. Along the coast and in the semidesert sandy tract in the extreme south the Palmyra palm, *Borassus flabellifer,* forms dense groves and thickets; similar aggregations of another palm, *Phoenix sylvestris,* occur inland. The true sandal ood, *Santalum album,* is found in the south central part.

The chief cultivated plants of India include rice, wheat, many pulses and grains; castor, sesame and peanut oilseeds; fruit trees such as the mango, citrus fruits and coconut, palmyra and arecanut palms; and apples, pears, peaches, apricots, walnuts in the Himalayan valleys. Tea plantations cover large areas in the north as well as in the south Indian mountains; and in the latter are also extensive coffee, rubber, cardamom and pepper gardens. Rubber is also grown in the north. In several damp localities cinchona is successfully grown. (c. E. C. F.j

See H. G. Champion, *A Preliminary Survey of the Forest Types of India and Burma* (Delhi, *1936)*; C. Chakravarti, *The Common Indian Plants* (Calcutta, *1938)*; *J. F. Dastur, Useful Plants of India and Pakistan* (Bombay, 1951).

FAUNA

Mammals. — The lion *(Felis leo)* was not uncommon within historical times in Hindustan proper and the Punjab. A peculiar variety, often described incorrectly as maneless. is preserved in the Gir, or rocky hill-desert and forest of Saurashtra. It is protected by law and its stock was improved by the import of east African lions for breeding purposes.

The tiger *(Felis tigris)* is found in every part of the country, from the slopes of the Himalaya to the Sundarbans swamps. The average length of a tiger from nose to tip of tail is g ft. to 10 ft. for males, and 8 ft. to 9 ft. for tigresses, but a tiger of 12 ft. 4 in. has been shot. The advance of cultivation. even more than the incessant attacks of sportsmen, reduced numbers, but extermination remained unlikely. The malarial Tarai fringing the Himalaya, the uninhabitable swamps of the Gangetic delta and the wide jungles of the central plateau are the chief home of the tiger. His favourite food appears to be deer, antelope and wild hog. When these abound, he will disregard domestic cattle. Indeed, the Indians are disposed to consider him as in some sort their protector since he saves their crops from destruction by the wild animals on which he feeds. But he may develop a taste for human blood, and the confirmed man-eater, generally an old beast disabled from overtaking his usual prey, seems to accumulate victims from instinct rather than for food. A favourite mode of shooting the tiger is from elevated platforms (machans).

The leopard or panther *(Felis pardus)* is everywhere far more common than the tiger and at least equally destructive of life and property. Its greatest length is about 7 ft. 6 in. A black variety, as beautiful as it is rare, is sometimes found in the extreme south of the peninsula, as also in Java. The cheetah, or hunting leopard *(Acinonyx jubatus),* found only on the Deccan, is trained for hunting antelope. The' cheetah's limbs are long, its hair rough and its claws blunt and only partially retractile. Other cats are the ounce, or snow leopard *(Felis uncia),* the clouded leopard *(Felis nebulosa),* the marbled tiger cat *(Felis marmorata),* the jungle cat *(Felis chaus)* and the viverrine cat *(Felis viverrina).*

Wolves *(Canzs lupus)* abound in open country preying on sheep, but are said to run down or ambush antelopes and hares. The Indian wolf has a dingy reddish-white fur, some of the hairs being tipped with black. By some naturalists it is regarded as a distinct species, *Canis pallipes.* Three distinct varieties, the white, red and black wolf, are found in the Tibetan Himalaya. The Indian fox *(Vulpes bengalensis)* is comparatively rare. but the jackal (*Canis aureus*) abounds. The wild dog, or dhole *(Cuon dukhunensis),* is found in all the wilder jungles. Its characteristic is that it hunts in packs, sometimes comprising 30 dogs, and is mute. Among other dogs are the pariah, which is merely a mongrel, running wild and half starved; the poligar dog. an immense creature peculiar to the south; the greyhound. used for coursing; and the mastiff of Tibet and Bhutan. The striped hyena *(Hyaena striata* or *hyaena)* is common, being found wherever the wolf is absent. Like the wolf, it is very destructive.

Of bears, the common black or sloth bear *(Melursus labiatus)* is common wherever rocky hills and forests occur. It is distinguished by a white horseshoe mark on its breast. Its food consists of ants. honey and fruit. When disturbed, it will attack man, and it is a dangerous antagonist for it always strikes at the face. The Himalayan or Tibetan sun bear (*Ursus malayanus*) is found along the north, from the Punjab to Assam. During the summer it remains high up in the mountains. near the limit of snow, but in the winter it descends to 5,000 ft. and even lower.

The elephant (*Elephas indicus*) is now, at any rate, an inhabitant not of the plains but of the hills; and even on the hills it is found usually among the higher ridges and plateaus and not in the valleys. From the peninsula of India the elephant was gradually exterminated, being found now only in the primaeval forests of Coorg, Mysore and Travancore and in Orissa. It still exists in places along the Tarai, or submontane fringe of the Himalaya. The main source of supply is the northeast transition zone from Assam to Burma. Two varieties are there distinguished, the gunda, or tusker, and the makna, or hine, which has no tusks. The maximum height is probably 12 ft. The elephant must be hunted on foot. A law regulates the licensing of hunting.

Of the rhinoceros, three distinct varieties are enumerated, two with a single and one with a double horn. Most familiar is *Rhinoceros unicornis,* commonly found in the Brahmaputra valley. It has one horn and is covered with massive folds of naked skin. It sometimes attains a height of 6 ft.; its long horn is much prized by natives for medicinal purposes. The Javan rhinoceros *(Rhinoceros sondaicus).* found in the Sundarbans, also has but one horn and mainly differs from *Rhinoceros unicornis* in being smaller and having less prominent "shields." The Sumatran rhinoceros *(Rhi-*

noceros or *Ceratorhinus sumatrensis*), found from Chittagong southward, has two horns and a bristly coat.

The wild hog (*Sus cristatus*) is well known. It frequents cultivated situations and is the most mischievous enemy of the villager. A rare animal, called the pygmy hog (*Sus salvanius*), exists in the Tarai of Nepal and Sikkim and has been shot in Assam. Its height is only 10 in. and its weight does not exceed 12 lb. The wild ass (*Equus hemionus*) is confined to the sandy deserts of Sind and Cutch, where it is almost unapproachable.

Many wild species of the sheep and goat tribe are to be found in the Himalayan ranges. The *Ovis ammon* and *Ovis poli* are Tibetan rather than Indian species. The urial and the skapu are kindred species of wild sheep (*Ovis vignei*), found respectively in Ladakh and the Sulaiman ranges. The former comes down to 2,000 ft. above the sea. the latter is never seen below 12,000 ft. The bharal, or blue wild sheep (*Pseudois nahura*), and the markhor and tahr (both wild goats) also inhabit the Himalaya. A variety of the ibex is also found there, as well as in the highest ranges of south India. The serow (*Naemorhedus sumatraensis*), allied to the chamois, inhabits the northern mountains.

The antelope tribe is represented by comparatively few species, as compared with the great number peculiar to Africa. The antelope proper (*Antilope*), the "black buck" of sportsmen, is very generally distributed. Its special habitat is salt plains, as on the coast line of Gujarat and Orissa, where herds of 50 does may be seen, accompanied by a single buck. The doe is of a light fawn colour and has no horns. The colour of the buck is a deep brown-black above. sharply marked off from the white of the belly. His spiral horns, twisted for three or four turns like a corkscrew, often reach a length of 30 in. The flesh is dry and unsavoury but is permitted meat for Hindus, even of the Brahman caste. The nilgai, or blue cow (*Boselaphus tragocamelus*), is also widely distributed, but especially abounds in Hindustan proper and Gujarat. As with the antelope, the male alone has the dark blue colour. The nilgai is held peculiarly sacred by Hindus from its fancied kinship to the cow. The four-horned antelope (*Tetraceros quadricornis*) and the gazelle (*Gazella bennetti*), the chikara or "ravine deer" of sportsmen, are also found in India.

The sambar or jarau (*Cervus aristotelis*) is found on the forest-clad hills in all parts. It is deep brown, with hair on its neck almost like a mane; and it stands nearly 5 ft. high, with spreading antlers nearly 3 ft. in length. Next in size is the swamp deer or barasingha, signifying "12 points" (*Rucervus duvaucelli*), common in lower Bengal and Assam. The chital or spotted (axis) deer (*Cervus axis*) is generally admitted to be the most beautiful inhabitant of the Indian jungles. Other species include the hog deer (*Cervus porcinus*), the barking deer or muntjac (*Cervulus muntjac*) and the chevrotain or mouse deer (*Tragulus meminna* or *kanchil*). The musk deer (*Moschus moschiferus*) is confined to Tibet. The gaur (*Bos gaurus*), the "bison" of sportsmen, is found in the hill jungles, in the Western Ghats, in central India and in Assam. This animal sometimes attains a height of 20 hands (about 7 ft.), measuring from the hump above the shoulder. Its short curved horns and skull are enormously massive. Its colour is dark chestnut or coffee brown. From the difficult nature of its habitat and from the ferocity with which it charges an enemy, the pursuit of the bison is no less dangerous and exciting than that of the tiger or the elephant. Akin to the gaur, though not identical, is the gayal, or mithun (*Bos frontalis*), confined to the hills of Assam, where it was domesticated for sacrificial purposes by the aboriginal tribes. The wild buffalo (*Bos bubalus*) differs from the tame only in being larger and fiercer. The finest specimens come from Assam. The horns of the bull are thicker than those of the cow, but the horns of the cow are larger; in the domestic kind they are often of irregular form. A head has been known to measure 13 ft. 6 in. in circumference and 6 ft. 6 in. between the tips. The greatest height is 6 ft. 6 in. at the shoulder. The colour is a slaty black; the hide is immensely thick, nith scanty hairs. The domestic variety is the ungainly "water buffalo," familiar as a draught animal throughout the subcontinent. During the heat of the day it likes to stand in water with only its nostrils showing. The cow gives nutritious if, to western palates, oddly flavoured milk.

The rat and mouse family is only too numerous. The loathsome bandicoot (*Nesokia bandicota*), which sometimes measures 2 ft. in length, including its tail. and weighs three pounds. burrows under houses and is very destructive to plants, fruit and even poultry. More interesting is the tree mouse (*Dendromus*). about 7 in. long. which makes its nest in palms and bamboos. The field rats (*Mus mettada*) occasionally multiply so exceedingly as to diminish the out-turn of the local harvest.

Birds.—The ornithology of India is not considered so rich in specimens of gorgeous and variegated plumage as that of other tropical regions. The parrot tribe is the most remarkable for beauty. Four vultures are found. including the common scavengers (*Gyps indicus* and *Pseudogyps bengalensis*). The eagles comprise many species, but none to surpass the golden eagle of Europe. Of falcons. there are the peregrine (*Falco peregrinus*), the shaheen or royal falcon (*Falco peregrinator*) and the lagar (*Falco jugger*), which are all trained by the Indians for hawking; of hawks, the shikra (*Astur badius*), the goshawk (*Astur palumbarius*) and the sparrow hawk (*Accipiter nisus*). Ringfishers of various kinds and herons are sought for their plumage. The mynah (*Acridotheres tristis*), a member of the starling family, lives contentedly in a cage and talks well. Snipe (*Gallinago caelestis*), pigeons, partridges, quail. plover, duck, teal, sheldrake, widgeon—all of many varieties—make up the list of small game. The red jungle fowl (*Gallus ferrugineus*), supposed to be the ancestor of domestic poultry, is not good eating; and the same may be said of the peacock (*Pavo cristatus*).

Reptiles.—Serpents intrude into gardens and dwellings, especially in the rainy season. The cobra de capello, the name given by the Portuguese to *Naja tripudians* from the appearance of a hood produced by the expanded skin about the neck, is the most dreaded. The Russelian snake (*Vipera russelli*), about 4 ft. in length, is pale yellowish-brown, beautifully variegated with large oval spots of deep brown with a white edging; its bite is fatal, as is that of the krait (*Bungarus coeruleus*). Salt-water snakes in India are poisonous; fresh-water forms are innocuous.

Other reptiles include two species of crocodile (*Crocodilus porosus* and *C. palustris*) and the gavial (*Gavialis gangeticus*), all more ugly than destructive. Lizards and scorpions abound.

Fish.—Among edible Indian fish, the Cyprinidae, or carp, and the Siluridae, or catfishes, are best represented. From the angler's point of view, by far the finest fish is the mahseer (*Barbus mosal*), a species of barbel, found in all hill streams, whether in Assam, the Punjab or the south. One of the richest and most delicious of Indian fishes is the hilsa (*Clupea ilisha*). Fish are eaten as nearly fresh as may be, for the practice of curing or refrigerating them is rather exceptional.

Insects.—Mosquitoes are innumerable, as are moths and ants of the most destructive kind, especially the white ant and "fish insect," together with others equally noxious and disagreeable. Useful insects are the bee, the silkworm and the insect that produces lac. Clouds of locusts which leave no green thing behind occasionally appear. There are many beautiful butterflies.

See K. *N*. Bahl, *Indian Zoological Memoirs* (Lucknow, 1926 ff.); Indian Zoological Survey, *Annual Report* (Calcutta, 1917 ff.); S. *A*. Ali, *Book of Indian Birds*, 5th ed. (London, 1955).

HISTORY

Prehistoric India.—The history of India, in so far as it is attested by literary documents, begins shortly after the invasion of northwestern India by those Aryan tribes who established in the subcontinent a unifying civilization and a tradition of culture which, in spite of profound modifications and changes, maintained through the ages an unbroken continuity. The nature of our sources does not permit any accurate dating of this event, but a general consensus of opinion, based on such evidence as is available, places it about the middle of the 2nd millennium B.C. or in the centuries immediately following. The country invaded by the Aryans mas already occupied by numerous and various populations, some of whom possessed a material culture superior to that of the invaders. Of this early prehistoric period some information can be derived from the study of linguistics and ethnogra-

phy, while in the case of the northwest the work of modern archaeology revealed rich civilizations hidden for millennia beneath the soil.

Two important pre-Aryan linguistic families have preserved themselves against the Aryan inundation: the Munda, or Kolarian, and the Dravidian. It is interesting that these linguistic families too, no less than the Aryan, can be shown to be of extra-Indian origin. their introduction to India having taken place at a period prior to the invasion of the Aryans which it is not possible to specify. The Kolarian languages exhibit unmistakable signs of affinity with Mon, Khmer and a large group of other languages which are found in southeast Asia, and it is clear that their presence in India is due to a migration of peoples from the east at an early time. On the other hand, the Dravidian languages, like the Aryan, appear to have been introduced from the northwest; and the isolated Dravidian language Brahui still remains in Baluchistan as a pointer in this direction. Striking resemblances in vocabulary between Dravidian and the Finno-Ugrian languages confirm this northwestern origin. In the extreme northwest the isolated Burushaski represents yet another extraneous element of unknown origin; and the traces of others may have perished in the course of time.

The conclusions of ethnography correlate themselves only vaguely with the conclusions of linguistics, since populations have mixed with each other and changed in their environment during the ages. Nevertheless, the gradual change of colour from light to dark as we move south fits in well with a pattern of invasion which gradually pushed the original populations before it. In isolated mountain regions of the south there exist small groups of tribes who have maintained their identity from pre-Dravidian times. In general it may be said that the ethnographer's material takes him back to periods long antedating the linguistic invasions which we have been led to assume.

The investigations of archaeologists revealed traces of man in India from early Palaeolithic times onward, but the materials are not numerous enough to establish. on the European model, any sequence of cultures or any approximate dating. It is only when we come nearer historic times, and that in northwest India, that the results of archaeology can be used to any great extent for historical purposes.

Excavations beginning in 1922 at Harappa and Mohenjo-Daro brought to light the existence of a hitherto unsuspected civilization, antedating the Aryan period and not inferior in achievement to the contemporary civilization of Mesopotamia. Like the latter, the Indus civilization, as it is called from the site of its two great cities, is essentially an urban civilization; and in this respect it differs markedly from what we know of the Vedic Aryans. It is also clear from the finds that it was a civilization devoted extensively to trade and commerce, and there is evidence from both sides of lively intercourse of this kind between the Indus and Mesopotamia. It is from this contact that it has been found possible to date the civilization approximately, since numbers of objects of Indus origin have been unearthed in datable strata of the Mesopotamian cities. According to this evidence and from calculations based on the excavation of the Indus cities themselves, the flowing period of this civilization may be placed around 2300–2200 B.C.; and if, as the evidence seems to indicate, we allow a period of about 600 years for the whole course of occupation, the rough dates 2500–1900 B.C. may be provisionally established as the period of the Indus civilization.

Excavations revealed the cities as being populous and closely packed communities built round a citadel which served at the same time as the centre of government and religion and as a defense against enemies in time of war. Centralized arrangements for grain storage existed, and the water supply and drainage systems nere carefully and even elaborately organized. The material in nhich the cities were constructed were burnt red brick, and this stood the test of time well enough for the essential features of many structures to be still clear at the time of the excavations. Many indications point to the fact that the climate of the region was different from what it is now and wetter; and there is evidence of the presence of animals (tigers, etc.) which are not now found in the area. Of the many material remains some reach a high standard of artistic excellence and can be compared with anything found in contemporary civilizations. From artistic representations it is possible to form some idea of the religion of the people. In this the worship of a mother-goddess, as so frequently elsewhere, plays a prominent part; and as her consort there appears a deity who has some of the characteristics of the later Rudra-Siva.

Most interesting among the finds, but unfortunately not utilizable, is a fully developed system of writing. This appears mainly in impressions on seals and consequently includes no extended passages of text. If such existed they were on perishable material and have therefore not been preserved. In the absence of any bilingual passage (it is possible, in view of the connections with Mesopotamia, that such may one day be found), it has not been possible to decipher the script, which would enable us to identify the creators of this civilization. Of the many theories propounded none can be regarded as established, and the only thing that can be said with certainty is that they were different from the Vedic Aryans, whose civilization as revealed in the texts differs widely from theirs in almost every respect.

In addition to the civilization above described, other cultures either immediately preceding or immediately following were discovered. Of these cultures, which are named after the places where they were first revealed. the Amri culture precedes Harappa and Mohenjo-Daro and the Jhukar and Jhangar cultures follow in that order Less developed than the Indus civilization proper and without a system of writing, they appear, from material evidence to have connections with Iran. But anything that would connect these cultures with the Aryans is lacking, just as in the case of the great Indus civilization.

ANCIENT HISTORY

The invasion of India by Aryan tribes from the northwest inaugurates the historical period proper. The oldest literary document of India was composed in the period immediately following this event, when the invading tribes were still battling in the Punjab and the adjacent regions for possession of the land. The date of these events can be reached only by approximate calculations. The close linguistic connection between Vedic Sanskrit and the ancient Iranian language of the *Avesta* argues against too long a period of separation; and the literary and linguistic evolution of Sanskrit between the earliest hymns of the *Rig-Veda* and the period of Buddha and Mahavira (which can be dated *c.* 500 B.C.) indicates a considerable period, but definitely not the millennia in which the age of the *Vedas* is sometimes reckoned. A period of 600 years or at most 700 years from the earliest compositions of the *Veda* to the end of the Vedic period, about 500 B.C., is most commonly assumed. Behind this and at least some centuries earlier, since the early documents do not speak of it, lies the invasion. or rather the series of invasions, c. 1500 B.C. onward. The original home of the Aryans appears to have been southern Russia. from which they spread out in several directions. At a date roughly contemporary with that postulated for the beginning of the invasion of India, we find another group of Aryans in the near east ruling in the country of the Mitanni, where they were eventually absorbed into the native population. The Indo-Aryans and Iranians on the other hand moved eastward across the steppes, whence they proceeded to found their two great nations in India and Iran.

It has been pointed out that when the Aryans entered India they found it in the possession of peoples whose material civilization was in many respects superior to their own. The superiority of the invaders lay in political and military organization and in the technique of warfare. The *Rig-Veda* abounds in allusions to the bitter warfare between the invaders and the previous occupants of the country. Particularly numerous are the references to cities (pur) destroyed, the significance of which term was not fully appreciated until excavations unearthed the great Indus cities. At the same time. it is still not possible to say whether it was the Aryans who destroyed the Indus cities, or whether the cities destroyed had succeeded those of the Indus. The Aryans

themselves were a pastoral and agricultural people living mainly in villages and made no attempt to occupy the cities that they overcame; it was only centuries later, with the advance of civilization and prosperity, that the great historical cities of northern India began to arise.

The geographical horizon of the early Vedic period as depicted in the hymns of the Rig-Veda is fairly narrowly delimited. The centre is the Punjab, the land of the five rivers. To the west the frontier rivers (Gomal, Kurram, etc.) are known, and to the east Aryan tribes are found settled on the Sarasvati, a region which later counts as the most sacred land of Brahmanism. Mention of a battle fought on the banks of the Yamuna against non-Aryan tribes indicates the easternmost point of Aryan expansion at that period. Over that country the consolidation of Aryan power was first completed, and it is served as a base for the rapid occupation of the greater part of northern India in the succeeding centuries.

The later Vedic period, during which this process was achieved, may be placed between the 10th and 6th centuries B.C. The latest hymns of the Rig-Veda and also its final redaction date from the beginning of this epoch. The three other *Vedas*, Sama-, *Yajur-* and Atharva-, follow closely in time. After them there arose a large body of explanatory and commentatorial literature, the *Brahmanas,* devoted to the explanation of the sacred literature. Toward the close of the period the Aranyakas and, in particular, the *Upanishads* indicate a new philosophical approach and herald the beginnings of the intellectual revolution to come. None of this literature is devoted to history; and, though many rulers and their kingdoms are mentioned casually, it is rarely possible to fix their place in time. More information can be gathered from them about social and material conditions that prevailed in pre-Buddhist India The famous Purusasukta, one of the latest hymns of the Rig-Veda, proclaims for the first time the basic principles of the caste system—the division of society into the four "colours" (Varna), Brahmana, Kshatriya, Vaisya and Sudra The growth and increasing complication of this system is already apparent in the later Vedic texts and is progressively accentuated as the centuries go by.

Apart from the contemporary literature some information may be gathered from the great epic *Mahabharata* and the *Puranas.* The tradition of the former was founded in Vedic times, but since it was not established in its present form till 1,000 years later, it is not reliable as a detailed chronicle of events. The Puranas contain dynastic lists dealing with the major early kingdoms, which on the whole appear to be founded on sound tradition. Moreover, the early Buddhist literature—particularly the *Jatakas*—contains many references to kings of the late Vedic period whose historicity seems to be established.

The general picture that emerges from all this material is that of the continued expansion of Aryan pomer; of the establishment of a series of permanent kingdoms or states which retain their identity throughout the period and later; and of a gradual shift of the centre of gravity toward the east. After the Rig-Veda the region of the Punjab fades into the background. The centre of Aryan power becomes the land of the Kurus with their capital (*hastināpura*) near Delhi, with whom are closely associated the neighbouring Panchalas. It was there that the Brahman religion was finally consolidated, and it was there also that classical Sanskrit, which was to become the national language of India for 2,000 years, was evolved. It was the centre of an empire of the Kurus that was the chief political pomer in the early part of the period, its greatness being reflected after many centuries in the *Maha*bhauata. Some of its rulers are mentioned in contemporary literature, and a list is provided by the Puranas. Like its successors, the empire crumbled and vanished, so that a proverb current in the later Vedic period asked "What became of the descendants of Pariksit?"

Aryan expansion from that centre proceeded in two main directions and is reflected in the much wider geographical nomenclature of the later Vedic texts. The advance was steadily continued down the Ganges valley, and stable kingdoms arose in Kosala, Videha, Kasi and other centres. Magadha remained longer outside the Aryan pale, but a powerful dynasty was installed there by the end of the period. This expansion was associated with a shift of power to the east. and the later Vedic texts indicate that kingdoms of Kosala and Videha had replaced the Kurus and Panchalas as the most important centres of political power. Another road of expansion led southmest to Avanti (capital Ujjayini, modern Ujjain) and thence to the ports of the west coast, where trade with the near east was early established. It is probable that writing was first introduced into India by this route toward the close of the Vedic period. To the south the Xsmakas, Vidarbhas and allied tribes crossed the Vindhya and established Aryan rule in Maharashtra at an early date.

Kosala and Magadha.—Toward the close of the 6th century B.C. the Vedic period reaches its close in the face of the rise of new religions and ideologies which transformed the intellectual climate of the country. Gautama Buddha (563–483) and Vardhamana Mahavira (540–468) stand out among many teachers and reformers as the founders of religions which have survived to this day (see BUDDHA AND BUDDHISM; JAINS). Because of the interest that believers took in the lives of these two leaders, the history of India is for a short time illuminated by more than usual information.

The various states (*mahajanapadas*) which had been established in late Vedic times are enumerated in the Buddhist literature, and at that period there appears a tendency for the smaller to be incorporated in the greater. The most important states of the time were the eastern monarchies of Kosala and Magadha, which were not only the political centre of India at the time, but also the home of the new religious and intellectual ferment which was affecting the country. To the southwest lay the kingdom of the Vatsas ruled by Udayana, later to become famous in Indian legend; and to the southwest again Avanti was ruled by Pradyota the Fierce, a powerful and ruthless king. To the northwest the Kuru and Panchala countries maintained their identity; and on the extreme northwest of the Indo-Aryan territory lay the kingdom of Gandhara, soon to be incorporated, together with Sind, into the Persian empire. To the north of the hfagadhan and Kosalan kingdoms lay a series of aristocratic republics (Licchavis, Sakyas, etc.), from among which the founders of the new religions sprang.

The kingdom of Kosala (capital Sravasti). at that time ruled by Prasenajit, roughly a contemporary of Buddha, had already incorporated the older kingdom of Kasi, which in Vedic times had existed as an independent and power kingdom. To the north the expansive tendencies of the Kosalan kings tended to reduce the neighbouring republican tribes to the state of vassals. More important in the long run was the neighbouring kingdom of Magadha, whose expansion, already evident at that period. was destined to create the most extensive empire that ever held sway in ancient India. About 600 B.C. a new dynasty in that kingdom had been founded by Sisunaga; and a successor of his, Bimbisara (c. 550–490), held sway in the time of Buddha. He is represented as busily engaged in extending the frontiers of his kingdom, his most important acquisition being the annexation of the kingdom of Anga to the east. Bimbisara was followed by his son Ajatasatru; who .attained the throne by murdering him. Ajatasatru pursued his father's policy of expansion with the conquest of Videha and adjoining territories to the north. On the other hand, a war against Kosala seems to have been undecisive. Ajatasatru also founded a royal residence at Pataliputra (modern Patna). which was to become the premier city of northern India for centuries afterward. For the next century information from Buddhist and Jaina sources is almost completely lacking. From the *Puranas* we learn that the dynasty founded by Sisunaga continued to rule in Magadha; and we may be certain that this was a period of imperialist expansion, since when light again appears in the middle of the 4th century Magadha has outclassed all its rivals and emerges as the premier pomer of northern India. At that time the old dynasty was overthrown, and a usurper. Nanda, occupied the throne. At the time of Alexander's invasion of India (327–325) the major portion of the Ganges valley was under Nanda's dominion; and the occupation of considerable territories in the south appears attested by native tradition. The Magadhan army

consisted of 200,000 soldiers and a corresponding number of elephants, horses and chariots.

The Mauryas.—The dynasty of Nanda was short-lived. In 320 Chandragupta Maurya (*q.v.*), assisted by the Brahman Vishnugupta, or Chanakya, and by allies from the northwest of India, overthrew the sons of Nanda and established himself in Pataliputra. Once established, Chandragupta proceeded to expand the empire in every direction. The territories of the northwest conquered by Alexander were occupied by him; and in 305 Seleucus Nicator found it advisable to cede to him all the Indian territories up to Afghanistan in return for a treaty and a gift of 500 elephants. Chandragupta died *c.* 297 and was succeeded by his son Bindusara, about whom little is known though it is clear from the result that he was successful in the expansion and consolidation of the empire.

Bindusara's son Asoka (*q.v.*) (274–237) was the greatest and most celebrated of all Indian rulers. Of Asoka's reign we are well informed in his own edicts, which are engraved in stone in various parts of his vast empire, particularly in the frontier regions, so that an accurate idea of its boundaries can be gained. It is clear that the whole of India except the Tamil south was under the direct control of the Mauryan empire. Asoka himself undertook only one campaign of conquest, that of Kalinga (Orissa and the region to the south); afterward. distressed by the slaughter and misery involved, he renounced further ideas of conquest and devoted himself to the promotion of righteousness. He became an earnest adherent of Buddhism; and in his reign, if not at his instigation, a great council was held in Pataliputra to establish the tenets of the Buddhist religion and the organization of its members. Buddhist missionary activity dates from that period, and Asoka's own son Mahendra is credited with the conversion of Ceylon.

The Mauryan empire did not long survive Asoka. A number of his successors are mentioned in the Puranas and Buddhist literature, but it is not clear whether they reigned successively over the whole empire or over parts of it as it began to disintegrate. Finally, c. 185, Pushyamitra, commander in chief of the last Maurya, assassinated his master and founded the dynasty of the Sungas (185–72 B.C). Pushyamitra was an opponent of the Buddhists, and a growing Brahmanical reaction dates from that time. His empire seems to have been considerable, though not on the Mauryan scale; but it was progressively weakened under his successors. The last Sunga met the same fate as the last Maurya, and after him a short-lived Kanva dynasty held sway in the north until about 28 B.C. From then till the rise of the Guptas no power of importance arose among the native kingdoms of northern India.

Foreign Invasions, 180 **B.C.—A.D.** 200.—The fall of the Mauryan empire was followed by two major developments in the political history of India. On the one hand, there arose in the Deccan a new imperial power, the Andhras, known also by their family name of Satakarni, or Satavahana. Northern India, on the other hand, was subjected to a series of invasions from the west—by Greeks, Sakas. Parthians and Kushans—which constituted the major political pattern for the next three centuries.

The empire of the Andhras, or Satavahanas, arose on the ruins of the Maurya empire and provided a unitary rule for the greater part of the Deccan for nearly three centuries. The earlier rulers were engaged in conflict with the Sungas and Kanvas, and the destruction of the latter dynasty is attributed to them. The period of their greatest power and influence came later, in the 2nd century **A.D.**, when under the rulers Gautamiputra Satakarni (c. **A.D.** 100–130) and Vasishthiputra Pulamayi (c. 130–155) they were successful in guarding the Deccan against foreign invasion. The last great Andhra ruler was Yajnasri (c. 166–195). By the 3rd century the Andhra empire was replaced in the Deccan by a series of minor kingdoms, Ikshvakus, Salankayanas, etc.

The Andhras were noted as patrons of Prakrit literature, and it was under them that the Maharashtri Prakrit was elevated to the status of a literary language. An anthology attributed to the Andhra king Hala is all that now remains of this literature. The Brhatkatha of Gunadhya, written in a different Prakrit (Paisaci) was also a production of the Andhra period. In the religious field Buddhism prospered under the Andhras, and Nagarjuna, the great propagator of Mahayana Buddhism, flourished under their patronage.

Contemporary with the early Andhras, the kingdom of Kalinga came into prominence for a short time during the reign of Kharavela, who in a famous inscription left a detailed account of his reign. The kingdom, at that time a home of Jainism, was clearly powerful enough to compete with the Andhras and to overrun the weakened states of northern India; but after Kharavela complete darkness descended upon it, and it must be assumed that the growing power of the Andhras led to its eclipse.

The fall of the Maurya empire was followed immediately by the first of a series of foreign invasions from the northwest. Such invasions were not new. The empire of the Achaemenids had embraced the provinces of Gandhara and Sind; and, after destroying the Persian empire, Alexander had invaded India to subdue those provinces which owed allegiance to the Persian kings. But these invasions had not penetrated farther than the northwestern corner of India, and the greater part of the country had been left untouched, whereas the invasions which followed penetrated deeply into northern India and prevented the emergence of any formidable native power in the region as long as they lasted.

The first of the new invaders were Greeks from the kingdom of Bactria, which had established itself in the eastern part of Alexander's empire. In 183 B.C. Demetrius, the Greek king of Bactria, crossed into India and carried all before him. He occupied the country as far as Pataliputra, which he besieged; and had he not been recalled by treachery at home he might have achieved what Alexander failed to achieve. As it was, Pushyamitra gradually asserted himself against the Greeks in northern and central India, and Greek rule was confined to the region of the Punjab. There their most famous ruler was Menander, whose name is perpetuated in a Buddhist work (*Milindapanha*) in which a teacher expounds the doctrines of his faith to the Greek king. After Menander's death (c. 145) the Greek kingdom lasted into the early part of the following century but was gradually weakened by the onslaughts of the Sakas, or Scythians. The Greek invasions were not without effect in the cultural field. In sculpture there arose in Gandhara a school operating almost entirely under western inspiration. In science Indian astronomy is notably indebted to the Greeks, from whom it has borrowed some of its technical terms. But on the whole the influence was short-lived, and in the long run little remained.

The Sakas, moving from their central Asian home, brought about the do nfall of the Greek kingdom of Bactria and followed the Greeks in the invasion of India. About 80 B.c.. under their ruler Maues. or Moga, they appeared in control of the Punjab; and under his successor they were firmly established in Muttra. Closely associated with the Sakas were the Parthians (in Sanskrit, Pahlava). aho eventually established some kind of suzerainty over them. Their most powerful ruler in India, Gondophares, achieved fame in Christian legend, since it was under his rule that the apostle Thomas is said to have gone to convert India.

A later group of Sakas established itself in Ujjayini. and it is possible that the Saka era (A.D. 78 *ff.*; see CHRONOLOGY) was founded on that event. Inscriptions record Ysamotika and Cashtana as early rulers of this dynasty, and they still bear Iranian names; later they were progressively Indianized, and by **A.D.** 150 Rudradaman, in a famous inscription, speaks as a purely Hindu monarch. The dynasty lasted till the close of the 4th century, when it was destroyed by the Guptas.

The most powerful of all the invaders of the period were the Kushans, a people known to the Indian tradition as Tukhara (Tokharians) (see YUE-CHI). Their early wanderings in central Asia are recorded by the Chinese historians; they appear on the Indian scene when the first Kushan dynasty under Kujula Kadphises (Kozulokadphises) and Vima Kadphises (Ooemokadphises) established itself on the borders of India in the latter part of the 1st century A.D Their greatest figure is Kanishka, founder c. 130 of the second Kushan dynasty. Inscriptions shon that the whole of northern India. at least as far as Benares, was subject to Kan-

ishka; and in addition to this his empire included considerable stretches of central Asia. He was a great patron of Buddhism, and the fact that his empire combined the central Asian area with India contributed as much as any other single factor to the spread of that religion throughout Asia. Kanishka's recorded successors are Huvishka and Vasudeva, after whom, early in the 3rd century, the Kushans recede into obscurity.

The Guptas and Classical India. — The 3rd century may be taken as the beginning of the classical age of Indian civilization. The series of foreign invasions in the preceding period had in no may interfered with the cultural life of the country. On the contrary it had been one of the most creative periods in Indian history. and during that time literature. art, science and philosophy had gradually evolved the form that they were to retain, in the main, through the succeeding centuries. The foreign rulers were on the whole eager to adopt and patronize the native culture and by doing so contributed materially to its advancement.

After a period in which no major power appeared on the scene and of which the political history remains comparatively obscure, a new and successful attempt at empire-building was begun in the 4th century by the Guptas, a dynasty originating in the same part of India as the imperial Mauryas. The accession of Chandragupta I (320) marked the beginning of their greatness; and from that date the Gupta era was founded. The great conqueror of that dynasty was Chandragupta's son Samudragupta (c. 340–380). The details of his career were engraved by his minister Harishena on an Asokan pillar at Allahabad. from which he is seen as the main founder of the Gupta empire.

The campaigns of Samudragupta soon resulted in the incorporation of the major part of northern India in the Gupta empire. In the east the kingdoms of Nepal and Assam and in the northwest the trihes of the Punjab paid him tribute. To the south Samudragupta undertook an ambitious campaign down the east coast. advancing as far as Kanchi to defeat the early Pallava king Vishnugopa. The son and successor of Samudragupta, Chandragupta II Vikramaditya, further expanded the empire by the conquest of the Saka kingdom of Ujjayini and the surrounding territories (Malava, Aparanta). Under him the Gupta empire reached the zenith of its power and splendour. His reign coincides also with the golden age of Sanskrit literature. Indian tradition relates that nine literary notables, including the poet Kalidasa. resided at the court of Vikramaditya.

The Guptas, unlike the Mauryas, did not seriously attempt to incorporate southern India in their dominions. The successful campaign of Samudragupta was more in the nature of a raid than an organized plan of conquest. The chief power in the Deccan at the time was the Vakataka kingdom. with whom the Gupta kings found it politic to maintain friendly relations. These relations were strengthened by matrimonial alliances, and the agreement between the two powers seems to have continued throughout the period.

At the very end of the long reign of Kumaragupta I (c. 414–45j) we hear of serious trouble in the northwest, and for the first time the Ephthalites, or White Huns, appear on the Indian scene. *(See* HEPHTHALITES.) Under Skandagupta (455–470) the empire was successfully defended against the impending dangers and the Ephthalite invasions postponed for nearly 50 years.

After Skandagupta the imperial period of the Guptas came to an end, though the family continued to rule with lessened authority for some centuries. At first the empire was split up, with a western centre at Ujjayini and an eastern at Pataliputra. At the same time new dynasties began to arise. In the west a general of the Guptas established at Valabhi the Maitraka dynasty, which was to reign with distinction for several centuries; in the north, at Kanauj, the Maukhari dynasty grew into a formidable power.

In these circumstances the Ephthalites finally succeeded in making a successful invasion and conquering a considerable part of northern India. In 510 Toramana overcame all opposition and penetrated deeply into India.. His son Mihiragula (*c.* 512–528) maintained this supremacy, until toward the end of his reign a successful campaign by the Gupta Baladitya drove the Ephthalites from eastern India. Soon after (533) in western India Yasodharman, a prince of obscure origin, was successful in re-establishing Hindu supremacy.

In the following century a successful, though short-lived attempt at empire-building was undertaken by Harsha (Harshavardhana) of Thanesvar (606–647). In a series of campaigns he established himself as the dominant ruler of northern India; but against the powerful Chalukya kingdom of the south he was unable to make any impression. Harsha was a great patron of letters and himself an author of Sanskrit dramas. At his court lived Bana, one of the most famous of Sanskrit authors, and it is to his pen that we owe an account of the youth and early career of Harsha. Harsha was also favourably inclined toward Buddhism, and it mas during his reign that the Chinese pilgrim Hsüan Tsang visited India. The account that Hsüan Tsang left of his travels is one of the most valuable documents for the history and civilization of the time.

Dynastic Rivalries, 650–1200. — After the death of Harsha northern India was again divided into a large number of separate states. An attempt by Yasovarman of Kanauj, early in the 8th century, to build a northern Indian empire was shattered on his defeat (736) by Lalitaditya of Kashmir. Gradually two main powers arose in the north. In Rengal the Pala dynasty established itself in the middle of the 8th century and reigned till the 12th. The Palas were noted as supporters and protectors of Buddhism at a time when in the rest of India it was giving way to Hinduism. They were followed by the Senas, who after a short but culturally brilliant period of rule were uprooted by the Mohammedans. In the western portion of northern India a new series of rulers — the Rajputs — came into prominence then. Their origin remains somewhat obscure, as does that of the Gurjara tribe, which appeared then for the first time in Indian history and provided in the Gurjara-Pratihara dynasty the leading power of the period. Tradition relates that the four leading Rajput families, Paramara, Chahamana. Pratihara and Chaulukya, originated in a sacrificial fire at Mount Abu; modern historians, with little direct evidence, have seen in them the descendants of the various foreign invaders of India.

By the 8th century the power of the Gurjara-Pratiharas was consolidated under Nagabhata, and he was successful in repelling (740) the further advance of the Mohammedan invaders, who in 712 had occupied Sind. The supremacy of the Gurjara-Pratiharas in northern India continued for two centuries, and during that period they maintained a successful front against further Mohammedan encroachment. They were also in recurring conflict with their main Indian rivals, the Palas of Bengal and the Rashtrakutas of the Deccan. In the latter part of the 10th century the Gurjara supremacy was destroyed, and northern India was again split up into a multitude of small and warring principalities. Among these dynasties mention may be made of the Chaulukyas of Gujarat (c. 950–1300), the Paramaras of Malava (Bhoja, 1010–55), the Chandellas and Kalachuris of central India and the Chahamanas of Rajputana. In those circumstances the task of the Mohammedan invaders was made easier especially because the native powers, who had little inkiing of what was in store for them, were more interested in pursuing their own private quarrels than in combining against the invader. In 1001 Mahmud of Ghazni (see below) made himself master of the Punjab and from that centre carried on a series of devastating raids against northern and western India. The final debacle did not come until nearly two centuries later. In 1192 Prthviraja, the Chahamana ruler of Delhi, was defeated and slain in a decisive battle; and in a few years from that date the whole of northern India was engulfed by the Mohammedan flood.

In the south the period saw the consolidation of two main centres of political power, one centred in the Deccan and covering the Maratha (Mahratta) and Kanarese areas. the other in the south centred in the Tamil country. After the end of the rule of the Vakatakas the Deccan came again under unitary rule by the rise of the early Chalukyas (*q.v.*) (*c.* 550–757). Pulakesin I established his capital at Vatapi (Badami). where it remained, and under him the Chalukyas acquired the status of a great power. The most powerful ruler of this dynasty, Pulakesin II (608–642),

extended his territory in all directions and in doing so came into conflict with both Harsha in the north and with the Pallavas in the south. From the latter he acquired territory on the east coast around the mouth of the Krishna and Godavari, where a junior branch of the family continued to rule for several centuries (Chalukyas of Vengi). Successful during most of his reign, he was finally defeated and slain in conflict with the Pallavas. In spite of this the Chalukya kingdom continued to flourish under his descendants, until power was wrested from them by the Rashtrakuta family (757–973). The Rashtrakutas organized their state on strongly militaristic lines, and their history consists mainly of aggressive campaigns against their northern and southern neighbours. In these they were predominantly successful, and in northern India in particular their attacks contributed not a little toward the weakening of those states in face of the coming Mohammedan invasion. Toward the end of the 10th century the Chalukya family again won mastery of the Deccan. and its second phase of rule, centred this time at Kalyani (Hyderabad state), continued for about 200 years (973–1190). After the fall of this dynasty a series of smaller kingdoms — the chief of whom were the Yadavas of Deogir (1187–1312) (see DAULATABAD), the Hoysalas of Dorasamudra (Dvarasamudra; 1191–1317) and the Kakatiyas of Warangal (till 142 j) — partitioned their territories. As in the north, no great imperial power remained in the Deccan to meet the Mohammedan attack.

In the extreme south the three Tamil kingdoms — Chola, Pandya and Chera — which had for long maintained an independent existence together with an indigenous Dravidian culture, were overshadowed by the Pallavas, a dynasty of northern origin. The Pallavas are first noticed in the 3rd or 4th century, in Prakrit inscriptions, in Kanchi, where they were established as successors of the Satavahanas: but it was not until the latter part of the 6th century, under Simhavishnu. that they acquired the status of a great power. Under Mahendravarman I (600–630) and Narasimhavarman I (630–660) the Pallavas reached the height of their power and prosperity. In the south they were without rivals, and to the north they maintained a successful front against the contemporary Chalukya power. Under their rule northern culture penetrated in a greater degree to the south; and in particular the Saiva and Vaishnava religions attained in that period the predominant position in the Tamil country which they still held at mid-20th century.

The Pallava power continued till toward the close of the 9th century. when it was replaced by a new empire of the Cholas (*q.v.*). One of the three ancient Tamil dynasties, the Cholas had long subsisted as vassals of the Pallavas. but during that period they were able not only to assert their independence of the Pallavas, but also to replace them as the new imperial power of the south, with such success that they achieved for a time a dominion wider than anything seen under the Pallavas. Under the kings Rajaraja (985–1014) and his son Rajendra (1014–44) the Cholas reached the height of their power. They not only controlled the whole of southern India and Ceylon but also were able to send a military expedition as far as the Ganges and to defeat the Pala king of Bengal. They were moreover the greatest naval power of the time, and under Rajendra a successful naval expedition was dispatched to Malaya and Indonesia.

Toward the close of the 12th century the Chola supremacy became seriously weakened and under Rulottunga III (c. 1180–1216) the rival Pandya dynasty asserted its independence. With the accession of Sundara Pandya (1251) the Pandyas replaced the Cholas as the premier dynasty of the south, but their triumph was short-lived because early in the next century (1310) the Moslem invader appeared in southern India and inaugurated a new epoch. (T. Bw.)

THE MOHAMMEDAN PERIOD

The Arab conquest of Sind in A.D. 712 was merely an episode in the history of Arab expansion for, although Hajaj, the viceroy of the eastern provinces of the caliphate. was an imperialist. Sind was not rich enough nor sufficiently well placed strategically to serve as a base from which the Arabs could extend their rule over the rest of India. Moreover, the difficult nature of their line of communications through Baluchistan and the decline of the central government prevented the dispatch of adequate reinforcements. In India. as in Europe, the 8th century witnessed the end of the wave of Arab expansion; and it was not until Islam had been firmly established in the area corresponding to modern Afghanistan that the Moslem conquest of India became possible.

Mahmud of Ghazni.—With the decline of the effective power of the Abbasid caliphate independent Moslem dynasties had arisen in Persia, Afghanistan and Turkistan. So far as India was concerned the most important of these was the Yamini, or Ghaznevid, dynasty founded by Turkish slaves in the mountainous regions surrounding Ghazni. It was under their ruler Subuktigin (977–997) that they first began to raid into northern India. At that time large tracts of the Punjab and the Kabul valley between the Chenab river and Lamaghan acknowledged the rule of the Hindushahiyyas under Raja Jaipal; but he proved no match for Subuktigin, who wrested from him the country between Lamaghan and Peshawar. The most famous of the Ghaznevids was Mahmud (*q.v.*) (998–1030), whose empire at its greatest extent stretched from the frontiers of Mesopotamia to the river Ganges and from Transoxiana to the deserts of Rajputana. Authorities differ as to the extent of his expeditions into India and also as to their number, which is varied between 12 and 1 j. As a result of these expeditions he destroyed the power of the Hindushahiyyas, annexing all their territories between Lamaghan and the Chenab; captured the famous fort of Nagarkot in the Kangra valley and the stronghold of the heretical Carmathians of hlultan; and seized Bhatinda, which guarded the route to the Ganges valley. Mahmud was therefore an Indian ruler only in a very limited sense, for his Indian conquests were confined to the Punjab, which became a frontier province of his extensive empire. But his plundering incursions carried him as far afield as the Jumma-Ganges Doab and the coast of Kathiawar. The most famous of his expeditions was that across the desert from hlultan to the temple of Somnath, which housed a huge Hindu idol in the form of a *lingam,* or phallus, that was mashed daily in water brought by runners from the Ganges. It was served by 1,000 Brahmans and 600 musicians, dancers and attendants. who mere supported by the offerings of innumerable pilgrims and by the revenues of 10,000 villages owned by the temple. Mahmud with iconoclastic fury razed the place to the ground, and no fewer than 50,000 Hindu devotees are said to have laid down their lives in defense of their deity. Mahmud was a zealous upholder of Islam, an ardent warrior against idolaters and a stern persecutor of heretics. particularly those who were politically as well as doctrinally dangerous. So far as India is concerned the importance of his career is that by his systematic policy of plunder and massacre he shattered the economic strength of northern India and paved the way for its final subjugation by later Moslem invaders.

Delhi and the Sultanates.—Mahmud's descendants were driven from Ghazni by a rival Moslem power, the Shansabanis of Ghur, and forced to take refuge in the Punjab. Mohammed of Ghur, the ablest of the Shansabani sultans, departed from the policy of predatory incursions and resolved to conquer northern India. The expulsion of the Ghaznevids from Lahore in 1186 was followed by several years of narfare, culminating in the defeat of the Hindu forces of Rai Prithiraj of Delhi at the final battle of Taraori in 1192, after which northern India almost as far as the gates of Delhi was annexed. The work of conquest was completed by Mohammed's generals, who subjugated the Gangetic Doab and overran Bihar and Bengal. After Mohammed's assassination by Moslem heretics in 1206, his general, Kutb ud-Din Aibak, founded the dynasty knonn as the Slave kings of Delhi (*q.v.*). Thus was established the sultanate of Delhi, which lasted until Babur laid the foundations of the Mogul empire in 1526. During that period Hindustan was ruled by five successive dynasties: (1) the Slave dynasty (1206–90); (2) the Khaljis (1290–1320); (3) the Tughlaks (1320–1413); (4) the so-called Sayyids (1414–51); and (5) the Lodis (1451–1526).

Of the 33 sultans of Delhi. few deserve to be remembered. The work of Aibak was completed by Iltutmish (1211–36), who ruth-

lessly crushed internal revolts, reannexed Bengal, conquered Sind and, toward the end of his reign, advanced through Malwa to the Narbada river. His death was the signal for dissensions which, together with Mongol raids across the northwest frontier, prevented the consolidation of Moslem power; and it was not until the reign of Balban (1266–86) that the sultanate became powerful again. Balban's time was fully occupied with the suppression of rebellion, which gave him little opportunity for entertaining ideas of fresh conquests. It must be remembered that throughout the 13th century the Moslem hold on Hindustan was extremely precarious. In fact, it was a military occupation effective only in the neighbourhood of Moslem garrisons and military forces. Because of the numerical inferiority of the invaders and the vastness of the country large areas had necessarily to be left in the hands of Hindu chiefs, who probably were the dominant factor in the situation.

Balban's successors were worthless, and power passed to the Khaljis, the ablest of whom was Ala ud-Din (1296–1316). His short reign was characterized by oppressive regulations designed to crush the Hindu chiefs and prevent rebellion. His demand for one-half of the gross produce of the land as revenue impoverished the peasantry, and he has therefore been condemned as a ruthless tyrant; but the necessity for consolidation called for stern measures. He not only restored order but conquered the Hindu kingdom of Gujarat and stormed the Rajput fortresses of Ranthambhor and Chitor. It is recorded that before the sack of Chitor its defenders performed the horrible rite of *jauhar* and immolated their wives and daughters to save them from dishonour. The Khalji period is important because it marks the beginning of Moslem penetration across the Narbada into the Deccan and southern India. At that time the chief Hindu powers to the south of the Narbada were the Yadavas of Deogir, the Kakatiyas of Warangal, the Hoysalas between the Krishna and the Cauvery and the Pandyas of Madura and the far south *(see* above). No united front was presented to the invader and Ala ud-Din's general, the eunuch Malik Kafur, easily penetrated to the extreme south of the peninsula, plundering the principal cities and temples. There was a fundamental difference between the Deccan policy of the Khaljis and that of their successors, the Tughlaks. Khalji policy was not one of occupation, whereas the Tughlaks aimed at permanent conquest.

Under Mohammed ibn Tughlak (1325–51) the sultanate attained its greatest extent and in the year 1330 stretched from Madura to the borders of Kashmir. Mohammed's removal of the capital from Delhi to Deogir and his attempt to rule over the whole of India from the Deccan was doomed to failure, for no strongly centralized government was possible until the development of communications in the second half of the 19th century. Mohammed has been eulogized as a cultured dreamer and denounced as a bloodthirsty tyrant. An attempt to whitewash his character has been made by those who refuse to accept the contemporary evidence of travellers like Ibn Batuta and historians like Zia ud-Din Barni; but he appears to have been guilty of revolting cruelties which would be unpardonable in any age. Toward the end of his reign the sultanate began to decline. Madura broke away as early as 1334. By 1341 Bengal had been lost. In 1347 the whole of the Deccan, except Khandesh in the Tapti valley, was formed into an independent Moslem kingdom under the Bahmanis. His successor, Feroz Shah (1351–88), made little attempt to recover these possessions; and after his death Malwa, Jaunpur and Gujarat refused to acknowledge the suzerainty of Delhi, and the whole of northern India relapsed into anarchy. This was the state of affairs when Timur (Tamerlane) crossed the Indus toward the end of 1398. His invasion, which lasted until March 1399, was merely a large-scale raid, and his depredations and ruthless massacres were confined to the vicinity of his Line of march through the Punjab to Delhi. Its chief result was to intensify the existing anarchy. From Timur's visitation to the establishment of the Lodi dynasty in 1451 no regular government existed, since the authority of the so-called Sayyids was confined to a small area around Delhi.

The Lodis were Afghans, or Pathans, with a tribal conception of sovereignty, the sultan being merely the most powerful of the tribal leaders. Bahlul, their first ruler, fully realized his position, but the attempt of his successors, Sikandar and Ibrahim, to revert to the autocratic methods of Balban and Ala ud-Din Khalji estranged their followers and produced rebellions which weakened the sultanate and paved the way for the Mogul conquest of Hindustan. Moreover, northern India was hopelessly divided, since independent Moslem states had arisen in Sind, Multan, Gujarat, Malwa, Khandesh and Bengal. Another outstanding feature of the 15th century was the growing strength of the Rajputs in the deserts of Rajputana, where they had taken refuge after their defeat in the days of Mohammed of Ghur. In the Deccan the Bahmani kingdom had resolved itself into five independent Moslem sultanates: (1) the Nizam Shahis of Ahmadnagar; (2) the Adil Shahis of Bijapur; (3) the Kutb Shahis of Golconda; (4) the Barid Shahis of Bidar; and (5) the Imad Shahis of Berar. To the south of the Krishna and Tungabhadra rivers stretched the mighty Hindu empire of Vijayanagar. Founded on the ruins of Chola power, it reached its greatest extent under Krishna Deva Raya (1509–29); and it was not until 1565 that the Moslem kingdoms of the Deccan combined to overthrow this last stronghold of Hinduism.

The Mogul Empire.—Baber (Babur; *q.v.*), the founder of the Mogul, or Mughal, dynasty, was descended from Timur and Jenghiz Khan, the two great scourges of Asia. He records in his famous Memoirs that his chief ambition was to recover the vast territories which had once formed part of Timur's mighty empire. In this he was thwarted by Shaibani Khan, ruler of the Uzbeg tribes of Turkistan. Ousted from his ancestral dominions in central Asia, he was eventually forced to take refuge in the mountain fastnesses of Kabul, which served as a convenient base for his attacks upon India. In April 1526, after a series of preliminary raids, he routed the forces of Ibrahim Lodi on the historic field of Panipat, where the fate of India has so often been decided. This victory has long been regarded as resulting from the extensive employment of artillery, but there is neither textual nor circumstantial evidence to support this contention. In the following year at Khanua he overwhelmed the Rajput confederacy under Rana Sanga of Mewar; and by 1529 he had overrun Bihar. At his death in 1530 he controlled the greater part of northern India. His son Humayun succeeded to a troublesome charge, for the Afghan chiefs had been only temporarily crushed and it cannot be said that Baber had consolidated his power in Hindustan. Moreover, Humayun, an opium addict, lacked the energy necessary for the completion of Raber's task. After years of desultory warfare he was defeated by an extremely able Afghan rebel named Sher Shah and was forced to seek asylum in Persia in 1544. Sher Shah proved himself a capable general and an able administrator during his short reign of five years, but under his successors anarchy supervened and gave Humayun the opportunity to attempt the reconquest of his lost dominions. Humayun succeeded in recapturing Delhi and Agra in 1555 but died in the following year. His importance lies in the fact that he mas the father of Akbar, who, at the second battle of Panipat, in 1556, defeated the forces of a Hindu usurper called Hemu and re-established his dynasty in Hindustan. Panipat may therefore be termed a decisive battle, for there had been no Mogul empire before Akbar, only the attempt to create one.

Akbar (*q.v.*) (1556–1605) was undoubtedly the greatest of the Mogul emperors. For the first five years of his reign his kingdom was restricted to the Punjab, Ajmere. Gwalior, the basin of the Ganges and Jumna and the country between the Gumti and the foothills of the Himalaya. A further 15 years of incessant warfare resulted in the annexation of the whole of northern India with the exception of lower Sind Between 1586 and 1601 he extended his rule over Kashmir, Baluchistan, Kandahar, Khandesh, Berar and parts of Ahmednagar and Orissa. At his death in 1605 his empire comprised 15 provinces, or *subas,* and stretched from Ahmednagar in the Deccan to Kabul and Kashmir in the north.

As far as his Hindu subjects were concerned. Akbar's policy was one of conciliation, for he realized that it was impossible

for him to rule as a strictly orthodox Moslem sovereign whose duty it was to spread the Islamic faith. He therefore abolished the *jizya* (the hated poll tax on non-Moslems) and the taxes which had previously been levied on Hindu pilgrims. For the same reason he sought to obtain the active support of the Rajput chiefs and enlisted Hindus in his armies and in the imperial service. At the same time his conception of sovereignty was autocratic, and this led him to crush the *ulema,* a religious body of Moslem doctors and scholars ahich constituted a check upon his powers. Although genuinely interested in the study of comparative religion and inclined to toleration, his religious policy appears to have been to a very great extent secondary to dynastic and political considerations. A further basic principle of his administration was to demand no more than one-third of the gross produce from the peasant. for he was convinced that the stability of his empire depended upon an equitable system of assessing and collecting the land revenue. The structure of the central government which he evolved. the elaborate checks upon the powers of the provincial governors, and his military organization testify to his administrative ability. It was only when his successors departed from the main principles of his rule that the empire began to decline.

His son Jahangir (1605–27) neglected the administration and was subservient to a selfish *junta* controlled by his favourite wife, Nur Jahan. The extravagant expenditure of the court was a serious drain on the financial resources of the country. and Jahangir was forced to make use of the accumulated cash reserves of his father. It was during his reign that the Persians recovered Kandahar. Important European evidence on the prevailing conditions is contained in the *Remonstrantie* of the Dutch factor Francisco Pelsaert and in the *Journal* of Sir Thomas Roe, the first English ambassador to the court of the Great Mogul. Jahangir is chiefly remembered for his self-revealing *Memoirs,* from which it appears that he was a drunken despot subject to outbursts of fiendish cruelty.

He was succeeded by his son, Shah Jahan, who had an almost insatiable passion for building. Iiot content with erecting a new capital city at Shahjahanabad he enriched the world's store of beauty by many other buildings, outstanding among which are the Moti Masjid and the Taj Mahal, both at Agra. His reign was also a period of great literary activity while the arts of painting and calligraphy were not neglected. That the splendour of the Mogul court reached its zenith under Shah Jahan must not blind one to the fact that he set in motion influences which finally led to the decline of the empire. His expeditions against Balkh and Badakhshan and his attempts to recover Kandahar brought the empire to the verge of bankruptcy. Moreover, unlike Akbar, he displayed a religious bigotry surpassed only by his more orthodox successor, Aurangzeb. In 1657 Shah Jahan fell ill, and in the civil war that ensued between his sons Aurangzeb defeated Dara Shikuh at the battle of Samugarh in 1658, after nhich he assumed the imperial title and imprisoned his father in the fort at Agra until his death in 1666.

The political and religious intolerance of Aurangzeb (*q.v.*) (1658–1707) was the chief cause of the decline of the empire. Puritanically orthodox and extremely bigoted, he departed from Akbar's conciliatory policy toward the subject Hindu population. It is significant that during the war of succession he claimed the throne as the champion of orthodox Islam against the heretical principles and practices of his brother Dara Shikuh. As soon as he assumed power, the *kalima,* or Mohammedan confession of faith, was removed from all gold and silver coins lest it should be trampled underfoot or otherwise defiled by unbelievers. Censors of morals were appointed to suppress unorthodox practices. Courtiers were forbidden to salute in the Hindu fashion. Hindus were excluded from public office, their schools and temples destroyed and the detested poll tax was reimposed. Aurangzeb subjected the Sikhs of the Punjab to persecution and put their religious leader, or *guru,* to death because he refused to embrace Islam. This transformed the Sikhs from a sect of quietists into a brotherhood of fanatical soldiers opposed to Moslem rule. The result was that the Rajputs, Jats and Sikhs of the north and the Marathas of the Deccan under their famous leader Sivaji raised the standard of revolt.

Aurangzeb's revenue policy led to a steady impoverishment of the agricultural classes, for the pressure on the peasant was increased by raising the revenue demand to one-half of the gross produce. The writings of contemporary European travellers contain frequent references to absconding peasants and untilled soil which lead one to infer that the mass of the population must have lived dangerously near the subsistence level. The general result of all this was a decay in all branches of the administration accompanied by a corresponding economic decline.

It is true that during Aurangzeb's reign the empire attained its greatest extent and, after the annexation of Bijapur and Golconda, stretched from the Hindu Kush to the Coromandel coast. But his policy of expansion in the Deccan and his attempt to rivet his authority on the whole of India was a military and political miscalculation since consolidation did not keep pace with conquest. When he died in 1707, he had failed to crush the Marathas (Mahrattas) of the Deccan and his authority was disputed throughout the length and breadth of his dominions.

BY COURTESY OF THE CANADIAN PACIFIC S.S. CO.

CONJURORS PLAYING FLUTES TO CHARM THE COBRAS

The successors of Aurangzeb were wretched puppets controlled by favourites and court factions. Between the death of Bahadur Shah in 1712 and the accession of Mohammed Shah in 1719, five puppets were successively installed on the throne of Delhi. During the reign of Mohammed Shah (1719–48) able adventurers rose to power and provincial governors laid the foundations of independent dynasties. Nizam ul-Mulk, the Mogul viceroy in the Deccan, founded the state of Hyderabad. From a Moslem adventurer, Ali Vardi Khan, descended the nawabs of Bengal, while the kings of Oudh sprang from Saadat Ali Khan, the Mogul governor of that province. It was during this reign that the Marathas of the Deccan overran Malwa, Gujarat, Bundelkhand and parts of Rajputana and made repeated incursions into Bihar and Bengal. In 1737 they even defeated an imperial army outside the walls of Delhi. Eventually the emperor was forced to come to terms. To make matters worse, northern India was invaded by Nadir Shah of Persia, who in 1739 defeated the emperor's forces at Karnal, about 20 mi. N. of the historic field of Panipat. A popular uprising in Delhi in which several hundred Persian soldiers lost their lives was the signal for an indiscriminate massacre of the inhabitants of that city, after which, in the words of the contemporary chronicler "the streets remained strewn with corpses, as the walks of a garden with dead flowers and leaves." Nadir Shah made no attempt to annex northern India to his empire and was satisfied with the acquisition of vast booty, which included the famous Peacock throne of Shah Jahan and the Koh-i-Nor diamond. Apart from this, the chief result of Nadir's expedition was to intensify the existing anarchy and accelerate the decline of the empire. Foreign invasion was not so much a cause of the downfall of the Mogul empire as symptomatic of a decline that had already taken place.

After the death of Mohammed Shah the Marathas overran almost the whole of northern India from the river Narbada to Peshawar in the vicinity of the Khyber pass. They were gradually driven southward from the Punjab by Ahmad Shah Durrani, who had risen to power as ruler of the turbulent Afghan tribes of Kabul and Kandahar. Between 1747 and 1769 he led no less than ten invasions into Hindustan. The Marathas had to face a formidable coalition of the northern Moslem chiefs, who joined forces with the Afghan invader. They also had to fight without the assistance of the Rajputs and other Hindu powers, whom their revolting cruelties and extortionate demands had estranged. Eventually they were crushingly defeated by Ahmad Shah Durrani at the third battle of Panipat in 1761. This victory had

far-reaching consequences. It enabled the nizam to recover his power in the Deccan and probably saved the state of Hyderabad from extinction. It proved to the Indian world that neither the Marathas nor the Mogul emperor could protect them from foreign aggression. Internal dissensions now seriously impaired the strength of the Marathas and power passed from the peshwa, or titular head of the confederacy, to the generals — Sindhia of Gwalior. Holkar of Indore, the gaikwar of Baroda and the raja of Berar, or Nagpur. But the real importance of the Maratha defeat was that it granted the British the respite needed for the consolidation of their power in Bengal.

EUROPEAN SETTLEMENTS

Portuguese Enterprise. — The quest for India by sea was begun by Portugal, the smallest nation on the Atlantic seaboard and the first of the European states to become consolidated. After more than 50 years of preliminary exploration by intrepid Portuguese mariners, Vasco da Gama rounded the Cape of Good Hope and anchored off Calicut on May 20, 1498, the voyage from Lisbon having taken 10 months and 12 days. Friendly relations were established with the zamorin, or Hindu raja, of Calicut; but Cabral, the leader of the second expedition which reached India in 1500, quarrelled with the zamorin and sought trading concessions from his rival, the raja of Cochin, with the result that Cochin, with its excellent harbour, became the first trading headquarters of the Portuguese in India. The first Portuguese viceroy was Francisco de Almeida (1505–09), a firm believer in the importance of sea power, who gained command of the sea in Indian waters by the destruction of the Turco-Egyptian fleet in 1509. It is important to note that the absence of timber on the shores of the Red sea, which prevented this fleet from being rebuilt, was one of the principal causes of the growth of Portuguese power in the east. Almeida's successor, Alphonso d'Albuquerque (*q.v.*) (1509–15), believed that it was also essential to build fortresses on land and aimed at establishing a coastal empire based on the retention of important strategical positions. Since the carrying trade of the Indian ocean was in the hands of Arab merchants, he attempted to intercept this trade at its base. With this object he seized the island of Socotra and built a fortress at Ormuz which enabled him to control the mouth of the Red sea and the entrance to the Persian gulf. Realizing that a fortified base was essential for supremacy at sea, he captured Goa and thus obtained command of the trade with the Malabar ports. Because of its central position Goa became the capital of the Portuguese possessions in India. The conquest of Malacca in 1511 enabled him to control the valuable spice trade of the Malay archipelago. It was fortunate for the Portuguese that, during the critical years when they were establishing their power on the Malabar coast, the rivalry between the Moslem kingdoms of the Deccan and the Hindu empire of Vijayanagar prevented any effective resistance to their schemes.

The Portuguese empire reached its greatest extent in the middle of the 16th century. Its existence depended upon the command of the sea in Indian waters. With the arrival of more powerful Dutch and English fleets in the first half of the 17th century Portuguese power rapidly declined, and Portugal lost its monopoly of eastern trade.

Dutch Enterprise. — The closing of Lisbon to Dutch vessels toward the end of the 16th century adversely affected their carrying trade, especially the pepper trade, and prompted them to trade directly with the spice islands of the archipelago. Their first expedition under Cornelis Houtman reached Bantam in Java in 1595, one year and three months after leaving the Netherlands. A realization of the weakness of a system of separate voyages led to the formation in March 1602 of the United East India Company of the Netherlands. This powerful concern, with inscribed funds totalling £540,000, was granted a monopoly of trade and was emponered to maintain fleets and armed forces. The Dutch concentrated on establishing themselves in the archipelago; and their first governor-general. Pieter Both (1609–14), established factories or trading posts at Bantam and Jacatra (*i.e.*, Jakarta. or Batavia) The most important of their governors-general was Jan Coen (1617–22), who was to the Dutch in the 17th century what Albuquerque had been to the Portuguese in the 16th. Intensely prejudiced against the English. Coen protested to the home authorities when his hands were tied by the Anglo-Dutch treaty of 1619 that amalgamated the two companies for a period of 20 years. In 1623 Herman van Speult, the Dutch governor of Amboina, executed 12 Englishmen whom he considered guilty of conspiracy. This lamentable occurrence, known as the massacre of Amboina, had important results, for from that date the English confined their activities to the mainland of India. After this the Dutch were not seriously challenged in the archipelago until Lord Minto's conquest of Java in 1811. Even in India the Dutch were the real successors of the Portuguese and established factories on the Coromandel coast, in Gujarat and in Bengal. The death blow to Dutch interests in India proper was Robert Clive's capture of Chinsura in Bengal in 1759.

The English East India Company. — On Dec. 31, 1600, Queen Elizabeth granted a charter to the "Governor and Company of Merchants of London trading with the East Indies." Compared with the Dutch company already in the field this company was an insignificant body of private traders with inscribed funds amounting to only £30,133. For the first 12 years of its existence it was run as a regulated company, gradually developing after 1612, into a joint-stock concern.

The first two voyages, following the Dutch example, proceeded to the archipelago for pepper and spices. It was during the third voyage that the "Hector," commanded by William Hawkins, reached Surat on the Gujarat coast. Thence Hawkins travelled to the Mogul court at Agra. where for a time he became the boon companion of Jahangir but failed to obtain trading concessions. In 1611 the ships of Sir Henry Middleton reached Surat but met with a hostile reception. the result of Portuguese intrigues. In the following year Thomas Best anchored off the mouth of the Tapti, where he defeated a much superior Portuguese fleet. thereby increasing the prestige of his compatriots. Eventually, in 1613, an imperial firman granted permission for the establishment of a permanent English factory at Surat. The Portuguese persisted in their hostile attitude but in 1614 were again defeated. by four English vessels under Nicholas Dowton. One of Dowton's ships, the "Hope," which left India in March 1615. was the first English vessel to return to England with a cargo from India In September of the same year Sir Thomas Roe arrived in India as the first English ambassador to the court of the Mogul emperor, where he created a good impression and obtained important privileges for his countrymen. By 1619 English trading posts had been established at Surat, Agra, Ahmedabad and Broach. Surat became the company's headquarters, with a president and council who controlled the other factories.

The island of Bombay formed part of the dowry of Catherine of Braganza when she married Charles II of England in 1661 Seven years later Charles handed it over to the company, reserving an annual quitrent of £10 as a mark of sovereignty. This payment appears to have lapsed in 1730. It was Gerald Aungier, governor there from 1670 to 1677, who first realized that Bombay was a more suitable base for English enterprise on the west coast than Surat, which suffered from the Iack of a good harbour and was exposed to Maratha raids. Despite its foul climate, to Aungier it was "a city which by God's assistance is intended to be built." He laid the foundations of English justice, fixed the land revenue and established the first English mint in India. For its defense was raised the first European regiment in India, the Bombay Fusiliers. It was not. however. until 1687 that Bombay replaced Surat as the company's headquarters on that coast.

The first English settlement on the Coromandel coast was at Masulipatam in 1611. In 1626 a subsidiary settlement was formed at Armagaon. In return for a substantial annual payment. permission was obtained in 1639 from the local Hindu ruler to build a fortified factory at Madraspatam. There in the following year Francis Day built Fort St. George, which developed into the company's headquarters on that coast. When the Moguls overran the area, the company's status remained unchanged except that hlogul sovereignty nas acknowledged on its coins. Settlements were formed at Porto Novo and Cuddalore in 1681.

Because of the unhealthful climate of Cuttack in Orissa, where they had settled in 1633, the English moved to Hugli in Bengal and obtained permission to build a factory there in 1651. To protect themselves from the exactions of local rulers it was decided in 1681 to fortify the settlement. After an attack by the local Mogul governor, Job Charnock (who was in charge of the settlement) deemed it advisable to abandon the place for Sutanati lower down the river Sutanati was temporarily abandoned in 1689 in favour of Chittagong; but in 1690 Charnock returned to Sutanati, where he laid the foundations of modern Calcutta (*q.v.*). The settlement was fortified in 1696 and renamed Fort William in honour of William III. In 1700 all the Bengal factories were placed under the control of a president, Sir Charles Eyre becoming the first president and governor of Fort William in Bengal.

Between 1600 and 1750 the company had to contend with serious difficulties both at home and abroad. Not only had it to withstand the attacks of rival European nations but, in England, its monopoly of eastern trade was the subject of much hostile criticism. which led to the formation of rival trading associations and to attacks by pirates or interlopers, for whose depredations the Indian coastal powers held the company responsible. Moreover, the anarchy which accompanied the decline of the Mogul empire placed the company's settlements at the mercy of semi-independent provincial governors and encouraged the Marathas to attack Surat. In 1698 the enemies of the 'company in England, with the consent of parliament, formed themselves into a rival company known as the "English Company trading to the East Indies." After much bickering the two companies came to an agreement in 1702 by which they were amalgamated into the "United Company of Merchants of England trading to the East Indies." This was the company which obtained territorial sovereignty in India and retained its possessions until the crown assumed control in 1858. Despite all these difficulties, in the first half of the 18th century the volume of India's overseas trade, which was chiefly an export trade. increased enormously. The most important exports were cotton and silk piece goods, cotton yarn and raw silk. An important change in its export trade was the decline of the spice trade, occasioned by the European demand for sweet in preference to spiced dishes and by the use of winter fodder for cattle to ensure a supply of fresh meat throughout the year. Bullion, particularly silver, was the principal import into India; next in importance came broadcloth, lead, copper, tin and quicksilver.

The French Company. — It was not until 1664, In the reign of Louis XIV, that the Compagnie des Indes Orientales was formed. Between 1666 and 1690 French settlements were established at Surat, Pondicherry, Masulipatam, Chandernagore, Balasore and Kasimbazar; to these were added Calicut in 1701 and Mahé in 1721. Unfortunately the company became entangled in John Law's financial schemes and suffered severely when the crash came in 1720. After this it was reorganized as the Perpetual Company of the Indies. By 1744 the chief European rivals for the trade of India were the English. Dutch and French. There were other European companies in the field, such as the Ostend company formally chartered in 1722, the Banish company re-established in 1729 and the Swedish company of 1731, but they cannot be regarded as serious competitors.

When news reached India in 1744 that England and France had become involved in the War of the Austrian Succession, an unsuccessful attempt was made by Joseph Dupleix, the French governor of Pondicherry, to secure French interests in the east by a treaty of neutrality between the two companies. The arrival of an English squadron under Commodore Curtis Barnett, which swept French shipping from the seas and captured their China fleet. forced Dupleix to summon the comte Mahé de la Bourdonnais from Mauritius to his assistance. The death of Barnett and the timorous tactics of his successor gave the French command of the sea long enough to enable them to capture Madras. It was not until the arrival of Adm. Ednard Boscauen with reinforcements, in April 1748, that the English recovered their power at sea. By the treaty of Aix-la-Chapelle (1748) Madras was restored to the English in exchange for Louisbourg, the capital of Cape Breton Island.

After 1748 an unofficial war gradually developed in southern India between the English and French companies. The death of Nizam ul-Mulk in 1748 was the signal for a struggle between his descendants for the viceroyalty of the Deccan, and the death of Anwar ud-Din produced a similar struggle for the nawabship of the Carnatic. While the French supported Muzaffar Jang for the viceroyalty of the Deccan and Chanda Sahib for the nawabship of the Carnatic, the English espoused the causes of Nasir Jang and Mohammed Ali. To relieve the pressure on Mohammed Ali, who was beleaguered in Trichinopoly. the English sent Robert Clive, one of their servants, to attack Arcot. Clive's capture of Arcot in 1751 and his successful defense of it against the forces of Chanda Sahib and his French allies proved the turning point in the struggle. Stringer Lawrence's defeat of the French before Trichinopoly and the capitulation of the French forces, together with Dupleix's failure to reverse this decision, mearit the ruin of French schemes for controlling the Carnatic.

Muzaffar Jang, the French candidate for the viceroyalty of the Deccan, had been escorted to Hyderabad and Aurangabad by a French army under Charles de Bussy, the ablest officer in the service of the French. On the assassination of Muzaffar Jang, Bussy championed the cause of another claimant, Salabat Jang. who, in Oct. 1751, granted to Dupleix and after him to the French nation, free of all tribute, the southern provinces of Arcot, Trichinopoly and Madura. This grant was rendered worthless by the English victories in the Carnatic. Bussy's expedition into the Deccan proved a fatal division of forces and a dissipation of military strength. The failure of Dupleix's ambitious plans for a French empire in India led to his recall in Aug. 1754, and, with the arrival of his successor, Charles Robert Godeheu, a provisional treaty was arranged which terminated the unofficial war between the two companies. The final struggle between the French and English was postponed until the outbreak of the Seven Years War, in the course of which Eyre Coote defeated the French general Thomas de Lally at Wandewash on Jan. 22, 1760. Pondicherry surrendered to a combined land and sea force in Jan. 1761.

BRITISH ASCENDANCY

Clive and Bengal.—The privileges enjoyed by English merchants in Bengal were based on an imperial firman of 1717; but in practice this often proved valueless against the extortionate demands of semi-independent provincial governors and local officials. With the decline of Mogul power the nawabs of Bengal became practically independent of the central government. In 1756 the nawab Suraj ud-Daulah attacked and captured the English settlement at Calcutta. He incarcerated 146 English prisoners in the notorious Black Hole, a small military prison 18 ft. by 14 ft. 10 in. in size; and in the morning only 23 persons emerged alive. The chief reason for Suraj ud-Daulah's attack was the fear of foreign aggression—a fear which had its origin in recent events in the Carnatic and the Deccan. There was also much truth in his contention that the English had fortified their settlements in Bengal without his permission and had abused the trading privileges granted by the imperial firman of 1717.

To avenge this outrage Robert Clive (*q.v.*) and Adm. Charles Watson sailed to the Hooghly with a force from Madras. Clive easiiy recaptured Calcutta and forced Suraj ud-Daulah to sign a treaty confirming all the privileges which the English had formerly enjoyed. But it soon became obvious that the nawab had no intention of keeping his word and that he was intriguing with the French. Clive therefore decided to replace him with Mir Jafar, a person more favourably inclined to the English company. In this he was supported by the famous Hindu bankers, the Seths, whom Suraj ud-Daulah had threatened with circumcision. On June 23, 1757, Suraj ud-Daulah's forces were easily defeated at the battle of Plassey. This victory was of supreme importance in the growth of British power in India, for, by making the British the de facto rulers of Bengal. it placed at their disposal one of the wealthiest parts of India, the resources of which were used

to destroy the French power in the Carnatic. All European opposition in Bengal ceased with the repulse of a Dutch naval expedition to the Hugli and the capture of the Dutch settlement of Chinsura in 1759. In the following year Clive returned to England. His policy had been to strengthen the British position in Bengal and rule through a puppet nawab. His successor, Henry Vansittart, replaced Mir Jafar with Mir Kasim but made the mistake of strengthening the new nawab, who, from the beginning, asserted his authority and quarrelled with the company over the question of the abuses connected with the internal trading of its servants. It cannot be denied that the company's servants and their native agents had been guilty of gross abuses and oppression. Mir Kasim has therefore been depicted by Indian writers as a great patriot solicitous for the welfare of his subjects. The important point to remember is that he was aiming at complete independence of foreign control and at reversing the decision of Plassey. Vansittart failed to realize this and adopted a conciliatory policy which encouraged the nawab in his designs. Exasperated by the attitude of Vansittart's colleagues who were opposed to the governor's policy, Mir Kasim perpetrated the horrible massacre of Patna, in 1763, when 150 Englishmen were put to death in cold blood, a far more deliberate crime than the Black Hole of Calcutta. The defeat and flight of Mir Kasim was followed by the restoration of the more pliant Mir Jafar. A final attempt to oust the British from Bengal was made by Shah Alam, the titular Mogul emperor, and his nawab-wazir, Shuja ud-Daulah, the ruler of Oudh, but they were crushingly defeated by Maj. Hector Munro at the battle of Buxar in 1764. This victory completed the work of Plassey. Henceforward the British were the unchallenged rulers of Bengal. This was the position when, in 1765, Clive returned to India as governor of Bengal for the second time. By the treaty of Allahabad (1765) he restored Oudh to Shuja ud-Daulah, with the exception of the two districts of Kora and Allahabad, which were handed over to the emperor for his support. By a special agreement with the emperor the company was granted the *diwani,* or right to collect and administer the revenues of Bengal, Bihar and Orissa, in return for a promise to pay the emperor an annual tribute of 26 lakhs of rupees. Clive's foreign policy thus aimed at converting Oudh into a buffer state to protect the company's possessions from Maratha attacks. Clive left India in 1767 and for the next five years Bengal was governed by mediocrities.

Warren Hastin@.— When Warren Hastings became governor of Bengal in 1772, the Mogul empire had resolved itself into conflicting factions. In the struggles of the nizam of Hyderabad, of Hyder Ali of Mysore and of the Maratha confederacy there was no idea of a balance of power in the European sense. Territorial aggrandizement and paramountcy in the Indian peninsula were the declared aims of the Marathas. Thus, the foreign policy of Hastings was to maintain intact the British possessions in India, threatened as they were during his term of office (1772–85) by the Marathas, by a formidable coalition of the country powers round the nizam of Hyderabad and by the arrival of a French armament in Indian waters.

By the treaty of Benares (1773) Hastings reversed Clive's policy. Because the emperor by this time had deserted the British for the Marathas, in whose hands he had become a puppet, Hastings refused to continue the payment of the tribute since this would have been tantamount to furnishing the Marathas with financial aid to facilitate their attacks on Bengal. For the same reason he reclaimed the districts of Kora and Allahabad, which were sold to the ruler of Oudh. In order to strengthen the northwestern frontiers of Oudh he assisted Shuja ud-Daulah to conquer the Rohilla country. Because Clive's alliance with Oudh had been a financial drain, Hastings entered into a subsidiary alliance with that state whereby its ruler subsidized a British force for its protection, His relations with Oudh and his Rohilla policy aimed at strengthening an important buffer state upon whose security the safety of Bengal depended. Similar motives influenced him in an unsuccessful attempt to form a subsidiary alliance with the Maratha state of Berar, or Nagpur, which commanded the land route between Bengal and Madras. Had he been given a free hand he would have protected the British possessions by a chain of allies stretching from the Jumna to Gujarat. He would also have allowed the Indian states to ally themselves with the crown of Great Britain but was overruled. The remarkable thing is that he was able to accomplish so much during his 13 years of office for he was severely handicapped by the Regulating act of 1773, which, although making him the first governor-general of Bengal, placed him at the mercy of a bare majority on his council. The Regulating act also allowed the subordinate presidencies of Bombay and Madras to act on their own initiative in cases of imminent necessity or where they had received direct orders from the home authorities. Bombay's interference in Maratha affairs, which had been encouraged by the court of directors in England, led to war with the Marathas; and the situation was retrieved only by the prompt action of Hastings, who dispatched Gen. Thomas Goddard against them. After the defeat of the Marathas by Goddard and the storming of Mahadaji Sindhia's rock-fortress of Gwalior by Capt. William Popham peace was concluded by the treaty of Salbai in 1782.

While the Maratha war was taking place, Hyder Ali of Mysore, who had been estranged by the policy of the Madras council, invaded the Carnatic in 1781 and threatened Madras. Once more Hastings rose to the occasion and sent Eyre Coote by sea to Madras. After much bitter fighting the war was brought to an end by the treaty of Mangalore (1784), which stipulated a mutual restoration of conquests. During this war the situation had been further complicated by the arrival of a French naval force under the famous admiral Pierre André de Suffren (*q.v.*), who, between Feb. 1782 and June 1783, fought five more or less indecisive conflicts with the English squadron under Adm. Sir Edward Hughes. Although he was unable to destroy the French squadron Hughes was able to thwart their efforts to obtain command of the sea. Peace between England and France in Europe led to a cessation of these naval encounters. While his masters in England had lost the American colonies, Hastings had preserved their Indian empire intact.

Cornwallis, Shore and **Wellesley.**—The most important problem of internal administration, apart from the preservation of law and order, was the assessment and collection of the land revenue. The efforts of Warren Hastings had been merely experimental. To estimate the fertility of the soil required a detailed survey, for which the company's servants were unfitted. Moreover, the local Indian revenue officials conspired together to keep the British in ignorance of the real assets of Bengal. In 1793 Lord Cornwallis, against the advice of his ablest revenue officer, Sir John Shore, and without a survey, ordered a permanent settlement of the land revenues of Bengal. The demand from the *zamindars,* or landholders, was fixed in perpetuity, and they were declared to be the hereditary proprietors of their holdings. This was a grave error since the same advantages could have been secured by a temporary settlement for a long term of years without the disadvantage of unalterably fixing the revenue demand. Fortunately this system was not extended to the rest of India.

Cornwallis also attempted to reform the administration of justice. Although Hastings had made serious efforts to grapple with this problem, the administration of criminal justice was notoriously defective. Cornwallis, who distrusted Indians, placed it entirely under European supervision. The civil courts were also reorganized. In the districts of Bengal he vested the collection of the revenues and the administration of justice in separate officers, thus making the collectors purely fiscal agents. Cornwallis' reforms were defective in many respects: no means existed whereby the new laws could be brought to the notice of an illiterate peasantry; the courts were not numerous enough to cope with the cases brought before them, and accused persons were confined in prison for long periods pending trial; in the long run his mistrust of Indians in the administration of justice proved to be a fundamental error; and his separation of the revenue and judicial functions proved unworkable and too expensive.

His principal achievement was the reorganization of the Indian civil service on a footing worthy of its task. This was accomplished by prohibiting the collectors from engaging in private

trade and by paying them adequate salaries, thus placing them above corruption.

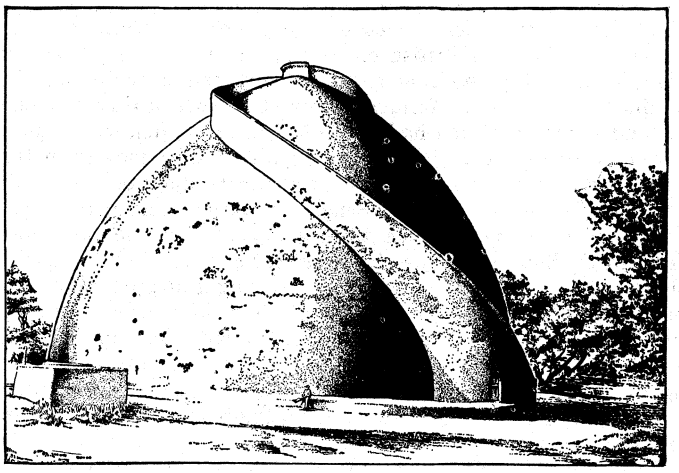
From the earliest days of the British connection with India there were two opposing forces at work, a forward tendency and a policy which sought to restrict or prevent expansion. In accordance with Pitt's India act of 1784, both Lord Cornwallis and his successor, Sir John Shore, pursued a policy of nonintervention in the affairs of the native states. To this there were two exceptions. Cornwallis found it impossible to avoid a conflict aith Tipu Sultan (Tippoo Sahib) of Mysore, who in 1790 made an unprovoked attack upon a British ally, the ruler of Travancore. After initial reverses Cornwallis, in 1792, advanced to the walls of Seringapatam and dictated terms by which Tipu was deprived of one-half of his territories and compelled to pay a huge indemnity. Neither can it be contended that the policy of Cornwallis and Shore toward Oudh was one of nonintervention. for they recognized that some control of this buffer state was essential. Shore even found it necessary to depose its ruler, Wazir Ali, because he was hostile to British interests. Elsewhere Shore's policy was one of unenterprising neutrality, and his refusal to protect Hyderabad from Maratha incursions resulted in the defeat of the nizam at Kharda in 1795. The system of neutrality prescribed by the home authorities lowered British prestige and increased the influence of French adventurers at the Indian courts. Lord Wellesley therefore found the British without allies when he arrived as governor-general in May 1798: both Daulat Rao Sindhia and the nizam had entrusted their best battalions to French officers; Tipu Sultan was intriguing on all sides against the British; Oudh was in no condition to serve as a buffer state; and the Carnatic and Tanjore had lapsed into anarchy. He also found the army badly organized and the financial condition of the company distressing.

As a result of Tipu's intrigues a small French force from Mauritius reached Mysore in 1799. A Jacobin club was formed, a tree of liberty planted and Tipu was hailed as "Citoyen Tipou". Eventually Wellesley declared war, and after a short campaign of three months Tipu was defeated and slain in May 1799. Wellesley decided to form a small central kingdom of Mysore and to restore the ancient Hindu dynasty. What was left was divided between the British and their allies. From that time Mysore was really under British control. Between 1799 and 1801 Tanjore, Surat and the Carnatic were placed under British administration. Because of the weakness of Oudh as a buffer state its ruler was compelled, in 1801, to surrender Rohilkhand, Farrukhabad, Mainpuri, Etawah, Cawnpore, Fategarh, Allahabad, Azimgarh, Basti and Gorakhpur. Thenceforward it was entirely surrounded by British territory, except on the Nepalese frontier, and ceased to be a buffer state.

Wellesley was the first governor-general to realize that the time had come for the British to stand forth as the paramount power. To accomplish this it was essential to control or crush the Marathas. His efforts at forming separate subsidiary alliances with each member of the Maratha confederacy ended in failure. Dissensions among the Marathas and the flight of the peshwa to British territory gave him the opportunity he sought. By the treaty of Bassein (1802) the peshwa entered into a subsidiary alliance and accepted British arbitration in his disputes with the other country powers. This naturally proved unacceptable to the other members of the confederacy and made war inevitable. In southern India the forces of Sindhia and Berar were crushed by Lord Wellesley's brother, Gen. Arthur Wellesley (later duke of Wellington), at Assaye and Argaon in 1803. In the same year Gen. Gerard Lake defeated Sindhia's forces in northern India at Aligarh and Laswari. As a result of these victories the British annexed Cuttack and all of Sindhia's territories in the Upper Doab. Wellesley was recalled before he was able to crush the forces of Holkar.

Minto and the Marquess of **Hastings.**—For a few years after Wellesley's departure British prestige was once more lowered by the resumption of a policy of nonintervention; but French intrigues in Persia forced Lord Minto (1807–13; later 1st earl of Minto) to adopt a more active foreign policy. After the treaty of Finkenstein (1807) by which Napoleon promised to force Russia to restore Georgia to Persia, French influence became paramount at the Persian court. This prompted Minto to send John Malcolm on a mission to Persia, Mountstuart Elphinstone to the Afghan Shah Shuja at Peshawar and Charles Metcalfe to Ranjit Singh, the Sikh ruler of Lahore. It was Napoleon's sacrifice of Persian interests at Tilsit in 1807, not Minto's diplomatic measures, that brought about the decline of French influence at Tehran. Elsewhere more concrete results were obtained. An expedition to the French islands in 1810 led to the capture of Bourbon and Mauritius; and in the following year Java was taken from the Dutch.

Establishment of British Paramountcy.— From 1813 to 1823 the company's territories were governed by the marquess of Hastings. Like Wellesley before him, he found that the policy of nonintervention prescribed by the authorities in England had broken down and that the country was being plundered by well-organized bands of brigands. He was first called upon to deal with the Gurkhas of the Himalayan state of Nepal, whose continual raids across an ill-defined frontier into British territory compelled him to declare war. The incompetence of the British officers chosen and the stubborn resistance of the Gurkhas prolonged the campaign from Nov. 1814 to March 1816. The situation was retrieved in the final stages by Sir David Ochterlony; and the Nepal durbar, after the capture of Fort Malaun, came to terms. By the treaty of Segauli (1816) the Gurkhas were forced to cede Garhwal and Kumaon together with most of the Tarai. They also agreed to withdraw from Sikkim and to accept a British resident at Katmandu.



BANKIPORE, INDIA. A GREAT GRANARY BUILT IN 1780 TO BE FILLED WITH GRAIN TO GUARD AGAINST FAMINE. STAIRWAY LEADS TO TOP: GRAIN TAKEN OUT AT BOTTOM

This accomplished, the governor-general turned his attention to the extirpation of the Pindari robber bands, who. urged on by the Marathas, had begun to plunder the company's territories. Eventually the home authorities gave a reluctant consent to military operations, and in 1818 the Pindaris were destroyed by a huge force of 20.000 men and 300 guns, the largest force that the British had been able to command in India up to that date. The Pindari war developed into a struggle with the Marathas. For this Hasting was fully prepared and, in the final Maratha war (1817–19), British arms were everywhere successful. As a result of this war the military power of the Maratha states was completely shattered and the territories of Holkar and the raja of Berar greatly reduced in size. Holkar was forced to cede Ajmer, the strategical key to Rajputana. The peshwa was deposed and forced to reside as a pensioner at Bithur near Cawnpore. Thus, by the suppression of the Pindaris, the defeat of the Marathas and the inclusion of the Rajput and other states within the pale of British protection, the British became the paramount power in the Indian peninsula. Except on the northwest frontier all the Indian states accepted the British ascendancy and from that time began to look to the British for rights and privileges.

Burmese aggressions on the northeast frontier led to war with Burma from 1824 to 1826. After a badly managed campaign the British dictated terms in the treaty of Yandabu, by which the Burmese agreed to accept a British resident, pay an indemnity of £1,000,000, surrender Assam, Arakan and the coastal strip of Tenasserim and abstain from all interference in Cachar, Jaintia and Manipur.

British Social Policy. — Amid the wars attending the establishment of British power in India there had been little time for social reform, although such practices as slavery, infanticide and suttee (*sati*) were extremely prevalent. Even though it was decided. in 1833, to emancipate all slaves in British territory, it was not until 1843 that slavery lost its legal status in British India. As early as 1795, as a result of the efforts of Jonathan Duncan, the company's resident at Benares, female infanticide was declared to be murder, but it was a difficult order to enforce and, as late as 1870, it was necessary to verify the existence of female children some years after birth. Suttee, or the burning of Hindu widows on the funeral pyres of their husbands, was sanctioned by the Hindu religion. This horrible rite was also tolerated by the British because it was feared that its suppression would provoke widespread disturbances. Despite the protests of Christian missionaries. of isolated British officials and of the Indian reformer Ram Mohan Roy, nothing effective had been done before the administration of Lord William Bentinck, by which time a strong demand for its abolition had arisen in England. Bentinck, therefore, arrived in India in 1828, armed with instructions from the court of directors to consider measures for its abolition. In 1829 it was declared illegal in the Bengal presidency, and persons assisting a voluntary sacrifice were guilty of culpable homicide. To Lord Dalhousie must be given the credit for its abolition in the Indian states. The honour of suppressing thuggee (thagi), a semi-religious cult and an organized system of murder, must be shared between Bentinck and Captain William Sleeman. It was not until an approver, named Feringhia, saved his life by betraying its secrets to Sleeman that the various gangs were hunted down. Between 1831 and 1837, 3,266 thugs were disposed of in one way or another.

Until the third decade of the 19th century no attempt was made to impose a European culture on India. The British conception of empire was confined to the establishment of law and order, the foundation of an administrative system, the dispensing of justice and the collection of revenue. There gradually developed a deeper sense of responsibility for the welfare of the inhabitants of India. As early as 1792 Charles Grant, supported by William Wilberforce and Zachary Macaulay, fellow members of the Clapham sect, had advocated the regeneration of India by the introduction of a knowledge of the Christian religion, the English language and western science For many years they were voices crying in the wilderness, for the company's policy was one of strict neutrality as far as Hindu and Moslem religious observances were concerned. As late as 1833 the government of Madras was responsible for the administration of 7,500 Hindu shrines. This was denounced by public opinion in England as tantamount to the encouragement of idolatry. With the growth of the humanitarian and evangelical movements the support of missionary enterprise increased, and one of the main achievements of the Whigs in 1833 was that missionaries were allowed to proceed to India without a licence. From 1813 to 1835 there was a period of controversy between the Orientalists and the Anglicists. Thomas Babington Macaulay, who became in 1833 the first legal member of the governor-general's council, supported the Anglicists in a famous minute which was largely responsible for the fact that English became the principal medium of instruction and western literature and science the chief subjects of study. In 1837 great encouragement was given to western learning by the supersession of Persian as the language of the law courts. The administration of Bentinck (1828–35) therefore stands out as a great landmark, for the study of the English language unlocked the door to a study of modern scientific knowledge and brought Indians into closer contact with the liberal and democratic ideas of the west.

Frontier Wars and Annexations — Soon after the arrival of Lord Auckland as governor-general in 1836 the British became alarmed at the growth of Russian influence in Persia. At that time the British sphere of influence in northern India extended to the river Sutlej. Between British India and Afghanistan lay the independent states of the Punjab under its Sikh ruler, Ranjit Singh, and Sind under the Talpur amirs. Shah Shuja, the Sadozai ruler of Afghanistan with whom Minto had concluded a treaty, had been ousted from his dominions and forced to take refuge in British territory. Auckland found Afghanistan divided into three states: Dost Mohammed Barakzai had extended his rule over Kabul, Ghazni and Jalalabad; Kandahar was independent under Dost Mohammed's brothers; and Herat was governed by Kamran Mirza, a Sadozai.

In the 1830s Russophobia was at its height. Urged on by Count Simonich, the Russian envoy at Tehran, the shah had laid siege to Herat, which in those days was regarded as the gate to India. In June 1836 Auckland was warned by the foreign office in London of these intrigues and that Dost Mohammed was in active correspondence with Persia. To ascertain the exact state of affairs Auckland dispatched Alexander Burnes ostensibly on a commercial mission to Kabul. Friendly relations could have been established had Auckland been prepared to help Dost Mohammed recover Peshawar, which had been lost to the Sikhs. This Auckland could not promise since he was anxious to conciliate Ranjit Singh. Burnes, who was tied by his instructions, was therefore outmanoeuvred by the Russian agent P. Vitkevich and recalled. Auckland, influenced by his private secretaries and other irresponsible advisers, decided to replace Dost Mohammed by the more pliant Shah Shuja. To this the government in England agreed. One of the chief reasons for Auckland's decision to invade Afghanistan was to relieve Herat, yet, when news arrived that the shah had abandoned the siege, he persisted in his efforts to oust Dost Mohammed from Kabul. At first the British were successful. Shah Shuja was restored and Dost Mohammed took his place in India. Eventually there was a general rising of the Afghan tribes against the British. The principal reasons for this were the unpopularity of Shah Shuja, hatred of foreign domination and the licentious conduct of British troops at Kabul. Both Burnes and Sir William Macnaughten, the British envoy, were assassinated and the troops besieged in Kabul. Gen. William Elphinstone and his military advisers eventually decided to retreat to India, but the force was practically annihilated before reaching Jalalabad. Out of 4,000 troops and 12,000 camp followers only W. Brydon, Maj. Lisant of the 37th native infantry, a merchant named Barnes and a few Indians reached Jalalabad. The restoration of the British position in Afghanistan was the work of Lord Ellenborough. who succeeded Auckland in Feb. 1842. After British honour had been satisfied by the avenging armies of Generals George Pollock and William Nott, Dost Mohammed was allowed to return to Kabul as ruler. The first war with the Afghans was a melancholy piece of folly which left a legacy of hatred and poisoned Anglo-Afghan relations for many years.

The reverses sustained by the company's troops in Afghanistan were not calculated to raise British prestige on the northwest frontier. Moreover, Auckland's treatment of the amirs of Sind had made them distrustful of British motives. In 1832 the British had pledged themselves to protect the territories of the Hyderabad and Khairpur amirs. In contravention of these treaties Sind had been used as a base for the British advance into Afghanistan, and Auckland in 1839 had forced the amirs to subscribe to a subsidiary treaty which practically deprived them of their independence. The policy adopted by Ellenborough was not less highhanded and eventually provoked the amirs into attacking the British residency. In 1843 they were defeated by Sir Charles Napier at the battles of Miani and Dabo and their country annexed. The annexation of Sind may have been expedient both politically and strategically; on moral grounds it was indefensible.

It was left to Ellenborough's successor, Sir Henry Hardinge (1844–48), to deal with the situation in the Punjab. After the death of Ranjit Singh in 1839, the Punjab had become the scene

of widespread lawlessness and domestic contentions. The only effective power was the Sikh army, which in 1845 comprised 88,662 men supported by a powerful artillery. Suspecting the British of contemplating the annexation of its country and eager for war. the Sikh army in Dec. 1845 crossed the Sutlej and invaded British territory, whereupon Hardinge declared war. The Sikhs were defeated in desperate struggles at Mudki, Ferozeshah, Aliwal and Sobraon, after which they were forced to surrender all territory on the British side of the Sutlej together with the Jullundur Doab, to pay an indemnity and to limit the strength of their armed forces. In 1846 Gulab Singh, a Dogra raja, was placed in possession of all the hill country between the Indus and the Ravi, including Kashmir, Ladakh, Gilgit and Chamba. The administration of the Punjab was entrusted to a council of regency presided over by Sir Henry Lawrence with a team of brilliant colleagues. the chief of whom were John Lawrence. Herbert Edwardes and John Nicholson. These arrangements did not prove acceptable to the Sikhs; and Lord Dalhousie, who succeeded Hardinge in 1848. was faced with a second war six months after his arrival in the country. The indecisive battle of Chillianwalla was followed by the destruction of the Sikh army at Gujrat, whereupon Dalhousie annexed the Punjab to British India. After nearly a century of incessant warfare the British political and geographical frontiers had become conterminous.

Dalhousie's period of office was marked by extensive annexations, and as a stage in the growth of British power in India it is comparable only with those of Wellesley and the marquess of Hastings. Soon after the defeat of the Sikhs his attention was directed to the northeast frontier, where Anglo-Burmese relations had steadily deteriorated since the conclusion of the treaty of Yandabu in 1826. The arrogant insolence of the Burmese and Dalhousie's failure to obtain satisfaction for acts of oppression on British merchants eventually compelled him to declare war in 1852. After a short well-organized campaign, Dalhousie, contrary to the instructions of the court of directors, contented himself with the annexation of Pegu or Lower Burma, which gave the British complete control of the Burmese coast line and enabled them to develop the port of Rangoon.

In India itself he complied nith the directors' instructions and, in accordance with what has been aptly termed the doctrine of lapse, annexed any tributary or dependent Hindu state whose ruler had died without a natural successor or without having previously adopted an heir with the sanction of the paramount power. In pursuance of this policy the following Hindu states became British territory: Satara (1848); Jaitpur, to the north of Jhansi (1849); Sambalpur (1849); Jhansi (1853); and Nagpur (1854). Tears of chronic misgovernment under a succession of dissolute rulers prompted Dalhousie to annex Oudh in 1856. This was the only case of annexation not in accordance with the doctrine of lapse or the result of conquest.

The Mutiny.—Dalhousie's successor, Lord Charles Canning, reached India in 1856. A year later the sepoys of the Bengal army mutinied An analysis of the factors underlying this revolt brings to light social. religious, economic, political and military causes. To regard it merely as a sepoy mutiny is to underestimate the increasing pace of westernization after the establishment of British paramountcy in 1818. Despite numerous invasions the structure of Hindu society had persisted; and it looked at first as if the British, like previous conquerors, had merely superimposed a political structure on the underlying Hindu social system. It soon became apparent, however, that Hindu society was being affected by the introduction of western ideas. Missionaries nere challenging the religious beliefs of the Hindus. The humanitarian movement had led to reforms which went deeper than the political superstructure. Dalhousie had made efforts for the emancipation of women and had introduced a bill to remove all legal obstacles to the remarriage of Hindu widows. Converts to Christianity were to share with their Hindu brethren in the property of the family estate. There was a widespread belief that the British aimed at breaking down the caste system. The introduction of western methods of education was a direct challenge to orthodoxy, both Hindu and Moslem. The mutiny therefore was not so much a revolt against foreign political domination as a protest against westernization, the pace of which had been accelerated in the years immediately preceding its outbreak. These changes threatened the supremacy of the Brahmans, who were the upholders of orthodox Hinduism. Many of them had been dispossessed of their revenues or had lost lucrative positions. Everywhere the old Indian aristocracy was being replaced by British officials; and recent land-revenue settlements in Allahabad and Oudh had favoured the peasants at the aristocracy's expense. Dalhousie had instituted an inquiry into the titles of landholders and it had been discovered that many of their claims rested on patents of doubtful authenticity. More than 20.000 estates had been confiscated in the five years tefore the mutiny. The annexations of Dalhousie, especially the annexation of Oudh, had produced a discontented nobility and a disbanded soldiery.

The mutiny broke out in the Bengal army because it was only in the military sphere that Indians were organized. From 1764 onward there had been frequent sepoy mutinies. The conquest of Sind and the Punjab produced great discontent since the sepoy no longer received extra allowances for service in provinces which had become British territory. Four Bengal regiments warned for service in Sind refused to march until these extra allowances were restored. There mere also serious defects in the administration of the army. The growing centralization of military authority at headquarters and Bentinck's abolition of corporal punishment in the native army had deprived commanding officers of adequate powers of punishment, for it was not until after the suppression of the mutiny that summary courts martial were instituted. There had been recruited high-caste sepoys, whose caste prejudices interfered with their military duties. Until the General Enlistment act of 1856 sepoys could refuse to proceed on foreign service. At the close of Dalhousie's administration the distribution of European troops was unstrategic. Only three regiments garrisoned the 900 mi. between Calcutta and Meerut. To make matters worse European troops were hopelessly outnumbered. In fairness to Dalhousie it must be stated that his appeals to rectify this grave error had been pigeonholed in London. The pretext for revolt was the introduction of the new Enfield rifle; to load it the cartridges had to be lubricated and to have their ends bitten off by the sepoys. There appears to be some foundation for the popular belief that the grease used for this purpose was a mixture of pigs' and cows' lard, an insult to both Moslems and Hindus.

Geographically the mutiny was practically confined to Upper and Central India and did not spread to Bombay and Madras. Thanks to the efforts of Herbert Edwardes, John Nicholson and John Lawrence the Punjab remained loyal. With the exception of the Mogul emperor and his sons and Nana Sahib, the adopted son of the deposed peshaa. none of the important Indian princes joined the mutineers. The extension of the revolt was gradual and resulted from gross British incompetence in the early stages when sterner and prompter action might have prevented it. But Canning was incapable of rapid decisions. and mediocrity was the prevailing note on his council. (For the military history of the mutiny *see* INDIAN MUTINY, THE.)

BRITISH IMPERIAL ADMINISTRATION

After the fall of Delhi, Bahadur Shah, the last puppet Mogul emperor, was tried for complicity in the revolt and condemned to exile. The crown took over the government of India from the East India company and a secretary of state, assisted by a council of experts, took the place of the board of control dating from William Pitt's India act of 1784. Lord Canning became the first Viceroy and Governor-general. The assumption of direct government by the crown was the occasion for a royal proclamation. To the peoples of India the queen proclaimed her deep personal concern for their welfare. The hour of victory was not to be an opportunity for repressive legislation An assurance was given that neither race nor religion should debar Indians from employment in the government of the country. Henceforth fitness was to be the criterion of eligibility. To the princes the crown relinquished the right, recently enforced by Dalhousie, of resuming

their territories on the failure of natural heirs. One of the most important questions after the mutiny was the reorganization of the military forces in India. It was eventually decided to amalgamate the British forces with the British army under the nominal control of the crown, thus ensuring that the Indian army should be an imperial force and not a local militia.

The second half of the 19th century was a period of consolidation and conciliation. It was an age of moral and material progress, of commercial development and constitutional experiments, of administrative and legal reforms. It witnessed a centralization under the crown made possible by the rapid development of communications, with the result that the secretary of state's powers increased at the expense of those of the governor-general. It also witnessed the fixed resolve of educated Indians to secure a larger share in the government of their country. Of outstanding importance were the legal codes. The Indian penal code, first drafted by Macaulay as early as 1834, became law in 1860. Codes of criminal and civil procedure were enacted in 1861. The same year saw the unification of the judicial system by the amalgamation of the supreme court and the adalats (courts) of the company into high courts. In 1861, for the first time, provision was made for the nomination of unofficial members to the governor-general's legislative council. The working of the executive council was also remodelled by the introduction of the portfolio system of business.

The mutiny left the government of India saddled with an enormous debt. By 1864 the efforts of James Wilson and his successor, Samuel Laing, had converted the debt into a surplus by means of large economies in military and civil expenditure and by introducing an income tax and other imposts. The year 1871 saw the beginnings of financial decentralization. which made the provincial governments more responsible for their own finances. This was gradually extended until, in 1882, the provinces received a share of the revenues instead of a fixed grant from the central treasury. During the viceroyalty of Lord Lytton (1876-80), Sir John Strachey, his finance minister, abolished the internal customs line, a huge cactus hedge interspersed with stone walls and ditches extending from Attock to Berar. This had been erected to prevent the untaxed salt of Rajputana and the lightly taxed salt of southern and western India from entering British territory. By granting compensation to the Indian states the British were able to control the sources of supply and remove this fiscal anachronism. In accordance with the doctrines of free trade, Strachey remitted the import duties on many articles. In 1882 the general customs tariff, with the exception of salt, liquor, tobacco and kerosene oil, was abolished. This lasted until 1894 when the progressive decline in the exchange value of the rupee made additional taxation imperative. A general duty of 5% was therefore imposed on imports. In the interests of the Lancashire manufacturers a countervailing excise duty was placed on Indian manufactured cotton cloth—a measure which rankled with growing bitterness in the Indian mind until abolished in 1926.

Before 1858 no attempt had been made to grapple with the problem of recurrent famines by introducing ? system of famine relief and there had been little expenditure of public funds. The modern idea that famine relief is the responsibility of the state was not recognized until India passed under the crown. The Famine commission of 1867 under Sir George Campbell laid the foundations of a more humane policy and enunciated the principle of preventing deaths from starvation. In the Bihar famine of 1873–74 village inspection, the basis of modern organization against famine, was carried out for the first time. The idea of insurance against famine originated with Sir John Strachey, who in 1874 contended that famines were normal periodic calamities against which it was necessary to make financial provision. During the southern Indian famine of 1876–78 the Temple, or reduced, ration, named after Sir Richard Temple, was adopted in Madras and Bombay but was abandoned after three months as insufficient. The Famine commission of 1878–80, presided over by Sir Richard Strachey, Sir John's elder brother, recommended that a definite system of procedure should be embodied in a famine code to be put into operation by the local governments subject to the financial control of the central government. A commission in 1898 under Sir James Lyall confirmed these principles but advocated in addition a more liberal famine wage and an extension of gratuitous relief. Unfortunately before these proposals had been incorporated in the provincial codes the great famine of 1899–1900 occurred. The Famine commission of 1901 recommended an efficient system of intelligence in order to obtain earlier estimates of anticipated crop failure and placed special emphasis on the importance of moral strategy since moral depression led to physical deterioration.

Of all the viceroys between 1858 and the end of the century Lord Ripon (1880–84) did most to make the British connection acceptable to educated Indian opinion. Appointed by a Liberal ministry in England, he sponsored a factory act, the first of its kind in India, and repealed the Vernacular Press act of 1878, which had muzzled the Indian press. In 1882 he decided to foster local self-government as a measure of political education even at the cost of administrative efficiency. But his rule is chiefly remembered for the famous Ilbert bill of 1883 by which he sought, as a minor administrative reform, to permit senior Indian judges to try criminal cases in which Englishmen were involved. Furious opposition from the unofficial English element in Bengal and Bihar resulted in the measure's being considerably modified. The importance of the controversy is that it intensified racial antagonism.

Foreign Policy.—The death of Dost Mohammed in 1863 was the signal for fratricidal conflicts in Afghanistan, and it was not until 1868 that his son Sher Ali succeeded in crushing all rival claimants. The policy of the government of India under Sir John Lawrence (1864–69) was one of abstention from interference in Afghan affairs and no attempt was made to recognize Sher Ali until his power had been firmly established. The desire for a closer alliance prompted Sher Ali in 1869 to meet Lawrence's successor, Lord Mayo (1869–72), at the conference of Amballa, the results of which have been much overrated by historians. The advance of Russia in central Asia led to a further conference at Simla in 1873, but Sher Ali failed to obtain dynastic pledges and had to content himself with vague promises of support. From this date Russian influence gained ground at Kabul. Sher Ali was further estranged by the Seistan arbitral award of 1872, which in his opinion favoured Persia. and by the British occupation of Quetta in 1876, which he regarded as a knife pointed at him. Caution therefore marked the policy of the government of India toward Afghanistan until the arrival of Lord Lytton in 1876. The Peshawar conference of 1877 was a final attempt to reconcile Sher Ali, but it was wrecked by the efforts of Lytton and his advisers in England to force British residents on the amir. Russia's reply was the mission of Stolyetov to Kabul. The refusal of Sher Ali to allow a British mission under Sir Neville Chamberlain to cross the frontier at Ali Masjid furnished Lytton with his famous *casus belli* for the Second Afghan War (1878–80). .On two occasions, in 1839 and in 1878, Russian intrigues had led to a British invasion of Afghanistan. The proper solution would have been to bring pressure to bear on Russia in Europe, for strained relations between India and Afghanistan were obviously to the advantage of Russia. British military operations were successful and Sher Ali fled the country. By the treaty of Gandamak (1879) his son Yakub Khan was recognized as amir and the British position around Quetta in Baluchistan was acknowledged. The assassination of Sir Louis Cavagnari, the British resident, in Sept. 1879, was followed by the reoccupation of Kabul by a force under Gen. Sir Frederick Roberts. In July 1880 Abdur-Rahman Khan, the nephew of Sher Ali, was recognized as amir of Kabul in return for his acknowledgement of the British right to control his foreign relations. Three years later this promise was renewed by Lord Ripon, who also bestowed on Abdur-Rahman an annual subsidy of 12 lakhs of rupees to be spent on the defense of his northern frontiers. In promising to protect Afghanistan against unprovoked aggression the British pledged themselves to defend a country of unknown limits. The Russian occupation of Merv in 1884 gave the necessary impetus to negotiations which ended in the appointment of an Anglo-Russian commission for the delimitation and demarcation of the northern boundary of Afghanistan. Although the Panjdeh incident of 1885, when an Afghan

force suffered heavy losses in an engagement with Russian troops, brought Britain and Russia to the verge of war, the process of demarcation was completed by the year 1888. The last frontier dispute in which Russia was concerned was settled by the Pamir agreement of 1895. Thus, in the closing years of the 19th century, the recognition of a definite frontier between Russia and Afghanistan led to a decided improvement in Anglo-Russian relations. The boundary between India and Afghanistan was delimited by the Durand agreement of 1893. British penetration into the tribal areas of the northwest frontier of India provoked the Pathan tribesmen to revolt in 1897. The Tirah expedition of 1898 was followed by a temporary cessation of hostilities. On the northeast frontier strained relations with Burma led to the Third Burmese War of 1885, which ended with the acquisition of Upper Burma. By the convention of Peking in 1886, China recognized British rule in Burma and arrangements were made for the delimitation of the frontier between Burma and China.

Lord Curzon as Viceroy (1899–1905).—Lord Curzon's attention was first directed to the problem presented by the tribes of the northwest frontier, largely an aftermath of the forward policy adopted by his predecessors. His policy has been aptly summarized as one of withdrawal and concentration. Regular troops were recalled from isolated garrisons in tribal territory and the defense of these forward areas entrusted to a tribal militia supported by British movable columns. In 1901, to increase the control of the government of India over frontier administration, he created the North-West Frontier province, which he placed under a chief commissioner assisted by officers of the political department and other specially recruited officials. Curzon's foreign policy aimed at the exclusion of Russian influence from areas of vital importance to the protection of India. Convinced of the necessity of maintaining British political and commercial supremacy in the Persian gulf, he frustrated Russian schemes for a coaling station at Bandar Abbas and for a railway terminus at Kuwait and also the French attempt to obtain a naval base on the coast of Oman. Similar motives influenced him in sending an expedition into Tibet in 1904 under Col. Francis Younghusband. Since the dalai lama had come under the influence of a Russian Buddhist named Dordzhiyev, Curzon considered it essential that British influence should be recognized in such a manner at Lhasa as to make it impossible for any other power to exercise pressure on the Tibetan government inconsistent with the interests of British India. It appears that his fears of Russian penetration into Tibet were not well founded. The Younghusband expedition, which slaughtered 700 badly armed Tibetans, was an inglorious episode in British history and served no useful purpose.

His internal administration was characterized by far-reaching reforms. The Punjab Land Alienation act protected the peasant against moneylenders. Co-operative credit societies and agricultural banks were instituted. An agricultural department was formed to improve farming and cattle breeding, and a department of commerce and industry was founded to encourage trade. The administration of the Indian police was reformed and a criminal investigation department created. In addition, commissions were appointed to inquire into education, irrigation and famine administration. His interest in Indian culture resulted in the Ancient Monuments Preservation act of 1904 and the appointment of Sir John Marshall as director-general of archaeology. Unfortunately Curzon lacked tact; and his unguarded utterances, especially his Calcutta convocation speech, and his attitude to the Indian princes were, to say the least, regrettable. His attitude of mental superiority combined with unpopular proposals for the partition of Bengal were largely responsible for the unrest and the outbreak of grave political crime with which his successors were confronted. As in the days of Dalhousie, the pace of reform had been too rapid. His viceroyalty may be said to mark the end of benevolent autocracy.

The Indian Nationalist Movement.— In its early stages this movement took the form of constitutional agitation which aimed at securing for Indians a greater share in the administration of the country. At first there was no desire to dispense with the British connection, but the reluctance of the government of India to grant reforms produced a distrust of British motives which led in the 20th century to a revolutionary movement demanding self-government and freedom from foreign control. A Hindu religious renaissance in the second half of the 19th century, by focusing attention on India's great cultural heritage, fostered national consciousness and racial pride. Prominent among the religious reformers were Keshub Chunder Sen (*q.v.*) (1833–84), who broadened the basis of the Brahma Samaj; Dayanand Saraswati (1824–83), founder of the Arya Samaj; and Ramakrishna (1834–88), whose work was continued by his more famous disciple Swami Vivekananda. But the most important factor underlying the growth of the nationalist movement was the influence of British rule. The establishment of British paramountcy and the development of communications facilitated centralization and tended to greater unification. English became the *lingua franca* of educated Indians and brought them into contact with European liberalism and political philosophy and with the ideas of nationalism and patriotism prevalent in the west. It enabled them to study the works of Edmund Burke, John Stuart Mill and other political philosophers and to read the lives of Giuseppe Garibaldi. Giuseppe Mazzini and Lajos Kossuth. They saw the part played by nationalism in the Italian *risorgimento* and how it had helped to unify Germany. The awakening of Japan and the defeat of Russia by an oriental poser was looked upon as symptomatic of general occidental decadence. Beneath the constitutional agitation lay a stratum of bitter economic discontent, and unemployment among educated Indians produced a vehement demand for a more rapid indianization of the administration. Racial discrimination against Indians. especially in South Africa, the controversy about the Ilbert bill of 1883 and the partition of Bengal in 1905 all played their part and led to the Swadeshi movement. which advocated the use of Indian-made goods. This developed into an agitation for the boycott of British goods resembling the boycott of American goods in China.

In imitation of western methods Indians formed societies for the discussion of political affairs. This was the purpose of the Indian association formed by Surendranath Banerjea in 1876. It was not until 1885, however, that the first Indian national congress met at Bombay. Its founder was Allan Hume, an Englishman who had consistently advocated the introduction of a more representative form of government; and it was hoped that it would develop into a sort of Indian parliament for the discussion of grievances. The first congress was attended by 72 delegates, chiefly lawyers, schoolmasters and newspaper editors. Of these only two were Moslems. The second congress in 1886 was composed of 440 delegates, but because of the influence of Sir Sayyid Ahmad only 33 Moslems attended. In reply to Lord Dufferin's description of the congress as a microscopic minority. 1.248 delegates attended the annual meeting in 1888. The last decade of the 19th century witnessed a change in the character of Indian nationalism, and by 1907 the moderate party led by Banerjea and Krishna Gokhale had given way to a virulently anti-British party under a Maratha Brahman journalist Bal Gangahdar Tilak and a Bengali named Arabindo Ghose, who had taken a first class in the Classical tripos at Cambridge. The anarchist movement was first organized by the Brahmans of Poona and owed much to inflammatory articles advocating the assassination of British officials which appeared in Tilak's paper, the *Kesari*. Centres of conspiracy were also formed in London, Paris and San Francisco, Calif. From Bombay the movement spread to Bengal, where, under Barindra Ghose and his brother Arabindo. recruits were trained both mentally and physically for revolution. The English secondary schools and colleges of Bengal were the most fruitful recruiting centres. Eventually. in 1908, as a result of the discovery of bombs, dynamite and correspondence. 35 conspirators were arrested, of whom 15 nere found guilty. An approver was shot dead in jail, the public prosecutor was assassinated in Calcutta and a deputy-superintendent of police murdered while leaving the high court. From this it is clear that the most important problem of Lord Minto's viceroyalty (1905–10) was the suppression of political conspiracy.

The **Morley-Minto** Reforms.— In an attempt to meet Indian

political aspirations, important constitutional reforms were carried out in concert between Lord Minto and Lord Morley, the secretary of state for India. In 1907 Morley appointed two Indians, Sayyid Husain Bilgrami and Krishna Gupta (afterward Sir), as members of his council in London. By the Indian Councils act of 1909 the governor-general's legislative council and the provincial legislative councils were considerably enlarged and their powers increased to enable them to adopt resolutions on matters of administrative and financial policy. In the provinces the official members were outnumbered, but an official majority was still retained at the centre. Because of Moslem agitation the principle of communal representation was formally incorporated in the constitution. For the first time an Indian was appointed to the governor-general's executive council. Unfortunately these reforms did not go far enough. Because of the restricted franchise, the reformed councils were not based on any system of direct popular representation. The percentage of lawyers among the nonofficial elected members was too great; and the official bloc was always strong enough to dominate the voting power in all councils. In fact, they were merely advisory bodies and lacked ministerial responsibility, the essence of the parliamentary system. Neither did these reforms, as Morley had expected, check the rising tide of unrest in India.

From 1909 to 1914.—Between 1909 and 1914 the terrorist movement spread from Bombay and Bengal to Bihar, the United Provinces, Madras and the Punjab. In July 1909 Sir Curzon Wyllie, political aide-de-camp at the India office. was assassinated by an Indian at the Imperial institute in London. Five months later an unsuccessful attempt was made to assassinate Lord and Lady Minto at Ahmedabad. In December of the same year Arthur Jackson, the district magistrate of Nasik, was shot dead at a farewell party given in his honour. In 1910 a secret society was unmasked at Satara. Robert Ashe. the district magistrate of Tinnevelly in Madras, was killed in June 1911. In Dec. 1911 occurred the Delhi bomb outrage. in which Lord Hardinge of Penhurst, who had succeeded Minto in Nov. 1910, was seriously wounded. The archconspirator behind the Ghadr (mutiny) movement in the Punjab was one Hardayal, who had proceeded to Oxford university with a state scholarship which he surrendered in order to return to India to preach sedition. Hardayal was later arrested in the U.S. but, escaping from custody, fled first to Switzerland and then to Berlin, Ger., leaving his unfortunate dupes in India to pay the penalty for their crimes.

It must not be imagined that these acts of violence were typical of the Indian attitude toward British rule. Among the moderates, at least, there was for some time after the Morley-Minto reforms a better feeling; and at the 1910 congress, for the first time, an address of welcome was presented to the new viceroy. The visit of the king-emperor to India in 1911 and the revocation of the partition of Bengal temporarily checked the growing unrest. For a time the new system of communal electorates strengthened Moslem loyalty, but this attitude gradually changed as a result of the apparent indifference of the British government to Moslem interests, which were endangered by the Italo-Turkish and Balkan wars. A motion proposed in the imperial legislative council on Jan. 24, 1911, demanding the discontinuance of separate representation for Moslems, served only to exacerbate Hindu-Moslem relations. By 1913 the attitude of the Moslem league, which had been formed in 1906 as a counterpoise to congress, became so hostile that the Aga Khan resigned the presidency. The treatment of Indian immigrants in the self-governing dominions and colonies intensified the growing resentment against western supremacy. The leader of the Indian movement of passive resistance in South Africa was Mohandas Raramchand Gandhi, soon to become famous for the adoption of a similar plan of campaign in India itself.

Despite all this unrest the opening years of the 20th century witnessed a great increase and a striking change in the trend of India's ioreign trade. Cn the eve of World War I, although Great Britain still had the bulk of this trade, the C.S. and Japan had become more serious rivals.

World War I.—Although the government of India was automatically involved in World War I by the royal declaration, Indians of all classes and shades of political opinion, with the exception of a minority of extremists, gave positive proof of their support of the Allied cause. The martial classes Aocked to the recruiting centres; the Indian princes offered their imperial service troops; Nepal placed its Gurkhas at the disposal of the empire; and even Tibet offered to provide a contingent of 1,000 soldiers. Amir Habibullah of Afghanistan remained loyal to his engagements, despite the fact that his country was much disturbed by the presence of German and Turkish emissaries. Notwithstanding the fact that the military forces in India had been raised purely for local defense, the loyal response of the country made possible the dispatch of troops to all theatres of war with the result that for some time India was so denuded of troops that only 15,000 were available for its immediate defense. These were later reinforced by contingents from the territorial regiments of Great Britain. About 80,000 British and 230,000 Indian troops were sent overseas from India in the first few months of the war. Indian sepoys were called upon to endure the European winter campaign of 1914–15 and distinguished themselves at the battles of Neuve Chapelle and Loos. In Nov. 1915 it was decided to withdraw the bulk of Indian troops from France for service in the middle east and other theatres of war. They fought throughout the badly managed Mesopotamian campaign; served with Viscount Allenby in Palestine and with Jan Christiaan Smuts in East Africa; bore their full share of the fighting in Gallipoli and Salonika. Egypt and the Cameroons; were used to protect Aden and the Abadan pipe line in the Persian gulf; and saw service in Kurdistan. Trans-Caspia, North China and on the northwest and northeast frontiers of India. India's total contribution to the war effort was 1,302,000 men; casualties amounted to 106.594, including 36.696 deaths from all causes. Out of the total number of combatants Bengal, with a population of 45,000,000 provided only 7,000. The much less densely populated Punjab was the chief recruiting centre and provided roughly 300,000 fighting men, Moslems, Sikhs, Dogras and Jats. of whom more than one-half were Moslems. Of the total number of combatants recruited throughout British India, three-quarters came from the Punjab and the United Provinces. India's financial contribution was no less remarkable. At its own request it bore the expense of its overseas forces and, in addition, made a free gift of £100,000,000 to the imperial exchequer. By means of war loans in 1917 and 1918 a sum of £73,000,000 was raised. India's immense wealth of raw material was placed at the service of the empire and, by 1918, it had supplied stores and equipment to the value of £80,000,000.

It would be a mistake, however, to infer that the internal situation was free from anxiety since the government of India had to contend with the Ghadr conspiracy in the Punjab and with the terrorist movement in Bengal. Every effort was made by Germany to take advantage of this. On the outbreak of war an Indian Tamil, Chempakaraman Pillai, who had formed the International Pro-Indian committee at Zurich. Switz., left Switzerland for Berlin, Ger., where he and Hardayal were employed by the German foreign office to disseminate anti-British propaganda. The chief centres of German propaganda were Bangkok and Batavia. which were under the direction of the consul general for Germany at Shanghai, himself acting under instructions from the German embassy in Washington, D.C. The refusal of the Canadian authorities to allow Sikhs, who failed to comply with the immigration regulations, to land in Vancouver, B.C., was skilfully exploited by the Ghadr party in the United States and Canada. The return of these discontented Sikhs to India led to serious unrest in the Punjab, and in Feb. 1915 an abortive attempt was made, in conjunction with the Bengal revolutionaries, to overthrow British rule. Efforts by the Germans to co-operate with these conspirators and to land arms and ammunition met with no success since they had overestimated the organizing ability of their Indian confederates and underrated the vigilance of the British authorities.

The entrance of Turkey into the war was followed by efforts to undermine the loyalty of Indian Moslems. Discontent ex-

pressed itself in the Khilafat movement, the members of which regarded the sultan of Turkey as the legal caliph. The arrival of a Turco-German mission in Kabul gave rise to exaggerated rumours which prompted some of the younger members of the Khilafat party to cross the frontier and join forces with certain discontented mullahs in Afghanistan and the tribal tracts of the northwest frontier. Although a small punitive expedition had to be undertaken against the Mohmand tribes to the northeast of Peshawar, the danger of a rising of the powerful Afridis was averted when the British, in Feb. 1915, decided to double their allowances. In Aug. 1916 Turkish emissaries visited the frontier with money for the notoriously anti-British Haji Sahib of Turangzai. one of whose evil counsellors was Mohammed Ali, a graduate of Cambridge and a lecturer in the amir's college at Kabul. Great pressure was also brought to bear on the amir Habibullah to declare war, but he refused to break his engagements with the government of India.

During World War I the conception of India as a self-governing dominion within the empire took a firmer hold than ever before on the politically minded classes. In his presidential address to the national congress of 1915 Sir Satyendra P. (afterward Lord) Sinha spoke with pride of the fact that India's contribution to the war effort had not fallen behind that of other parts of the empire: although, in his opinion. India was not ripe for self-government, he was convinced that this should be the final aim of British rule. Events proved that this pronouncement did not go far enough to meet the aspirations of educated Indians; and Lord Chelmsford, who succeeded Lord Hardinge as governor-general in 1916, was confronted with a widespread agitation for home rule sponsored by Mrs. Annie Besant and B. G. Tilak, who had been released from detention. A home rule league was established in Sept. 1916, and Mrs. Besant's paper, ***New*** India, became the medium for an intensive campaign. In October of the same year 19 members of the governor-general's legislative council published a memorandum in which they complained of the inadequacy of the Morley-Minto reforms and claimed that India's loyalty during the war had earned for it the right to parliamentary institutions. In November proposals for extensive constitutional reform were made by joint representatives of the congress and the Moslem league. This Hindu-Moslem rapprochement, known as the Lucknow pact, recognized the principle of communal electorates as far as Moslems were concerned and was hailed somewhat prematurely by M A. Jinnah, a prominent Moslem leader, as the birth of a united Indian nation. The policy of the national congress for 1916 was a triumph for the principles of the Home Rule party, and political independence was advocated by both moderates and extremists. A resolution was passed that a proclamation conferring self-government on India should be immediately issued by the British government. Widespread agitation continued throughout 1917 and forced the British government to turn its attention to Indian affairs. Eventually on Aug. 20, 1917, E. S. Montagu, the secretary of state for India, declared in the house of commons that "the policy of His Majesty's Government, with which the Government of India are in complete accord, is that of the increasing association of Indians in every branch of the administration and the gradual development of self-governing institutions with a view to the progressive realisation of responsible government in India as an integral part of the British Empire." The announcement went on to emphasize that the stages in this development had to be gradual and that the pace would be determined by the British government. Indians naturally interpreted this as a promise of equality with the self-governing dominions. Moslems, however, regarded it as a victory for the Hindu majority and saw in it a threat to communal representation. From this time onward Hindu-Moslem rivalry developed apace and expressed itself in violent communal outbreaks. The visit of the secretary of state to India to hold consultations with the viceroy resulted in the publication of the famous Montagu-Chelmsford report of 1918.

The **Punjab** Rebellion, 1919.—In order to cope with revolutionary conspiracy, the ramifications of which had been disclosed by the publication of the report of the Sedition committee presided over by Sir Sidney Rowlatt, it was proposed to endow the government of India with emergency powers. The draft bills, published in Jan. 1919, provided for the internment of persons suspected of subversive activities and for the trial of political offenders by judges unassisted by juries since it was feared that juries would be intimidated by deliberate terrorism. The agitation which ensued saw the emergence of Gandhi as a factor in Indian politics and the organizing of a movement of passive resistance, known as Satyagraha, the use of which in South Africa had first brought him into prominence. Now too for the first time the masses began to be affected. When the Rowlatt act was passed in March 1919 Gandhi announced that as a protest March 30 should be observed as a hartal, or day of abstention from business. Events soon proved that his doctrine of ahimsa, or nonviolence, was not appreciated by the Indian mob, and his preaching of passive resistance led to violent outrages in Delhi, Gujarat and the Punjab. The railway station at Delhi, focus of all the railway traffic of northern India, was stormed by the mob, and British troops and police officers were assaulted. In the firing which followed eight persons were killed. Because of the subversive activities of Kichlu, a Kashmiri Moslem who had taken a degree at a German university, and a Hindu assistant surgeon named Satya Pal, the Punjab had been seriously disturbed since the middle of 1918. Not dissuaded by what had happened in Delhi, Gandhi ordered another hartal for April 6. Posters appeared in Lahore and Amritsar announcing this date as the day of *ghadr*, or mutiny, and urging the populace to "kill and die." Proclamations by the Punjab authorities forbidding public meetings were openly defied, and riots took place throughout the province. Emissaries were sent to the border tribes and Afghanistan, but fortunately war with Afghanistan did not coincide with the Punjab disturbances. Chaos reigned in Amritsar between April 10 and April 12. The mob murdered five Europeans and attempted to murder two Englishwomen (a missionary and a doctor). It set fire to the Anglican church and to the mission school while the teachers and pupils were at work; looted two English banks and put to death three British managers; set fire to the railway goods station and murdered a British official on duty (an attack on the passenger station was repulsed); attacked and gutted the central telegraph office; set fire to the town hall; and finally attacked the Calcutta mail train. Similar outbreaks occurred at the same time in Lahore. At Kasur, 25 mi. from Lahore, the mob, on April 12, held up the trains and murdered two British warrant officers. Turning their attention to government buildings, the rioters attacked the treasury and burned the civil courts. The whole outbreak appears to have been a well-organized attack on communications, with the result that Sir Michael O'Dwyer, the lieutenant governor. was forced to rely on radio. At Amritsar, on April 13, took place what has been termed the Amritsar massacre, when Brig. Gen. Reginald Dyer's troops fired on a mob which had collected in the Jallianwalla Bagh in defiance of the prohibition, killing 379 and wounding 1,208. His action was approved by the Punjab government but condemned by the secretary of state for India, the army council and the Hunter commission. The house of lords, however, justified his conduct on the ground that he had saved British rule in the Punjab. As a result of this unfortunate affair racial feeling in India became more bitter than at any other time since the mutiny, and many moderate "home rule" enthusiasts changed over to a more extreme nationalism.

The Third Afghan War.—On Feb. 20, 1919, Habibullah Khan was assassinated in his camp near Jalalabad and his brother Nasrullah Khan was proclaimed as amir in his stead. A few days later Amanullah Khan. a son of the late amir, who controlled the arsenal and treasury at Kabul, was accepted as ruler by the army and the Young Afghan party, and Nasrullah was imprisoned because of his guilt in instigating the murder of his brother. The assassination of Habibullah had not been entirely unexpected in Afghanistan since his policy of neutrality from 1914 to 1918 had incensed the mullahs and other powerful sections of the population who blamed him for not having gone to the assistance of Turkey. Anxious to placate the mullahs and allay this discon-

tent, Amanullah, at a durbar in Kabul on April 13, declared Afghanistan to be free from foreign control. On May 4, unable to resist the popular demand for war against Britain as the chief enemy of Turkey, he proclaimed a jehad, or holy war, and pamphlets calling upon the tribesmen to rise u-ere distributed by the Afghan postmaster at Peshawar. An attempted rising in Peshawar, in co-operation with the Indian revolutionary party, was foiled by the vigilance of the local frontier officials. On May 3 Afghan troops crossed the frontier near Landi Khana and occupied the village of Bagh, whereupon British reinforcements were rushed through the Khyber pass to Landi Kotal. The Afghans were driven from Bagh on May 11, and within eight days of mobilization British troops had advanced through the Khyber into Afghanistan and occupied Dakka. The only Afghan success during the campaign was the penetration of Nadir Khan to Thal in the Kurram valley. After Jalalabad and Kabul had been bombed the amir on May 31 asked for an armistice. A preliminary treaty was signed at Rawalpindi on Aug. 8, 1919, and ratified by a formal treaty on Nov. 22, 1921. In the future Afghanistan was to be free to control its own foreign affairs, but the government of India withdrew the privilege enjoyed by Afghanistan of importing arms and ammunition through India and discontinued the subsidy which had been paid since the viceroyalty of Lord Ripon. Amanullah persisted in regarding his defeat as a victory and erected a monument at Kabul depicting the British Lion with one leg chained. The cessation of hostilities with Afghanistan did not bring peace to the northwest frontier, and from 1919 to 1920 punitive operations had to be undertaken against the fierce Mahsud tribes inhabiting the heart of Waziristan.

The Act **of** 1919.—The main trend in Indian history after the conclusion of World War I was the development of self-governing institutions and the rapid growth of the nationalist movement under the leadership of Gandhi. The Government of India act of 1919 was based in the main on the principles adumbrated in the Montagu-Chelmsfotd report. Before 1919 the chief characteristics of British rule in India, from the administrative, financial and legislative points of view, had been the concentration of authority at the centre; the control of the executive over legislative functions; and the responsibility of the British parliament for the whole of Indian government. Under the reformed constitution, authority, instead of being concentrated at the centre, was to be in large measure devolved on the provinces; the opportunities of the central legislative for influencing the government of India were to be increased; and the control formerly exercised by parliament was to be modified by handing over certain subjects of provincial administration to Indian ministers responsible to the provincial legislatures.

At the centre the first reform was to increase the number of Indian members on the governor-general's executive council from one to three. The central legislature was entirely remodelled and made bicameral by the creation of a new body called the council of state composed of 60 members, not more than 20 of whom were to be officials (that is, persons in the full-time civil or military service of the crown). There was to be a majority of elected members, but the franchise was extremely limited in order to give this new body the character of an upper chamber. The legislative assembly (that is, the old imperial legislative council) consisted of 145 members, 104 of whom were elected. Of the elected members 52 were returned for general constituencies, 30 for Moslems. 9 for Europeans, 7 for landowners, 4 for commerce artd 2 for Sikhs. The franchise was on the same lines as for the provincial councils with a somewhat higher electoral qualification. The durdtion of the council of state was to be five years; that of the legislative assembly, three. It is important to note that this was the first time that the official majority was withdrawn from the central legislature. A bill rejected by the assembly could be certified by the governor-general as essential to the peace or good government of the country. The same applied to the grant of supplies or new taxation proposals.

At first there were eight major provinces under governors; viz., Madras, Bombay, Bengal, the Punjab, the United Provinces, the Central Provinces, Bihar and Orissa, and Assam. The North-West Frontier Province, Baluchistan, Delhi, Coorg, Ajmer-Merwara and the Andaman and Nicobar Islands were left in charge of chief commissioners or agents of the central government. Burma became a governor's province in 1923, as did the North-West Frontier Province in 1932. Reserved for the administration of the central government n-ere military matters and foreign affairs, tariffs and customs, railways, posts and telegraphs, income tax, currency and coinage, the public debt, commerce and shipping and civil and criminal law. The subjects allocated to the provincial governments included local self-government, medical administration and public health, education, public works, irrigation, land revenue, famine relief, agriculture, forests and police.

By an ingenious device unofficially known as dyarchy the provincial executive was divided into two parts: a governor and executive council responsible for what were termed "reserved subjects"; and ministers chosen by the governor from the elected members of the provincial legislature to whom were entrusted the "transferred subjects." Reserved subjects included irrigation, land revenue, famine relief, administration of justice, development of mineral resources. police, control of newspapers and printing presses, criminal tribes and prisons. The transferred subjects under the control of Indian ministers included local self-government, medical administration and vital statistics, public works, education, agriculture, the civil veterinary department, fisheries, co-operative societies, forests, excise and industries. In this way Indians were to take charge of great departments of provincial administration as leaders of elected majorities in the legislatures.

The provincial legislatures were unicameral, the legislative councils varying in size from province to province. In all cases they were considerably enlarged and were nearly twice the size of the 1909 councils. The franchise was extended mainly by lowering the property qualification, which resulted in an electorate of about 5,500,000. Since a large proportion of the voters were illiterate use was made of ballot boxes of different colours; or pictorial symbols, such as tigers and umbrellas, were used on ballot papers. Communal electorates were 'maintained for Moslems. Sikhs, Anglo-Indians and Europeans. In Madras seats were reserved for non-Brahmans and Christians. It will be noted that the device known as dyarchy, or double government, was confined to the provinces and was intended to train Indians for responsible government. There was no dyarchy at the centre, where the governor-general continued to be directly responsible to the secretary of state for India and the British parliament. Provincial legislatures were thus set the difficult task of discharging two different functions at the same time: in one sphere (the transferred subjects) they were to exercise control over policy; in the other (the reserved subjects), while free to criticize, they were to have no responsibility. There was therefore a tendency in the years that followed for these councils to regard the government as a whole and to think of the ministers as if they were executive councillors. There was also a tendency to magnify the functions of the reserved field.

The Government of India act of 1919 received the royal assent on Dec. 23. 1919. Elections were held in Nov. 1920, and in the first week of Jan. 1921 the new provincial executives came into office. The central legislature at Delhi was opened in state by the duke of Connaught on Feb. 9, 1921. On the previous day he had opened the new chamber of princes, thus placing on a permanent footing the previous system of informal conferences. Provision was made in the act for the appointment of a parliamentary commission after a period of ten years to inquire into the working of the new constitution and into the possibilities of further constitutional advance.

Khilafat and **Swarajists.**—The idea behind the Montagu-Chelmsford reforms had been to allay political agitation and to inspire Indians with a spirit of co-operation and a sense of responsibility. Many factors combined to defeat this object. The new constitution did not prove acceptable to the Congress party, which boycotted the first elections in 1920; thus only about one-third of the total electorate went to the polls, and the abstention of the extremists left the moderates in a majority on the new

councils. India was also seething with racial and religious discontent. The memory of Amritsar still rankled in the minds of both Hindus and Moslems. India's position as a member of the League of Nations and the presence of its representatives at the imperial conferences led to an increasing demand for dominion status since Indians resented their position of inferiority and their failure to obtain redress ior the disabilities suffered by their compatriots in South Africa. Resentment was also caused by the attitude adopted by European colonists in East Africa, who were advocating the restriction of Indian immigration on the ground that it was antagonistic to the best interests of the African natives. All this was accentuated by the treatment of Indian indentured labourers in Fiji. Considerable unrest was also caused by the publication in Oct. 1920 of the Esher committee's report, the recommendations of which were tactlessly aimed at subordinating the Indian army to the needs of imperial strategy. Indians naturally regarded this as an attempt to deprive India of the control of its military forces, which were to be used for what was termed imperial aggression in the middle east.

The Khilafat movement, which aimed at the preservation of the Turkish empire and of the sovereignty of the sultan as caliph, was another source of anxiety to the government of India. The demand by influential sections of British and U.S. opinion that the Turks should be expelled from Constantinople and the failure of the Khilafat deputation to obtain satisfaction from David Lloyd George produced great discontent among Indian Moslems and prompted two agitators, the brothers Mohammed and Shaukat Ali, to proclaim that it was the duty of all true Moslems to leave India for countries where Islam was respected. In obedience to this call many thousands of Moslems sold their goods and joined the, *hijrat* (flight) movement from India to Afghanistan. It was calculated that in the month of Aug. 1920 more than 18,000 people, the *muhajrin,* as they were called, moved in the direction of Afghanistan. The limited resources of Afghanistan compelled the Afghan government to forbid their entry into the country, with the result that the road from Peshawar through the Khyber pass was strewn with the graves of old men, women and children who had succumbed to the hardships of the journey. The failure of this movement was a severe setback to Khilafatist agitation.

The death of Tilak in Aug. 1920 left Gandhi undisputed leader of the nationalist party. In a letter to Lord Chelmsford he announced his adoption of a policy of non-co-operation as a remedy against a government for which he retained "neither respect nor affection." This was the situation facing Lord Reading when he succeeded Lord Chelmsford as viceroy in April 1921. Gandhi had no sooner taken charge of the nationalist party than he formed an entente with the leaders of the Khilafat movement. Hindu and Moslem grievances were now combined in subversive agitation, which produced the Moplah rebellion of 1921–22 and caused bloodshed and disorder for more than two years in every province in India.

The Moplahs of Malabar, fanatical Moslems of Arab descent, broke out into rebellion in Aug. 1921. The aim of these people was to establish an independent Khilafat kingdom in Malabar. A reign of terror ensued in which thousands of innocent Hindus were either massacred or forcibly converted to Islam. Since the topography of the country favoured guerrilla warfare the rebellion was not suppressed until Feb. 1922. The chief result of this abortive insurrection was to shatter the Hindu-Moslem entente and to exacerbate communal relations It is recorded that 450 lives were lost and 5,000 persons injured in communal disturbances between 1922 and 1927. The Khilafat agitation gradually petered out after the failure of the *hijrat* movement, but the chief reason for its decline was the establishment of a strong secular Turkish republic and the abolition of the caliphate in 1924.

Serious rioting resulting from Gandhi's policy of non-co-operation marred the occasion of the landing of the prince of Wales at Bombay in Nov. 1921. On Feb. 4, 1922, mob violence was responsible for the murder of 21 police officers at the village of Chauri Chaura in the United Provinces. Eight days after this tragedy Gandhi, realizing his responsibility for the massacre, suspended his campaign of civil disobedience. On March 10 he was arrested, tried for sedition and sentenced to six years' imprisonment. In 1922 the peace of the Punjab was seriously disturbed as a result of the efforts of the Akalis, a reforming sect of Sikhs, to redeem certain shrines and temples from the maladministration of their *mahants,* or hereditary incumbents, in order to apply the revenues for the spiritual benefit oi the Sikh community. Unfortunately the movement, laudable enough in itself, was exploited for political purposes by extremists, and troops had to be employed to suppress disturbances. It was not until the passing of the Sikh Shrines' act of 1925 that more sober views began to assert themselves.

At the end of 1923 the Swarajists, a Congress home-rule party under the leadership of Pandit Motilal Nehru and Chitta Ranjan Das, contested the elections to the legislatures, their aim being to wreck the constitution from within by consistent obstruction. Although large numbers of Swarajists were returned to the legislative assembly and to all provincial councils. it was only in the Central Provinces that they obtained an absolute majority which made the working of dyarchy impossible. In Bengal the support of certain independent members, chiefly Moslems, gave them a majority, and their refusal to vote ministerial salaries led to the suspension of the transferred subjects. Elsewhere dyarchy continued to function, especially in Madras where the opposition to Brahman supremacy united to form the Justice party.

Indianization of the Services.—The growth of the nationalist movement naturally led to the demand for a more rapid indianization of the civil and military services. Although the principle of indianization had been adopted as early as 1833 and had been incorporated in the royal proclamation of 1858, the British showed a reluctance to admit Indians into the higher ranks of the civil service. As late as Aug. 1922 Lloyd George. in his "steel-frame" speech, declared that he could see no period when India would be able to dispense with the guidance and assistance of a British element in its civil service. This was followed in June 1923 by the appointment of a royal commission under the chairmanship of Viscount Lee of Fareham to examine the position of the superior civil service in India. The report of this commission, published in May 1924, contained proposals for a large increase in the recruitment of Indians; but, although it recommended that the Indian civil service should be half Indian after 1j years and the Indian police likewise after 25 years, the proposed pace of indianization did not prove acceptable to Indian opinion. Whereas Indians had been slowly and reluctantly admitted into the higher ranks of the civil service, they had been rigidly excluded from the commissioned ranks of the army; and it was not until 1918 that they became eligible for the king's commission. In the same year ten places were reserved for Indians in the Royal Military academy at Sandhurst, Eng. The year 1923 saw the introduction of a cautious experiment known as the "eight units scheme" which aimed at building up a small force (five infantry battalions, two cavalry regiments and one pioneer unit) entirely officered by Indians. In 1927 the number of reservations at Sandhurst was raised to 20 and Indians also became eligible for admission to Woolwich and Cranwell, both in England. It was not until 1934, however, that an Indian Sandhurst was opened at Dehra Dun.

Political Assassination, 1923–32.—The year 1923 witnessed a recrudescence of terrorist activity with a new and bolder technique. Terrorists entered the Congress party, were elected to its committees and forced their resolutions upon its conferences. Bombs of a more powerful type were manufactured and leaflets were issued proclaiming that the Bengal Revolutionary council had decided to assassinate police officers and any persons assisting them. The old method of obtaining funds by the robbery of wealthy Indians was discarded in favour of skilfully planned attacks on post offices and railway cash offices by gangs of armed dacoits. In 1924 an Englishman was murdered in Calcutta by mistake for Sir Charles Tegart, the commissioner of police. To combat this type of crime, special measures were introduced by the Bengal Criminal Law Amendment act of 1925, which led to the internment of 150 ringleaders and to a temporary cessation

of outrages. It was calculated that in Bengal, out of a total population of 50,000,000, not more than 2,000 men and women were in the inner circle of the anarchist movement. Checked in Bengal, the terrorists transferred their activities to the United Provinces and the Punjab. In Dec. 1928 two police officers were murdered in Lahore. In April 1929 bombs were thrown into the legislative assembly at Delhi; and in December of the same year an unsuccessful attempt was made to wreck the viceroy's train. Because of the improved situation in Bengal all interned terrorists were released in Jan. 1929, and in the following year the Bengal Criminal Law Amendment act was allowed to lapse. This was the signal for a revival of terrorism in the province. In April 1930 there occurred the most daring raid that had yet been attempted; a gang of about 100 Bengali youths dressed in uniform attacked the police armoury, the European club and the telegraph office at Chittagong. There were 30 outrages besides this in 1930, including the assassination of the inspector general of police and of the inspector general of prisons and an unsuccessful attempt to assassinate the governor of the Punjab. Attempts were also made in July 1931 and in Feb. 1932 on the lives of the acting governor of Bombay and the governor of Bengal. Between 1931 and 1932 in Bengal three district magistrates and one district judge were assassinated and several senior officials of the civil service wounded. The Congress party contended that these murders were the outcome of repressive legislation. but others pointed out that an amnesty had always been the signal for further outrages. The formation on the northwest frontier of a revolutionary party known as the Red Shirts under the leadership of Abdul-Ghaffar Khan, a Pathan of Utmanzai, was followed by grave disturbances in Peshawar, Bannu, Mardan and Kohat in April 1930. In the same month Abdul-Ghaffar was arrested, but as a result of Gandhi's intercession with the viceroy he was released in March 1931. In August of the same year the Red Shirt movement was officially affiliated to the Congress party; but because of his subvereive activities Abdul-Ghaffar was once more arrested in Dec. 1931.

In addition to the recrudescence of anarchical crime, the government of India under Lord Irwin, who had succeeded Lord Reading in April 1926, was confronted with the rapid growth of communal antagonism and with a civil disobedience movement under the leadership of Gandhi, who had been released from prison because of ill health. Although Lord Irwin showed a marked sympathy with the cause of Indian self-determination and attempted by means of conferences to bring the leaders of the two religions into agreement, his efforts proved unavailing and communal bitterness remained an outstanding feature of the Indian situation from this time onward. When the third elections were held in Nov. 1926, appeals were made to electors in many cases on communal lines. Relations between Hindus and Moslems were exacerbated by the anti-Moslem attitude of the Mahasabha, an extremely orthodox Hindu organization, and by the rejection of communal electorates in the Nehru constitution drawn up by an entirely Indian body under the chairmanship of Pandit Motilal Nehru in 1928.

The Simon Commission. — It will be remembered that the act of 1919 provided for an inquiry into the working of the new constitution after a period of ten years. In response to Indian wishes this inquiry was expedited by two years, and the appointment of a statutory commission was announced on Nov. 8, 1927. Appointed by a Conservative government in England, it consisted of seven persons, all members of the British parliament, under the chairmanship of Sir John Simon. Two visits were paid to India: Feb. 3–March 31, 1928; and Oct. 11, 1928–April 13, 1929. The noninclusion of Indians offended the strong sentiment of national self-respect that prevailed in India, and at first the commission was boycotted even by moderate nationalists like Sir Tej Bahadur Sapru. When the members of the commission landed at Bombay on Feb. 3, 1928, they were greeted with hostile demonstrations which included a *hartal,* or suspension of business. During their second visit, however, they found committees from both the central and provincial legislatures prepared to co-operate in the examination of witnesses. In the same year the Nehru report was published advocating the immediate grant of "full responsible government on the model of the constitutions of the self-governing dominions"; but extremists under the influence of Motilal's son. Jawaharlal Nehru, declared that they would be satisfied with nothing short of *purna swaraj;* that is, complete national independence. At the Calcutta congress of Dec. 1928 a resolution was passed giving the British until the end of 1929 to accept the Nehru constitution, their refusal to be followed by a civil disobedience campaign. The disturbed condition of India prompted Lord Irwin to proceed to London for consultation with the Labour government, which had come into office. On Oct. 31, 1929, after his return to India, he was authorized to make two important announcements:

1. "In view of the doubts which have been expressed both in Great Britain and India regarding the interpretation to be placed on the intentions of the British Government in enacting the statute of 1919, I am authorized on behalf of His Majesty's Government to state clearly that, in their judgment, it is implicit in the Declaration of 1917 that the natural issue of India's constitutional progress as there contemplated is the attainment of Dominion status."
2. To disperse the distrust concerning British intentions, which had been aggravated by the exclusion of Indians from the statutory commission, he also declared that, after the report of the Simon commission, there should be a round table conference in London to uhich Indians would be invited in order to express their views before proposals for the future government of India were laid before the British parliament.

These pronouncements were accepted by the moderates, but the Lahore congress of Dec. 1929 passed resolutions in favour of complete independence and authorized immediate preparations for a campaign of civil disobedience. The signal for this campaign was given by Gandhi when he set out on his ceremonial march from Ahmedabad to the sea coast and on April 6, 1930, broke the law by manufacturing salt on the beach at Dandi. Widespread disturbances followed, from which Moslems as a body held aloof. One feature of the movement was the unexpected assistance of women, some of whom emerged from purdah to join the Congress demonstrations and assist in the picketing of liquor shops. Details of the terrorist outrages have already been given. Both Gandhi and Jawaharlal Nehru were arrested.

In June 1930 the Simon report was published. Its main recommendations were that dyarchy should be replaced by full responsible government in the provinces, the governors still retaining special powers in an emergency; that the existence of racial and religious differences necessitated the retention of communal electorates; and that any constitutional reconstruction should take into consideration not only the provinces of British India but also the Indian states. Since the report contained no mention of dominion status and expressed doubts about the suitability of a parliamentary system of government in India it met with a hostile reception.

The Round Table Conferences. — Between 1930 and 1932 three conferences were held in London to enable representatives of the various Indian communities and of the three British political parties to consider proposals for the future constitution of India. Because of the refusal of Congress to co-operate the first conference (Nov. 1930–Jan. 1931) was representative only of a minority of politically minded Indians. Nevertheless, the success of this conference, at which the general principle of an all-India federation was accepted, was a severe blow to the influence of Congress and was an important factor underlying what is called the Irwin-Gandhi pact of March 1931, whereby the government of India agreed to release all political prisoners provided Congress would suspend the civil disobedience campaign. This was followed by a temporary improvement in the Indian situation, and Gandhi attended the second London conference (Sept. 7–Dec. 1, 1931) as the sole spokesman of Congress. For many reasons he was unable to make any constructive contribution to the deliberations of the conference and failed to bring about any solution of the communal problem. On his return to India early in 1932 he again fomented civil disobedience and was promptly arrested by Lord Willingdon. who had taken over the viceroyalty in April 1931. Because of the difficulties revealed at the second conference a franchise committee under Lord Lothian, a federal

finance committee under Lord Eustace Percy and an Indian states inquiry committee under J. C. C. Davidson proceeded to India for further investigation of these problems. For the same reason, in Aug. 1932, the British prime minister, Ramsay MacDonald, made his communal award by which the existing system of communal electorates was preserved and the depressed classes recognized as a minority community. This did not prove acceptable to Gandhi, who was in prison at Poona; and in deference to his wishes the caste Hindus and the depressed classes accepted a scheme known as the Poona pact, by which a larger number of seats was reserved for the depressed classes. After a third conference (Nov. 17–Dec. 24, 1932) which chiefly concerned itself with a consideration of the reports of the Lothian, Percy and Davidson committees, the British government elaborated its draft proposals, which were examined by a joint select committee of lords and commons assisted by specially selected Indians. From these discussions emerged the Government of India bill of 1935.

The Act of 1935.—The three main principles underlying the new constitution were an all-India federation, provincial autonomy and responsibility with safeguards. The federation was not to come into operation until the rulers of Indian states representing not less than half of the aggregate population of the states signified their desire to accede. Each state had to sign a separate instrument of accession, but for the provinces entry into the federation was compulsory. Power to amend the constitution was vested in the British parliament, and a federal court was to be established to determine disputes between the constituent units of the federation. For the central government a system of dyarchy was devised whereby all departments, with the exception of foreign affairs and defense, were to be in charge of ministers responsible to the federal legislature consisting of a council of state and a house of assembly. The council of state was to be composed of 156 representatives of British India directly elected on a population basis, with the exception of six seats reserved for nomination by the governor-general; and not more than 104 representatives of the Indian states appointed by the rulers of the states concerned. The house of assembly, which was to be reelected every five years, was to consist of not more than 125 nominees of the states and 250 representatives of British India elected by the provincial legislatures. Communal representation was to be retained both at the centre and in the provinces. Because the federal legislature never came into operation, the central constitution continued to be that of the 1919 act.

British India was to be divided into 11 governor's provinces (Madras, Bombay, Bengal, United Provinces, Central Provinces, Punjab, Bihar, Assam, North-West Frontier Province, Orissa and Sind). Burma was separated from India, and Aden placed under the colonial office. Responsibility of the executive to the legislature was to be the basic principle of government in the provinces; the governor's special powers were to be exercised only in an emergency. British Baluchistan, Delhi. Ajmer-Menvara, Coorg and the Andaman and Nicobar Islands were to be administered by chief commissioners responsible to the governor-general. Except in the Central Provinces, Punjab, North-West Frontier Province, Orissa and Sind, the provincial legislature was to be bicameral. Provincial autonomy was established April 1, 1937.

The proposals for an all-India federation were bitterly assailed by Congress politicians on the ground that there was no true basis for a federation since the Indian states did not approximate to the provinces of British India in the establishment of responsible government, civil liberties and method of election to the federal legislature. Great exception was also taken to the reservation in the hands of the viceroy of powers over defense and foreign affairs. Moslems fought shy of the federation because it would strengthen the Hindu predominance in the central legislature. Although the states had at first supported the proposals for a federation their attitude gradually changed as they came to realize the sacrifice of sovereignty required of them.

At the first general elections in Jan. and Feb. 1937 the Congress party secured large majorities in all provinces except Bengal, the Punjab, Sind and Assam but refused to accept office unless provincial governors pledged themselves not to use their special powers of interference or to set aside the advice of their ministers. Since the governors declined to compromise their statutory powers it was not until June 1937, when Lord Linlithgow announced his intention of striving for "the full and final establishment in India of the principles of parliamentary government," that Congress ministries were formed and the minority cabinets, which had bridged the gap, disappeared. During their period of office from July 1937 to Sept. 1939 communal tension increased because of the grievances of Moslems under Congress rule in Bihar and the United Provinces. This was aggravated by the claim of Congress to represent Moslems as well as Hindus, a claim vigorously opposed by the Moslem league under Jinnah. As a result of Congress agitation for constitutional reforms in the Indian states serious disturbances broke out in Mysore, Hyderabad, Kashmir and Travancore. The new provincial governments were also confronted with agrarian unrest and with industrial disputes, the result of Communist propaganda. But useful social and agrarian legislation was introduced. Relief was given to certain classes of agricultural tenants, the burden of peasant indebtedness was reduced and an attempt was made to enforce prohibition.

World War II.—When war broke out in Sept. 1939 India was declared a belligerent by the governor-general without even the pretence of consultation with the central legislature or the provincial governments. The result was that Congress, although expressing its condemnation of nazi aggression, refused to associate itself with the war effort unless India were declared an independent nation. The governor-general therefore announced that dominion status was already envisaged by the British government as the goal of its policy and that at the end of the war it was prepared to modify the act of 1935 in consultation with the leaders of the various Indian communities and parties. At the same time he proposed to establish an advisory council representative of all major Indian interests in order to associate Indian public opinion with the prosecution of the war. This assurance did not satisfy Congress, and in Nov. 1939 all Congress ministers resigned on the ground that the British government had failed to make an acceptable declaration of its war aims. The governors of the provinces concerned therefore assumed powers in accordance with section 93 of the act of 1935.

India's contribution to the war effort, though impeded by the refusal of Congress to co-operate, was magnificent. In 1939 the Indian army consisted of about 200,000 regular soldiers. By 1945 the government of India had recruited on a voluntary basis more than 2,000,000 Indians, the largest voluntary recruitment ever recorded in history. Indian troops served with distinction in all theatres. They played a major part in the first Allied victory of the war, the conquest of Italian East Africa. Out of the 1,000,000 troops engaged in the final Allied victory of the war, the defeat of the Japanese in Burma, 700,000 were provided by the Indian army. India's total casualties during the war were 179,935, of whom 24,338 were killed or died of wounds, 11,754 were reported missing. 64,354 were wounded and 79,489 were prisoners of war. But India's most important contribution was economic and the development of the industrial system enabled India not only to produce the bulk of military supplies needed at home but also to equip the imperial armies in Africa and the middle east. Many hitherto neglected resources were exploited, and the war saw a remarkable revival of the old Indian industry of shipbuilding. The net expenditure on defense rose from £34,500,000 in 1939 to £300,000,000 in 1945. One result of the Allied calls on its resources was to transform India from a debtor to a creditor nation with accumulated sterling balances at the end of 1945 amounting to about £1,250,000,000.

On several occasions during the war attempts were made to put an end to the political deadlock. On Jan. 10, 1940, Lord Linlithgow announced that the object of the government of India was the development of full dominion status in accordance with the Statute of Westminster. But in March of the same year the Moslem league under Jinnah's leadership condemned the act of 1935 as unacceptable to Moslems, whose aim was the establishment of an autonomous Moslem state embracing the areas where Moslems formed a majority of the population.

Once more in Aug. 1940 the viceroy repeated his statement that dominion status was the goal of British rule in India and announced that the British government wished India to enjoy that position under a constitution framed primarily by Indians as soon as possible after the end of hostilities. At the same time Indian political leaders were invited to serve as heads of departments on the viceroy's executive council. The reply of Congress to this proposal was that India should be granted immediate independence and that the task of drafting a constitution should be committed to an assembly elected by universal suffrage.

In Dec. 1941 Japan entered the war and in the opening months of 1942 occupied Singapore, Malaya and the Andaman Islands, overran Burma and threatened India with invasion. In spite of all this the political deadlock remained. On March 11, 1942, Winston Churchill. the British prime minister, announced that it had been decided to send Sir Stafford Cripps. a member of the war cabinet, to India with proposals for a settlement of the Indian constitutional problem. It was proposed to create a new Indian union as a fully independent dominion. As soon as the war ended, a new constitution was to be framed by a body consisting of elected representatives of British India and nominees of the Indian states. Membership in the proposed union was not to be compulsory, and dissenting provinces were to be free to form separate unions. Until the new constitution of the Indian union came into being the British government was to be responsible for the defense of India with the help of an Indian government composed of members of all parties and with the full co-operation of the Indian people. These proposals were rejected by Congress because they did not comply with its demands for the immediate establishment of a fully independent national government and by the Moslem league because they did not meet its wishes for an independent Moslem state. On Aug. 8, 1942, Congress passed a resolution calling upon the British to "quit India" immediately, failure to comply to be the signal for mass civil disobedience. This was followed by widespread disorders in the autumn of 1942, which were suppressed by the end of the year uith the arrest of the Congress leaders. Meanwhile, in 1941, Subhas Chandra Bose, a left-wing nationalist extremist, had escaped to Berlin, where he was made the focus of an anti-British, anti-American Indian "freedom movement." In 1943–45, successively in Singapore, Rangoon and Bangkok, he headed a "provisional government of free India" which in July 1943 set up the "Indian National army (I.N.A.)," composed of Indian prisoners of war and deserters and Indian residents in overrun British territories, to fight with the Japanese on the Burma front. The extent and effectiveness of I.N.A. participation, though this certainly took place at times in some strength, has not been finally assessed. Bose died after an air crash in 1945.

In 1943 and 1944 more than 1,500,000 people died in India as a direct result of famine and the epidemics that followed in its wake. The Bengal famine of 1943 was caused by the failure of the main rice crop harvested in the winter of 1942. This, unfortunately, was aggravated by the loss of Burma rice caused by the war with Japan and by a failure to ensure an equitable distribution of the available supplies. In Oct. 1943 Lord Linlithgow was succeeded as viceroy by Lord Wavell.

INDIAN INDEPENDENCE

With the end of World War II and the return of a Labour government to power in England it was announced that elections would take place to the central and provincial legislatures in India and that as soon as possible afterward a constitution-making body would be convened. In Feb. 1946 it was decided to send a British cabinet mission to India to discuss with the viceroy and Indian political leaders the constitutional future of the country.

When the mission reached India in March, responsible ministries were functioning in all provinces for the first time since 1939. Since the main political parties failed to reach an agreement, the mission was forced to produce its own scheme. Until an elected constituent assembly had decided on India's future constitution, it was proposed to set up an interim government in which all portfolios would be held by Indians. The demand for a separate Moslem state of Pakistan was rejected as incompatible with the requirements of Indian defense. Eventually the Congress party agreed to form an interim government, which came into office on Sept. 2 with Nehru as vice-president to the viceroy. This was followed by Hindu-Moslem clashes in which about 7,000 persons were killed. When the constituent assembly met on Dec. 9, 1946, it was boycotted by the Moslem league and the Indian states. On Feb. 20. 1947, the British government announced its intention of transferring power into Indian hands by a date not later than June 1948. At this juncture Lord Wavell resigned and was succeeded on March 23, 1947, by Viscount Mountbatten, who after a series of consultations with Indian political leaders announced that the only solution was the division of India into two separate states. An Indian independence bill became law on July 18, 1947. Its effect was to set up on Aug. 15, 1947, two completely independent states in India, the Dominion of Pakistan and the Dominion of India, their eventual boundaries in the Punjab and Bengal to be determined by a commission presided over by Sir Cyril Radcliffe. Partition mas the signal for mass migrations accompanied by hideous massacres, but by the end of Sept. 1947 the fury of the slaughter had died down. Gandhi's supposed responsibility for the partition of India was given as the reason for his assassination on Jan. 30, 1948, by a member of the Hindu Mahasabha.

On June 21, 1948, Mountbatten was succeeded as governor-general of India by Chakravarti Rajagopalachari, a distinguished Madrasi Brahman and a minister in the interim government.

India's desire to reach more than dominion status was soon formally expressed; and the draft constitution of Feb. 1948 proposed that it should be a federal republic. The London commonwealth prime ministers' conference of April 1949 agreed that India could adopt this republican constitution yet remain within the British Commonwealth (as the Indians had decided to do in 1948). The constitution itself came into effect on Jan. 26, 1950. The first president of the new republic was the former chairman of the constituent assembly, Rajendra Prasad. a devoted Gandhian. Nehru, who had become prime minister of the dominion in 1947, continued in office under the republic. During 1948–50 the outstanding feature of internal affairs was the modification of the provincial structure. The governors' provinces (or "states," as all the federated units were now to be called) remained more or less as in British days—except, of course, for the partitioned Punjab and Bengal. But the continued separate existence of about 570 princely states, ranging in area from that of France to that of the City of London, was clearly out of the question. With the passage of the 1947 independence act British paramountcy over these states lapsed. Together, they contained nearly half the country's area and nearly one-third of its population; and the immense task of making them part and parcel of the ne nation was entrusted to the deputy prime minister, Vallabhbhai Patel.

The big south Indian state of Mysore was considered capable of continued provincial autonomy, and its maharaja remained at its head as *rajpramukh* (*q.v.*) or constitutional "prince president." Many of the smaller states, however, were grouped into more manageable "unions," each under a *rajpramukh;* one such union, Saurashtra, absorbed no fewer than 222 states in the Kathiawar peninsula. Other principalities were taken over by the central government and administered, either singly or in convenient groups, through chief commissioners. The remainder, mostly those interspersed with the districts of governors' provinces, were merged with those provinces. The refusal of the Moslem nizam of Hyderabad to accede his mainly Hindu-populated state led to its occupation by Indian troops in Sept. 1948; following his enforced accession he was left at the head of his people as *rajpramukh.* In 1952–54 there was increasing pressure from some quarters for the redrafting of internal boundaries on a linguistic basis: in Oct. 1953 Andhra state, composed of the Telugu-speaking districts of northeastern Madras, was inaugurated.

The government at first resisted the establishment of further linguistic states, but the commission appointed in 1953 to examine the-whole question of state reorganization recommended in

Sept. 1955 a drastic redrafting of boundaries largely on this basis. This the government accepted in Jan. *1956*, proposing, however, to divide Bombay state into Gujarati- and Marathi-speaking provinces, leaving aside as a nationally administered "city-state" Bombay city, 20% of whose population comprised wealthy Gujaratis, 50% working-class Marathas. This last proposal caused serious riots in the city.

India's relations with Pakistan were marred from the outset by a dispute for the possession of Kashmir (*q.v.*), which, in spite of the attempts of a Gnited Nations commission to arrange a settlement, remained partitioned de *facto* into two states. On May 14, 1954, President Prasad extended the Indian constitution to Kashmir. Another cause of friction was Pakistan's refusal to follow India in devaluing the rupee in terms of the dollar; in consequence Pakistan stopped jute supplies to India and India suspended coal exports to Pakistan. The deadlock was ended on Feb. *25*, 1951, by a trade agreement. In Aug. 1953 Nehru and Mohammad Ali, the Pakistan prime minister, reached accord about a Kashmir plebiscite; but in 1954 relations were again troubled by Pakistan's military aid negotiations with the U.S. and by a dispute about the control of the Punjab river waters. On Oct. *21*, 1954, the long-standing dispute with France about the latter's settlements on the Indian coast was ended by an amicable agreement for their merger into India. This was carried out on Nov. *1*, and on Jan. 6, 1955, the four settlements were reorganized as the chief commissioner's state of Pondicherry (*q.v.*). Portugal continued to insist upon its sovereign rights in Goa, Damão and Diu, despite agitations by "nationalists" and mass frontier crossings. On Dec. *18, 1961*, however, Indian troops invaded the three enclaves, and the following day the Portuguese forces surrendered.

The 1952 general elections, the biggest ever undertaken by any country, confirmed Nehru and Congress in power. But the Communists, especially successful in Madras and Travancore-Cochin, emerged as the principal opposition. Even after China's aggression in Korea, its assertion of sovereignty in Tibet and its support of Vietminh in Indochina, Indian public opinion did not seem to consider Communist expansion to be a serious threat. Guided by Nehru in foreign policy, India declared its "noninvolvement" with either the Soviet bloc or the west and trusted to negotiation to settle international difficulties. Nehru offered friendship to all, based on his *panch sila* or "five points" (see NEHRU, JAWAHARLAL). This position was confirmed by his speeches at the Asian-African conference at Bandung, Indonesia, in April *1955* and maintained in the face of a successful tour of India by the Soviet leaders N. A. Bulganin and N. S. Khrushchev in Nov.–Dec. *1955*.

BIBLIOGRAPHY.—*Cambridge History of India*, 5 vol. (Cambridge, 1922–32); G. N. Joshi, *Constitution of India*, 3rd ed. (London, 1945); *White Paper on Indian States*, rev. ed. (Delhi, 1950); R. Coupland, *India* (London, 1945; New York, 1946); C. C. Davies, *An Historical Atlas of the Indian Peninsula*, rev. ed. (Oxford, 1953); W. H. Moreland and A. C. Chatterjee, *A Short History of India*, 3rd ed. (London, New York, 1953); L. S. S. O'Malley, *Modern India and the West* (London, New York, 1941); C. H. Philips, *India* (London, 1949; New York, 1950); K. P. Karakuran, *India in World Affairs: Aug. 1947–Jan. 1950*, vol. i (Calcutta, 1952); K. M. Panikkar, *Survey of Indian History*, 2nd ed. (London, Bombay, 1954). (C. C. D.; X.)

ETHNOLOGY

Races.—It is generally accept'ed that in remote antiquity India was occupied by a Negroid people of low culture, ethnically related to the aborigines of Ceylon, Sumatra and possibly even Australia. At a still prehistoric stage, it is believed that an inflow of what are loosely called Dravidian races made its way through Baluchistan from western Asia and slowly penetrated India to the far south. Another prehistoric movement, more restricted in its scope, was an infiltration of Mongoloid races from the northeast. The fusion of these elements with the indigenes had probably gone far when the invasions through the northwest passes began.

From that period successive waves swept through and were largely absorbed among the older inhabitants. Seven racial types can be traced with some confidence; for them Sir H. Risley's names are provisionally retained though some are now mere labels.

1. The aboriginal, or pre-Dravidian, type, surviving in the short, platyrrhine men of certain scattered primitive tribes of the hills and jungles, such as the Santals, Bhils, Kurumba, etc.

2. The Dravidian type, extending from Ceylon, all over the southern peninsula. up to the Gangetic valley.

3. Indo-Aryans in Rajasthan and Punjab.

4. The Aryo-Dravidian, or Hindustani, type in the Gangetic valley, the product of the absorption into a mainly Dravidian population of colonies from the more definitely Indo-Aryan country farther west.

5. The Scytho-Dravidian type, running east of the Indus, down through Gujarat and the western part of Bombay and represented chiefly by the Marathas.

6. The Mongoloid type, in Assam and the foothills of the eastern Himalayas, clearly originating in China and Tibet.

7. The Mongolo-Dravidian type, probably a blend of Dravidian and Mongoloid elements, with a strain of Indo-Aryan blood in the higher groups, of which the Bengalis are representatives.

The discoveries at Mohenjo-Daro in Sind include the skeletal remains of a dolichocephalic (longheaded) people, who, in Sir John Marshall's opinion, "may reasonably be assumed to have belonged to the great longheaded race of southern Asia and Europe to which the name 'Mediterranean' is commonly applied." One skull approximating to the brachycephalic (roundheaded) type, which seems to possess the same characteristics as the pronouncedly brachycephalic statues, was found.

These remains are of the Chalcolithic period and subsequent to the abandonment of the latest city (c. *2500* B.C.). Two skulls found buried deep in alluvial deposits near Bombay are perhaps *2,000* years old and were regarded by Sir Arthur Keith as of the small size and narrow shape now prevalent in India. Two of the skulls discovered at Aditanallur in a prehistoric burial site are conspicuously prognathous (with prominent jaws), and others are markedly longheaded, a feature still noticeable in south India.

In early Indian literature mention is made of people having the complexion of a charred stake, flattened features and very short stature, a type quite common in the present population.

The Andamanese (*see* ANDAMAN ISLANDS) are typical Negritos and may be considered to be a pure race. It is possible that this Negrito element may at one time have existed on the Indian subcontinent, but it has left no traces in the present population. More widely spread is a stock marked by short stature, longish heads, broad noses, very dark skins and curly, even frizzly, hair and lips inclined to be everted. This class includes in its numbers the jungle tribes of southern India and of Chota Nagpur, the lower castes in western Bengal and to a slight extent the lowest castes in upper India. This element appears to be related to the Veddas of Ceylon, the Sakai of Malaya and the Australoids.

An important element, conspicuous in southern but found in western India as well, is longheaded, with medium to fine noses, shortish, with darkish skin and fine wavy hair. The lips are thin. This element resembles in many respects, the Mediterranean stock. The dominant element in the northern, especially the northwestern, area is tall. longheaded, with fine noses, fair skins (allowing for the effects of exposure to the sun) and in many instances light-coloured eyes. The lips are thin. It is a type represented among the higher castes of Bengal, and the Nambutiri Brahmans of Malabar, the Nayars, the Coorgs and the Todas also must be regarded as of this stock. In the mountain regions on the west and in Baluchistan is found a roundheaded stock, fairly tall, with fine features, wavy hair, ranging from dark brown to fair, and occasional lightish eyes, which seems to be affined to the Alpine stock. A somewhat similar roundheaded element can be traced along the west coast but is darker in skin, hair and eyes.

Many groups in central, northern and eastern Bengal have Mongoloid features, and the Savaras on the east coast in the state of Andhra have the Mongolian eyefold. While these main elements may be distinguished in the Indian population, miscegenation has taken place in varying intensity under different conditions all over the continent from prehistoric times.

The dissociation of language and race is complete in many parts of India so that terms such as Aryan or Dravidian have no significance when attached indiscriminately.

Languages. — The linguistic survey of India made at the 1951 census suffered from two radical defects. First, an attempt fully to affiliate dialects to their parent languages was made in only four states; in four others only the more obviously assimilable dialect returns were combined with parent language data; and in the rest of India, in contrast with the 1931 survey, no affiliation was made. Thus no fewer than 782 "languages" were listed. Secondly, in northwest India there was wholesale falsification of returns because of agitation by certain Hindu political factions that people should return Hindi instead of Punjabi as their mother tongue. Therefore only a combined all-India total could be given for the important Hindi-Urdu-Hindustani group and Punjabi.

The 1951 data for languages "specialized" in the constitution (*i.e.*, the *lingua franca* and the greater regional languages) were as follows:

Hindi, Urdu, Hindustani, Punjabi	149,944,311	Bengali	25,121,674
Telugu	32,999,916	Gujarati	16,310,771
Marathi	27,049,522	Kannada (Kanarese)	14,471,764
Tamil	26,546,764	Malapalam	13,380,109
		Oriya	13,153,909
		Assamese	4,988,226

Kashmiri (5,086 speakers outside Kashmir, where no census was taken) and Sanskrit (555 speakers) are also specified in the constitution.

In addition 23 tribal languages were spoken by 100,000 or more people each; 24 other Indian tongues were used by 100,000 or more people each; and 720 languages and dialects were spoken by less than 100,000 people each. (ME.; X.)

SOCIAL INSTITUTIONS

Caste. — So far as Hinduism is concerned, the intermixing of the racial types described above left one definite ethnical legacy in caste; for it is apparently from the difference in civilization and political power resulting from the imposition of successive strata of conquerors over the conquered that the Hindu system of caste arose. The census report of 1911 defined a caste as "an endogamous group or collection of such groups bearing a common name and having the same traditional occupation. who are so linked together by these and other ties, such as the tradition of a common origin and the possession of the same tutelary deity, and the same social status; ceremonial observances and family priests, that they regard themselves, and are regarded by others, as forming a single homogeneous community." Not only is the caste usually endogamous, but within it there are a number of smaller circles, each of which is also endogamous. Caste has come to be the chief factor in the life of the ordinary Hindu, regulating his acts from the cradle to the grave; and its influence extends to the Mohammedan masses who are descended from the more recent converts to Islam. (*See* CASTE [INDIAN].)

Aryan Settlement. — The evidence as to the social system of the early Vedic Aryas is singularly vague. They were settled in the Punjab between the Indus and the Sarasvati, but had also occupied lands on the Jumna and even on the upper Ganges. This area was of very varying fertility. Probably the central Punjab was then, as later, a barren steppe; but the riverain tracts, the Kurukshetra and the sub-Himalayan belt were doubtless fertile, well-wooded and possibly densely forested. We may thus expect to find pastoral types in the steppes and agricultural in the cultivable areas. We have no good reason to assume that the Aryas found these lands unpeopled; on the contrary the pre-Aryans of the north were probably quite as advanced as the Dravidians. who seem to have been settled in villages from an early period. Even in the Rig-Veda we find mention of measured fields and of ploughlands. The village (*grama*) sometimes contained a fort (*pur*), doubtless a tower, and might be of considerable size. Grain was certainly stored; so the villagers cannot always have been nomadic; but hints are given that the village-folk were in places a body of herdsmen, wandering in search of pasture under the guidance of the god Pushan. Of the social economy of the settled villages we learn little. At its head was the village leader, but he seems to have been the chief of its militia, often connected with the *senani*, or "leader of the host," which would be quite compatible with the exercise of civil or fiscal functions.

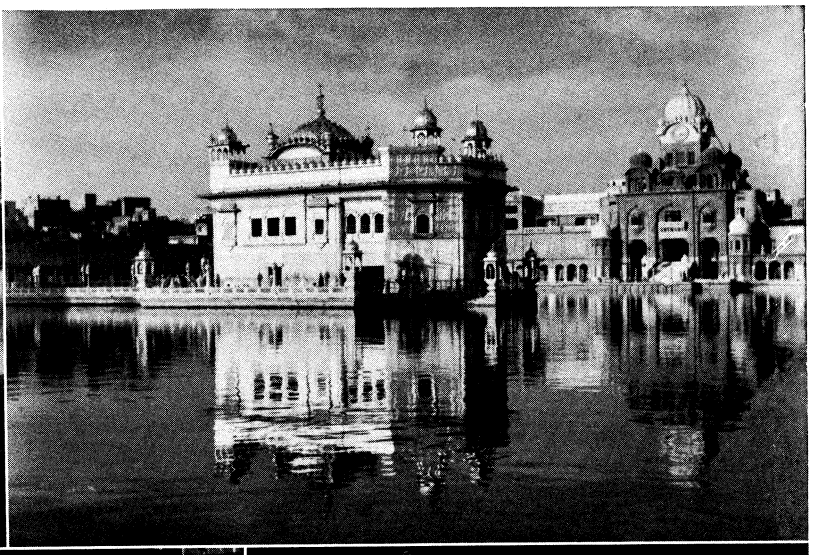
Of village councils we hear nothing, although assemblies (sabha *samiti*) of the people met to advise the king; but in the epics they disappear.

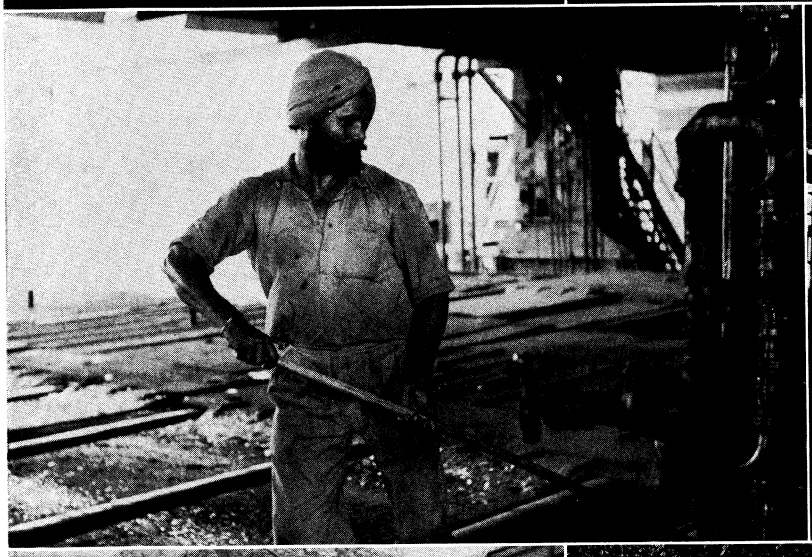
The village body included such artisans as the *rathakara*, "chariotmaker," carpenter! smith and others, but they are not described as members of it. Only once do we read of a *gramyavadin*, seemingly a village judge. Indeed, we find no term to define a "village-owner" in any way equivalent to the modern usage. On the other hand the king's relation to the soil is equally indefinite. That he was not formally its superior owner is clear, yet he could grant villages or assign his fiscal rights over them to favourites, though such gifts to Brahmans were reproved. And later the idea developed that he was legal owner of the soil, and that his grantees were landlords. Doubtless the feuds between nobles and people arose out of these nebulous relations.

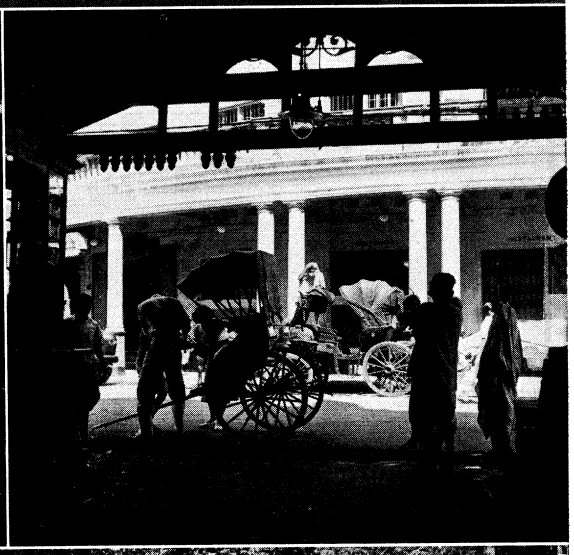
When we turn to the Vedic organization of the tribes the darkness deepens. The *vish* was the people as opposed to the *kshatra*, "nobility," but originally the word doubtless meant "settlement" or merely "dwelling." and the head of it was the *vishpati*, its "lord"; but again the king is *vishpati* as "lord of the people." The *vish* did not, however, include all the *jana*, a term which means "man" and collectively "people," or "tribe." It seems to have denoted the "host" collectively as well as units of it; but whether those units were clans or cantons is not explained, and we have no mention of either tribal chiefs or headmen of cantons. We cannot, however, be very wrong if we picture the Aryan hosts as composed of tribal rather than territorial levies under their own "kings" (*vishpatis*), obeying the *senani* or *senapati* with village leaders under them.

Villages, Gotras and Families. — The process whereby the Aryan village developed into the modern village community is nowhere described, but it is not difficult to form some idea of it. First of its factors must have been a change in inheritance laws which now gave each son an equal share in the paternal land. This stereotyped the sept, or *gotra*. Meaning at first merely a "herd," or "cowstall," this word assumed later a new significance. A change of *gotra*, once quite possible, became unthinkable, and marriage within it was disallowed. The older system had prohibited it only within three or four degrees on either side and even so permitted a union with the daughter of a paternal uncle; but some instinctive dread of inbreeding seems to have extended the exogamous principle not only to the whole *gotra*, necessitating its immutability, but to the descendants of three more kinships. the mother's and the grandparents'. The result was a solidifying, as it were, of the proprietary body which held a village or a number of villages, whether grouped or dispersed. This principle was applied with equal stringency to nonlandholding castes of all degrees, though it was often relaxed so as to exclude only one or two kinships beside the paternal *gotra*, and in extreme cases it might be further relaxed by splitting even that *gotra* in two, after a long period of time had reduced the perils of inbreeding to zero. The original *gotra* indeed seems to have been an artificial unit, at least among the Brahmans, whose *gotras*, named after the semimythical sages (*rishis*), may well have included their disciples as well as their own issue. Not until the epic period do we find one of the *Upanishads* enunciating the rule that spiritual succession must descend from father to son, thus closing the *gotra* to new blood. It is, however, important to note that in the south the exogamous instinct still permits cross-cousin marriage.

The village community no doubt has been and still is a real commonwealth. But if we ask how it has enforced its collective will, we shall find it rarely evolving a constitution written or unwritten. Sporadically, in the south of India some interesting inscriptions of the 10th century tell us of village committees. under royal control, on which the members sat in rotation determined by lot and on which a low-caste man was eligible if he had undergone expiation. But elsewhere investigation fails to trace any ordered forms of village rule. The convention of the village owners; often called its *panchayat*, or "council of five." includes in fact all its members. Its headmen rarely possess definite authority. Yet it has achieved much: it has enabled provinces devastated by war to reconstruct their rural economy; it has





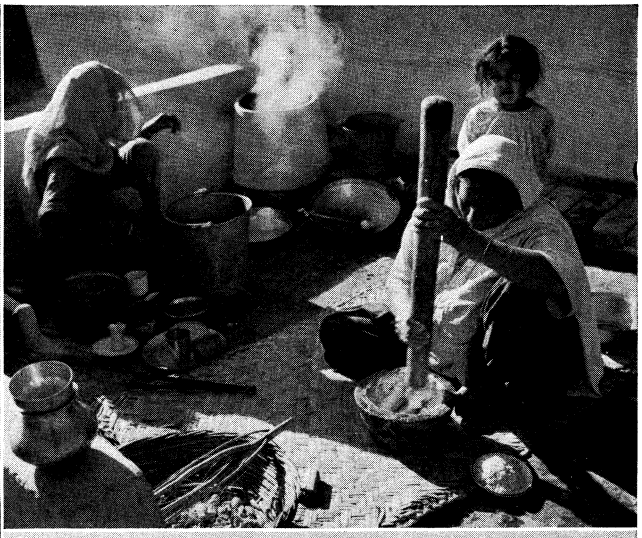


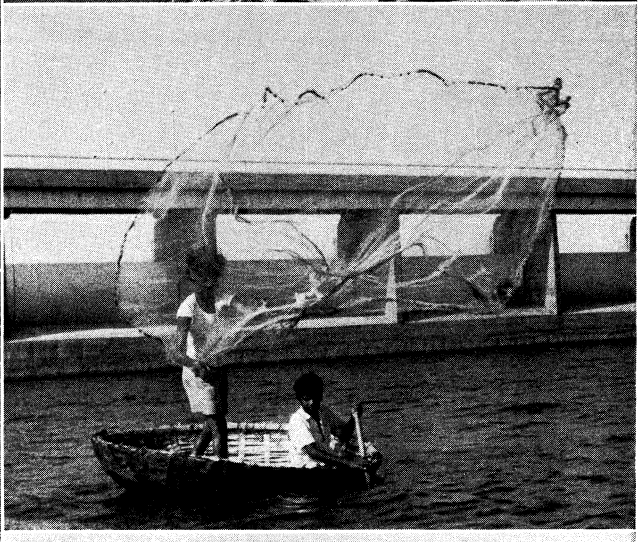
BY COURTESY OF (CENTRE LEFT) UNITED NATIONS; PHOTOGRAPHS, (TOP LEFT, CENTRE RIGHT) TIERS FROM MONKMEYER, (TOP RIGHT) CAMERA PRESS FROM PIX, (BOTTOM LEFT) NORMAN GORDON FROM BLACK STAR, (BOTTOM RIGHT) DUNGAN FROM PIX

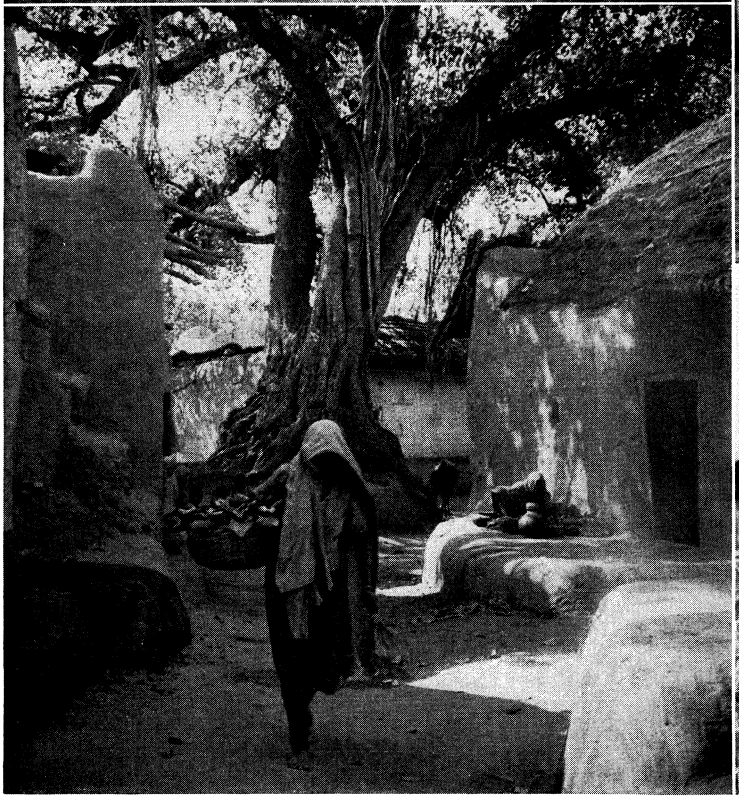
VIEWS OF INDIA

Top left: The Victoria memorial in Calcutta, opened in 1921
Top right: The Golden temple of Amritsar, centre of the Sikh religion, built in 1579
Centre left: Worker at steel factory in eastern India
Centre right: Street scene in Calcutta
Bottom left: Produce on sale at the public market, Bombay
Bottom right: Work elephants moving teak logs. Marks on elephants' heads serve for decoration

INDIA







BY COURTESY OF (TOP RIGHT, CENTRE RIGHT, BOTTOM RIGHT) UNITED NATIONS, (BOTTOM LEFT) MCKIM MARRIOTT; PHOTOGRAPH, (TOP LEFT) CYGNET FROM BLACK STAR

RURAL INDIA

Top left: Farmer of central India with his team of bullocks and primitive plow

Top right: A woman of the Tarai area, northern India, preparing a meal for her family

Centre right: Boys fishing on an artificial lake behind a dam across the Damodar river, eastern India

Bottom left: Street in small Indian village

Bottom right: Child harvesting rice, one of India's staple foods

helped vaster areas, ruined by repeated famines, to recover their prosperity; it has repeopled regions left desolate by massacres like those of Timur. But it has failed to set up any working system of self-government on which could be grafted a legal structure.

No doubt the Indian village varies in the types of its tenures. In the north its lands may be held on the precise shares heritable by descent, the tenure favoured by the Rajputs. Or it may be that in the fragmentation of the holdings ancestral right is no longer the measure of actual occupatiori which has been allowed to individual coparceners according to their energy and enterprise; so that the industrious, having brought much of the common waste under the plough, have bequeathed to their descendants, on its final partition. an indefeasible right to the lion's share of what is left of it. Much has been done to consolidate holdings, by enforced mutual exchange of scattered ones. but only under state action. In the south of India a more individualistic system was observed to exist by the earliest British administrators. There they found the village not strictly regarded by its former rulers as collectively responsible for the payment of its land tax, and consisting of individual holdings. The village community therefore was held to be less often existent; and the *ryotwari,* or system whereby each holder paid his own land tax to the government. was favoured. The repercussion., of these economic phases in Indian society have been marked. The refusal to endure primogeniture fragmented wealth too rapidly and above all impoverished the smaller gentry who were compelled to adopt widow-remarriage as an economy. The denial of all testamentary power to the father weakened social discipline. Hindu law and custom often almost entail property on all the sons alike, abolishing incentives to effort in the cadets.

Indian society must not be regarded as aristocratic but as an infinite series of democratic strata lying one above another. Within the *gotra,* now the *got* or whatever its modern synonym may be. all men are equal. But the dictum at once calls for qualification. Within the *got* individuals shall not excel, but groups may; and so where a *got* holds a big cluster of villages and hamlets. one or two bigger, older or more prosperous than the rest mill set up a claim to be superior to the rest. This superiority will be manifested by a denial of brides to a hitherto equal clan, more extravagance at births. weddings, funerals and so on. But as the cost of placing daughters hypergamously or even isogamously is prohibitive, they will be made away with or so neglected that their chances of life are far below those of boys. Hence there is a loss of almost a moiety of the best-bred strata in the finest *gots,* an unparalleled sacrifice on the altar of snobbery. But the repercussions spread further. The *gotra* must always have been an unprogressive body, its pace being that of its slowest members, and the *got* has inherited its retardation and has rarely if ever created a council of canton or tribe. It has had a keen spirit of tribal self-esteem. It has done nothing to advance self-administration in the village or over it.

So far what has been said applies peculiarly to the Hindu castes, including the Sikhs and Mohammedanized tribes which hold the plains of northern India. In the south, caste is tenser, but there is less apparent tendency to subdivide socially. On the other hand two great factions—the right-hand, which is headed by the Brahmans and includes curiously the Pariahs; and the left-hand. headed by the Panchalars, the "five-castes." workers in stone, metal. etc., and including the Pullars or Pullans—have been formed.

How the feud between these factions originated is unknown. The causes of collision were trivial and apparently for the most part of a purely sumptuary character. The Pullans are agricultural serfs, little. if at all, above the Pariahs. Offspring of a Brahman woman by a Shudra, Devendra, they say created the work for the Tamil peasantry. which hints at a pre-Tamil origin. A stocky, sturdy black man eating meat (but not beef, and so superior to the Pariahs). the Pullan specializes in the cultivation of wet riceland. but is excelled by his womanfolk. Some old sumptuary law forbade a Pullan woman to be clothed above the waist, and when Christian converts broke this rule disturbances ensued. Divided into numerous endogamous and innumerable exogamous groups, they trace descent through females and bury their dead. Yet they adopted some Hindu gods and even claim descent from Indra. In a faction fight they form the vanguard, as do the Pariahs on the other side. Yet, low in the caste as they are, the Pullans evince a consiilerable power of self-organization. They have caste-couricils. which punish theft and adultery, and discipline is enforced by flogging (of both sexes) or expulsion.

In northern India it may be said that caste self-government is confined to the artisan castes, with occasional guild committees among the traders. But no general assemblies ever seem to have existed. The traders settle commercial disputes in townships and their associations may also decide matrimonial questions, but the latter form the main if not the sole matter which interests the artisan *panchayats* or juries. These are presided over by elders, usually hereditary. and sometimes have an appellate system. Because of the dispersion of such castes, the jurisdictional area may be large and it is often contermirious with an old fiscal area.

To sum up, the social organization of India presents a wide range of complexity from the simple tribe, an endogamous group with its exogamous subdivisions, or from the local group, be it village or simple hunting group, with local exogamy, divided into family groups (the debris or the rudiments of a clan system), to an organized polity wherein the castes are ranged in order of purity, which is determined by factors deep in the history of the people, some economic, others racial, others purely political. Clearly, there was in ancient India an advanced urban organization, the influence of which upon the social history, upon the development of caste, upon the economic and industrial life of India has not yet been explored. The family, be it joint or divided, is ultimately in India, as elsewhere, the primal unit in the social organization within which are built up the dispositions which, universalized within the society, become its institutions. Kinship —whether matrilineal: as in Malabar, or, as more generally, patrilineal—is with the *got,* or clan system, reckoned unilaterally; but with the system of cousin marriage, still, as in the early days, typical of southern India, from the highest to the lowest groups, the true bilaterality of the family appears. In this vast area marriage rites have been developed to great variety. The caste system exhibits even now, with a vigorous endogamy strong with religious and social sanctions, the principle of separatism, of emphasis on the differences between groups, and it finds scope for perennial application. *(See* CASTE [INDIAN]; also CLAN; COUSIN MARRIAGE; FAMILY; HINDUISM; HYPERGAMY; LEVIRATE; POLYGYNY; SORORATE; TRIBE.)

RELIGIONS

According to the census of undivided India taken in 1941, the numbers of adherents of the principal religions were as follows: Hindus *254,930,506*: Moslems 92,058,096; Christians *6,316,*549; Sikhs 5,691,447; Jains 1,449,286; Buddhists 232,003; and animists and others 25,873,846 The Sikhs were found mainly in the Punjab and adjacent states (their homeland was almost bisected by the partition); more than two-fifths of the Jains were in Bombay and its states, including Baroda; and all but *28,620* of the Parsees were in Bombay. The other religions were widely distributed *(see* below). At the 1951 census the following was the position (first figure is for republic of India, figure in parentheses for Pakistan): Hindus *303,186,986* (9,770,000); Sikhs *6,219,134;* Jains 1,618,406; Buddhists *180,767 (319,630);* Zoroastrians (Parsee and Irani) 111,791 (5,356); Moslems 35,400,117 (64,959,000); Christians 8,157,765 (541,000).

The oldest of these religions is animism, which represents the beginnings of religion in India and is still professed by the more primitive tribes, such as Santals, Bhils and Gonds. The transition from this crude form of religion to popular Hinduism is comparatively easy. The most obvious characteristics of the ordinary Hindu are that he worships a plurality of gods, looks upon the cow as a sacred animal, regards certain rivers and pools as holy and accepts Brahmanical supremacy and the caste system; and when it is a question whether one of the animistic tribes has or has not entered the fold of Hinduism, these seem to be the proper tests to apply.

On the other hand there are various offshoots from orthodox Hinduism, the distinguishing feature of which, in their earlier history at least, is the obliteration of caste distinctions and the rejection of the Brahmanical hierarchy. It is doubtful if Buddhism, and still more so if Jainism and Sikhism, all of which are commonly recognized as distinct religions, ever differed from Hinduism to a greater extent than did the tenets of the earlier followers of Chaitanya in Bengal or those of the Lingayats in Mysore; and these three religions are therefore presented here only in their relation to the general development of Hinduism, their particular features being discussed in separate articles.

HINDUISM AND ITS OFFSHOOTS

Pre-Vedic Animism.— In the beliefs of the most backward tribes of India, observers have detected animism, definable concisely as a worship of spirits including impersonal forces But it is doubtful if Indian animism ever had any real conception of an impersonal force. It lacked quite completely a vivid idea of personality. The Santal, who still believes that if he takes a false oath on a piece of tiger skin he will be devoured by a tiger, does not seem to attribute any impersonal power to the relic, but to regard it as a convenient substitute for the live tiger which mill eat him if he calls upon him to do so in his oath and then commits perjury: So inchoate is the concept of personality that his primitive mind fails to draw much distinction between inanimate things and living beings. It is equally incapable of realizing death. Accustomed to obey his living village chiefs, he continues to placate them when dead. but worships neither their ashes nor their memorial stones nor their spirits. The last are not deified or even ranked as specially endowed *bongas,* the so-called spirits who in human shape marry Santal men and maidens, cause disease and mischance when so bidden by witches and display gratitude in tangible form by material acts. The Santals seem to have no words of their own for ghosts or spirits and their native god is Marang Buru, the "great mountain," whose personality can only be described by using a borrowed term, *deo,* the Sanskrit *deva,* and whose main function appears to be the instruction of maidens in witchcraft. But the Santals cannot be safely regarded as typical pre-Aryans. They dwell in the eastern outskirts of the Chota Nagpur plateau and are hunters in the forest, not assiduous cultivators. In more favoured localities the Dravidians may have attained a much higher civilization. Still less can we be certain that the conceptions of impersonal forces, of the soul and of a future life were unknown to them before the Aryan conquests.

Vedic Theology.— The *Vedas* however display much loftier conceptions. The cosmogony of the *Rig-Veda* fluctuates between two theories, one regarding the universe as the work of a great architect, the other as the result of natural generation. In the first Indra measured out the six regions, made the expanse of earth and the dome of heaven. He and other gods built a cosmic house of timber, framed on posts but rafterless; and why the sky does not fall is a marvel. Savitri made fast the earth with hands, Vishnu fixed it with pegs and Brihaspati supports its ends. In a frame Indra fixed the air, and the morning light enters by the portals of the east. But the generation theory is more complex. Dawn, Ushas, born of Night, generates the Sun and morning sacrifice. But parentage is more easily assigned to place than it is to time; so Heaven and Earth, containing all, are universal parents. Dyaus, the sky, is father; the Dawn is his daughter. Generically again, he who is the chief, the most prominent of a group, is their parent. Vayu, the wind, fathers the storm-gods; Rudra, the Maruts (*q.v.*) or Rudras; Soma, all plants; and Sarasvati, all rivers. But abstractions are already used figuratively so that the gods are "sons" of immortality and of skill: Agni is son of night; Pusan, of freedom; and Indra, of truth. This concept recalls the Semitic idiom. On the other hand, in the latest canto of the *Rig-Veda* the world is primitively imaged as a giant from whose members sprang the universe, as Indra and Agni from his mouth (which also became the Brahmana); the Rajanya, "warrior," from his arms; and the Vaishya, "commonalty," from his thighs. His head became the sky; his navel, the air; and his feet (which also produced the Shudra), the earth. Moreover, the gods are also moral, all are true and "not deceitful," friendly to honesty and righteousness. In this aspect Varuna (*q.v.*) is foremost. The Vedic gods however lack individuality and clearness of outline. Already in the *Rig-Veda* they are said to be 33 in number, a figure constantly increased. And these gods are graded, classed as celestial (those who dwell above the firmament), aerial and terrestrial.

But when we inquire into each god's special functions we find a singular vagueness, a puzzling overlapping of jurisdictions. It is as if the Vedic Aryans had been formed of a confederacy of tribes, each affecting a god of its own, not differing much one from another, often bearing the same names with function adapted now to pastoral, now to cultivating, clans, but generally warlike; and as if these gods had been transferable from tribe to tribe as treaties united their followers. Most of the gods have at least some solar attributes. None has a monopoly. If Varuna upholds physical and moral order, so does Mitra. If Varuna is invoked as universal king *(sumraj),* so are Mitra, Indra and even Agni. as though aspirants to the supreme monarchy over the Aryan hosts grasped and lost political power. Though the Vedic gods remain interdependent (Varuna and Surya subordinate to Indra; Indra, Mitra, Varuna and Rudra, to Savitri; and Varuna with the Asvins, to Vishnu), every god is praised in turn, even the exalted Varuna being mostly invoked in conjunction with at least one colleague while verses to pairs, triads and groups are frequent. The Vedic pantheon resembles the Aryan polity in that it never arrived at an uncontested monarchy. But the *Rzg-Veda* closes with some notable hymns which treat the origin of the world as a philosophical problem; and the sun, as a golden embryo, is given the new name of Prajapati (hitherto a mere epithet of Savitri), "lord of creatures." Foreshadowing or reflecting some monotheistic innovation, Parjapati is the All, soon to become the anthropomorphic personification of the desire (*kama*), which is the first seed. Such in outline is the story of the *Rig-Veda's* development, but it does not exhaust all its slowly achieved conceptions. We must at least add to them the toothless Pushan, the "prosperer," an indistinct individuality, hardly yet anthropomorphic, who watches over paths and guides the dead on the last road. Naturally such a concept is capable of almost infinite expansion, and Pushan was later to become a sun-god and Aditya, "the preserver of all things," and then to fade into oblivion. The Adityas, sons of Aditi, a group of some six or more gods whose names are variously given, included not only Mitra and Varuna (Indra was added later) but such minor deities as Aryaman, Bhaga. Daksa and Amsu; later they too will be sun-gods and include Vishnu. Aditi denoted bondlessness and may be regarded as the only abstraction personified as a goddess in the *Vedas.* Aditi is the great mistress of the devout, but motherhood is her ,essential trait. Her epithet is *pastya,* "housewife." She cannot. honever, be safely regarded as "Mother of the Gods" in the *Rig-T'eda,* her recognition as such not appearing till the epic period Her lesser sons are as indistinct as herself, Bhaga besought to be Bhagavan, "bountiful." and Amsha also connoting "bounty"; Aryaman, "comrade"; and Daksa, "dexterity"; yet the first must be of great antiquity, *bogŭ* being "god" in old Slavonic, while Aryaman is Avestan. In Vedic worship goddesses are fairly numerous but quite subordinate even when wives of the high gods like Indrani. They bear simple names, Ushas (*q.v.*), Night, Earth, Speech, Parendi, or Puramdhi, a goddess of plenty like Dhishana. Ila, or Ida, "abundance" of milk, later "cow." Not until we come to the *Brakmanas* (*q.v.*) do the wives of the gods have a place in the cult assigned to them apart from their husbands. Lower deities like the *Apsarasas* and Gandharvas (*q.v.*) deified priests and heroes like Manu (*q.v.*), animals, especially horses, kine (the cow is not to be slain), birds such as Garuda, inanimate objects from rivers and hills down to weapons and tools, but not the phallus, abound. Opposed to the benevolent deities is a host of demons: *asuras* ("gods" in the *Rig-Veda* like the Avestan *ahura)* and *dasus,* possessed of occult power, the term *dasu* being at first applied to the dark aborigines, then to demons of the air and finally to slaves (on the other hand *vritras* were at first demons and later human foes); *rakskasas* and others.

In the *Rig-Veda* we find belief in a future life, delectable for penitents, heroes and donors of sacrificial gifts; and, though burial is mentioned in the earliest hymns, cremation of the dead was preferred because the soul could ascend to heaven with the smoke. Yama was a god of the dead but hardly their judge since they had to pass between two fires which burned the wicked and let the good go by. Belief in metempsychosis does not appear at all in the *Vedas* but is mentioned in a *Brahnzana* and accepted in the *Upanishads* and in all later Hindu sacred writings and has influenced nearly all Hindu thought. An essential part of this belief is the doctrine of *karma* (*q.v.*), developed in Jainism and Buddhism, whereby a man's actions in one life determine his position in the next. Though this interpretation of *karma* was originally atheistic, the old Vedic ritual was not abandoned: and the *Sutras* which were now written were intended to aid the student, being classified indices of its increasing perplexities, more or less unintelligible by themselves and requiring a commentary to explain them. They reflect ritualism and polytheism which are retained without misgivings as to their contradictions by the *karma* theory.

Sectarianism. — The significance of the *Mahabharata* and the *Ramayana,* the first epics, is discussed in the article SANSKRIT LANGUAGE AND LITERATURE. The next great batch of religious writing was the *Upanishads,* or secret doctrine. These were probably put together by Kshatriyas, but they are assigned to Brahmanical schools and some like the *Chhandogya Upanishad* bear the very names of their *Brahmanas.* The essential teaching of the *Upanishads* is that knowledge gives release. Dating from about 500 B.C. they took form in the lands of the Ganges and the Jumna, and they are followed by versified condensations of little later date. But these introduce Vishnu and Shiva as symbols of Brahma; and Isha, or Ishvara, appears as the Supreme in the *Isha Upanishad,* while in the *Saetashvatara* Shiva is introduced under his older title of Rudra and. for the first time in Hindu literature, *bhakti,* or devotional feeling, is spoken of as being due to him. In these treatises also first occurs the term Vedanta as a name of the Upanishad philosophy.

Hence. by the middle of the 6th century, we find a network of Hindu schools, already in full working order and represented by the prose *Upanishads,* the *Karma Mimamsa,* etc.

Probably in the 4th or 3rd century B.C. appear the Sankhya and Yoga (*q.v.*) systems. The former admitted Sudras; the latter, outcasts as well; the one derived from the *Upanishads* in the main; the latter: uitimately from popular magic and hypnotism. The Lokayata, or materialistic school, was probably also in existence. To these must be added Jainism and Buddhism *(see* BUDDHA AND BUDDHISM; JAINS), both founded by Kshatriyas.

The great movement toward theism may be said to have begun about 200 B.C. In the conditions which then prevailed it could hardly have had a more unpromising outlook, and to add to its misfortunes its earliest writings perished. *Upanishads* continued to be written but its principal manual disappeared, only the sectarian writings such as the *Sannyasa, Yoga* and *Shiva Upanishads* surviving. It seems indeed to have been an epoch when works which struck at particularism were deliberately destroyed. The original version of the laws of *Manu,* the *Dharmasutra,* was replaced by the *Dharmashastra* in verse. Probably some early versions of the Sankhpa and Yoga systems also existed, but both disappeared as did the fundamental texts of the *Vaishesika, Nyaya* and *Charvaka.* The Vaishnavas took over the great epics and changed their character.

Vishnu and Shivs.-Among the twice-born we must recognize two great divisions: the orthodox faithful to the Vedic pantheon and ritual; and the sectarians exalting one god to the neglect of the rest and in his cult using a ritual and liturgy of non-Vedic origin chiefly by temple and image. The sectarian position was greatly strengthened by the *Bhagavadgita,* the earliest and greatest of the didactic epics. In its present form it cannot be earlier than the 1st or 2nd century A.D., but its original may go back to the 4th century B.C. Suddenly in the added matter of the great epics we find the doctrine of divine incarnation. It is useless to ask nhence it came or to point to gods in the *Brahmanas* taking temporarily the forms of animals. fish or dwarf. The Vaishnavas go much further. They identify Vishnu with the Brahman-Atman of the *Upanishads* and with Krishna, to whom is given the title of Bhagavan (whence the name of the poem "The Lord's Song"). Vishnu's selection is inexplicable. He was one of the great trio but Brahma was the more likely to be chosen as chief of the gods, as the Supreme. Krishna, man, a partial incarnation of Vishnu in the second stage of the epic, is promoted as a full incarnation of Vishnu-Brahman. The change is not merely revolutionary but unexplained. The theology of the poem is thus a theism, but still imperfect. The song is coloured, as it were, with some pantheistic passages. Sankhya, Yoga and the *Upanishads* are all dragged in without any attempt to reconcile their differences. It recognizes no animal sacrifice but it tightens up the bonds of caste and establishes the regular worship of ancestors. If the Dharmashastras as we have them are those to which it refers. the ideal is laid down that every man ought to pass through the four *asramas* and that not even a virgin widow may remarry. Scholars who hold that the song was contaminated by the pantheism of the *Upanishads* in the 2nd century A.D. have much on their side. Rut how did it in the 2nd century B.C. appear as a purely theistic tract glorifying Krishna? It began as a sectarian thesis; it became the very cream of orthodoxy.

This by no means exhausts the Vaishnava material in the didactic epic. It mas followed by a flood of writings, notably by the *Marayaniya* section of the *Mokshadharma.* This seems to present a later period in the history of Vaishnavism and adds *inter alia* the doctrine of *vyuha,* or expansion, according to which Vishnu exists in four forms, denoting the steps of his ascent to Brahma. The second of these forms is Samkarshana, "withdrawn," because Vishnu, identified with primaeval matter, was drawn from his mother's womb and placed in Rohini. But Vasudeva is Krishna; Balarama or Samkarshana. Krishna's brother; Pradyumna, his son; and Aniruddha, one of his grandsons. The *Narayaniya* has ten incarnations of Vishnu, whereas the *Anugita* mentions only six, adding four to the original two but othentise making no advance whatsoever. The *Narayaniya* also has a tale of Narada, the saint, taking a long journey to the north where he came to the White Island in the Sea of Milk, wherein white men worshipped Narayana; *i.e.,* Vishnu. Here we have seemingly allusions to Christianity. But as yet there is nothing to suggest any worship of the child Krishna or any association of Krishna with the Gopis, "cowherdesses." The story of his rescue from the wrath of Kamsa is still untold and Radha is not mentioned.

In the didactic epic, Shiva follows Vishnu, but at a long interval. His new theology is clearly in its inception an imitation. Its name, Pasupata, is formed from *Pasu pati*, "lord of flocks," once an epithet of Rudra. Shiv worshippers today revere the phallus (*e.g.,* the Lingayats, *q.v.*), but though it appears on pre-Christian monuments no mention of it occurs in literature before this period.

Buddhism was developing similar traits. This can be stated with confidence if we regard the literature which has been preserved. The Mahayana is the acute Hinduizing of Buddhism, and in it Buddha is conceived of as the Supreme, boundless in power and wisdom and surrounded by Bodhisattvas just attaining Buddhahood. The textbook of this school was the *Lalita Vistara,* originally the Buddha biography of the Sarvastivadins but taken over and rewritten. In it the old Hindu self-torture reappears. In his efforts to save men Analokitesvara, "looking down from above," can save from danger.

With Jainism there was a good deal of literary activity between 200 B.C. and A.D. 500, but much of it was lost or altered. The main writers were connected with Pataliputra and the norks of one were used by both the Jain sects. They also adapted the *Ramayana.* All this shows how the sects were inclined to mingle with the Hindus.

Saktism.—About AD. *550* we see the dawn of the Saktas though they may have been known earlier. In this system the god is neutral or inactive — apparently because he must be so if he is to remain beyond the sway of the law of *karma* — *and* his spouse, the goddess, embodies his energy *(saktia).* The oldest goddess

of this type is Durga, the virgin goddess of the Vindhyas. Her alliance as Uma with Shiva is later and she is no longer regarded as a virgin. Here we have palpably a fruitful field for new philosophers, sects and almost religions, and we begin to get onto historical ground Shankara in the first half of the 9th century took up the teaching. A series of works is attributed to him; but all of it is probably not from his pen. He certainly. however, wrote commentaries, or *vhashyas,* on the *Vedanta-Sutras,* the *Bkagavadgita* and many *Upanishads.* Shankara distinguishes between the supreme truth and that of experience. Besides the supreme or para-Brahman is a lower (*apara*) one. the world-soul and personal god. All our lower knowledge, our personal experience and conception of ourselves as distinct'personalities is ignorance rather than knowledge. Liberation comes when a man rises to true knowledge. which is finally granted by the grace of God and for which a man may prepare himself by the study of the Veda and the discipline of the Vedanta. Hence, when a man became a *sunnyasi* of the Advaita Vedanta, he gave up all the duties of the ordinary Hindu, laying aside even the sacred thread. Naturally its illusion and doctrine of double truth led its opponents to term it covert Buddhism. By Shankara's day the *Upanishads,* the *Bhagavadgita* and the *Vedanta-Sutras* nere recognized as fundamental for the Vedanta Later they were called the Triple Canon. Shankara re-regulated its orders, dividing them into ten, whence their name of Dasnamis. He founded Sringeri in Mysore as his chief monastery, where he himself nas the head, Govardhan in Puri. Sarada (Saraswati as patroness of sciences) in Dwarka, and Joshi at Badrinath And he was able to reform the Bhagavatas, a Ramaite sect in the south. and the Shaivas of Kashmir. Many other writers followed The Puranas, whose history is as old as it is obscure, had virtually all come into existence by the end of this period and two of them betray Sakta influence

The Vaishnavas of the Bhagavata school also accepted the Advaita Vedanta and the five gods. but still more serious was their identification of Shiva with Vishnu in the Skanda *Upanishad.* Today in the Tamil country the ritual is that of the Pancharatra Samhitas said to be unorthodox as inconsistent with Vedic usage, but we cannot be certain when they were written..

The Samhitas mark first the appearance of Sakta principles among the Vaishnavas; indeed. the theology of the chief one is a development of the Naraniya episode with the considerable addition of Saktism. The basis of their philosophy is the theistic Yoga, but it is manipulated so that it is hardly recognizable. Vishnu and his Sakti are one in the primary creation, which is followed by 36,000 secondary ones, in which a Sankhyan evolution appears. Their description is that of an attempt to combine most of what has gone before into a single but disconnected system. Even magic is commended. The Sri-Vaishnavas have a sect mark, two white curving lines with a vertical red one between them, the red representing Vishnu's Sakti. The Samhitas ordain that this symbol shall also be branded on the body. The cult is open to all four castes but not to outcasts. But besides the Sri-Vaishnava several other sects arose, notably the Narsimha (Narsingh) sect, which worships the man-lion incarnation of Vishnu, especially in the south, and had two *Upanishads* of its own. The Shaivas had a bewildering number of sects and schools such as the Kapalikas, or skull-men, perpetrating human sacrifice and full of Sakta ideas.

The sect of Durga, reorganized with a new theology, a more varied cult and a fresh literature, appears as the Sakta sect. Its writings still await scholarly investigation but many of them were in existence by 600. Its system is fundamentally an unlimited array of magic rites drawn from the practices of the most ignorant classes; and it has been credited with ritual usually ascribed to secret sects. It was divided into the left-handed, or those who pushed such usages to an extreme, and the right-handed, as reformed possibly by Shankara.

Bhakti — Between 900 and 1350 there was a new movement in Hindu literature — that of Bhakti. The earlier singers of the Tamil country, the Alwars, in their lyrics introduced great changes in the Sri-Vaishnava temples and paved the way for Ramanuja, whose influence reacted on all the sects.

So, too, the chauntries of the Shaiva gave their cults a great uplift and made possible the creation of the Tamil Shaiva Siddhanta. The two great books are the *Sri-Bhashya* of Ramanuja and the *Bhagavata Purana,* whence sprang two streams of Bhakti, the one meditative, the other explosively emotional. While the Sankhya and Yoga schools stood still, all the others continued their literary activity in which Bhaskaracharya, author of the *Bhaskara-Chashya,* attacks Shankara and in turn is assailed by Udayana in the Kusummanjali, between 850 and 980, while Madhva, founder of the Madhva sect, left Dvaita commentaries on ten principal *Upanishads.* The *Bhagavata Purana* seems to have sprung from the Bhagavata community and from its influences were born a number of new sects. It has several distinctive features. It devotes itself to Krishna's boyhood and youth and to the Gopis, or cow-maidens; but even yet Radha does not appear. her place being foreshadowed by a favourite gopi. Further. Bhakti now attains its highest point of mystical expression, and it must have arisen among Vaishnava ascetics. It is a surging emotion which leads to tears and laughter, to sudden fainting fits and long trances of unconsciousness. But it has one fatal feature in its sensuous description of Krishna's dalliance with the Gopis. Hindus are by no means in accord as to its age or authorship, but, since Alberuni mentions it, it can hardly have been written after 900 and must be due to a community of singers in the Tamil country. The sects due to the *Blzagavata Purana's* influence are numerous. They included the now possibly extinct Raseshvaras, or Mercurials, who acquired a divine body by the use of mercury and then by Yoga an intuition of the Supreme; the aspirant is then liberated in this life. Another inchoate sect is that of the Gorakhnathis — closely related to the Kapalikas — with an unorganized laity. They have temples all over India from the Gorkatri in Peshawar, in Nepal, right down to the south. Its adherents, mainly called Kanphatas, Yogis, or split-eared. are its strongest part. Both Tantric Hinduism and Tantric Buddhism glorify Goraksha Nath and his companion saints; yet Goraksha himself probably flourished about 1200; and with his name is associated a new type of Yoga, the Hatha-yoga, destined to attain the *samadhi,* "supreme concentration of mind," by strange bodily postures, breathing exercises and attention. In the later books on this cult is added Raja-yoga, a more intellectual discipline. The book by Goraksha on the Hatha-yoga seems to be lost.

On the other hand. some of the older sects have disappeared; *e.g.,* the Rama sect which rewrote the *Ramayana,* adding Sakta elements to it so that Sita's illusory self is carried off by Ravana and when Rama speaks as a man he is explained to be under the influence of *maya,* "illusion." This elevates the pair to the position of the Supreme.

Syncretism **and** Monotheism. — The earliest influences of the Moslem invasions were naturally confined to Sind, the Punjab and Hindustan. They were often unorthodox, the purer forms of the faith being too intent on the establishment of their own sternly monotheistic creed to win acceptance from Hindus. Not much before 1400 did Sufism begin to make headway in India and most of the institutions which have survived from that period are due to it. The Mohammedans certainly destroyed Hindu temples, which they called Jain, but more for the sake of their materials than for any other purpose. With the reign of Akbar began a new movement; namely, the attempt to create a new world-religion which should unite the warring elements. This religion borrowed from all. It was never strictly defined since Akbar was suspect to his Moslem subjects, but he was at least tolerant, which the later Aurangzeb was not. It would be as difficult to deny that his austere faith was one of the principal causes of the fall of the Mogul empire as it would be to dispute its influence on Hindu monotheism. Weak as we have seen the movement toward theism to have been, it found support from Islamic example. It was the same with idolatry. To this movement must be ascribed the teachings of Namdeva and Trilochan in the Maratha land, of Sadana and Beni in the north and of Ramananda, who lived from about 1400 to 1470. He was followed by his disciple Pipa and by Kabir. Ramananda seems to have been under Ramanuja's influence; yet he worshipped Rama and Sita and their attendants alone. He probably derived his doctrine from the Ramaites of the south, but

he came to the north and among his personal followers were an outcast, a Mohammedan and a woman; yet he attempted no reform of caste restraints though he mitigated some in the matter of food. The most numerous of the ascetics founded by him are the Bairagis, "passionless." or Avadhuta, "liberated." equalled today in numbers only by Shankara's Dasnamis. But he founded no regular sect. Indeed, sectarianism was in process of decay. Ramananda still affected images. but Kabir denounced them and worshipped God (Ram) alone. Many of his sayings were included in the Sikh Granth (*q.v.*).

Of the ten sects founded by his followers during the next three centuries, the Sikhs (*q.v.*) are undoubtedly the most important. Their religion, which rejects caste and Brahminist dominance was founded by Nanak in 1469. His tenth successor as *guru* in the 18th century transformed the Sikhs into a military community because of persecution. More widely travelled than any other Indian community — Malaya, Hong Kong, Shanghai, Vancouver and Hankow know them well — the Sikhs are fine craftsmen, good soldiers, able administrators and resolute politicians. (See also **HINDUISM.**)

MOSLEMS AND CHRISTIANS

Moslems. — The bewildering diversity of religious beliefs collected under the name of Hinduism has no counterpart among the Mohammedans, who are limited as to their main tenets by the teaching of a single book, the Koran. The two main sects are Sunnis and Shiahs. In India the Sunnis greatly preponderate, but they usually share with the Shiahs their veneration for Hasan and Husain and strictly observe the Moharram. However, an orthodox reformer Mirza Ghulam Ahmad (1839–1908) started at Qadian (Punjab) the sect known as Ahmadiyahs. or Qadianis. Its missionary enterprise made it better known in the west than its importance in India warranted, but it has had as adherents leading Moslem personalities and even has its onn mosque at Putney in England. Partition left Qadian in Indian territory, though close to the Pakistan border; and Lahore has the headquarters of an offshoot of the sect, politically passive but energetic in disseminating Islamic liberal ideas.

The Mohammedans of the subcontinent may be divided into two classes: (1) pure Mohammedans from the Mogul and Pathan conquering races; and (2) Mohammedan converts. who differ little racially from the surrounding Hindu population from which they originally sprang. The pure Mohammedans may again be subdivided into four sections: (1) Moguls, or the descendants of the great conquering race, including Persians; (2) Afghans or Pathans, in the Punjab and in the Rohilkhand division of the Uttar Pradesh; (3) Saiyads, who claim to be lineally descended from the Prophet; and (4) Sheikhs, which is a name sometimes adopted by converts. The remainder are unspecified. In Bengal the vast majority of the Mohammedans in their devotion to hereditary occupations are scarcely to be distinguished from Hindu castes. In the Punjab, besides the Pathan immigrants from across the frentier, Islam has taken a strong hold on the Jats. Rajputs and Gujars. Western India and Pakistan have three peculiar classes of Mohammedans. each of which is specially devoted to maritime trade: (1) the Memons, chiefly in Sind; (2) the Borahs. mainly in Gujarat; and (3) the Khojahs, of whom half live on the island of Bomhay. In southern India are found the two peculiar races of the Moplahs and the Labbays, both of which are-seated along the coast and follow a seafaring life. Descended from the Arab traders who settled there in very early times, and recruited partly by voluntary adhesions and partly by forcible conversions during the persecutions of Hyder Ali and Tippoo Sultan, they have been prone to fanatical outbreaks.

For the partition of 1947 the classification of Islamic elements in India was thus made from 1941 census figures: northwestern area (Punjab, Korth-West Frontier Province, Sind, British Baluchistan) 60.02%; northeastern area (Bengal, Assam) 51.697,; rest of British India 10.6%. To effect partition there had to be a division of the Punjab and Bengal.

Christians. — The Christian community of 1941 in undivided India included 6,040,665 Indian members. Of these about two-fifths were Roman Catholics, with metropolitan see in Bombay. More than half of the Indian Christians are found in Madras and the adjoining states. a tribute to the labours of St. Francis Xavier and the Protestant missionary Christian Friedrich Schwartz. "Christians of St Thomas" in Malabar, Travancore and Cochin are the most ancient Christian community in the south. They are, however. now much divided and comprise two Roman Catholic "uniat" churches, two Jacobite (Monophysite) bodies, an autonomous reformed group and a Nestorian group. After these come the Latin Roman Catholics, who trace their origin to the teaching of St. Francis Xavier and the Madura Jesuits. The Anglicans originated in the Church of England chaplaincies to the East India company, but their hierarchy (with metropolis at Calcutta) dates only from the early 19th century, as do the Protestant churches, whose progress after that time was considerable. Taking Indian Christians alone, their numbers increased from 1,246,288 in 1872 to the above-mentioned figure in 1941, and the rate of increase was even greater than these figures would show, because they include the Christians of St. Thomas, whose numbers are practically constant. The classes most receptive to Christianity have been those outside the Hindu system, or whom Hinduism regarded as degraded. Conversions from Islam have been relatively scarce.

Under the Indian Church Measure act. 1927, the Anglican body — the Church of India. Burma and Ceylon — became independent of its parent body, the Church of England, in 1930. The Church of South India was formed by a union of Anglicans, Methodists, Presbyterians, Dutch Reformed and Congregationalists in 1947. The Anglicans ceased thereby to be members of the Anglican communion. although attempts were later made to regularize relations between the two churches. A bishop administers "continuing" Anglicans in Xndhra and Madras. (ME.; H. **A. R.**; X.)

ECONOMICS

Nearly three-quarters of the total population of India ordinarily derive their living from occupations connected with the land. The fertility of the land. except where it is protected by irrigation, largely depends on the adequacy and timeliness of the monsoon rains. Should they fail, vast areas remain unsown or yield no harvest; masses of people. chiefly agricultural labourers and petty cultivators, are thrown out of employment; and famine results.

The second powerful force which affects the economic situation in India is the constant demand of the outer world for its raw produce, coupled with its own industrial weakness in converting that produce into manufactured articles, From earliest times India was noted for its spices, precious stones and delicate textiles; in return, it imported gold and silver in untold quantities and absorbed them. Spices are no longer a necessity in western diet; the diamond mines of Golconda have been worked out; and the famous cashmeres and muslins have been ousted. as have cottage industries everywhere, by loom-made substitutes. Before World War II, India's exports included coal, jute and jute products, hides and skins, lac, manganese. mica, tea, oilseeds and vegetable oils. spices, cotton and manufactured cotton. The war increased the export of many of these items; and during the German occupation of continental Europe. the British Commonwealth and the United States became the chief recipients. Among India's imports were machinery, chemicals, glassware, hardware, oils, rubber manufactures, textiles and automobiles.

NATURAL RESOURCES

Agriculture. — The cultivation of the soil occupies the Indian people in a sense which it is difficult for the foreigner to realize. The operations of rural life are familiar to every class. Everywhere. the same untiring labour is found, but inherited experience had taught the cultivators to adapt their simple methods to different conditions. Irrigation, apart from the great network of government canals, is practised wherever possible from wells of all types and depths, from tanks and evanescent streamlets. Manure is applied to the more valuable crops wherever it is available. although the land as a rule is starved by the much more insistent demand for manure as fuel. The rotation of crops is an ideal that is widely recognized, but poverty makes the use of periodic fallows unattainable.

On the other hand, the regularity of the seasons allows two, and on highly manured soils even three, harvests in the year, though comparatively rarely on the same fields; and there is much natural fertility. For inexhaustible productiveness and for retentiveness of moisture in a dry year, no soil could surpass the "black cotton soil"; but at the other end of the scale vast areas of the driest sandy land are coaxed to yield a scrannel harvest of poor millets and thin pulses.

Despite the innate conservatism of the peasantry and in the face of a very inadequate provision of staff and funds, the departments of agriculture, which were organized early in the 20th century, achieved a variety of important results. In the forefront of their work was the introduction of improved varieties of plants. The area sown in 1923–24 with improved varieties popularized in this way exceeded 5,000,000 ac. and had risen to 23,000,000 ac. by 1942. The Research institute at Pusa (*q.v.*) had remarkable success in its work with wheat, particularly in the introduction of types which are immune from rust; very valuable work was also done on sugar at Coimbatore. Experiments there led eventually to the establishment of the sugar-cane industry in Uttar Pradesh and Bihar.

Irrigation.—In the age-long contest against the tyranny of a semitropical climate, irrigation has played the dominant part, not only as a preventive of scarcity due to drought, but as an everyday adjunct to the productivity of the soil. In 1939–40 the area actually sown (some of it more than once) in British India was 244,500,000 ac., of which nearly 56,000,000 were irrigated. About half the irrigated area was supplied with canals; the rest, largely from wells and tanks. The canal system is one of the greatest achievements of the British. It embraces the great Ganges canals in northern India, with more than 1,200 mi. of main channels and 6,500 mi. of distributaries; the vast network of the Punjab canals; and the elaborate delta systems of Madras, besides extensive works in Sind and Deccan. Some of these draw on rivers fed by the Himalayan snows; others are channels for inundation and thus of less assured permanency; others again, chiefly in Madras, are supplied by storage works. The substitution of a permanent supply for the uncertainties of an inundation supply is in the forefront of the modern projects. Among these the greatest, and, indeed, one of the largest in the world, is the Sukkur barrage in Sind. At the point where the combined five rivers of the Punjab enter Sind through a narrow gorge, the flow is stemmed by a barrage 4,725 ft. long between abutments. The inundation system of Sind is served, and a vast new area brought under irrigation, by seven canals which take off from the barrage and which will ultimately water 6,000,000 ac.

Second only to the Sukkur scheme in magnitude is the Sutlej valley project, also mainly in Pakistan. It consists of four weirs, with ten main canals taking off from above them and irrigating more than 5,000,000 ac., which are partly waste and partly served inadequately by inundation channels. Outside the Indus basin there is no scope for works of equal magnitude, but a great scheme was completed for the irrigation of Oudh, by a canal fed from the Sarda river. This project had been under contemplation for 50 years but was in abeyance because of the opposition of the Oudh landowners. The area irrigated is 1,700,000 ac. In Madras even older schemes first planned by Sir Arthur T. Cotton were revived, for great storage reservoirs in the Cauvery, Bhavani, Tangabhadra and Kistna rivers. The Cauvery-Mettur system was inaugurated in 1934. With a capacity of 93,500,000 cu.ft., it was then the largest single block masonry reservoir in the world.

For the plan of 1950, which combined irrigation with the development of hydroelectricity, see Finance, below.

Co-operation.——To the improvement of Indian agriculture few obstacles are as grave as the chronic indebtedness of the peasantry. Legislation to combat this by restricting the alienation of rights in land has long been active; but a much more effective remedy was the establishment of rural credit banks on the Raiffeisen plan. It was initiated by an act of 1904, when registrars of co-operative societies were appointed for the different provinces, to draft model rules, register, inspect and audit the accounts of co-operative banks and also to carry on propaganda and education in co-operative principles. In 1912 an amending act was passed as the result of eight years' experience; this act also extended the official encouragement to co-operation in other fields. The number of registered societies in 1949–50 was 173,090, with a total membership of about 12,600,000; the capital employed was Rs. 233.1 crores (about £174,825,000). The great majority of the societies were village banks; but there were a large number of "central banks" situated in towns, which gathered in deposits, supplied funds to the rural banks in their neighbourhood and acted as links between them. There were also "apex" banks for most of the states.

Cereals.—Of the total cropped area in undivided British India one-third was occupied by rice, which is the dominant crop of the staple food in Bengal, Bihar and Orissa, as well as in parts of Madras and Uttar Pradesh, the so-called Patna rice coming mainly from the latter.

In area the next most important crops are the great variety of millets and pulses. The millets are probably the most prolific grain in the world and the best adapted to the vicissitudes of a tropical climate, requiring practically no irrigation.

Gram is the predominant variety and occupied more than 11,000,000 ac. in Uttar Pradesh and Punjab alone; but lentils and the smaller pulses are more universal. They are not an export commodity.

The wheat area sown was estimated at 34,862,000 ac. in 1940–41 and at 22,769,000 ac. for India in 1951–52 and 10,651,000 ac. for Pakistan in 1953–54; and the production, at 11,205,600 short tons in 1940–41 and at 5,679,000 for India (1951–52) and 3,683,000 for Pakistan (1953–54). More than two-thirds of the wheat crop is ordinarily grown in Uttar Pradesh and Punjab. The canal colonies of the Punjab turned northern India into the chief granary of the subcontinent.

Barley, maize and fodder crops cover about 59,000,000 ac.

Cotton.—Undivided India was the world's second largest producer of cotton, following the U.S. Partition changed this position, roughly half the area under cotton going to Pakistan. Bombay, Hyderabad, Madhya Pradesh, Madras and Uttar Pradesh all have important cotton tracts producing distinct types with widely varying yields. The total area in 1947–48 was about 10,900,000 ac., giving 2,100,000 bales (400 lb. each). About 5,100,000 ac. were under improved varieties. Raw cotton exports were 187,000 bales from India and 1,095,000 bales from Pakistan in 1951–52 (1 bale = 392 lb.).

Oilseeds, Sugar and Jute.—A crop of importance universally grown is the mixed group which yields oilseeds. Oil is an essential to the Indian toilet and to Indian cookery and as an illurninant. Chief varieties are peanuts, sesamum, rape or mustard and linseed. Export values in 1949–50 were £12,000,000.

Sugar cane covers 3,300,000 ac., most of which is in Uttar Pradesh and Bihar. The total yield in raw sugar was 4,493,000 tons in 1946–47. The world's supply of jute is derived almost wholly from the two Bengals, but partition gave 70% to East Bengal (Pakistan). India's jute crop in 1947–48 covered 646,000 ac., yielding 1,027 lb. per acre and producing 1,658,000 bales (400 lb. each). In 1952–53 Pakistan produced 6,823,000 400-lb. bales on 1,907,000 ac.

Tea.—The cultivation of tea in India replaced indigo as the chief article for European capital, more particularly in Assam. The real tea (Thea *viridis*), a plant akin to the camellia, grows wild in Assam, being commonly found throughout the hilly tract between the valleys of the Brahmaputra and the Barak. There it sometimes attains the dimensions of a large tree; and from that, as well as from other indications, it has been plausibly inferred that Assam is the original home of the plant, which was thence introduced at a prehistoric date into China. In 1949–50 the area under tea was 771,000 ac., yielding 585,030,000 lb. in India; in 1953–54, 75,000 ac. yielded 57,700,000 lb. in Pakistan.

Coffee.—Thecultivation of coffee is confined to southern India. The coffee tract includes almost the whole of Coorg, the districts of Kadur and Hassan in Mysore, the Nilgiri hills and the Wynaad. The cultivation has also extended to the Shevaroy hills in Salem district and to the Palni hills in Madura. Although local tradi-

tion dates its introduction in the 18th century, coffee was not grown systematically until 1840. After 1860 it spread with great rapidity along the whole line of the Western Ghats, clearing auay the primaeval forest and opening a new era of prosperity to the labouring classes. The export of coffee annually is about 3.000 tons. The area cultivated in 1950–51 was 224,215 ac. Local consumption of coffee is encouraged by the setting up of coffeehouses by the Coffee board.

Cinchona.—The cultivation of cinchona was introduced into India in the year 1860 under the auspices of the government through the efforts of Sir Clements Markham, and a stock of plants nas prepared and distributed to planters in the Nilgiris and in Coorg. At the same time governmental plantations were established in the Nilgiri hills and at Darjeeling. A considerable amount of the bark from private plantations is bought by the government and treated at the government factories.

Miscellaneous Crops.—Vegetables occupy an important place in the Indian dietary and are grown everywhere. Besides the ordinary European species which can mostly be grown in the cold season. the favourites are the eggplant (brinjal), garlic, yams and a great variety of cucurbitaceous plants. Among cultivated fruits the commonest are the mango, plantain, guava tamarind, jack, pomegranate, pineapple, papaw, custard apple and several varieties of fig, melon. orange, lime and citron. The mangoes of Bombay and the oranges of Nagpur and the Khasi hills enjoy a high reputation, while the guavas of Madras make an excellent preserve. Spices form another essential element in the Indian diet; turmeric and chillies are in universal use and are cultivated everywhere. Ginger, coriander aniseed, black cumin and fenugreek come next in importance. Pepper is confined mostly to the Malabar coast, and cardamoms are hardly less localized. But betel leaf, used in making the various delicacies grouped under the name pan, is grown pretty generally; it is a difficult crop to grow. The betel nut. or areca palm, is found in the deltaic districts of Bengal and the highlands of northern India. Other palms include the coconut, which flourishes on the uestern coast of south India; and the bastard date, which supplies the jaggery sugar of commerce and the intoxicating liquor known as *tari* or toddy.

Cattle.—Throughout the whole of India horned cattle are the only beasts used for plowing. The well-known humped species of cattle predominates everywhere, being divided into many varieties. The livestock estimate of 1937 returned 188,000,000 cattle in what was then British India; but, because of unfavourable conditions of climate and soil, insufficiency of grazing ground and want of selection in breeding, the general condition of the cattle was miserably poor. There are, however, some fine breeds in existence. In Mysore the *amrit* mahal, a breed said to have been introduced by Hyder Ali for military purposes, was kept up by the state. In the Madras districts of Nellore and Kurnool the indigenous breed was greatly improved, and in Madhya Pradesh there is a peculiar .breed of trotting bullocks in great demand for wheeled carriages. The large and handsome oxen of Gujarat in Bombay are excellently adapted for drawing heavy loads in a sandy soil. Cattle-breeding farms were set up by the government in different parts of the country; and invaluable work was done by the veterinary service in the discovery and use of a serum prophylactic against the devastations of rinderpest The worst cattle are to be found always in the deltaic tracts, but there their place is to a large extent taken by buffaloes. These last are more hardy than ordinary cattle; their character is maintained by crossing the cows with wild bulls. and their milk yields the best ***ghi***, or clarified butter. (See also Fauna.) The breed of horses is little better than that of the milch kine. In Bengal and in Madras it may be broadly said that horses are not bred. But horses are still required for the Indian cavalry and the police; and in order to maintain the supply a civil veterinary department was founded in 1892. Horse breeding is carried on chiefly in Uttar Pradesh, and there are a number of stallions in the various provinces. Formerly Norfolk trotters held the first place in point of number. but their place was taken by English thoroughbreds, Arabs and especially Australians. For the supply of ordnance, baggage and transport mules a large number of donkey stallions were imported by the government.

Forestry.—Up to 1850 the destruction of forests by timber cutters, by charcoal burners and above all by shifting cultivation was allowed to go on everywhere unchecked. But as the pressure of population on the soil became denser and the construction of railways increased the demand for fuel, the question of forest conservation forced itself into notice, while its importance also as affectingthe general meteorology of a country was being learned from bitter experience in Europe. In 1865 an act of the legislature was passed (no. vii of 1865).

Sound principles of forest administration after that date were gradually extended. Indiscriminate timber cutting was prohibited; the burning of the jungle by the hill tribes was confined within bounds; large areas were surveyed and demarcated; plantations were laid out; and, generally, forest conservation became a reality. In 1894 the government divided forests into four classes: (1) forests, the preservation of which was essential on climatic or physical grounds; (2) forests which supplied valuable timber for commercial purposes; (3) minor forests; and (4) pasture lands. In the first class the special purpose of the forests, such as the protection of the plains from devastation by torrents and the conservation of the rainfall for the service of the great canals, came before any smaller interests. The second class included tracts of teak, sal or deodar timber and the like, where private or village rights of user were few. In those forests, while every reasonable facility was afforded to the people concerned for the satisfaction of their needs, restrictions were imposed, and the system of shifting cultivation was permitted, under due regulation, only where forest tribes, depended on it for their sustenance. In the third class there were minor forests which produced inferior or smaller timber. These were managed mainly in the interests of the surrounding population and supplied grazing or fuel to them at moderate rates. The fourth class included pastures and grazing grounds. In these, even more than in the third class, the interests of the local community were made to stand first. The state forests, under the control of the forest department, amounted to about 89,019 sq.mi. in 1946–47, or more than 7% of the total area of the republic. In 1951 the total forest area of the republic was about 265,700 sq.mi., of which about 69% was exploitable. Pakistan's total forest area in 1953 was only 5,800,000 ac.

A large part of the reserved forests, where the control of the forest department is most complete, consists of valuable timber, in which the first place is held by teak on the southwest coast of India and inland from the Ghats as far as the middle of Madhya Pradesh. There it meets the sal, which, however, is more especially found in the sub-Himalayan tracts of Uttar Pradesh and East Bengal and Assam. In the Himalaya themselves the deodar and other conifers form the bulk of the timber while in the lower ranges, such as the Khasi hills in Assam, various pines are prominent. In the northeast of Assam the Ficus *elastica*, a species of India-rubber tree, is found. The sandalwood flourishes all along the southern portion of the Ghats, especially about Mysore and Coorg; and in the same regions, as well as in upper India, the blackwood occurs. A valuable tree. known as the *padouk*, is restricted almost entirely to the Andaman Islands. There are many other timber trees that are in general demand in different parts of India. The annual yield of timber and fuel from the Indian forests is more than 293,655,000 cu.ft. Many by-products of the forests are now being exploited on commercial lines; and the great Forest Research institute at Dehra Dun is busy on silvicultural work and wood technology.

Mineral Resources.—The chief underground wealth of India, apart from salt which will be discussed separately, is derived (in order of its value) from coal, manganese, gold, petroleum, iron, mica, copper and ileminite, the first two being by far the most important.

Coal was first mined at Raniganj in 1820. It exists in varying quantity under a very extensive area, being found almost everywhere except in Bombay and Mysore. The finest coal, however, and the largest output by far come from the seams in Chota Nagpur and the adjoining districts of West Bengal. There are also considerable mines in Madhya Pradesh and the contiguous district

of Rewah. Vindhya Pradesh, and an important field in Hyderabad. Production reached a yearly average of 20,160,000 short tons in World War I and had risen to more than 31,360,000 by 1938. The total output in 1955 mas 38,832,000 metric tons.

The oil fields of India are in Assam, and the total output in 1951 was only 260,400 tons, petroleum products being mostly imported.

Manganese ore is found in large quantities in Madhya Pradesh and Orissa, as well as in scattered parts of Madras, Bombay and elsewhere. Output rose from 504,466 tons in 191j to 1,120,000 in 1937. The export in 1951–52 was 1,143,356 metric tons of high-grade ore (30% manganese).

The mining of gold is practically confined to the Kolar gold fields in Mysore, the amounts obtained by sand washing in scattered areas elsewhere being negligible. The mines were worked under leases from the Mysore government, which secured to the state a royalty of 5% of the production. In 1956 it was decided to nationalize them.

The main iron deposits are in Bihar, Mysore and Orissa. It is the contiguity of iron ore and coal that determined the site of the great Tata works at Jamshedpur, Bihar, in the midst of what was formerly a primitive jungle. Production of iron ore increased from 448,000 tons in 1914–18 to more than 3,080,000 tons in 1937–38. In 1955, 1,920,000 metric tons of pig iron and 1,728,000 tons of crude steel were produced. A state steelworks at Bhilai, central India, was to be opened in 1959 with Soviet equipment.

The subcontinent has valuable chrome mines and is an important producer; in 1937 output was 70,405 tons, double the output of 1914–18; and in 1950 the output of chromic oxide was estimated at 16,729 tons for India and in 1953, 23,390 tons for Pakistan. Copper production in 1914–18 averaged 8,960 tons and increased to 379,680 tons by 1938; the copper refined in 1955 was about 7,400 metric tons, although the government aimed at increasing this to about 20,000 tons.

Mica has long been obtained in Bihar, chiefly in the Hazaribagh district, and there is a ruby-coloured variety which is held in great estimation; in Madras also a mica industry has grown up. Plumbago is found in Madras; corundum, in southern India.

Despite its legendary wealth, which is really due to the accumulations of ages, India cannot be said to be naturally rich in precious stones. Under the Mohammedan rule diamonds were a distinct source of state revenue, and the name of Golconda has passed into literature; but that city, once the Moslem capital of the Deccan, was the home of diamond cutters rather than the source of supply. By the 20th century the only place where the search for diamonds was pursued as a regular industry was the state of Panna in Bundelkhand. The stones are found by digging down through several strata of gravelly soil and washing the earth. In 1956 the government decided to nationalize and develop the Panna workings, as well as some of the copper industry. Pearls are found off the southern coast of Madras, on the shores of Gujarat and in the Mergui archipelago.

MANUFACTURING INDUSTRIES

Textiles. — Textiles constitute the major nonagricultural industry of the subcontinent, if we reckon by the number of persons employed. Of these textiles cotton is the most important, followed by jute and then by silk and wool. In 1947, out of about 2,235,188 workers in factories of all sorts, 995,411 were employed in textile mills and 17,481 in cotton gins and presses. In World War II Indian supplies of textiles had amounted to $360,000,000 by June 1942 and increased rapidly thereafter.

Cotton. — The first cotton mill in India was opened in 1851, and the industry received a powerful stimulus during the U.S. Civil War. The staple, however, is short; and with the cultivation of better varieties lacking, no competition was possible with cottons of the U.S. type, and trade was confined to the home and far eastern markets. Before 1914 Indian mills supplied a little less than 30% of the total Indian consumption of mill-woven cloth. From 1922 onward, in the competition between Indian and Japanese mills, it was the hand-loom weavers who suffered most. In some districts they were compelled to abandon their hereditary calling; in others, where the level of skill and enterprise was higher, they gave up cotton weaving for silk or textures with gold or silver thread interwoven. The industry as a whole showed a surprising degree of vitality; fly shuttles, which increase a weaver's output from 20% to 100%, were adopted widely, and so also were simple machines for winding and warping, owned and used co-operatively. Indeed, the growth of the industry notwithstanding the Japanese rivalry may be judged from the following figures: in 1914 it included 271 cotton mills, with 6,788,895 spindles, 104,179 looms and 260,276 workers; by 1941 there were 390 mills, 9,961,178 spindles, 198,574 looms and 459,509 workers; in the same period output of cotton yarn rose from 268,000,000 to 1,303,000,000 yd.; net imports fell from a pre-1914 average of 192,000,000 to 38,000,000 yd.; mill-made cloth increased from 1,164,000,000 to 4,269,000,000 yd., supplying 52% of India's consumption, imports falling from 3,100,000,000 to 556,000,000 yd. In 1943, 35% of India's cotton textiles production (excluding hand-loom), amounting to about 5,000,000,000 yd. yearly, was earmarked for war supply. The output of army clothing in 1943 was more than 8,000,000 garments per month. In 1955 the republic of India produced 744,800 metric tons of cotton yarn and 4,681,000,000 m. of fabrics; and Pakistan, 414,000,000 m. of fabrics.

Jute. — In the manufacture of jute the supremacy of Bengal became firmly established. Nearly two-thirds of the jute crop is ordinarily worked up in the Bengal mills; so that Bengal produces about tuice as great a bulk of jute manufactured goods (gunny bags, hessian cloth, cordings, etc.) as all the rest of the world, Sixty jute mills which existed in Bengal before 1914–18 had increased by 1938–39 to 100. Partition, however, affected the industry adversely; all the jute mills went to India whereas 70% of the jute acreage remained in Pakistan. The situation was made the more unsatisfactory by the different rates of exchange prevalent after Sept. 1949. (See PAKISTAN.) In 1952–53, 1,717,000 ac. in East Pakistan yielded 6,823,000 400-lb. bales of jute. In 1951–52 Indian mills produced 931,400 tons of jute hessian, sacking, cordage, etc.

Silk —The silk industry in India experienced many vicissitudes. Under the East India company large quantities of mulberry silk were produced chiefly in West Bengal and exported to Europe; and Malda, Murshidabad and other places in that state have long been famous for their silk manufactures. Other kinds of silk are native to certain parts of India, but the chief of the wild silks is the tussore silk, which is found in the jungles almost throughout India. Large quantities of comparatively coarse silk are made from silk so produced.

Other than Bengal, the main silk centres are in Mysore, Madras, Kashmir (all mulberry fed), Assam, Bihar and Madhya Pradesh (nonmulberry).

Wool.—The demand of the Indian population for woollen fabrics is very small in comparison with that for cotton, and although the manufacture of blankets is carried on in many parts of India, the chief part of the indigenous woollen industry was originally concerned- with shawls. Kashmir shawls were at one time famous, but the industry is practicallv extinct. The chief seat of the woollen industry is the Punjab,-where a considerable number of weavers, thrown out of work by the decline of the shawl industry, have taken to carpetmaking. The chief centre of this industry is Amritsar. The output of the woollen mills at Cawnpore and elsewhere was chiefly used for the army and the police. (ME.; X.)

Metallurgy and Heavy Industries. — Many industries beside textiles made progress between World Wars I and II, including engineering, railroad workshops, cement, hides and skins, rubber, electric insulators, paint and enamel, chemicals, etc.; and World War II led to an increased demand for India's manufactures, which were moreover stimulated by a big drop in imports as well as by the government's decision to expand armament production greatly. Production of steel was minute and of pig iron only a few thousand tons prior to 1914–18; in 1938–39, however, 1,764,560 tons of pig iron, 1,094,688 tons of steel ingots and 1,048,208 tons of finished steel were produced. In World War II, again, pig iron output increased to the point where not only was

the domestic demand fully met but there was a surplus for export to the United Nations. In May 1942 the output of finished steel was already 50% above the prewar production level. The prewar production of ordinary steel was substantially increased and the industry also began to produce a large variety of special steels for shells, armour plate, machine guns, high-explosive shells, machine tools, surgical instruments, steel mill rolls, shipbuilding, steel billets for telegraph wires, barbed wire and alloys for steel helmets, armour-piercing bullets, etc. Acid for hard steel for gun chargings, gun-carriage mountings, axles, railroad wheels, etc., was developed. India thus was able, barring certain exceptional types of steel, to meet all its own requirements. Total output of all heavy chemicals was about 78,400 tons in 1940. *(See* also *Mineral Resources,* above.)

The Chatfield Committee on Defense (see **Defense,** below), whose recommendations were published in Sept. 1939, included plans for extensive mechanization of the army and expansion of the ordnance factories. Further armament expansion followed the creation of the Eastern Supply Group council. For the first two and one-half years of World War II, India was responsible for supplying nearly all the war materials for the middle east. By July 1943 Indian industry (excluding government-owned factories) had executed war orders to the value of $1,917,000,000. Output rose steadily year by year and was many times any comparable figure of World War I, while an enormously larger range of products was involved. amounting to nearly 20,000 different articles. India supplied 80,000 medical instruments of indigenous production to the U.S.S R. in 1943.

The output of India's ordnance factories was in 1943 many times the prewar quantity. The production of rifles had increased 6 times, of machine guns 8 times, of bayonets 10 times, of small arms ammunition 4 times, of gun ammunition 24 times and of guns and carriages 9 times. The manufacture of armoured fighting vehicles in India progressed steadily after the Indian steel industry succeeded in producing an armoured plate of the required specification at an early stage of the war. In 1941 an aircraft factory in India turned out the first indigenously assembled aeroplane and thus marked the beginnings of an aircraft industry in India; the factory was primarily engaged in the servicing and repair of aircraft.

Before World War II there was no shipbuilding in India; thereafter Indian shipbuilding yards began working to capacity on the construction of ships for antisubmarine and general patrol duties, minesweepers, motor launches and other craft. The number of vessels launched in Indian shipyards during 1942 was two and one-half times the combined total of 1940 and 1941. More than 4,000 seagoing vessels of all types were repaired in Indian shipyards during the first two and one-half years of the war. In the 1950s small-scale shipbuilding was being developed at Karachi, Pakistan, with German aid, while a French firm was helping to develop existing shipbuilding facilities at Visakhapatnam, India.

Pottery and Hardware.— Pottery is made in almost every village, from the small vessels required in cooking to the large jars used for storing grain and occasionally as floats to ferry persons across a swollen stream. Sind, West Pakistan, has pottery of two kinds: encaustic tiles and vessels for domestic use. In both cases the colours are the same—turquoise blue, copper green, dark purple or golden brown, under an exquisitely transparent glaze. The tiles. which are evidently of the same origin as those of Persia and Turkey, are chiefly to be found in the ruined mosques and tombs of the old Moslem dynasties. Artistic pottery is made at Hyderabad. Karachi, Tatta and Hala and also at Multan and Lahore in the Punjab. The Madura pottery deserves mention from the elegance of its form and the richness of its colour. Uttar Pradesh has, among other specialties, an elegant black ware worked with designs in white metal.

The village brazier, like the village smith, manufactures the necessary vessels for domestic use. Chief among these vessels is the *lota,* or globular bowl, universally used in ceremonial ablutions. Benares enjoys the first reputation for work in brass and copper. In the south, Madura and Tanjore have a similar frame, and in the west, Ahmedabad, Poona and Nasik. Silver is sometimes mixed with the brass, and in rarer cases gold. The brass or rather bell-metal ware of Murshibad, known as khagrai, has more than a local reputation because of the large admixture of silver.

Miscellaneous Industries.— Other industries of the subcontinent naturally include rice mills, timber mills, leatherworks (India produced more than 4,000,000 pairs of army boots a year in World War 11), oil mills, iron and brass foundries, tile factories, printing presses, lac factories, silk mills and paper mills. There is a large trade in wood carving, the material being generally Indian ebony in northern India, sandalwood in southern India.

TRADE

Local Trade.— Local trade is conducted either at the permanent bazaars of great towns, at weekly markets held in certain villages, at annual gatherings primarily held for religious purposes or by means of travelling brokers and agents. The cultivator, who is the chief producer and the chief customer, knows little of the great towns and expects the dealer to come to his door. Each village has at least one resident trader, who usually combines in his own person the functions of moneylender, grain dealer and cloth seller. The moneylender deals chiefly in grain and in specie. In those districts where the staples of export are largely grown, the cultivators commonly sell their crops to travelling brokers, who resell to larger dealers, and so on until the commodities reach the hands of the agents of the great shipping houses. The wholesale trade thus rests ultimately with a comparatively small number of persons, who have agencies, or rather corresponding firms, at the great central marts.

Buying and selling in their aspects most characteristic of India are to be seen at the fairs which are held periodically in most districts. Crowds of petty traders attend, bringing all those miscellaneous articles that can be packed into a pedlar's wallet; and the neighbouring villagers look forward to the occasion to satisfy alike their curiosity and their needs.

Foreign Trade.— The trade of India with foreign countries is ordinarily conducted partly by sea and partly across the land frontiers; but the frontier trade, though capable of much extension, is only a small fraction of the whole. The sea-borne trade is carried on chiefly through the great ports. Calcutta serves the fertile valley of the Ganges and Brahmaputra; Bombay serves the cotton trade of western India; Madras with its artificial harbour serves southern India. Pakistan is less well served—by the major port of Karachi in the west, by Chittagong (before partition a small river port) and by the new Chalna-Mangla-Khulna anchorage scheme in the east. The land trade is carried on with Iran, Afghanistan, Nepal, Tibet and western China.

Between 1913 and 1939 there were significant changes in the trend of the overseas trade. There was a reduction in the volume of imports, most marked in cotton goods and other textiles; but from this decline, in spite of protective duties, iron and steel were exempt, the increase in Indian production being no greater than the increase in Indian demand; and there was a very great increase in the imports of machinery and millwork. Other imports which were greatly increased were mineral oil and motorcars. The volume of exports was at as high a level as before World War I; but the character was considerably altered. Less grain was being exported and more tea; much less raw jute and a great deal more manufactured; the export of raw cotton increased, and so did that of cloth, particularly coloured piece goods, but the export of yarn greatly declined.

India, in fact, became much more self-sufficing with regard to manufactures and less disposed to export food and raw materials except where, as in the case of cotton, high prices and increased production made export especially profitable. The causes of this change were partly to be found in higher freights and higher import duties; partly also in the changed condition of world trade as a whole, regarded as an interchange of manufactures for foodstuffs and raw materials, in consequence of which the Indian peasantry received only a small increase in price for most of what they sold but had to pay a great deal more for what they bought. But it was also partly because of Indian progress in manufacturing equipment and industrial organization.

Tariffs and Protection. — From 1894 there was a general standard customs duty of 5% ad valorem, with certain exemptions and certain exceptions; it was levied entirely for revenue purposes. Cotton goods were taxed at 3.5%, whether imported or uoven in Indian mills. During World War I financial exigencies drove up the standard rate to 7.5%; and in the postwar slump it rose further to 11%, with 20% on certain luxury articles. Then came the constitution of 1919, with its pronouncement in favour of allowing India to choose its own fiscal policy. It was speedily followed by the appointment in 1921 of the Indian Fiscal commission, which reported for "rapid industrialization by means of discriminating protection." Coinciding as this did with a prominent tenet in the nationalist creed, the recommendation was quickly put into practice, and an Indian tariff board was appointed in 1923 to deal with applications for protection. The first and most important of these was from the steel industry; and in the event the Tata enterprise was protected by a heavy tariff supplemented for several years by subsidies. The tariff schedule became a complicated document, divided into nonprotective duties and other duties ranging from 2½% to 30% ad valorem. The distinction was subtle, seeing that some of the "nonprotective" duties were as high as 25% (rough sugar) and 75% (cigars). The board decided against a general protective duty on coal. Besides the import duties, there were some low export dues on jute, hides and rice. The objectionable excise formerly levied on cotton goods manufactured in the country was removed in 1925, and the 11% duty on imported cloth became undisguisedly protective (see further under Finance, below, section Revenue).

In 1921 British exporters, who had formerly supplied the bulk of India's manufactured goods, were the chief sufferers since India's industries were built up behind tariff walls. For example, the Indian import of Lancashire cotton goods had averaged 2,j50,-000,000 yd. per annum before 1914, but by 1939 it had dropped to 205,000,000 yd., or less than one-twelfth of the total of a quarter of a century earlier. Other British exports to India declined similarly. Behind the tariff wall India built up a great steel industry; and the Tata steelworks (an Indian enterprise) became the largest single unit manufacturing steel in the British Commonwealth. The net effect was to reduce India's imports of British goods in quantity from 63% of its total imports in 1914 to 30% in 1938 and in value from an average of Rs. 915,801,000 ($274,740,300) in the years 1909–14 to Rs. 519,575,128 ($155,-872.538) in 1939. In 1938–39 Britain took 34% of all India's exports, to the value of Rs. 555,113,000, or $166,533,900. Britain, therefore, was buying more goods from India than it was selling to India. India had obtained economic independence as far as trade was concerned. In 1950 a new fiscal commission recommended important extensions of the policy of protection. A permanent statutory commission was appointed to replace the tariff board after Nov. 4, 1951. The Pakistan Tariff commission was set up in 1950. (X.)

GOVERNMENT AND ADMINISTRATION

The Union of India which came into being on Aug. 15, 1947, by partition of the former Indian empire, had in 1951 a total area of 1,176,864 sq.mi. and a population of 356,879,394. To begin with, the union operated under an adaptation of the Government of India act, 1935, pending the adoption of a new constitution which was then in process of drafting. This constitution was completed and approved by the Indian parliament on Nov. 26, 1949. Under it on Jan. 26, 1950, the Union of India became an Indian sovereign republic; but by an affirmation at the commonwealth ministers' conference in London in April 1949, India continued its "full membership of the Commonwealth of Nations and her acceptance of the King as the symbol of the free association of its independent member nations and as such the head of the Commonwealth." The last governor-general of India, before administering the oath of office to the new president, read a proclamation announcing that "India. that is Bharat, shall be a Union of States, comprising within the Union the territories which were hitherto the Governors' Provinces, the Indian States and the Chief Commissioners' Provinces." In the period following the transfer of power an extensive process of integration of the numerous Indian states, which represented about 45% of the area of undivided India and varied in siee from small landholdings to large countries, had either merged these states in the former governors' provinces or had formed them in groups of states, a few of the larger ones retaining their individual entity. The composition of the union of states (as the total was called) was as follows:

Part A: Assam, Bihar, Bombay, Madhya Pradesh (formerly Central Provinces), Madras, Orissa, East Punjab, Uttar Pradesh (formerly United Provinces), West Bengal.

Part B: Hyderabad. Madhya Bharat (west part of former Central India), Mysore, Patiala and East Punjab States union, Rajasthan, Saurashtra, Travancore, Cochin (Jammu and Kashmir under reference to the United Nations in dispute with Pakistan).

Part C: Ajmer, Bhopal, Bilaspur. Coorg, Delhi, Himachal Pradesh, Kutch, Tripura, Vindhya Pradesh (east part of former Central India).

Part A comprised the former British governors' provinces; Part B, Indian states and groupings of Indian states; and Part C, areas known as chief commissioners' provinces under the central government. In addition, the territories of the Andaman and Nicobar Islands also came under the central government's control.

In 1956 the government accepted the report of a commission which recommended the complete redrafting of the boundaries of states (with the abolition of some and the inauguration of others) on a basis of language, ethnic affinity and administrative convenience. The report was culminated in the States Reorganisation act, no. 37, which came into force on Nov. 1, 1956.

Constitution. — The constitution was passed by the constituent assembly on Nov. 26, 1949. It had been drafted by a committee presided over by B. R. Ambedkar, law member of the government of India and formerly leader of the "scheduled castes" ("untouchables"). Presiding over the assembly was Rajendra Prasad, destined to become the first president of the republic under the constitution. Based largely on the Government of India act, 1935, and on the constitutions of Great Britain and the United States of America, it contained 395 articles — an addition of 80 articles made by the assembly to Ambedkar's draft as first presented on Feb. 21, 1948. It provided for the setting up of parliament, the creation of an independent judiciary with wide powers and the guarantee of fundamental rights. The preamble says: "We, the people of India, having solemnly resolved to constitute India into a Sovereign Democratic Republic and to secure to all its citizens: justice, social? economic and political; liberty of thought, expression, belief, faith and worship; equality of status and opportunity; and to promote among them all fraternity assuring the dignity of the individual and the unity of the nation; in our constituent assembly this 26th November, 1949, do hereby adopt, enact, and give to ourselves this constitution."

The executive head of the republic is a president. elected by an electoral college of members of the Indian parliament and state legislative assemblies. His term of office is five years, but he is eligible for re-election. He must be a citizen of India, more than 35 years of age and qualified for election to the house of the people (the lower house of the bicameral central legislature). There is a vice-president, who is elected by both houses of parliament and who, in addition to being a citizen of India and more than 35 years of age, must be qualified for election to the council of states (upper house), of which he is ex officio chairman. The president acts on the advice of his council of ministers, over which the prime minister presides. The council is responsible to the house of the people. Ministers, following the practice of the former central legislature, can speak in either of the two houses but can vote only in the one of which they are members. The council of states (upper house) has not more than 250 members, a third of whom retire every two years, the election being by the states legislatures. The house of the people has not more than 500 members elected directly by the people on adult franchise at the rate of 1 representative to every 500,000 people. The duration of the life of the house of the people is five years. From it alone can money bills emanate. The official and national language is Hindi in the Devanagari script, though English was to be used for official purposes for 15 years after the inauguration of the constitution. "Untouchability" was abolished, and its practice in any form forbidden by law.

The constitution reversed the trends, shown in the later stages of British rule, to give the provinces greater powers at the expense

of the centre, with consequent difficulties in the way of co-ordinating effort on important financial and economic issues. The constitution therefore gave the central government definite powers to obviate that dapger. It also contains powers for the president to take over the administration of any state where an emergency exists. The republic is a federation of 26 units deriving their power from the centre. In fulfilment of the resolve to secure fundamental rights the constitution declared that the state shall not deny to any person equality before the law or the equal protection of laws within the territory of India; nor shall it discriminate on grounds of religion, race, caste, sex or place of birth. Equality of opportunity for all citizens in matters relating to employment under the state was prescribed. All titles were abolished, and no citizen of India henceforth could accept any title from any foreign state. Citizens of India all acquired the right to freedom of speech, of assembly, of association, of movement and of residence, to acquisition of property and to the practice of professions or trade. Traffic in human beings and forced labour was prohibited. Freedom of religion was assured.

The classification of the states has already been noted. The relations between the centre and the states in respect of legislation were determined by article 246; this gave parliament exclusive powers to make laws in respect of matters set out in what is called the Union list and also with respect to matters in the Concurrent list, which contains subjects with which both the centre and the states are competent to deal. The State list contains matters on which the legislatures of states of the Part A or Part B category have exclusive power to make laws.

The principle of universal suffrage was tempered by the reservation of seats in the lower houses of the union and states for scheduled castes and tribes; and authority given to the president to nominate not more than two Anglo-Indians to the lower house of the union if he is of opinion that their community is not adequately represented there. These special provisions were given a time limit of ten years. Governors are nominated by the president as constitutional heads of their states, advised by cabinets of ministers headed by a chief minister and responsible to the state legislatures. The governors' term, as before, is for five years.

The unicameral system of legislature was made applicable to all states except a few large ones, but even there the lower house has power to abolish the upper house by a resolution passed by a two-thirds majority. The lower house in the state legislatures is known as the legislative assembly and is to function for five years unless dissolved earlier. Representation in the lower house is on the basis of 1 member for every 75,000 of the population of the state, elected on adult suffrage. The total strength of a legislative assembly is to be not more than 500 nor less than 60. Each of the states has a high court, the appellate jurisdiction of which applies to all ordinary cases up to a certain limit.

Secession from the union is not permitted under the constitution. Single citizenship for the whole of India was prescribed, and there is no dual citizenship. Other principles recognized by the constitution are the abolition of landlordism (*zamindari*), the prevention of cow slaughter, the introduction of prohibition and the right of every citizen to admission to any educational institution maintained by the state or receiving state aid, whatever his religion, race, caste or language. Trade, commerce and intercourse throughout the union are free; but parliament has the right to impose such restrictions as may be rkquired in the public interest, and states may also impose on goods imported from other states any tax to which similar goods manufactured or produced in that state are subject. Restrictions were imposed on the powers of states to levy sales tax and purchase tax. For five years from the commencement of the constitution parliament was given power to make laws in regard to the following as if they were in the Concurrent list: (1) trade and commerce within a state; (2) production, supply and distribution of cotton and woollen textiles. raw cotton and cottonseed; **(3)** paper; (4) foodstuffs; (5) coal; (6) iron and steel; (7) mica.

For the constitutional development of India under British rule see History, above. (See also PAKISTAN.) Within the separate states the administrative unit is the district. Under British rule three or more districts (except in Madras) were formed into divisions, over each of which was set a commissioner. This grade was abolished in some states after the transfer of power. The districts were partitioned out into lesser tracts, which are strictly units of administration, though subordinate ones. Generally the subdivision,—called variously tehsil (tahsil), taluka (taluk) or peta in different states—became the ultimate unit, with none below. The thana, or police division, continued to exist, mainly for police purposes. The old pargana, or fiscal division, had now only historic interest; the 24 parganas, a district of West Bengal and the Santal Parganas in Bihar were reminders of it. The village remained as the agricultural unit and preserved its independence for revenue purposes in most areas.

The Indian States.—The relations subsisting between the Indian states and the British government were the outcome of an evolutionary process. The mutiny, the passing of the East India company and the grant of sanads of adoption to the rulers in 1862 obliterated the peril of annexation, breached the barriers of isolation and inaugurated for the states a new era of union under the crown. Queen Victoria's proclamation of 1858 announced to the "Native Princes of India" that all treaties and engagements made with them would be scrupulously observed and that their rights, dignity and honour would be respected.

Under British rule there were nearly 600 states, covering more than one-third of the whole territory of the Indian empire and one-quarter of the population. Their rulers had what were called treaty relations with the British crown as the paramount power. Under the Government of India act of 1935 it was proposed to create a federation of India under a government responsible to a federal legislature composed of representatives of the states and of British India; but this had not been achieved before the outbreak of World War II. In the period immediately preceding the final phases of the transfer of pomer in 1947, the uncertainty regarding the position of the states inspired an attempt to set up an extraconstitutional organ in the form of a chamber of princes (narendra mandal). When at length the transfer of power was effected in Aug. 1947, paramountcy was returned to the Indian states; but it was plainly intended that they should accede to one or the other of the two new governments, accession being mainly determined by the geographical situation of the states. This was a comparatively simple matter in regard to Pakistan, to which states such as Kalat, Dir, Chitral, Swat and Bahawalpur, by reason of their proximity, naturally acceded.

There remained in suspense for a short time the small state of Junagadh (*q.v.*); surrounded by Hindu states in Kathiawar but ruled by a Moslem, who eventually Ieft the state, it came under the government of India and was merged in Saurashtra. Then, too, Hyderabad (*q.v.*), with a predominantly Hindu population and ruled by a Moslem who was the premier Indian prince, showed hesitation regarding its destiny; negotiations for accession to India proved abortive for some time until Indian troops took what was described as police action and the nizam came to an agreement for accession to India.

Kashmir, where the predominantly Moslem population of about 4,000,000 was under the rule of a Dogra (Hindu) prince, also hesitated, but when Moslem tribesmen from over the frontier invaded Kashmir, the ruler applied for accession to India and abdication, which was accepted by the then governor-general on the understanding that the destiny of Kashmir would eventually be settled by the will of the people. From this a grave dispute arose, which was referred to the United Nations by India. Hostilities broke out between India and Pakistan until a cease-fire was arranged on Jan. 1, 1949, and a commission of the United Nations was appointed to investigate. Later Sir Owen Dixon, a judge of the Australian court, was appointed representative of the United Nations to propose a solution. After lengthy conversations with the prime ministers of India and Pakistan Sir Owen had to report failure, and the dispute persisted, despite all efforts, into the late 1950s.

Meanwhile, the government of India, recognizing the need for absorbing many of the petty states into the adjacent provinces and for grouping others so as to provide a sounder financial ad-

ministration, took steps along the lines that had been tentatively contemplated by the British. By dint of considerable forcefulness and expedition this merging of the states was accomplished, with a few states left for a further process of tidying up.

Under British rule the Indian princes were left in almost complete charge of their states, in fulfilment of the proclamation of Queen Victoria of 1858. Interference occurred only where gross misgovernment appeared, and this power of interference was exercised with considerable reluctance. By the new integration the princes were relieved of responsibility not only for defense and foreign affairs (as under the British regime) but also for the day-to-day administration of their states; forms of responsible government were introduced. and the senior ruler in each group, where grouping was concerned, became the equivalent to the governor of that group under the title of *rajpramukh* (*q.v.*).

Moreover. the new Indian government carried out a reform, which the British government had consistently favoured, by fixing a civil list for the former rulers of the states, whether they continued as *rajpramukhs* or became merely hereditary noblemen.

Where mergers occurred, the state territory in effect became part of the normal administrative demarcation of the province (now known as state) concerned. The rulers retained their hereditary rights of succession and the titles to which they were accustomed.

The underlying intention of this integration was to establish in the states democratic systems of government, toward which British influence through the various political officers attached to the states had been gently pressing. This creation of ministries and legislatures was not immediate. Interim ministries were set up to conduct the administration of unions of states; and in three unions (namely, Saurashtra, Travancore-Cochin and hladhya Bharat) legislatures were actually functioning very soon and their ministries made responsible to the legislatures. Representative governments were established in Mysore, in Hyderabad and, subject to the outcome of the dispute already mentioned. in Jammu and Kashmir. Certain areas. being centrally administered and coming under Part C, had advisory councils with a majority of elected representatives to assist the chief commissioners representing the central government. Two of the first of the new unions to have this form of constitution were Himachal Pradesh and Cutch. By the mid-1950s the government of all states, whether Part **A,** B or C, was more or less uniform, and the idea that those under part B were unions of princely states had become largely superseded.

In the merger of the former Indian states with provinces (now known as states) transfer of power to the people was automatic in that the merged states became part of the administrative units governed by the provinces or the centre as the case might be.

Judicial Service.—On the transfer of power the federal court (established in Oct. 1937) became the supreme court. Appeals to the judicial committee of the privy council in London ceased in respect of civil matters in Feb. 1948 and altogether in Oct. 1949. Article 124 of the constitution provided for a supreme court consisting of a chief justice and not more than seven other judges all appointed by the president and sitting in Delhi. Each state has a high court, the judges of which are also appointed by the president (article 214). Below these courts come district and sessions judges who perform the ordinary judicial work of the country, civil and criminal. Their jurisdictions coincide for the most part with the magisterial and fiscal boundaries. Except in Madras, however, where districts are large, a single civil and sessions judge sometimes exercises jurisdiction over more than one district. In some states, judicial and executive functions mere still to a certain extent combined in the same hands but the constitution prescribed the separation of the "judiciary from the executive in the public services of the state." (E. HD.)

The Police.—The police system was established by an act of 1561. It provides a regular force in each district, under a superintendent subordinate for general purposes to the district magistrate. The unit of work is the thana, or police station: some thanas have jurisdictions as big as some English counties and staffs of not more than 12 men. Control of the police rests in the government of each state. The central government has a central bureau of intelligence and investigation.

The regular force depends necessarily on the village watchmen, overworked and underpaid Dogberries, for information and help in their investigations; and they suffer from the steady failure of the general public to give them adequate support in the discharge of their duties. The old canker of corruption and abuse of power among the rank and file of the force mas greatly reduced and the morale of the force vastly improved. The force well stood the strain of the loss of British officers on the transfer of power.

The average population of jails in British India in 1938 was a little more than 122,000, a figure uhich, in its relation to the total population, is striking testimony to the general law-abiding disposition of the Indian people. Discipline was well maintained, though separate confinement had been abolished; and various industries especially carpet weaving, were profitably pursued.

A committee of inquiry laid stress on the reformative side of the prison system; and considerable progress was made by use of the Borstal system and similar treatment. It used to be the rule to transport to the Andamans convicts with more than six years to serve.

FINANCE

Currency and Exchange.—The foundation of the currency system is the rupee (16 annas or 192 pies), a coin weighing 180 gr. and containing 165 gr. of pure silver. The subsidiary coinage comprises pieces of silver. nickel and bronze; all being legal tender up to one rupee only, except the eight-anna piece, which, like the rupee itself, is legal tender without limit. Beside these is a paper currency, at first of slow and lingering growth, in the form of government currency notes; the favourite notes are for Rs. 1, 5, 10 and 100, but there are also others for Rs. 2.5, 20, 50, 500, 1,000 and 10,000. The note circulation as a whole is backed as to more than one-half by a reserve of gold and silver and as to the balance by government securities, with a margin for seasonal expansion based on trade bills up to a strictly defined amount.

The exchange value of the rupee (*q.v.*) follows the ordinary economic law and depends on India's trade balance with the outer world. The operation of this law, however, assumes a fairly constant adjustment of the volumes of currency to the requirement of trade. If there were no restriction on the output of rupees, the gold value of the coin would tend to fluctuate with the gold value of silver. Up to 1873, although the Indian mints were open, the rupee continued steady at an exchange value of two shillings; then the price of silver began to tumble until the rupee dropped almost to one shilling, and in 189.3 it was decided to close the mint to free coinage and establish a "managed" currency, with the rupee as a token coin.

By the start of World War I the rupee had been given by law a parity of 16*d*., and the government bought silver and coined rupees to meet the requirements of the country. So long as silver was under 43*d*. an ounce there was a profit on the operation, which was placed to the gold standard reserve. Against this reserve the government of India could sell sterling drafts (technically known as "reserve councils"), if the exchange value of the rupee threatened to fall. On the other hand, if it were rising, the secretary of state could increase his normal sales of rupee drafts on India (technically known as "councils"). Should this fail to check the rising exchange, it was generally possible to count on a free importation of private gold which would either pass into circulation or be presented to the government for the purchase of rupees. In 1914 the gold standard reserve stood at £26,000,000, the paper currency reserve had £24,000,000 in gold or gold securities and the note circulation had risen to Rs. 66 crores (£44,000,000). With the war, however, the government had therefore to disburse a rupee currency in very large amounts and was compelled to increase the note issue without a corresponding increase of rupees held against the notes. The notes were convertible and their encashment drained away the reserve stock of rupees. The time drew near when either inconvertibility must be declared or silver obtained in large quantities for coinage.

The political effects of inconvertibility were regarded with

grave anxiety; but in 1918 the U.S. came to India's aid, by passing the Pittman act and selling 200,000,000 oz of its silver dollar reserve to the government of India. From July 1918 onward US. silver was coined into rupees and by Dec. 1918 the convertibility of the note issue was secured. Within a few months the output of the mints was represented by the enormous quantity of 1,390,000 000 new rupees (£93,000,000) as currency.

Throughout this struggle another anxiety grew apace. in the risk of being unable to maintain the rupee as a token coin at its statutory parity with sterling. Sterling was depreciating and silver was rapidly appreciating. As the conversion of the rupee into bullion became profitable when silver touched 43d., the rapid rise beyond that figure led to a wholesale melting down of rupees for clandestine export; and the government was forced to protect itself by hurriedly pushing up the parity of the rupee until it stood at as. 4d. in Dec. 1919, while for a short time private remittances brought more than as. 10d.

In 1920 a committee of currency and banking experts in London recommended that the rupee should be correlated to gold and not to sterling and that it should be given a new statutory ratio equivalent to one-tenth of the gold contained in a sovereign. Accordingly. in Sept. 1920 the Indian Coinage act established the new ratio. But there was now a rush of remittances to England, and the former surplus of exports gave place during the second half of 1920 to a large adverse trade balance. which had to be liquidated by bills on London. Exchange persistently dropped from 2s. 6d. the rupee to below 1s. 4d. in the early part of 1921. and the price of silver receded to 32d. the ounce. At last. on the report of a royal commission in 1926, a gold bullion standard was established, under which the rupee was fixed by law at the equivalent of 1s. 6d. gold, its fluctuations being confined between the upper and lower gold points corresponding to that ratio. The maintenance of this ratio was. the commission advised. to be the duty of a reserve bank, obliged to buy and sell gold without limit at rates fixed to accord nith the gold parity of the rupee. The sovereign and half-sovereign were to be no longer legal tender; and thus the old attempts to introduce a gold circulation were finally condemned. Action on those recommendations was taken by the government of India as far as lay in its power. but it had to abandon the scheme of creating a new reserve bank. Meanwhile, the improvement in general economic conditions strengthened the new legal value of the rupee. In 1925–26 the daily telegraphic transfer rates betneen Calcutta and London averaged 1s. 6.08d.; and in 1926–27 the average was 1s. 5.902d.

The efforts made to preserve the convertibility of the currency notes were rewarded by a rapid expansion of their popularity. The circulation (Rs. 66 crores[1]) of March 1914 had trebled by Aug. 1926, when it touched Rs. 200 crores, notwithstanding the practical disappearance of the Rs. 2.5 and the Rs. 200 notes. In 1920 the whole system was improved by the Paper Currency Amendment act, which allowed an unlimited note issue provided a metallic basis of 50% was observed, required the gold backing to be held in India and introduced the principle of a certain definite expansion of the note issue during the busy season against trade bills of a durance not exceeding 90 days. Before the note circulation became firmly established. several attempts were made to lighten the task of supplying India with silver currency by the employment of gold. Among them was the opening of a branch of the British mint at Bombay, intended to coin sovereigns and Rs. 1j gold pieces, which, however disappeared immediately into the hoards of the people. Nearly 3,500,000 gold coins were minted at Bombay in 1918–19, and work was then abandoned.

The close of World War I was marked by a great outburst of speculation. The aggregate authorized capital of new joint-stock companies floated in the year 1919–20 alone was Rs. 281 crores, uhereas the paid-up capital of all registered companies in existence in 1914 was only Rs. 75 crores. Subsequent liquidations were heavy. The most important of the new projects which failed to realize expectations was the Tata Industrial bank, founded to finance new industries on much the same lines as those followed by the "D banks."

[1] One crore = 100 lakhs; 1 lakh = 100,000 rupees, written Rs. 1,00,000.

Exchange subsequently remained stable at the 1s. 6d. rate. The world depression in 1930 created difficulties for the government of India. but these ended nhen Britain left the gold standard in Sept. 1931 and the rupee was linked to sterling. India then benefited by the sale of large quantities of hoarded gold. A steadily favourable balance of trade maintained the rupee's value. In 1935 the Reserve Bank of India (see below) superseded the government's currency department by means of its issue department; and the combined assets of the gold standard reserve and of the currency department mere transferred to it. On the outbreak of World War II in Sept. 1939, restrictions on exchange operations were inaugurated. The rupee continued to maintain its strength nith ease during the conflict and without control would certainly have risen in value in terms of foreign currencies. It was revalued in Sept. 1949 to keep step nith the devaluation of the pound sterling, to which it therefore remained in the same relation as before; viz., 1s. 6d. As Pakistan did not follow suit (until 1955) the exchange with its rupee became 2s. 2d.

International Balances. — India's public debt at the time of World War II consisted of (1) loans raised in India; i.e., rupee loans; and (2) loans raised on the London market; i e sterling loans. On March 31. 1939, the end of the last prewar fiscal year, the sterling debt was £348 700,000, or $1,394 800,000 (conversion being at the rate of $4 to £1 and 30 cents to R. 1). The interest rate on the various sterling loans varied from 5% to 2.5%, and the total interest paid on the sterling debt in the fiscal year 1938–39 was £12,468,000, or $49 872 900. Later virtually the whole of the sterling debt was repatriated by the cancellation of sterling loans and their replacement by rupee loans. So rapid was repatriation that by Jan. 21, 1943, the sterling debt had been reduced to £12,250,000, or $49,000,000. In Sept. 1943 the sterling debt. therefore, was slightly less than the amount of interest paid on the sterling debt in 1938–39. Sterling balances continued to accumulate in the Reserve Bank of India through Britain's heavy purchases of war supplies.

India's sterling debt was mostly incurred for the creation of such enterprises as the government-owned railways (42,000 mi.) and the irrigation schemes that had added 55,076,625 ac to the fertile land of British India by 1944. Revenue from these sources so exceeded the interest payable on the debts as to cover more than the annual charge for India's total debt; that is to say, India acquired by these loans permanent assets yielding a return relieving the taxpayer of interest on debt Industrial and commercial enterprises passed steadily from British to Indian hands

A severe strain was imposed on India's economy by World War II and subsequently by partition. The financial arrangements under the Chatfield scheme were revised under the pressure of war conditions. For the period between April 1, 1940, and March 31, 1946. India bore a total of £13,097,000,000, while the British government bore £13,018,000,000 in respect of India's defense. In addition to expenditure on services and stores of a purely military nature. ministries in Great Britain made purchases of raw materials and food from India on their own account. The effect of this expenditure nas to increase the flow of exports from India with no corresponding flow of imports, thus contributing further to the sterling balances which India held jointly with Pakistan at the time of the transfer of power in 1947. In the course of the next few years these sterling balances were reduced by releases to India and Pakistan so that. according to the Bulletin of the Reserve Bank of India for Aug. 1949 they amounted to £596,333,000. Since under the Reserve Bank of India act not less than approximately £313,000,000 had to be held in sterling securities in support of the note issue. the real figure of the sterling balances by 1949 was about £283,000,000.

The size of foreign investment in India in relation to total investment is large according to the census conducted by the Reserve Bank of India in 1950. The market value of long-term private and foreign investment was £389 000,000, British investment being valued at £282,000 000 and U.S. investment at £22,000,000. The chief element in this foreign investment is "direct investment," in which control of operation is associated with ownership of capital. Its amount is estimated to be £323,000,000.

The government exercises power of control over the admission of new foreign enterprises for the purpose of preventing overinvestment in crowded sectors of the economy. The control of capital issues applies only to joint-stock companies with a capital of £37,500. The manufacture of munitions is reserved to the government. Enterprises of national importance, such as civil aviation and shipping, are open to participation by private enterprise with the government in semipublic corporations. The full current earnings of all foreign enterprises can be freely admitted abroad under existing regulations. (See also Trade, above).

Banking. — The considerable development of banking business which occurred in the years between World Wars I and II started with the formation in 1921 of the Imperial Bank of India by the amalgamation of the three presidency banks of Bengal. Bombay and Madras. But in 1934 the legislative assembly passed the Reserve Bank of India act. and on April 1, 1935. the Reserve bank came into existence. This took over the nork of the currency department of the government (see above) and also the clearing-house functions of the Imperial bank. It had a share capital of Rs. j crores fully paid up and a reserve fund of Rs. 5 crores provided by the government by means of government rupee securities. The scheduled (memberj banks were required to deposit percentages of their liabilities with it. The Reserve bank's first major test was successfully passed when it sanctioned special credits to southern Indian banks on the failure of an important local one in 1938. The Imperial bank could act as the Reserve bank's agent in all places where it had branches in 1934 so long as there were no Reserve bank branches.

Another type of business is done by the exchange banks, which finance practically ail India's export trade and had before 1939 begun increasingly to finance internal trade also. Their total deposits rose from Rs. 1,050 lakhs in 1900 to Rs. 17,900 lakhs in 1945.

The Reserve Bank of India was nationalized on Jan. 1, 1949. The shares of the Reserve bank were transferred to the central government, compensation being paid to persons registered as shareholders immediately before Jan. 1, 1949.

The Banking Companies act. 1949, consolidated and amended the law relating to banking companies. It regulates all banking companies and covers all states of India. to the extent to which the dominion legislature has power to legislate for states in respect of banking. It provides for the licences to banks to be issued by the Reserve bank: lays down the minimum requirements relating to the paid-up capital and reserves of a bank incorporated in India; scheduled banks continued to be required to keep minimum reserves with the Reserve bank arid to submit weekly returns under the Reserve Bank of India act, 1934; and interlocking directorates and the employment of managing agents are prohibited among banking companies.

The total of balance kept by the scheduled banks with the Reserve bank in Nov. 1949 was Rs. 8.063 lakhs.

Planning. — The republican government of India in 1950 drew up a plan for economic development covering a period of six years at a total cost of Rs. 322 crores, of which Rs. 184 crores was earmarked for most urgent projects. The plan included three important multipurpose projects on which work was already in progress for the advancement of agriculture. The Damodar valley project (Rs. 50 crores), the Hirakud dam (Rs. 30 crures) and the Bhakra Nangal project (Rs. 76 crores). The Damodar scheme in Bihar was desiened to harness the Damodar river to provide irrigation, power channels and navigation and to open up to full development the richest mineral base in India. The Hirakud dam was to control the floods of the Mahanadi valley in the south and supply irrigation for the crops and power for cottage industries In the north Bhakra (East Punjab) dams were erected across the river Sutlej and provided power for the cities of the north of India. including Ken Delhi.

Under these three projects 6,000,000 ac. of new land were to be brought under irrigation by 1956–57 and electricity-generating capacity increased by 708,000 kw The government's plan dealt also with the extension of cultivation on reclaimed land the use of fertilizers and improvement of railway communications The plan was directed at the centre by a planning commission which advised the central government. financial control being exercised by the ministry of finance and for some important schemes by the economic committee of the cabinet. Parliamentary control was exercised by the standing finance committee, nhose approval was necessary for all schemes involving nonrecurring expenditure of more than Rs. 5 lakhs, or recurring expenditure of more than Rs. 1 lakh.

The execution of the plan was expected to make possible net private investment to the order of Rs. 160 crores. a figure which it was hoped to increase to Rs. 260 crores at the end of the six years. Government investment in India was estimated to be Rs. 307 crores. and private investment 160 Rs. crores in 1951–52. The revenues of the central and state governments were estimated tor the six years from 1951 to 1957 at an annual average of £128,000,000 pr a total of £772,000,000. A further five-year plan, to begin in 1957, nas laid before parliament in May 1956. It gave priority to increased production of steel, heavy chemicals. machinery and heavy engineering products.

Revenue. — In India powers of taxation are possessed by three authorities: (1) the government of India; (2) state governments; and (3) corporations or municipal boards.

The government of India taxes income and takes excise duties on the production and manufacture of certain articles (*e.g.*, kerosene, matches, motor spirit, silver, steel ingots, sugar. tobacco, tires. vegetable products, cloth, coffee and tea) and customs duties on imports generally and on particular articles of export. State governments levy taxes on the sale of goods, the sale of motor spirit and the consumption of electricity. Municipalities levy octroi duties or terminal taxes on certain goods entering their jurisdiction and also impose water rates, etc.

Before the 1919 constitution, the resources of the state used to be divided, by a sort of variable contract, between the central government and the provincial governments. Part of the 1919 reform was the complete severance of the central from the provincial finances: from 1533 up to 1921 they had been amalgamated; from the budget for 1921–22 onward they were separated. Under this arrangement the provinces by World War II had received and disposed of more than £60,000,000 of receipts, representing their collections of land and irrigation revenue: excise, stamps and forest income. It was spent by them on their administrative business, justice, education, public works, police and jails, public health, etc. In other words, the local governments received the yield of the sources which they administered and were responsible for the expenditure of the provincial departments, both reserved and transferred. In order to enable local governments to discharge their new functions. they were given powers of taxation, scheduled so as not to invade the sphere earmarked for the requirements of the central government. They were authorized to raise loans, either through the central government or independently; and some of the provinces borrowed for works of improvement such as irrigation and city development schemes. At the outset, the central government found itself no longer in control of funds sufficient for its own business. The customs, salt, opium and net railway receipts, income tax, etc., when they ceased to be supplemented as before by a share of the provincial land revenue, stamps and excise receipts, etc., proved inadequate to meet the demands of defense, the public debt and the other central liabilities. It was thus necessary to impose a levy on the provinces, admittedly as a temporary measure pending the inevitable expansion of the central revenues. The provincial legislatures fastened on the arrangement as the main cause of their own financial stringency and magnified a not unreasonable expedient into an intolerable grievance, under cover of which there was a tendency to evade the imposition of taxation that might have balanced their own budgets. From 1928, however, the levy ceased. Meanwhile, local governments claimed, in addition to their own separate revenues, a share of the taxation upon income collected a-ithin their boundaries; and some concession on this point was yielded as an exception to the general rule of separate resources.

The municipalities of India in 1946–47 had the disposal of an annual revenue of £17,000,000 excluding abnormal iteins and bor-

rowings; and the district and local boards had a normal revenue of about £13,000,000. Both classes of bodies had been endowed by the 1919 constitution with a financial independence commensurate in its degree with that of the provinces. The six port trusts had statutory powers for their own business and controlled an income of approximately £8,000,000, Bombay and Calcutta in particular having raised considerable loans, which rank in the Indian market second only to government securities.

For tariffs see Trade, above.

Land *Assessment.*—Since the land revenue is the oldest and formerly by far the most important element in the state's income, some description of the machinery for assessing it seems desirable, especially since it is unique to India and since no field of government policy was more hotly canvassed.

That the state should appropriate to itself a direct share in the produce of the soil is a fundamental maxim of Indian finance recognized from time immemorial. In the old Hindu village community, the land was not held by private owners but by occupiers under the petty corporation; the revenue was due not from individuals, but from the community represented by its headman. The aggregate harvest of the village fields was thrown into a common fund, and before the general distribution the head man was bound to set aside the share of the state. No other system of taxation could be theoretically more just, or in practice less obnoxious to the people. Under the Mogul empire, as organized by Akbar, the share of the state was fixed at one-third of the gross produce of the soil; and a regular army of tax collectors was permitted to intervene between the cultivator and the supreme government.

Shah Jahan and Aurangzeb extracted a larger land revenue than the British. When the government mas first undertaken by the East India company, no attempt was made to understand the social system upon which the land revenue nas based. The joint responsibility of the village community for the revenue was overlooked, and the convenience of collecting it from some individual or group was magnified. The conception of private property in the soil, with which the early British authorities were familiar at home, was grafted from a rural policy to which it was wholly alien. As a result, the office of zamindar—originally a mere farmer or lessee of the revenue under the Mohammedan regime—mas transmuted into that of landowner; and zamindars were created, where they did not exist. from men or families who, for some reason, were prominent in the areas of their residence.

The annual government demand was made the first liability on the land; subject thereto, the registered landholder was given powers of sale or mortgage scarcely more restricted than those of a tenant in fee simple. At the same time the possible hardships, as regards the cultivator, of this absolute right of property vested in the owner were anticipated by the recognition of occupancy rights of fixity of tenure, under certain conditions. Legal rights were substituted for unwritten customs; and the new landowners were endowed with a credit which they had never before possessed, by allowing them a certain share of the unearned increment. Against the misuse of this credit the British government had consistently to struggle.

The means by which the land revenue was assessed was known as settlement, and the assessor was styled a settlement officer. In Bengal the assessment was accomplished once and for all, but throughout the greater part of the rest of India the process was continually going on. The details varied in the different provinces; but, broadly speaking, a settlement may be described as the ascertainment of the agricultural capacity of the land. The settlement officer estimated the character of the soil. the kind of crop, the opportunities for irrigation, the means of communication and their probable development in the future and all other circumstances tending to affect the value of the produce. With these facts before him, he proceeded to assess the government demand upon the land according to certain general principles, which varied in the several provinces. The result was the settlement report, which recorded, as in a Domesday book, the entire mass of agricultural statistics concerning the district.

Lower Bengal and a few adjoining districts of the United Provinces and of Madras had a permanent settlement, the land revenue having been fixed in perpetuity by Lord Cornwallis in 1793. The zamindars of that time became practically landlords, with rights of transfer and inheritance, subject to the payment of a rent charge in perpetuity. But no detailed record of tenant-right was inserted in the settlement papers, and the cultivators lost rather than gained in security of tenure. The peasantry found no protection in the law courts until 1859, when an act was passed which restricted the landlord's powers of enhancement. Later the Bengal Tenancy act of 1885, to be amended by an act of 1908, created various classes of privileged tenants, including one class known as "settled ryots," in which the qualifying condition was holding land, not necessarily the same land, for 12 years continuously in one village. Outside the privileged classes of tenants the act gave valuable protection to tenants-at-will: and the original vices of the Bengali system were partly overcome though the growing division of rights in the land is an abiding economic calamity.

The prevailing system throughout the Madras presidency was the ryotwari, which took the cultivator or peasant proprietor as its rent-paying unit.

The representatives of several ancient lines of powerful chiefs in the extreme south and in the north of the presidency had their estates guaranteed to them on payment of a *peshkash,* or permanent tribute, and were saved by the custom of primogeniture from having to subdivide them. Throughout the rest of Madras there were no zamindars either in name or fact. The influence of Sir Thomas Munro led to the adoption of the *ryotwari* system, which came to be associated with his name. According to his system, assessment was made with the cultivating proprietor upon the land taken up for cultivation year by year. Neither zamindar nor village officer intervenes between the cultivator and the state, which took directly upon its shoulders all the landlord's responsibility.

Nothing can be more complete in theory and mare difficult of exposition than a Madras *ryotwari* settlement. First, the entire area of the district, whether cultivated or uncultivated. and of each field within the district was accurately measured. The next step was to calculate the estimated produce of each field, having regard to every kind of both natural and artificial advantage. Lastly) a rate was fixed upon every field, which may be regarded as roughly equal to one-third of the gross, and one-half of the net, produce. The rates thus ascertained were fixed for a term of 30 years; but during that period the aggregate rent roll of a district was liable to be affected by several considerations, which were discussed and decided by the collector at the *jamabandi,* or court, held every year for definitely ascertaining the amount of revenue to be paid by each ryot for the current season.

In the early days of British rule no system whatever prevailed throughout the Bombay presidency; and even at the time of World War II there were tracts where something of the old confusion survived. The modern "survey tenure" as it is called, dates from 1838. Each field was measured, and assessment placed upon it according to the quality of the soil without any attempt to fix the actual average produce. This assessment held good for a term of 30 years.

In the other provinces variations of the *zamindari* and *ryotwari* systems were found. In the United Provinces and the Punjab the ascertainment of the actual rents paid was the necessary preliminary to the land revenue demand. In the Central Provinces, where the landlords (*malguzras*) derived their title from the revenue settlements made under British rule, the rents were actually fixed by the settlement officer for varying periods. In addition, nearly every province had its own laws regulating the subject of tenancy. In Uttar Pradesh, Bihar and West Bengal *zamindari* was abolished under the republic.

The principles of the land revenue settlement and administration were reviewed by the government of India in a famous resolution prepared under Lord Curzon's direction and presented to parliament in 1902. It gave a full description and justification of the system and its consequences. In the previous year, the Famine commission had come to the general conclusion that "except in Bombay, where it is full, the incidence of land revenue is

low to moderate in ordinary years. and it should in no way per se be the cause of indebtedness." Later there was an active movement to have the principles of valuation and assessment fixed by law instead of being left to usage. In areas ivhere enhancements in the land revenue were decided to be, in whole or in part. attributable to the benefits of state irrigation, an appropriate part of the field was transferred to the state irrigation department. Otherwise. that department charged by a rate on the land for the water it supplied. attempts to meter the flow and charge accordingly having met with imperfect success.

Income Tax.—Income tax was first imposed in 1860 to cope with the effects of the mutiny of 1857. The system underwent many vicissitudes but in an act of 1886 the schedule was consolidated. A tax was imposed on all incomes derived from sources other than agriculture—an exemption which still held good at mid-20th century. The tax remained at a low figure until World War I, when the schedule was revised upward. During World War II receipts from income corporation and excess profits taxes contributed an increasingly large proportion of the revenue, rising from 20.2% in 1940–41 to 57.2% in 1945–46. In 1950–51 it was estimated to be 44.9%. The range of the tax rate on incomes of Rs. 3,600 and upward was for 1950–51 from 1.8% to 77%. The excess profits tax imposed during World War II was abolished after March 31, 1946.

Salt.—Before the successive reductions of the salt duty in 1903, 1905 and 1907, next to land. salt contributed the largest share to the Indian revenue. In March 1947 the government of undivided India abolished the duty; but it had to be reimposed after the loss of Rs. g.j crores of revenue. Later, plans were put into effect to develop the industry. On April 23, 1948, it was announced that licences would no longer be needed by producers of salt.

Excise.—Excise duties vary greatly in different provinces, and flow from a special form of government monopoly. The articles taxed are intoxicants and drugs; and the avowed object of government is to check consumption as well as to raise revenue. No duty whatever is levied upon tobacco in any part of India. The plant is universally grown by the cultivators for their own smoking, and the impossibility of accurate excise supervision caused the government to abandon the impost.

The right to manufacture and the right to retail spirits and beer are monopolies of government permitted to individuals only upon terms and under strict supervision. In Madras and Bombay the governments under the republic abolished excise on the sale of liquor and instituted prohibition.

Of excisable drugs the most important are opium, bhang, ganja and charas. Opium is sold through private retailers at a monopoly price. Its importance as a source of revenue steadily diminished, however, the area under poppy cultivation having shrunk from 207,000 ac. in 1918 to 4,800 ac. in 1940, and being still further reduced later. Opium used to be largely auctioned for private export to China and elsewhere. But the attempts at social reform in China and the intervention of the League of Nations led to a profound modification of the system. and cultivation was regulated with a view to the extinction of the export trade. A certain amount of opium is also sold to state governments for local consumption in India; and attempts were made to develop the market for the medicinal products of the drug.

Bhang, ganja and charas are three different narcotic drugs prepared from the hemp plant. The plant grows wild in many parts of India; but the cultivation of it for ganja is practically confined to a limited area in the Rajshahi district of East Bengal (Pakistan), and charas is mainly imported from central Asia. In regard to ganja and charas, cultivation of the plants is severely restricted and a direct quantitative duty is levied on the drugs on issue from the warehouse in the province of consumption; while as regards bhang, cultivation of the hemp for its production is prohibited or taxed. and collection of the drug from wild plants permitted only under licence, a moderate quantitative duty being levied in addition to vend fees.

Other sources of revenue are stamps, levied on judicial proceedings and commercial documents; registration of mortgages and other instruments; and provincial rates, chiefly in West Bengai and Uttar Pradesh for public works or rural police.

DEFENSE

In undivided India defense forces consisted mainly of the army in India, the Royal Indian navy and the Royal Indian air force.

Army.—At the time of partition, the army in India had existed for nearly 300 years. It derived from the small forces which the East India company maintained for the local protection of its factories; but as time went on it took more organized form. At first it consisted of European troops only; then it was divided into three presidency armies, each having royal troops, company's European troops and company's Indian troops. Thus, the Indian army began. In 1860 the queen's and the company's European troops were absorbed into the British army in India, the Indian troops becoming at the same time part of her majesty's forces.

The change of the name of the Indian troops to the Indian army was incidental to Lord Kitchener's reorganization of 1903. Of the details of the reorganization it is not necessary to say more than that it divided the army in India (British troops and Indian army) into three commands, northern, eastern and ti-estern, roughly corresponding to the old Punjab, Bombay and Bengal commands. In 1907 the command system was abolished and India was divided into two armies, northern and southern.

In World War I both army commands took the field and were not replaced. In that war the Indian troops served on many fronts with great distinction, notably in France, at Gallipoli, in east Africa, in Palestine and in Mesopotamia. In the early days of the war the strain of the first German advance impelled the British government to withdraw many of the British regiments from India and to replace them by territorial units. The first territorials thus to arrive in India landed in Bombay in Nov. 1914; and. since in the first convoy was the territorial battalion of the Dorsetshire regiment, arrangements were made for it to be the first to disembark in order to carry on regimental tradition, because the first British regiment to land in India was the 39th foot —later 1st battalion of the Dorsetshire regiment—which arrived in Madras in 1754 and thus got the title of *Primus* in *Indis.*

Later: after serving in India, most of these territorials went eventually to other fields of the war, and their places were taken by garrison battalions formed in the United Kingdom from veterans who had already seen active service.

The Indian army had two main categories of officers, one holding the king's commission and the other the viceroy's, the latter being exclusively Indian and promoted from the ranks. In Jan. 1918 Indians were made eligible for the king's commission, and the accepted policy of indianization of the king's commission ranks was accelerated in 1924 by the selection of 8 units, subsequently extended to 16, for closure to any further posting of British officers. The scheme was eventually proved to be inadequate, and in 1932 the Indian military academy was established at Debra Dun, for it had been found that for various reasons the number of Indians who could be passed through Sandhurst was insufficient. In 1945 it was announced that the grant of permanent commissions in the Royal Indian navy and Indian army would in future be restricted to Indians as it had already been in the Royal Indian air force.

The regiments of the Indian army had long traditions of service in all parts of the world; in fact, during the Crimean War in 1854 Indian troops were sent to garrison Malta and Gibraltar to release British units for the front.

Special orders were instituted for recognition of gallantry in the field; the highest was the Indian order of merit instituted by Queen Victoria in 1837 Its standards were as high as those which 17 years later were to qualify for the order of the Victoria cross. At the time it was intended that all soldiers and sailors of the empire alike should be able to earn the Victoria cross; but the government of India of the day, jealous, it was thought, for the prestige of the Indian order of merit, did not agree and pointed out that to that order was attached an annual monetary reward similar to that given with the Victoria cross. As time went on the cause of this limitation was forgotten, and in 1911 at the

royal durbar at Delhi the king-emperor announced its removal as one of the boons forthcoming at that ceremony. The first award of the Victoria cross under this decision was made in 1914, to Naik Khudadad Khan of the 129th Baluchis. In World War II, 31 Victoria crosses were won by the Indian army, 10 of them by Gurkhas. The first Victoria cross in that war to be won by an Indian was awarded in 1941 to 2nd Lieut. Premindra Singh Bhagat, a former Dehra Dun cadet, for gallantry in Abyssinia. The Indian distinguished service medal was another distinction for soldiers of the Indian army; and the order of British India, established in 1937, went to Indian officers for long and faithful service. From 1815 onward the Indian army, by treaty with the kingdom of Nepal, recruited regiments of Gurkhas, the number reaching ten.

Because of the geographical and political situation of India the government's military expenditure was a heavy item in the budget, and this was naturally increased by war conditions. The need for keeping the army in India on a modernized footing permitted the setting up of a committee under Lord Chatfield in Sept. 1938; and as a result of this inquiry the annual grant of £1,500,000 (which had been paid to the government of India since 1933 in aid of Indian defense expenditure) was increased to £2,000,000 and a capital grant made for the re-equipment of certain British and Indian units in India and for the provision of aircraft to certain squadrons of the royal air force in India. It was further agreed that four British battalions should be transferred from the Indian to the imperial establishment. The number of British troops in India was reduced by about 25%. The committee's view was that the forces maintained by India could bear only a small share in the wider responsibilities of defense, and in the recommending of the increase in the payment by the British government it was laid down that the margin for external defense should be one-tenth of the military forces maintained in India. During World War II, because of the part played by India in the operations in the middle east and in Africa and in the subsequent attempted invasion by Japan, the Indian army was greatly expanded and reached a total strength of 2,250,000.

Transfer of power in r947 brought about partition of the Indian army. the Royal Indian navy and the Royal Indian air force, though both dominions retained British commanders in chief, India until Jan. 1 j, 1949, and Pakistan until Jan. 1, 1951.

The allocation of units of the former Indian army to the new dominions was made on the basis of the composition of the units. The majority of regiments already largely composed of Moslem soldiers were allotted to Pakistan, the rest to India. Moslem subunits of regiments predominantly Hindu and so assigned to India were left in Pakistan and vice versa.

This allocation gave India the following numbers of units, Pakistan's quota being noted in parentheses: infantry 15 (8); armoured corps 12 (6); artillery 19 (9); engineers 61 (34). The future of the ten Gurkha regiments of the Indian army was determined by a tripartite agreement between the United Kingdom, India and the independent kingdom of Nepal: four regiments (2nd, 6th, 7th and 10th Gurkhas) entered the British army under the king of England; the remaining six regiments became part of the new Indian army. The prevailing religions of Nepal being Hinduism and Buddhism, there was no question of allotment of any Gurkha regiment to Pakistan. The service of Gurkha soldiers either in the Indian army or in the British army was to continue to be voluntary.

Navy. — The East India company, under its charter, maintained an armed naval force, and in 1829 the company founded an Indian navy. After the mutiny this service was abolished for reasons of economy; and an Indian marine service was formed which developed, in 1892, into the Royal Indian marine. In 1914 this force consisted of six armed transports manned by British officers and native crews. During World War I the ships were employed in patrolling the Red sea and the Persian gulf, and the Royal Indian marine took charge of the inland water transport in Mesopotamia until the end of 1916.

Constitutional progress in India led to the desire for a full-fledged Indian navy, and in 1934 the council of state and assembly passed a bill authorizing its establishment. On Oct. 2, 1934, the Royal Indian navy was inaugurated at Bombay, the Royal Indian marine ceasing to exist. A flag officer of the royal navy was placed in command and training establishments were instituted. On the outbreak of war in 1939 a large program of construction was initiated, giving considerable stimulus to shipbuilding in India. During World War II, ships of the Royal Indian navy operated over wide theatres from the Atlantic ocean to the China sea, mainly in the escort of convoys, mine sweepers. antisubmarine operations and patrolling, and its personnel had grown from 1,400 before the mar to 20,000 men at the end of 1943. In 1955 the republic of India had two cruisers, six destroyers and four vessels of the frigate and escort type. The establishment was 1,000 officers and 10,000 ratings.

Air Force. — The royal air force in undivided India, under the control of the air vice-marshal, originally comprised six squadrons organized in three wings of two squadrons each; and its establishment was 218 officers and 1,757 British and 138 Indian other ranks. The aircraft depot and the various aircraft parks were directly under R.A.F. headquarters in India.

An Indian air force was formed at Karachi in 1933 with one flight and had grown to ten fully equipped squadrons by 1943. It served with distinction during World War II. In 1943 the personnel was 30,000. On partition India received seven fighter squadrons and one transport squadron.

Republican Changes. — On India's becoming a sovereign republic the designation of "royal" was dropped from the titles of the various regiments possessing it, as also from the Indian navy and Indian air force. India had already instituted its own awards for gallantry to replace the British awards. These were the Param Vir Chakra, to rank next and immediately after the Victoria cross and awarded for the most conspicuous gallantry; the Maha Vir Chakra, next to and immediately after the distinguished service order; and the Vir Chakra, next to and immediately after the military cross. The name "viceroy's commissioned officers" was changed to "junior commissioned officers."

COMMUNICATIONS

Railways. — The railways of the subcontinent serve at least three different purposes: (1) the ordinary business of carrying passengers and commerce; (2) safeguarding of the internal and external peace of the country; and (3) protection against famine by facilitating the movement of grain. For this reason the interest on capital cannot, in the case of all the lines, be judged by a purely commercial standard; but for India as a whole the return on the capital expended is normally between 5½% and 6%. In the early days of railway enterprise the agency of private companies guaranteed by the state was exclusively employed, and nearly all the great trunk lines were built under this system. In 1870 a new policy of railway development by the direct agency of the state was inaugurated; and the government of India was often criticized for lack of enterprise, undue complexity and vacillation in its railway policy. But the tide later ran strongly in the direction of taking the main lines under state control as the leases of their working companies fell in, or as the purchase powers under their original concessions matured. By World War II, 41,134 mi. of railroad had been constructed, comprising 21,255 mi. of broad-gauge (5½ ft.), 15,757 of metre-gauge and 4,122 of narrow-gauge, nearly all absorbed by the state or about to be absorbed. These conveyed passengers (an average of 622,000,000 in a year) at less than one-third of a penny per mile as the average third-class fare, and goods at a little more than a half-penny per ton per mile.

World War II imposed a tremendous strain on the Indian railways which they withstood well. Traffic increased tremendously with movements of troops and war supplies and also when for a period loss of control of the Bay of Bengal diverted much traffic from sea to land. Quantities of Indian locomotives, track and personnel were sent to Iran to open a new war supply route to the U.S.S.R.

Partition affected three railway systems: the North-Western, the Bengal-Assam and the Jodhpur railways. The North-Western

railway, with a mileage of 6,881 mi. before partition, was divided so that 5,026 mi. went to Pakistan and 1,855 mi. to India. Of the Bengal-Assam railway. 352 mi. of broad-gauge, 17 mi. of narrow-gauge and 1,573 mi. metre-gauge fell within India, leaving 1,613 mi. in Pakistan. The Sind section of the Jodhpur-Hyderabad railway (319 mi. metre-gauge) fell entirely within Pakistan. The total mileage of railways in India in 1952–53 was 34,275 mi. Among the lines constructed after partition was an addition to the Oudh, Tirhut arid Assam section of the North-Eastern railway of 145 mi., linking Assam with West Bengal and thus obviating the need for crossing Pakistani territory in that area. The majority of the railways in the republic were nationalized and regrouped in 1952 into six regional systems.

Civil Aviation. — Civil air transport first came to India in the international field when, in 1929–30, the British, French and Dutch extended their empire air services to and across India. In undivided India plans for the operation of a state service between Karachi and Calcutta were made but abandoned for financial reasons. The first effective step for the operation of internal air services in India was taken by the Tata Sons, Ltd., in organizing an air service from Karachi to Madras in 1932. On the introduction of the empire air mail scheme the government of India, in association with the government of Ceylon, participated. Between 1937 and 1939 three companies came into existence, but on the outbreak of World War II a drastic change was made in these arrangements: the empire air mail scheme was suspended and its resources diverted to the needs of war; and all transport operations in India were placed on a war footing. Plans for postwar reconstruction of civil aviation were drawn up by Sir Frederick Tymms and generally approved by the government of India; but with the partition in Aug. 1947 the air-route pattern underwent a change and, moreover, some of the companies operating found themselves in financial embarrassment. On June 30, 1948, there were 23 Indian air companies with an authorized capital of Rs. 42.2 crores. Nine of them operated 38 scheduled air services, internal and international, on 23 routes employing 191 aircraft, 229 pilots and 140 other air-crew personnel. In 1953 these nine companies were grouped in two state-owned corporations — Indian Airlines and Air-India International.

Posts and Telegraphs. — In addition to its primary duties, this department has served miscellaneous functions. It acts as the people's savings bank; it allows the people to do their shopping at all distances through the system known as the V(alue) and P(ayable) P(ost); it collects customs charges on dutiable articles coming to India by post; it has a life insurance department; it pays the pensions of retired officials of the Indian army; and it sells quinine. In 1946–47 there were 26,130 post offices; the number of postal articles handled was 2,263,000,000, and 9,300,000 articles were sent by V.P.P. Money orders issued amounted to Rs. 52,000,000. The number of village postmen was 19,000, and the total strength of the establishment was 170,000; boxes numbered 57,000. The telegraph lines totalled 653,340 mi. Radio telegrams totalled 51,439, but of this only 5,000 were sent, the rest were received. There were 551,000 mi. of telephone wire and 2,870 exchanges, including departmental, nondepartmental and branch exchanges. The total number of telephones connected was 123,000 and lines 105,000. In 1954 the republic had 210,314 telephones (Pakistan had 27,886).

Broadcasting. — The Indian Broadcasting company was licensed in 1927 but went into liquidation in 1930, after which the government of India took control of broadcasting. After the partition of India, regional stations at Peshawar, Lahore and Dacca were handed over to Pakistan. All-India Radio is attached to the department of information and broadcasting. Its headquarters are at New Delhi and its stations are situated at Delhi, Lucknow, Patna, Calcutta, Cuttack, Madras, Tiruchirapalli and Bombay, Shillong-Gauhati, Nagpur, Vijayawada, Baroda, Allahabad and Jullunder. The programs are broadcast in 13 Indian languages and in English. From Broadcasting house in New Delhi (completed in 1943) 22,980 news bulletins are issued in the year. Broadcasts are provided in the external services in English. Hindustani, Tamil and Gujarati for Indians overseas; radiating from Delhi but distinct from the Delhi regional programs, they also provide 24 news bulletins a day in 12 languages — 9 foreign and 3 Indian. The number of radio receiving sets in 1954 was 680,000 in India and 99,000 in Pakistan — a marked increase on the total figure for 1937, which was 50.680.

WELFARE

Public **Health.**—The sanitary welfare of the subcontinent is extremely backward, largely because of the climate, general poverty and the pressure of the population. For the years 1931–35 the average ratio of births was 34.4 per 1,000 of population, and the ratio of deaths 23.5, fully one-fifth of the mortality being among infants of less than a year old.

In years of bad epidemics, the death roll runs much higher; the ratio, for example, was 62.46 in 1918, the disastrous influenza year; and plague carried off 12,000,000 in a single decade. Cholera is endemic in some areas, malaria in almost all; hookworm and kala-azar are widespread. Medical relief hardly exists outside the towns, except at the dispensaries established by the government and now controlled by local authorities. Yet improvement was slowly effected. In the past, every important fair or seat of pilgrimage was a focus of disease and death to many thousands. This was later brought under control; and great strides were made in providing the cities and larger urban areas with a supply of pure drinking water and with proper sewage or conservancy. Elementary hygiene was also introduced into the teaching in schools; and interest was taken in child welfare.

In 1943 the government of India appointed a health survey and development committee under the chairmanship of Sir Joseph Bhore. Its report made important recommendations with the object of providing each individual in the country with adequate medical care irrespective of his ability to pay for such services; of making medical aid available to rural as well as to urban areas; and of securing the active co-operation of the people in the development of the program. A long-term plan was drawn up by the committee; and the new government of India in 1947 accepted all the recommendations in principle and started implementation of the report by the establishment of medical scholarships, the creation of an all-India medical institute and the examination of the state governments' five-year medical and public-health development schemes accordingly. In the year 1946–47, according to the economic adviser's report of 1949, there were in India about 3,500 hospitals and dispensaries of varying quality, at which 51,000,000 patients were treated, though the total number of beds available was only about 53,500.

Labour Organization and Legislation. — Trade unionism on British lines made its first appearance in Madras during World War I. The pioneer society, the Madras Labour union, was a fairly solid organization of the cotton-mill operatives, which quickly found imitators. The great rise of prices and the industrial boom of 1919 furnished the most favourable conditions for a rapid advance. notably in Bombay. The cotton operatives in particular showed unsuspected staying power and not only secured advances during the boom but also, in 1925, won a more remarkable victory in resisting successfully a reduction of wages during the slump. An act intended to recognize trade unionism and to encourage it on sound lines came into force on June 1, 1927, and the movement became a permanent and growing element in Indian industrial life.

India was represented at the International Labour conference at Washington. D.C., which was followed by an "All India Industrial Welfare congress" held in Bombay in April 1922. Important labour legislation was enacted in the same year. The Factories act of 1922 raised the age of admission for children from 9 to 12, for full-time work from 14 to 15, prohibited night work for women- and enacted for all workers a maximum day's work of 11 hours and a maximum week of 60 hours. The Mines act of 1923 forbade the employment of children and young persons below ground, while still permitting that of women, and limited the week's work to 60 hours above ground and 54 hours below. The Workmen's Compensation act of the same year allowed compensation for death or accident for 3,000,000 industrial workers. Fac-

tory law in India was completely overhauled by the Factories act of 1934, amended in 1936, 1940 and 1941. The act classified factories into seasonal and perennial. Seasonal factories are those engaged in processing such seasonal activities as cotton ginning or tea manufacture. The 1922 act's maximum hours of work had applied only to seasonal factories; in others a maximum of 10 hours per day and 54 hours per meek was allowed. The act of 1934 covered factory "spreadover" hours, artificial cooling and humidification, welfare (water, shelter, rest, first aid. reservation of rooms for men, uomen and children), holidays. overtime. certificates of fitness for children and security. Under the Factories act of 1948 (a consolidating measure) minimum requirements regarding the health. safety and general welfare of the workers were prescribed. The object was to remove a weakness in the act of 1934 which left, it was thought. too much to the rule-making powers of the state (then provincial) governments. The act which came into force on April 1, 1949, covered all industrial establishments employing 10 or more workers and using power and those employing 20 or more workers and not using power. It abolished the distinction between perennial and seasonal factories.

EDUCATION

At no period of its history has India been an altogether unenlightened country. Inscriptions on stone and copper, the palm-leaf records of the temples and in later days the widespread manufacture of paper all alike indicate not only the general knowledge but also the common use of the art of writing.

From the earliest times the caste of Brahmans has preserved, by oral tradition as well as in manuscripts, a literature unrivalled in its antiquity and in the intellectual subtlety of its contents.

The Mohammedan invaders introduced the profession of the historian, which reached a high degree of excellence, even as compared with contemporary Europe. Through all changes of government vernacular instruction in its simplest form has always been given, at least to the children of the higher castes, in every large village.

British India. — During the early days of the East India company's rule the promotion of education was not recognized as a duty of a government either in India or in England. Warren Hastings did indeed found the Calcutta *madrasa* for Mohammedan teaching, and the establishment of the Sanskrit college at Benares in 1791 was associated with the name of another servant of the company, Jonathan Duncan. But Wellesley's schemes of imperial dominion did not extend beyond the establishment of a college for English officials. On the Rs. 1,00,000 grant which was prescribed. the first of its kind, for the encouragement of education by the Charter act of 1813, no general scheme of public instruction could be built. But the Sanskrit college in Calcutta was founded in 1824, the medical college by Lord William Bentinck in 1835 and the Hooghly *madrasa* by a wealthy Indian gentleman in 1835; the Agra college had been established in 1823.

Meanwhile. the missionaries made the field of vernacular education their own. Discouraged by the official authorities and ever liable to banishment or deportation, they not only devoted themselves with courage to their special work of evangelization but also were the first to study the vernacular dialects spoken by the common people. Just as two centuries earlier the Jesuits at Madura, in the extreme south, composed works in Tamil, which are still acknowledged as classical, so did the Baptist mission at Serampore, near Calcutta, first raise Bengali to the rank of a literary language. The interest of the missionaries in education had two distinct aspects. They studied the vernacular, in order to reach the people by their preaching and to translate the Bible; and they taught English, as the channel of nonsectarian learning.

A fresh wind began to blow from England with the Charter act of 1833. The work of the missionaries received official licence; and in 1835 Bentinck decided that "the great object of the British government ought to be the promotion of European literature and science among the natives of India." This was the last word on a long-drawn controversy between a school which arrived at the extension of oriental learning in India in its own languages and the school which urged the teaching of elementary knowledge in the vernacular tongues and of the higher branches in English. The scale had been turned by Macaulay's minute in support of the latter view; and the low state into which Hindu morality and culture had sunk at the time was felt to be adequate justification for the decision. It settled the aim of the British governmental system of education in India, and Sir Charles Wood's dispatch of 1854 determined the methods and machinery. From that date onward education meant a network of schools, colleges and examinations ultimately controlled by the government.

Many of the institutions were maintained directly from public funds and staffed by teachers who were public officials. Another class was maintained by local authorities, subject to close control by the government. A third class under private (*e.g.*, missionary) management depended on the government for grants-in-aid or for "recognition"; and both grants and recognition implied strict compliance with governmental regulation. At the same time the government in its anxiety to hold an even balance between the different sects and creeds in India kept carefully aloof from the teaching of religion.

The British government thus, while honestly giving its best in teachers and what it believed to be its best in curricula, exposed itself to the odium of what were for long three grave defects in the system.

1. By making its own type of education the qualification for government service, it tended to concentrate the energies of the youth of India on the search for public offices, rather than on learning for its own sake or on that general development of the intelligence which would serve the industrial growth of the country.

2. The mass of students who clamoured for a purely literary education as the doorway to official employment was so great that the vast majority of them absorbed only a shallow and mechanical smattering of knowledge; and, since to those who failed in securing government service this education proved of no commercial value. a class of unemployable and half-educated lads grew up, who became ready vehicles for political unrest and in some cases for revolutionary crime.

3. Purely secular instruction which virtually ignored the vernacular languages involved neglect of the indigenous ethos and culture of India and became in time largely responsible for the reaction against western civilization.

To these defects the government was far from blind, and the educational policy of the British in the 20th century was a constant endeavour to mitigate them. Lord Curzon had the whole system overhauled and improved. The universities were liberalized, the colleges set on the way to becoming residential institutions and the assistance to elementary schools largely extended; while technical and agricultural schools were reformed. Lord Minto got a special ministry of education established; and the financial prosperity of Lord Hardinge's viceroyalty enabled him to make generous grants to the provinces for education and to wage war on illiteracy.

But the root of the matter was attacked when a special commission was appointed. under the chairmanship of Sir Michael Sadler, to inquire into the weaknesses of the Calcutta university and incidentally of university education generally. It reported in 1919 and condemned in emphatic language the whole conduct of secondary and university education.

The commission advised radical reforms. The universities should be centralized, unitary, residential teaching bodies with a government of their oun. Tuition of a preparatory type should be removed to a new grade of intermediate colleges where the curriculum u-ould be varied and would lead up to examinations not under university control. though qualifying for entrance to a university and having an independent value as a certificate of general education. Students would thus enter the universities at a later age and at a stage represented by the old "intermediate" examination, thus relieving the universities of a part of their unuieldy host of undergraduates. These recommendations were generally welcomed. and most of the former universities (including the Hindu university at Benares, which owed much to Mrs.

Annie Besant) reconstituted themselves accordingly, while new universities of the teaching and residential type sprang up at Dacca, Aligarh (Moslem), Lucknow, Patna, Nagpur and Delhi. In 1926 legislative provision was made for incorporating a university at Agra to relieve the external work at Allahabad, and in the same year a new Andhra university was inaugurated in Madras. In 1939 the number of students at university and professional colleges was 145,000, of whom 7% were women. By 1951 there were 34 universities in the republic with over 350,000 students (and 6 in Pakistan with about 55,000 students).

Secondary education advanced apace, and in high and middle schools of a nontechnical type the enrolment in 1939 was 2,659,000 pupils, including about 14% females. But shortage of funds interfered with the establishment of "intermediate" institutions advised in the Sadler report, as well as with the improvement of the mass of high schools.

The pace of development in primary education was also seriously retarded by financial difficulties; but by 1939 the number of children at primary schools had risen to 11,445,000, inclusive of more than 2,849,000 girls. Although it was recognized that here was the only nursery for an intelligent electorate in the future, the difficulties were many: the traditions confining education to certain castes, communal troubles, bad communications, the dearth of competent teachers and above all the poverty of the rural parent, who could not spare his sons from the ranks of the breadwinners and had no belief whatever in educating his daughters. To these permanent obstacles must be attributed the fact that, according to the census of 1941, only 195 in every 1,000 men and 55 in every 1,000 women in undivided India could read and write. In face of these figures it was not surprising that the legislatures had frequently turned to the remedy of compulsion. Acts asserting the compulsion principle were passed in several provinces, but the translation of principle into practice was still incomplete. Meanwhile the decentralization of the control of primary education offered a prospect of greater elasticity, especially in adapting the school curriculum to rural needs.

Female education was long the despair of reformers. Social prejudices and the subordinate and largely dependent position of women were antagonistic to it, and there was the greatest difficulty in obtaining, except in the Christian community, qualified women teachers. The Brahmo Samaj and a few enlightened groups and individuals persevered in the education of their womenfolk: but progress was deplorably limited and slow. With the awakening of national feeling, however, some advance became apparent. By 1926 there were a little more than 1,000,000 females receiving college and school education in the whole of British India. By 1939 this figure had risen to 3,270,000. By 1951–52 about 25,000,000 children were at school in India (and about 4,000,000 in Pakistan).

The Republic. — The general educational policy of the government of India is comprised in the report of the central advisory board of education. This report, popularly known as the Sargent report, because Sir John Sargent was deputed from England as educational commissioner to prepare it for the government of undivided India, was adopted by the government after partition as the basis of its educational policy. It aims at introducing as speedily as possible a system of universal compulsory education free of charges for all boys and girls between the ages of 6 and 14. The report estimated that 40 years were required to achieve 100% literacy, but in the new India an all-India educational conference in Jan. 1948 recommended a reduction of that period to 16 years by means of two 5-year plans and one 6-year. Shortage of funds seriously impeded the implementation of the Sargent recommendations in the 1950s. (ME.; G. MA.; E. HD.)

BIBLIOGRAPHY.—O. H. K. Spate, *India and Pakistan* (London, New York, 1954); Sir H. H. Risley, *The People of India,* 2nd ed. (London, 1915); W. H. Gilbert, *Peoples of India* (Washington, D.C., 1944); G. B. Jathar and S. G. Beri, *Indian Economics,* 9th ed. (London, Bombay, 1949–52); C. N. Vakil, *Economic Consequences of Divided India* (Bombay, London, 1950; New York, 1951); *Overseas Economic Surveys,* India (H.M.S.O., London, 1953); A. Gledhill, *The Republic of India* (London, 1952); G. N. Joshi, *The Constitution of India,* 3rd ed. (London, 1955).

INDIA, FRENCH, a general name for the former French possessions in India. When India received its independence in 1947, they comprised Pondicherry (112 sq.mi.), Karikal (52 sq.mi.) and Yanaon (Yanam) (6 sq.mi.) on the Coromandel coast; Mahé (23 sq.mi.) on the Malabar coast; Chandernagore (4 sq.mi.) in Bengal; and certain dependent loges, or plots, in the vicinity of former French factories.

Pondicherry was purchased in 1683 and Chandernagore permanently occupied in 1688. Mahé was acquired in 1721, Karikal in 1739 and Yanaon in 1750. They were captured by the English during the Anglo-French struggles in the second half of the 18th century and in the Napoleonic Wars but were restored to France in 1815 (see INDIA: History).

The dependent loges were ceded to the Indian union in Oct. 1947.

In May 1948 the French and Indian governments agreed to allow the populations of the French settlements to decide whether they should join India.

In 1948 the population, according to the census, was as follows: Pondicherry, 317,163; Karikal, 70,541; Mahé, 18,293; Yanaon, 5,853; and Chandernagore, 44.800.

Elections in Pondicherry, Karikal and Yanaon in Oct. 1948 resulted in a victory for those who favoured the retention of the connection with France; polling in Mahé had to be postponed because of rioting. As a result of municipal elections held on June 19, 1949, the inhabitants of Chandernagore opted for inclusion in the Indian union.

The remaining states of Pondicherry, Karikal, Yanaon and Mahé were transferred to Indian sovereignty Nov. 1, 1954, under an agreement signed by the French and Indian governments after a congress of representatives had voted in favour of union with India.

It was announced on Jan. 6, 1955, that the four settlements would constitute a single state of India under the name of the state of Pondicherry. The new state of Pondicherry had a population (1951 est.) of 330 688.

The chief town and seat of administration is Pondicherry (pop. [1955 est.] 62,716).

BIBLIOGRAPHY.—P. Kaeppelin, *Les Origines de l'Inde française* (Paris, 1908), M. V. Labernadie, *La Révolution et les e'tablissements français dans l'Inde* (Pondicherry, Paris, 1930); A. Martineau, *Les Origines de Mahé de Malabar* (Paris, 1916); H. Weber, *La Compagnie Française des Indes* (Paris, 1904). (C. C D.: X.)

INDIAN, LATIN-AMERICAN. Of the 16,000,000 or more people who, according to estimates of A. L. Kroeber and J. H. Steward, inhabited the western hemisphere at the time of European discovery, about 15,000,000 lived in what is now Latin America. Heavy concentrations were in Mexico and adjacent parts of Central America with perhaps 5,000,000, and the Andean area of western South America with at least 6,000,000. Today these same areas tend to have proportionally large Indian populations. Thus while of the population of the U.S., only about 0.4% are Indians, in Ecuador, Bolivia, Peru and Guatemala the percentage of persons recognized as and called Indians runs from 40% to 50% and higher. There are large areas in Mexico, Guatemala and the Andes where the vast majority of the people are Indian in ancestry and maintain Indian languages and cultures. In much of Latin America the aboriginal population therefore has been of great importance historically and represents in modern times a highly significant segment of life. Nor are the Indians disappearing in Latin America. (The same is true of North America.) Although many individuals join the ranks of caboclos, *criollos*, mestizos, Ladinos — as the Europeanized classes are variously called — and although some Indian communities substitute European languages and many European ways for their own, the population of "Indian" Indians may actually increase as such "losses" are compensated for by the population growth that modern medicine permits. As colonial-type class systems break before modern communications and democratic ideas, the Indians may be expected to maintain and increase their importance in the economy and politics of many Latin-American nations.

ABORIGINAL LANGUAGES AND TRIBES

It is generally agreed that Indians began to migrate across

Bering strait 15,000 to 20,000 years ago, and continued to come in small numbers until about 4,000 years ago. Presumably they began from earliest times to spread over the whole hemisphere, and by 10,000 years ago there were migrant hunters in South America. (*See* ARCHAEOLOGY: *The New* World: Early Man.) When about 4,000 years ago agriculture, based mainly on maize and manioc, developed in the new world, and village life and city-states grew, extreme cultural variation resulted. In addition to differences based on ecological variations, there mere those of cultural intensity or complexity, difference~between nomadic tribes, for example, and urban civilizations. Movements of people and wars and conquests continued throughout history, so that—as pieced together from archaeological evidences and linguistic and ethnological distributions, as well as from what documentary evidences there are—the picture is one not only of extreme mobility but of a patchwork. Mysteries like those of the Basques or the gypsies in Europe are common in aboriginal America. Despite this, and the relatively small amount of research so far done on South American archaeology and languages, anthropologists have brought remarkable order to the data.

About 1,700 mutually unintelligible languages appear to have been spoken by the Indians of the area. In the 20th century these languages have been ordered somewhat independently by Norman McQuown, by Joseph Greenberg and by Morris Swadesh. (*See* also AMERICAN ABORIGINAL LANGUAGES for description and discussion of their history and characteristics.) The accompanying table includes all languages about which linguists have substantial knowledge, classified mainly according to Greenberg. The number of independent groupings tends to be reduced with increasing research.

A "tribe" may be identified with a particular language, but it is an error to confuse languages with social units, especially where settled agricultural populations of a variety of language groups have been joined politically, or where single widespread language groups are socially distinct. Thus, in Guatemala, the Quiché-speaking villages have nothing more in common with one another than with neighbouring Cakchiquel-speaking or Zutuhil-speaking villages. One cannot therefore speak of "the Quichés" as though they were a tribe like the Yahgan or the Siriono. Generally only the marginal nonagricultural areas of South America, and some of the tropical forest groups, were organized in tribes identified by the linguistic name.

ABORIGINAL CULTURAL GROUPINGS

The variety of cultures has been grouped meaningfully into areas as follows:

The Greater Southwest.—This region includes northern Mexico and the southwest area of the U.S. It would all have been part of Latin America if most of it had not been annexed by the United States. Because so little of it is now a part of Latin America, it need only be mentioned that at the time of the conquest it included a wide variety of tribal groups—the Navahos, the Pueblos, the Huichols and so forth. Many of these still exist, maintaining their distinctive cultures. Those which are in Mexico are included in the table.

Mesoamerica to the south included about 3,000,000 people in central and southern Mexico, the Yucatan peninsula, El Salvador, Guatemala and parts of Honduras, Nicaragua and Costa Rica. Among the many tribes of the region at least two, the Aztecs of Mexico and the Maya of Central America, developed what we think of as high civilizations. Both had hieroglyphic writing, complex political and religious systems and great art and science. (*See* AZTEC.)

The classic Maya practised slash-and-burn agriculture; the cornfields cleared in the jungle were abandoned when they lost fertility and new patches were cleared. This system of shifting cultivation, involving gradual shifts in habitation, discouraged the development of true cities. Instead, the Maya built huge, monumental city ceremonial centres. populated largely by priests, around which the rest of the people were distributed for many miles in every direction. Classic Maya society was not oriented toward war; conquest, tribute taking and a warrior class were foreign to their way of life. The Maya priests, who had the highest status in the society, developed art, architecture and calendrical systems to a high degree of sophistication.

The Aztecs, flowering much later, based their civilization on intensive maize agriculture, which made possible the development of cities. The society which centred around these cities and their temples was rigidly stratified; at the bottom of the social pyramid were the commoners and at its apex, the priests. The temple cult was fundamental to Aztec life. Since the rites of the temple required frequent sacrifices of war prisoners, warfare was common, and the warrior had high prestige. The outlying peoples were forced to bring tribute to the Aztec rulers, but were never welded into an integrated empire.

The Tropical Forests and Southern Andes.—Numbering somewhat over 2,000,000, these forest peoples were scattered over a tremendous rain forest area, primarily the vast Amazon river drainage, and spilling over into the southern Andes. They lived in semipermanent villages, around which they carried on slash-and-burn cultivation of such crops as bitter manioc, yams, arrowroot, beans, squash and taro; the villages were moved every generation or so when the soil around ceased to be productive. Hunting and fishing were also important activities. Characteristically, each village was an independent unit, with no political allegiance to any other. Within the village, the main unit was the extended family or lineage. Where the village consisted of a single such family group, the village head mas merely the family head; some multifamily villages had a hereditary chief, of limited powers, who was often also a shaman. Religious activities were often centred in the shaman, whose main functions as medicine man were to cure sickness, to prognosticate and to perform magic. Warfare was carried on to obtain human trophies and victims for cannibalistic feasts—not for conquest.

The tribes of the southern Andes, inhabitants of the northern edge of Chile and a small slice of northwest Argentina, were much like the peoples of the tropical forest, except that they had taken over many techniques from the more "civilized" peoples of the central Andes. They lived in widely separated villages, fortified for defense since warfare was continual in the area, and practised intensive farming of corn, beans, quinoa and potatoes. They also raised llamas and guinea pigs, and wove cloth of wool and cotton.

The Circumcaribbean and Subandean Regions.—The peoples of northern South and Central America and the Antilles numbered a little over 1,000,000 village-dwelling farmers. Although intensive agriculture was the main basis of the economy, along the coasts and in the Antilles the ocean was an important source of livelihood. The technology of these peoples included many items—like pottery, woven basketry, hammocks, thatch houses—characteristic of the tropical forests, and others—such as the use of metals, salt, the raising of guinea pigs—which were typical of the people of the high Andes. They produced enough material goods to allow local specialization and trade in such items as metals, salt, cloth and beads. They lived in permanent villages, which usually consisted of several extended family or lineage groups. Bonds between these kin groups were reinforced by strong political controls as society was characteristically divided into somewhat fluid classes. A group of hereditary chiefs constituted the upper class; nobility in general seems to have developed from an earlier class of warriors. Shaman priests performed religious rites in local temples, celebrating the powers of tribal gods. Many of the tribes entered into multicommunity states through federation and conquest, but none of these ever became completely consolidated like the state of the Inca in the high Andes. The subandean peoples differ from this general pattern largely in their greater approximation to central Andean culture; *i.e.*, in such items as copper smelting and construction of roads, stone houses. forts and bridges.

The Central Andes.—This region is fully comparable to Mesoamerica in complexity and general cultural achievement. A population of more than 4,500,000 lived in this thin strip of high mountain country, stretching from Colombia 2,000 mi. S. along the Andes to Ecuador. Intensive farming and herding supported the densest population and the largest and most permanent communities in South America. This population was integrated by a most efficient

Provisional Classification of Aboriginal Languages of Latin America

After McQuown (1955) and Greenberg (1956)*

Phylum	Stock	Family	Subfamily	Languages
x ə Dene Algonkian-Mosan	Dene	Athabaskan		Apache, Jano, Jocome, Toboso (*Mexico*)
	Algonkian-Ritwan	Algonkian		Kickapoo (*Mexico*)
Azteco-Tanoan		Uto-Aztecan	Taracahitian	Acaxee, Achire, Ahome, Aibine, Baciroa, Baimena, Bamoa, Batuc, Chinarra, Chinipa, Chizo, Cinaloa, Comanito, Comopori, Concho, Conicari, Eudeve, Guasapar, Guasave, Hine, Hio, Huite, Hume, Jova, Jumano, Macoyahui, Mayo, Mocorito, Nacosura, Nio, Ocoroni, Opata, Sabaibo, Suma, Tahue, Tarahumara, Tebaca, Tehueco, Temori, Tepahue, Topiame, Tubar, Vacoregue, Varohio, Xixime, Yaqui, Zoe, Zuaque (*Mexico*)
			Aztecoid	Alaguilac (*Guatemala*), Azteca, Bagaz (*Costa Rica*), Cazcan, Coano, Coca, Cora, Desaguadero (*Costa Rica*), Guachichil, Huaynamota, Huichol, Lagunere, Meztitlaneca, Nahuatlate (*Nicaragua*), Nicarao (*Nicaragua*), Pipil (*Guatemala, Honduras, El Salvador*), Pochutla, Sayulteca, Sigua (*Panama*), ~ ɐ ɯ Tecoxquin, Tecual, Tecuexe, Tepaneca, Teul, Tolteca-Chichimeca (*Mexico; Guatemala?*), Totorame, Zacateca, Zayahueco (*Mexico* unless otherwise shown)
			Piman	Cocomacague, Colotlan, Himeri, Nebome, Papago (*Mexico, United States*) Piato, Potlapigua, Tepecano, Tepehuane (Norte), Tepehuane (Sur), Teul-Chichimeca, Ure, Vigitega, Yecora (*Mexico*)
Penutian	Mixe-Zoque	Zoquean	Zoquean	~ ¡ x ɐ Oluta, Popoluca (Sierra), Sayula, Texixtepec, Zoque (*Mexico*)
		Aguacateco II		Aguacateco II (*Guatemala*)
		Tapachulteco II		Tapachulteco I (*Mexico*)
	Huave			Huave (*Mexico*)
	Mayan	Mayoid	Huastecan	Chicomucelteco, Huasteco (Potosino), Huasteco (Veracruzano) (*Mexico*)
			Maya	Acala[1], Acalan, Bacalar, Bachahom, Chol (*Mexico; Guatemala?*), Cholti[1], Chontal (Tabasco), Chorti (*Guatemala, Honduras*), Chuj[1], Flores[1], Icaiche, Itza (*Mexico, Guatemala*), Jacalteco[1], Kanjobal, Lacandon (Chol), Lacandon (Yucateco) (*Mexico; Guatemala?*), Manche (*British Honduras; Guatemala?*), Mopan (*Guatemala, British Honduras*), Motozintleco, Puctun, Quehache[1], Santa Cruz, Solomeco[1], Tojolabal, Toquegua (*Guatemala, Honduras*), Tzeltal, Tzotzil, Yocotan, Yucateco ([1]indicates *Guatemala*; those not marked are *Mexico*)
		Quichoid	Mamoid	Aguacateco I, Mame (*Guatemala, Mexico*)
			Quichil	Cakchiquel, Ixil, Quiche, Rabinal, Tzutuhil, Uspanteco (*Guatemala*)
			Unclassified	Achi (*El Salvador*), Kekchi (*Guatemala*), Pokomam (*Guatemala, El Salvador*), Pokonchi (*Guatemala*), Tapachulteco II (*Mexico*)
		Poton		Poton (*Salvador*)
	Totonacan	Totonaco		Totonaco (*Mexico*)
		Tepehua		Tepehua (*Mexico*)
Hokan-Siouan	Hokal-Tecan	Hokan	Esselen Yuman	Akwa'ala[2], Alakwisa, Cochimi[2], Cocopa, Dieguenyo[2], Kamia[2], Kikima, Kiliwi[2], Kohuana, Laymon[2] ([2]indicates *Mexico and United States*, those not marked are *Mexico* only)
			Salinan-Serian	Guayma, Salinero, Seri, Tepoca, Upanguaima (*Mexico*)
			Tequistlatecan	Chontal (Guerrero), Tequistlateco (*Mexico*)
		Supanecan		Maribichicoa (*El Salvador*), Subtiaba (*Nicaragua*), Tiapaneco (*Mexico*)
		Coahuiltecan	Coahuilteco	Carrizo, Comecrudo, Cotoname, Janambre, Olive, Pisone, Tamaulipeco (*Mexico*)
		Guaycuran		Aripa, Cora, Didu, Edu, Guaycura, Ica, Monqui, Uchita, Pericu (*Mexico*)
	Jicaque			Jicaque (*Honduras*)
	Yurumangui			Yurumangui (*Colombia*)
Macro-Oto-Manguean	Oto-Manguean	Otomian	Otomi	Otomi (*Mexico*)
			Mazahua	Mazahua (*Mexico*)
			Ocuiltecan	Atzinca, Matlame, Matlatzinca, Ocuilteco, Quata (*Mexico*)
			Pamean	Chichimeca-Jonaz, Meco, pəmɐ, Tonaz (*Mexico*)
		Popolocan		Chocho, Ixcateco, Popoloca (*Mexico*)
		Mazatecan		Guatinicamame, Mazateco (Guerrero), Mazateco (Oaxaca), Mazateco (Tabasco) (*Mexico*)
		Trique		⊗ ~ ⓟ ɯ ɐ (*Mexico*)
		Chorotegan		Chiapaneco (*Mexico*)
			Manguean	Choluteca (*Honduras*), Diria (*Nicaragua*), Mangue (*Nicaragua*), Nagrandan (*Nicaragua*), Nicoya (*Costa Rica*), Orisi (*Costa Rica*), Orotinya (*Costa Rica*)

*Greenberg's is the most comprehensive classification. He succeeded in bringing into relationship hundreds of previously unclassified languages. This chart systematically incorporates information in McQuown ("The Indigenous Languages of Latin America," *Amer. Anthrop.*, June 1955) into Joseph Greenberg's unpublished 1956 classification, and omits those on which information is too sparse to permit even local classification.

Provisional Classification of Aboriginal Languages of Latin America—Continued

After McQuown (1955) and Greenberg (1956)*

Phylum	Stock	Family	Subfamily	Languages
Macro-Oto-Manguean —Continued	Mixtecan	Mixteco		Mixteco, Cuicateco, Amusgo (*Mexico*)
	Chinanteco			Chinanteco (*Mexico*)
	Zapotecan	Zapoteco		Zapoteco (Serrano Norte), Zapoteco (Serrano Sur), Zapoteco (Valle) (*Mexico*)
		Chatinoan		Chatino, Papabuco, Solteco (*Mexico*)
Tarascan				Tarasco (*Mexico*)
Macro-Chibchan	Misumalpan	Miskitoan		Baldam, Cabo, Mam (*Honduras*), Miskito, Tauira, Wanki (*Nicaragua; Honduras?*) (*Nicaragua* unless otherwise shown)
		Sumoan	Ulvan	Cucra, Guanexico (*Honduras, Nicaragua*), Prinzo, Ulva, Yosco (*Nicaragua* unless otherwise shown)
			Sumo	Bauihca, Boa, Carahuala, Coco[3], Huasabane, Lacu, Panamaca, Pispi, Sumo[3], Tauahca[3], Tunqui ([3]indicates *Honduras and Nicaragua;* those not marked are *Nicaragua* alone)
			Unclassified	Cu (*Nicaragua; Honduras?*), Musutepes, Silam, Yasica (*Nicaragua* unless otherwise shown)
		Matagalpan		Cacaopera (*El Salvador*), Chato, Dule, Matagalpa (*Honduras, Nicaragua*), Pantasma (*Honduras* unless otherwise shown)
		Unclassified		Bambana, Cucalaya, Kiwahka, Sumo-Sirpe, Tuŋgla (*Nicaragua*)
	Chibchan	Pacific-Chibchan	Isthmian	Burica (*Costa Rica, Panama*), Chaliva, Changuena, Chiru, Dorasco, Duy, Escoria, Move, Muite, Muoi, Murire, Nata, Penonomenyo, Valiente (*Panama* unless otherwise shown)
			Colombian	Aburra, Jamundi, Lile, Timba, Yameci, Yolo (*Colombia*)
		Talamanca		Boruca, Bribri (*Costa Rica, Panama*), Burucaca, Cabecar, Chiripo, Coto, Estrella, Guetar, Pocosi, Quepo, Quilla (*Colombia*), Suerre, Tariaca, Techbi (*Costa Rica, Panama*), Terraba (*Panama*), Tojar (*Panama*), Tucurrique, Turucaca, Voto (*Costa Rica* unless otherwise shown)
		Interandean-Barbacoan	Barbacoa	Cara[4], Cayapa[4], Coaiquer, Cocora (*Nicaragua*), Colima, Colorado[4], Cueva (*Panama*), Cuna, Paya (*Panama*), Gotane (*Costa Rica*), Guatuso (*Costa Rica*), Muellamues, Nigua[4], Patia, Sindagua ([4]indicates *Ecuador;* those not marked are *Colombia*)
			Paezan-Coconucoan-Popayanens	Coconuco, Guanaco, Moguex, Paez, Paniquita, Polindara, Popayan, Pubenaro, Purace, Totoro (*Colombia*)
		Eastern Chibchan	Cundinamarcan	Agata, Chibcha (Muisca), Duit, Sinsiga, Tunebo (*Colombia*)
			Arhuacoa	Atanque, Bintucua, Cagaba, Guamaca, Ica, Sanha (*Colombia*)
			Central American Chibchan	Melchora, Rama (*Nicaragua*)
	Yunca-Puruhan	Yuncan	Northern Yuncan	Canyari, Manabita, Puruha (*Ecuador*)
			Southern Yuncan	Mochica, Quingnam (*Peru*)
		Atalan		Manta, Puna, Tumbez (*Ecuador*)
			Caraquean	Caraque, Huancavilca (*Ecuador*)
	Jirajaran	a		Gayon (*Venezuela*)
		b		Ayoman (*Venezuela*)
		Xaguan		Xagua, Cuiba (*Venezuela*)
		d		Jirajara (*Venezuela*)
	Guarauan	a		Mariusa (*Venezuela*)
		b		Chaguan (*Venezuela*)
		c		Guaiqueri (*Venezuela*)
		d		Guarau (*Venezuela*)
	Chirianan	Guahariban		Chiriana (*Brazil*), Guaharibo, (*Brazil, Venezuela*), Uaica (*Brazil, Venezuela*)
		b		Carime (*Brazil*)
		c		Pusaracau (*Brazil*)
	Muran	a		Mura, Matanaui (*Brazil*)
		b		Piraha (*Brazil*)
		c		Jahahi (*Brazil*)
	Unclassified			Atacame (*Ecuador*), Choco (*Brazil*), Itonama (*Bolivia*), Lenca (*Honduras, El Salvador*), Xinca (*Guatemala*)

Provisional Classification of Aboriginal Languages of Latin America—Continued

After McQuown (1955) and Greenberg (1956)*

Phylum	Stock	Family	Subfamily	Languages
Ge-Pano-Carib	Macro-Carib	Cariban	Northern Cariban	Acawai (*British Guiana*), Acuria[5] (*British Guiana, Surinam*), Apalai[5], Aracuaju[5], Arecuna, Arinagoto, Atroahy[5], Azumara[5], Bonari[5], Caicuchana (*Colombia*), Calino (*British Honduras, Guatemala, Honduras, Dominica*), Calinya (*Surinam*), Camaracoto, Carib (*Honduras, British Honduras*) Caribice (*British Guiana*), Carijona (*Colombia*), Carinepagato (*Trinidad*), Catauian[5], Chacopata, Chayma, Chiquena[5], Core, Cuaga, Cumanagoto, Cumayena (*Surinam*), Cuneguara, Cunuana, Curasicana, Decuana, Diau (*British Guiana*), Galibi (*French Guiana*), Guagua (*Colombia*), Guaque (*Colombia*), Hianacoto (*Colombia*), Ihuruana, Ingarico (*British Guiana*), Jauaperi[5], Macussi (*British Guiana, Brazil*), Mahotoyana (*Colombia*), Maitsi, Maquiritare, Mapoye, Mayongong, Monoico (*British Guiana*), Mutuan[5], Oiana (*Brazil, Surinam, French Guiana*), Palenque, Paravilhana[5], Paria, Pariagoto, Patamona (*British Guiana*), Pauchi[5], Pauchiana[5], Pianocoto (*British Guiana, Brazil*), Piritu, Puricoto[5], Quenoloco (*Brazil, British Guiana*), Quiriquire, Riama (*Colombia*), Rucuyen (*French Guiana; Brazil?*), Sapara[5], Tagare, Taparito, Taurepan (*Venezuela, Brazil*), Teueia[5], Tivericoto[5], Toto, Totomaco, Trio (*Surinam*), Tsahatsaha (*Colombia*), Uaica (*Venezuela, British Guiana*), Uaimiri[5], Uaiquiare, Uaiumare[5], Uaiuai[5], Upurui (*Surinam*), Urucuena[5], Xiparicot, Yabarana, Yacaoyana (*Colombia*), Yecuana ([5]indicates *Brazil;* those not marked are *Venezuela*)
			Southern Cariban	Apalaquiri, Apiaca, Arara, Bacairi, Etagl, Guicuru, Jaruma, Mariape, Nahucua, Naravute, Pariri, Timirem (*Brazil*)
			Northwestern Cariban	Ancerma, Antioquia, Arbi, Arma, Bubure[6], Buga, Burede[6], Buritica, Calamari, Camaniba, Caramanta, Carare, Carate, Carex, Cari, Carrapa, Cartama, Catio, Cenufana, Chanco, Chanco, Chaque[6], Cima, Coanao (*Venezuela; Colombia?*), Colima, Corome, Dabeibe, Empera, Evejico, Funucuna, Gorron, Guatica, Guazuzu, Macoa[6], Mape[6], Mompox, Muzo, Naura, Nauracoto, Nonama, Nutabe, Opon, Pacabueye, Panche, Pantagoro, Paparo (*Panama*), Pariri[6], Patagon (*Peru*), Paucura, Pemeno[6], Pemeo, Picara, Pijao, Pozo, Quimbaya, Quindio, Quiriquire[6], Tabuya, Tahami, Tolu, Tucuco[6], Turbaco, Uruba, Yapel, Yarigui, Zapara[6], Zendagua, Zopia ([6]indicates *Venezuela;* those not marked are *Colombia*)
		Peba-Yaguan	Peba-Yagua	Peba, Yagua (*Peru*)
			Yameo	Masamai, Yameo (*Peru*)
			Witotoan	Andoque (Norte), Andoque (Sur), Araracuara, Bora, Fitita, Muenane, Nonuya, Ocaina, Coeruna, Witoto, Miranya, Orejon, Resigero (*Colombia*)
		Unclassified		Cucura, Palmela, Pimenteira (*Brazil*), Taruma (*Brazil, British Guiana*)
	Macro-Ge	Ge	Northwest Ge	Apanhecra, Apinage, Augutge, Caiamo, Caiapo (Norte), Caiapo (Sul), Caracatage, Caraho, Chacamecra, Craho, Creapimcatage, Crenge (Cajuapara), Cricatage, Cruatire, Cucoecamecra, Curupite, Duludi, Gorotire, Gradaho, Gurupy, Ira-Amaire, Macamecran, Mehin, Norocoage, Paicoge, Pau d'Arco, Piocobge, Poncatage, Purecamecran, Purucarod, Quencatage, Quenpocatage, Ramcocamecra, Suia, Uchicrin (*Brazil*)
			Central Ge	Acroa (Norte), Acroa (Sul), Aricobe, Arua, Chacriaba, Chavante, Cherente, Goia, Guegue, Ponta, Timbira (*Brazil*)
			Jeico	Jeico (*Brazil*)
		Caingangan	Caingang	Caingang (São Paulo), Caingang (Parana), Caingang (Rio Grande do Sul), Chiqui, Nhacfateitei (*Brazil*)
			b	Chocren (*Brazil*)
			Taven	Cabelludo, Chiqui, Guaiana, Gualachi, Ivitorocai (*Paraguay*), Tain (*Brazil* unless otherwise shown)
			d	Dorin (*Brazil*)
		Camacanian	Camacan	Camacan (*Brazil*)
			Cutachoan	Catethoi, Cutacho (*Brazil*)
			c	Menian (*Brazil*)
			d	Massacara (*Brazil*)
		Machacalian	a	Capocho (*Brazil*)
			b	Cumanacho (*Brazil*)
			c	Macuni (*Brazil*)
			d	Machacali (*Brazil*)
			e	Monocho (*Brazil*)
			f	Panhame (*Brazil*)
			g	Paraxim (*Brazil*)
		Purian	Coroado	Coroado (*Brazil*)
			Puri	Puri (*Brazil*)
			Patacho	Patacho (*Brazil*)
			Malali	Malali (*Brazil*)
			Coropo	Coropo (*Brazil*)
			Botocudo	Arana, Chonvugn, Crecmun, Gueren (*Brazil*)
			Gutucracan	Gutucrac, Minhagirun (*Brazil*)
			f	Nacrehe (*Brazil*)
			g	Giporoc, Poica (*Brazil*)
			h	Anquet (*Brazil*)
			i	Nacnhanuc (*Brazil*)
				Aimore (*Brazil*)
				Aimbore (*Brazil*)
		Chiquito		Chiquito (*Bolivia*)
		Unclassified		Fulnio, Guato (*Brazil, Bolivia*), Oti (*Brazil* alone unless otherwise shown)

Provisional Classification of Aboriginal Languages of Latin America—Continued

After McQuown (1955) and Greenberg (1956)*

Phylum	Stock	Family	Subfamily	Languages
Ge-Pano-Carib —Continued	Borotuque	Bororoan	Bororo	Acione, Aravira, Biriune, Bororo (Cabasal), Bororo (Campanha), Orarimugudoge, Umotina (*Brazil*)
		Otuquean		Covareca, Curuminaca, Otuque (*Bolivia*)
			Coravecan	Coraveca, Curave (*Bolivia*)
	Carajan	Caraja		Caraja, Carajahi (*Brazil*)
		b		Javahe (*Brazil*)
		ɛ		Chambioa (*Brazil*)
	Macro-Panoan	Panoan	Central Panoan	Amahuaca (*Peru, Brazil*), Aranaua, Arara, Busquipani[7], Cachinaua, Canamari, Capanahua[7], Carapacho[7], Catuquina, Caxibo[7], Chipinaua, Comobo[7], Conibo[7], Contanaua, Cuianaua, Culino, Epetineri[7], Espino, Jaminaua, Jauanaua, Jauavo, Jumbanaua, Jura, Manamabobo[7], Manaua[7], Marinaua, Maspo[7], Mochobo[7], Niaragua[7], Nucuini, Pacanaua, Panobo[7], Pichobo[7], Poianaua, Puyamanahua[7], Remo[7], Ruanagua[7], Runanaua, Sacuia, Saninaua, Saninauaca, Sensi[7], Setebo[7], Sinabo[7], Soboibo[7], Tuchinaua, Xipibo[7] ([7]indicates ɒɯɹall others əɹɐ *Brazil*)
			Southwest Panoan	ʎɪəuə, Atsahuaca, Yamiaca (*Peru*)
			Southeast Panoan	Capuibo, Caripuna[8], Chacobo, Jacaria[8], Pacaguara (*Bolivia; Brazil?*), Sinabo, Zurina[8] ([8]indicates *Brazil;* those not marked are *Bolivia*)
		Tacanan	Araonan	Araona, ʃəpəsbɐnɐ, Cavinya, Mabenaro, Machui (*Bolivia*)
			b	Arasa (*Peru*)
			Maropan	Maropa (*Bolivia*)
			Tacana	Tacana, Toromona (*Bolivia*)
			Tiatinaguan	Chama (*Bolivia*), Guacanahua (*Bolivia*), Tiatinagua (*Peru; Bolivia?*)
		Macro-Guaycuruan	Mataco-Maca	Abucheta, Axluslay (*Paraguay*), Choroti[9], Enimaca (*Paraguay*), Guentuse[9], Guisnay[9], Huexuo, Lengua (*Paraguay*), Mataco, Mataguayo, Nocten, Pesatupe, Vejoz ([9]indicates *Paraguay* und *Argentina;* those not marked əɹɐ *Argentina* alone)
			Guaycuruan	Abipon, Aguilot, Apacachodegodegi (*Paraguay, Brazil*). Caduveo[10], Eyibogodegi[10], Gotocogegodegi[10], Guetiadegodi (*Paraguay, Brazil*), Gulgaissen, Lichagotegodi[10], Magach, Mepene, Mocovi, Opaie[10], Payagua (*Bolivia, Paraguay*), Pilaga, Sarigue (*Paraguay*), Toba (*Paraguay, Argentina; Bolivia?*), Yaaucaniga ([10]indicates *Brazil;* those not marked are *Argentina*)
			Lule-Vilelan	Atalala, Chunupi, Lule, Malbala, Ocole, Pasain, Umuapa, Vacaa, Vilela, Yecoanita, Yooc (*Argentina*)
			Mosetenan	Chimane, Mosetene (*Bolivia*)
			Mascoian	Angaite, Caiotugui, Casquiha, Enenslet, Lengua, Machicui, Mascoi, Sanapana, Sapuqui (*Paraguay*)
			Unclassified	Charrua (*Uruguay*)
	Nhambicuran	Nhambicuara	Northeast Nhambicuaran	Anunze, Cocozu, Congore, Nene (*Brazil*)
			Southwest Nhambicuaran	Cabichi, Tagnani, Tauite, Uaintazu (*Brazil*)
		Pseudo-Nhambicuara		Pseudo Nhamibicuara (*Brazil*)
		ɛ		Nhamibicuara (*Brazil*)
	Huarpean	a		Allentiac (*Argentina*)
		b		Millcayac (*Argentina*)
		ς		Huarpe (Puntano) (*Argentina*)
		d		Puelche (Cuyo) (*Argentina*)
		ɐ		Pehuenche (ʎrgentina)
Andean Equatorial	Andean	Araucanian-Chon	Araucanian	Chilote, Cuncho, Diviche[11], Leuvuche[11], Manzanero[11], Mapuche, Moluche[11], Pehuenche (*Chile, Argentina*), Picunche, Pichihuilliche, Ranquelche[11], Serrano, Taluche[11] ([11]indicates *Argentina*; those not marked are *Chile*)
			Tehuelche	Inaquen, Payniquen, Poya, Teuex (*Argentina*)
			Ona	Haux, Selcnam (Norte), Selcnam (Sur) (*Argentina, Chile*)
			Alacalufan	Aduipliin, Alacaluf, Caucahue, Enoo, Lecheyel, Yequinahue (*Chile*)
			Unclassified	Puelche (*Argentina*), Yahgan (*Chile*)
		Zaparoan	Coronadoan	Coronado (*Peru; Ecuador?*), Oa (ɒɹɯ)
			Omurano	Pinche, Roamaina, Zapa (*Peru*)
			Andoan	Andoa (*Peru; Ecuador?*), Asaruntoa, Auve, Gae (*Ecuador*), Guallpayo, Guasaga, Iquito, Maracana, Murato (*Peru; Ecuador?*), Semigae (*Ecuador; Peru?*) (*Peru* unless otherwise sbown)
			Sabelan	Sabelaʌ(*Ecuador*)
		~ ¿ ~	p ə ɹ ~	Zaparo (*Peru, Ecuador; Colombia?*)
		Cahuapanan	Cahuapana	Cahuapana (*Peru*)
			Cheberoan	Ataguate, Chayahuita, Chebero, Yamorai (*Peru*)
		Quechu-Maran	Quechuan	Almaguero (*Columbia*), Ancax, Arequipa, Ayacucho, Cajamarca, Canelo (*Ecuador*), Cavina, Chachapoya, Chasutino, Chilque, Cuzco, Huanuco, Ingano (*Columbia; Ecuador?*), Junin, Lamanyo, Lare, Maina (*Ecuador, Peru*), Paucartampo, Quechua, Quechua (Argentino) (*Argentina*), Quechua (Boliviano) (*Peru, Bolivia, Chile, Argentina*), Quechua (Quitenyo) (*Colombia, Ecuador, Peru*), Quechua (Tuichi) (*Bolivia*), Quechua (Ucayali), Quijo (*Ecuador*), Santiago de] Estero (*Argentina*), Vilcapampa, Yanahuara (*Peru* unless otherwise shown)
			Aymara	Cana[12], Canchi[12], Caranga, Charca, Colla (*Peru, Bolivia*), Collagua[12], Collahuaya, Lupaca[12], Omasuyo, Pacasa, Paria, Quillaca, Sicasica, Ubina[12] ([12]indicates *Peru;* those not marked are *Bolivia*)
		II A-4(Greenberg)		Catacao (*Ecuador*), Colan (*Peru*), Leco (*Bolivia*), Sec (*Peru*), Xibito-Cholon (*Peru*)

Provisional Classification of Aboriginal Languages of Latin America—Continued

After McQuown (1955) and Greenberg (1956)*

Phylum	Stock	Family	Subfamily	Language
Andean Equatorial —Continued	II-B (Greenberg)	Jivaroan	Jivaro	Aguaruna (*Peru; Ecuador?*), Bolona (*Ecuador*), Jivaro (*Ecuador; Peru?*)
			Paltan	Malacato (*Ecuador*), Palta (*Ecuador, Peru*)
			Candoa	Candoa (*Ecuador; Peru?*)
		Unclassified		Cofan (*Ecuador*), Esmeralda (*Ecuador; Colombia?*), Yaruro (*Venezuela*)
	Macro-Tucanoan	Catuquinean-Tucanoan	Catuquinean	Amenadiapa, Bendiapa, Burue, Cadiudiapa, Caduquilidiapa, Canadiapa, Canamari, Catauichi, Cutiadiapa, Catuquina, Catuquino, Hondiapa, Marodiapa, Paraua, Pidadiapa, Tauare, Uadioparanindiapa, Uiridiapa, Ururudiapa (*Brazil*)
			Tucanoan	Amaguaje (*Colombia, Ecuador, Peru*), Arapaso[13], Ayrico, Bahuna, Baniua[13], Bara, Boloa, Buhagana, Carapana[13], Caxiita, Cieguaje, Coroua, Correguaje, Coto (*Peru*), Cubeo (*Colombia, Brazil*), Cueretu (*Colombia, Brazil*), Datuana, Dessana[13], Encabellado (*Colombia, Peru; Ecuador?*), Erulia, Guaciguaje, Hahanana, Hobacana[13], Holona, Julaimaua[13], Macaguaje (*Colombia, Ecuador*), Macuna, Neenoa (*Colombia; Brazil?*), Omoa, Opaina, Pamoa, Palanoa, Pioje (*Peru; Ecuador?*), Piratapuyo, Sara, Sioni (*Colombia, Ecuador, Peru*), Tama, Tsola, Tsoloa, Tucano[13], Tuyuca[13], Uaiana (*Brazil; Colombia?*), Uaicana[13], Uainana, Uanana[13], Uasona (*Brazil; Colombia?*), Uiua[13], Yahuna (*Brazil; Colombia?*), Yohorca (*Colombia, Brazil*), Yupua ([13]indicates *Brazil;* those not marked are *Colombia*)
			Munichean	Muniche, Otanabe (*Peru*)
			Unclassified	Auaque (*Venezuela*), Caliana[14], Canichana (*Bolivia*), Macu (*Venezuela*), Movima (*Bolivia*), Tucuna[14], Yuri[14] ([14]indicates *Brazil*)
		Simacu		Simacu (Urarina) (*Peru*)
		Puinavean	Puinave	Guaipunave, Puinave (*Colombia*)
			Macuan	Macu (*Brazil, Colombia*), Nadobo (*Brazil*), Yapooa (*Colombia*)
	Equatorial	Arawakan	Northern Arawakan	Achagua (*Venezuela, Colombia*), Alile[15], Amarizana, Axagua[15], Cabre (*Lesser Antilles, Colombia; Dominican Republic?*), Caouri, Caquetio (*Bonaire, Curacao, Aruba, Venezuela*), Chapan, Chimila, Chucuna, Ciguayo (*Dominican Republic*), Cosina[15], Eperigua, Guaicari[15], Guajiro (*Colombia, Venezuela*), Guanebucan, Guayupe, Igneri (*Trinidad, Tobago*), Lucayo (*Bahamas*), Masivaribeni, Mitua, Motilon (*Venezuela, Colombia*) Paraujano[15], Piapoco, Sae, Subtaino (Cuba) (*Cuba*), Taino (Haiti) (*Haiti, Dominican Republic*), Taino (Puerto Rico) (*Puerto Rico*), Tairona, Tayagua[15], Tecua, Toa[15], Yaguai[15] ([15]indicates *Venezuela;* those not marked are *Colombia*)
			Northern Amazon Arawakan	Adzaneni (*Colombia; Brazil?*), Amariba (*British Guiana*), Arawak (*Venezuela, British Guiana, Surinam, French Guiana, Brazil*), Arequena (*Brazil, Venezuela; Colombia?*) Arua, Aruaqui, Atorai (*British Guiana; Brazil?*), Avani (*Venezuela, Colombia*), Barauna, Bare[16], Cariaia, Carutana, Catapolitani, Caua (*Brazil; Colombia?*), Cauichana, Cauyari (*Colombia*), Cuati (*Brazil; Colombia?*), Guaniare[16], Guinao[16], Huhuteni, Ipeca (*Brazil; Colombia?*), Itayaine, Jabaana, Jauarete, Jumana, Jurupari, Maiopitian, Maipuri[16], Manao, Mandauaca, Mapanai, Maraon (*French Guiana; Brazil?*), Mariate, Masaca[16], Matapi (*Colombia*), Moriuene, Palicur (*Brazil, French Guiana*), Passe, Quirruba (*Colombia*), Siuci, Tapiira (*Colombia, Brazil*), Tariana, Uainuma, Uapichana (*Brazil; British Guiana*), Uirina, Yavitero (*Venezuela; Colombia?*), Yucuna (*Colombia*) ([16]indicates *Venezuela;* those not marked are *Brazil*)
			Pre-Andine Arawakan	Antaniri, Anti, Cacharari[17], Camatica, Campa, Canamari[17], Catiana[17], Catongo, Catuquina[17], Chontaquiro, Chicheren, Cujisenajeri[17], Cuniba[17], Cutinana[17], Huachipairi, Inapari[17], Ipurina[17], Machiguenga, Maniteneri[17], Maraua[17], Masco, Pangoa, Piro, Quimbiri, Quirinairi, Simirinch, Sirineri, Tampa, Uaraicu[17], Uainamari[17], Ugunichiri, Unini ([17]indicates *Brazil;* all others are *Peru*)
			South Arawakan	Baure[18], Cachiniti, Chane[18], Cozarini, Custenau, Echoaladi (*Paraguay*), Equiniquinao (*Bolivia, Paraguay, Brazil*) Guana (*Brazil, Paraguay*), Iranche, Izocenyo (*Paraguay*), Jaulapiti, Layana (*Paraguay*), Mehinacu, Mojo[18], Paiconeca[18], Paressi, Paunaca[18], Saraveca (*Brazil; Bolivia?*), Tereno (*Paraguay, Brazil*), Uaura ([18]indicates *Bolivia;* those not marked are Brazil)
			Chapacuran	Chapacura, Itoreauhip, Herisabocono, Jamara[19], Jaru[19], More, Napeca, Ocorono, Pacas Novas[19], Quitemoca, Sansimoniano, Tora[19], Urumi[19], Urupa[19] ([19]indicates *Brazil;* all others are *Bolivia*)
			Uanhaman	Abitana-Uanham, Cabichi, Cujuna, Cumana, Cutiana, Mataua, Urunamacan (*Brazil*)
			Arauan	Arauan, Cipo, Culina, Culinha, Culino, Curia, Jamamadi, Juberi, Madiha, Pama, Pamana, Paumari, Purupuru, Seuacu (*Brazil*)
			Chamicura	Chamicura (*Peru*)
			Unclassified	Amuexa (*Peru*), Apolista (*Bolivia*), Uru (*Peru, Bolivia*)

Provisional Classification of Aboriginal Languages of Latin America—Continued

After McQuown (1955) and Greenberg (1956)*

Phylum	Stock		Family	Subfamily	Languages
Andean Equatorial —Continued	Equatorial —Continued	1	Tupi-Guarani	Guaranian	Apapocuva, Arechane, Avachiripa, Avahuguai, Caingua (*Brazil, Paraşuay; Argentina?*), Canoeiro, Carima, Catanduva, Chane (*Bolivia*), Cheiru[20], Chiriguano (*Bolivia, Argentina*), Chiripa[20], Guarani (*Brazil, Paraşuay, Argentina*), Guayana[20], Guayaqui (*Paraşuay*), Guarayu (*Bolivia*), Itatin (*Brazil, Paraşuay*), Ivapare, Mbya (*Brazil, Argentina*), Oguiva, Paiguassu, Panh (*Brazil; Argentina?*), Paranae (*Paraşuay*), Pauserna (*Bolivia*), Siriono (*Bolivia*), Taioba, Tanygua, Tape, Tapiete (*Bolivia, Paraşuay*), Tapirape, Taruma[20], Tobatin (*Paraşuay*), Tora, Yvytyigua ([20]indicates *Brazil and Paraşuay*; those not marked are *Brazil* alone)
				Tupian	Aizuare, Amanage, Amoipira, Anambe, Anta, Apairande, Apiaca, Apoto, Ararandeuara, Arauine, Arauiti, Aricobe, Arupai, Asurini, Aueto, Bonama, Caete, Caiabi, Caliana, Camacom, Camaiura, Catuquinaru, Cauaiua, Chipaia, Cocama (*Peru*), Cocamilla (*Peru*), Cubeneire, Cujerob, Curuaia, Curuzicari, Cussari, Emerillon (*French Guiana*), Guaiajui, Guaja, Guajajara, Guaracaio, Itogapuc, Jacunda, Juruna, Manitsaua, Maue, Miranho, Mundurucu, Muriaipigtanga, Nhengahiba, Odiahuibe, Qiampi (*Brazil, French Guiana*), Omagua (*Brazil, Peru*), Pacaja, Paguara, Pairiipiranga, Paracana, Paranauat, Parintintin, Potiguara, Ramarama, Soliman, Tacunhape, Taipechichi, Tamoia, Tamoio, Tapanhuna, Tembe, Timimino, Tobajara, Tupi, Tupina, Tupinamba, Tupinambarana, Tupiniquin, Turuara, Uaraguassu, Uirafed, Urubu (*Brazil* unless otherwise shown)
		1	Unclassified		Ariqueme (*Brazil*)
			Cuica-Timote	Cuican	Cuica (*Venezuela*)
				Timotean	Timote (*Venezuela*)
			Cariri	Cariri	Camuru, Cariri, Dzubucua, Pedra Branca, Quipea (*Brazil*)
				b	Sapuia (*Brazil*)
		2	Zamucoan	North Zamucoan	Cucarate (*Bolivia, Paraşuay*), Guarayoca (*Bolivia*), Moro[21], Poturero (*Bolivia; Brazil? Paraşuay?*), Tsiracua (*Bolivia, Paraşuay*), Zamuco[21], Zatienyo[21] ([21]indicates *Paraşuay*)
				South Zamucoan	Caipotorade, Ebidoso, Horio, Imono, Tumereha, Tunacho (*Paraşuay*)
		3	Mocoa	a	Sebondoy (*Colombia*)
				b	Quillacinga (*Colombia*)
				c	Patoco (*Colombia*)
			Salivan	a	Saliva (*Venezuela, Colombia*)
				Piaroan	Ature, Macu, Piaroa, Quaqua (*Venezuela*)
				Pamiguan	Pamigua, Tinigua (*Colombia*)
			Guahibo-Pamiguan	Guahiban	Chiricoa[22], Churoya, Cuiba[22], Cunimia, Guahibo[22], Guayavero, Sicuane, Yamu[22] ([22]indicates *Venezuela and Colombia*; others are *Colombia* alone)
			Otomaco-Taparita		Otomaco (*Venezuela*)
					Taparita (*Venezuela*)
		4			Tuyuneri (*Peru*)
		5	Yuracarean	c	Yuracare (*Bolivia*)
		6			Trumai (*Brazil*)
			Cayuvava		Cayuvava (*Bolivia*)

administrative system, and produced some remarkable technological achievements. The attainment of agricultural surpluses coupled with the construction of an elaborate system of roads and communications permitted the growth of truly urban centres. A strong centralized government developed uhich replaced traditional tribal custom by a complex code of laws and regulations enforced through a judicial system.

Religion was organized around a state temple cult, served by a graded priesthood. Social classes became hereditary. self-perpetuating castes; high-caste nobles took part in government and religious affairs while commoners tilled the soil or engaged in manufactures. Warfare was an implement of imperialist conquest rather than a source of slaves and ritual victims.

Marginal Regions. — In greatest contrast are the marginal peoples, a term referring to clumps of tribes widely scattered over different areas of South America. They include small tribal groups in the Chaco and in the interior forests of Brazil, shellfish gatherers of Chile. hunters of Patagonia and Tierra del Fuego. Their cultures differed greatly one from another; nhat they had in common was that they were all peoples of simple technology and rudimentary social organization; all told. they numbered about 750,000 people. They lived chiefly by hunting and gathering. although some of the northern groups practised a limited and not very efficient agriculture. Mostly these were nomadic bands, made up of a single kinship group or of several unrelated families or clans. Lineage groups were rarely larger than 60 persons ; chiefs or formal government were usually lacking. With subsistence depending on the availability of wild foods, their life was materially meagre. Their cultures were able to develop only those elaborations possible under conditions of nomadism and simple technology; these were chiefly in the fields of personal adornment, dances, songs and games. Religion generally laid great stress on shamanism and magic. Warfare was unorganized and typically defensive.

It is worth noting again that these various areas differed frorn one another not only in

the way of life of their peoples, but in the density of their populations. At one extreme, the marginal tribes of southern Argentina and Chile had exceedingly sparse populations — less than nine persons per 100 sq.km. — and naturally so, because of their nomadism and their subsistence on widely scattered wild foods. At the other extreme, the two areas of high civilization — Mesoamerica and the central Andes — had relatively dense populations, supported by intensive agriculture. Population density in the central Andes was about 720 persons per 100 sq.km. and in Mesoamerica 300. In between were the tropical forest areas, with a density of something like 10 to 50 persons per 100 sq.km., and the circumcaribbean area with a wide range including West Indian islands with densities over 500. Density of population, then, was closely correlated with cultural complexity, and with the development of political systems integrating larger numbers of people.

THE INDIANS TODAY

Although there are still areas in the interior of South America where Indians are hostile and virtually isolated, almost all Indians have been greatly affected by European contact and settlement; there are large areas in which Indians are no longer identifiable as such. Nevertheless it is no less true that Indians and Indian culture have been remarkably resistant to erosion. Many Indian techniques, especially in agriculture, food and household arts, were adopted by Europeans as soon as they settled in the new environment. Likewise, the Indians quickly accepted many items of European technology and merged the new religious and governmental systems with their own. In virtually all of Latin America, Indian and European cultural elements (and African wherever African Negroes had been imported) blended freely. Most of the interchange came in the first years of conquest and colonization, after which there was a long period of consolidation in which the cultural mixture became well established. In recent decades, with the improvement in communications, there appears to have begun a second great adjustment of Indians to the novelties of the world outside.

Perhaps it should be said not so much that Indian culture has been resistant as that Indians have adjusted to new circumstances within their own systems of values. One assumes then that where adjustment required major changes in values, the Indians either did not adjust or else they stopped being Indians. At least the approximately 7,000,000 Indians counted in censuses generally live by the values of their traditional cultures. There are other millions who share Latin-American culture, but these also identify themselves not as Indians but as nationals of the countries in which they live.

The fate of Indian communities in Latin America depended less on the nature of the conquest and colonization (which was fairly uniform) than on differences in aboriginal settlement and culture. Where Indians were populous and highly organized (as in Mesoamerica and the Andes) the Spaniards simply replaced the native religious and political central organization with their own bureaucracy; the Indians were exploited, as Indians, and retained their identity and large numbers. These are the areas that Elman Service calls Indo-America, including central and southern Mexico, Guatemala, the highlands of Colombia, Bolivia, Peru and Ecuador. At the other extreme the aboriginal marginal areas had sparse Indian populations of mobile independent tribes who generally were subjugated one by one and administered only with difficulty. As in North America, these tribes tended to maintain their identity and their ways of life, but as small islands in a sea of European culture (Service's Euro-America). Most of the erosion therefore occurred only in the tropical forest and circumcaribbean areas. There the Indians were settled in villages where Europeans could easily maintain contact and control; but since the Indians were relatively few in numbers and lived in somewhat independent communities, they lost many of their members to the European society, which became mixed European-Indian. Compared with those of Indo-America and of Euro-America, the Indians of this mestizo America have been losing their identity. But even there (except in the West Indies) they are far from being on the verge of disappearance; about 1,200,000 Indians — 17% of the population of mestizo America — are considered and consider themselves Indians.

It would be rash to predict the disappearance of Indian identity and cultures. But perhaps for the first time in history there began in the second half of the 20th century a serious attempt to bring to the Indians the benefits of modern medicine and technology, to build highways so that they could move their goods by truck and to offer genuine opportunity to learn new techniques, including those of literacy and business institutions. Whether Indian communities which voluntarily accepted novelties (without building the resistances often engendered by attempts to apply pressure) would lose their community integrity and culture together with their isolation remained a question. The sympathetic "Indianist" movement is furthest advanced in Mexico, where the evidence tends to show that new "adjustments" can be made without necessarily changing Indian values or destroying community identity; but any conclusion had to await future developments. See also INDIAN, KORTH AMERICAN; ARCHAEOLOGY; CENTRAL AMERICA; SOUTH AMERICA; AMERICAN ABORIGINAL LANGUAGES; CENTRAL AND KORTH AMERICAN LANGUAGES; SOUTH AMERICAN LANGUAGES; and articles on individual countries.

BIBLIOGRAPHY.—Summaries including extensive bibliography will be found in Julian H. Steward (ed.), *Handbook of South American Indians,* 6 vol. with a general index (1946–1950); Sol Tax *et al., Heritage of Conquest: the Ethnology of Middle America* (1952); Norman A. McQuown, "The Indigenous Languages of Latin America," *Anzer. Anthrop.,* vol. 57, no. 3, pp. 561–570 (June 1955); Sidney Mintz (ed.), "New Views on the Anthropology of Latin America," *Amer. Anthrop.,* vol. 57, no. 3 (June 1955); Emil Haury (special ed.), Southwest issue, *Anzer. Anthrop.,* vol. 56, no. 4 (Aug. 1954); Julian S. Steward and Louis C. Faron, *Native Peoples of South America* (1959); Richard N. Adams, *Cultural Surveys of Panama-Nicaragua-Guatemala-El Salvador-Honduras* (1957). (S. Tx.)

INDIAN, NORTH AMERICAN. The European discoverers of the new world had at the outset only limited access to the two American continents and could not, therefore, form any judgment as to the extent and variety of the human settlement which had occurred prior to their coming upon the scene. Not until three centuries and more had gone by would all the regions of the western hemisphere be explored and the aboriginal inhabitants noted. For all practical purposes, it can be said that all geographical regions and all climatic zones of both continents were occupied. Human population had accommodated itself to sea level and to the ultramontane conditions of the high Andes, and from arctic to tropic temperatures. Moreover, this population, at the time of its greatest diffusion over the two continents, was divided into nearly 400 major tribal groups, with countless subdivisions. The social organizations developed within these groups ranged from the simplest atomistic nomadic societies to complicated religious and economic hierarchies. The languages spoken presented a bewildering variety and complexity. The accommodation was not limited to physical adjustments of the body, but was reflected in the extent to which the animal, vegetal and mineral resources of the various regions were utilized. This utilization included the diversion of water from natural stream beds to irrigate dry lands; the mining and processing of certain ores, such as gold, silver, and copper; the domestication of an astonishing number of food and fibre plants; the manufacture of textiles and ceramics; and the development of calendric systems involving accurate knowledge of the movements of heavenly bodies. No supportable evidence has been offered that the discoveries or inventions involved in these processes were imported from the old world.

Asiatic Origin. — It is generally agreed among students of man's prehistory that the first inhabitants of the western hemisphere did not originate there. The earliest remains of man thus far found in the Americas are essentially modern in type. They display none of the archaic or primitive characteristics of the man creatures found in Java (*Pithecanthropus erectus*) or China (*Sinanthropus pekinensis*) or the later Neanderthal man found widely in Europe and Africa. It is agreed also that America was never inhabited by anthropoids which could have given rise to a parent human stock. Granting that the point of origin was somewhere outside the hemisphere, it follows rationally that Asia

is the most likely place of beginning. The level of technological advancement could not have been too high at the time of the first migrations into the new world, and this fact must rule out long sea voyages or other hazards. The break between the American and Asiatic continents at Bering strait is so slight (a matter of 45 mi., with islands lying at the midway point) as to make it, in the opinion of authorities, the only practical route. The view is also held that the migration was not a single incident, but that waves of men continuing over a long period of time were responsible for the peopling of the continents. At least partial confirmation of this hypothetical route of migration is seen in the fact that various mammals invaded North America during Pleistocene (Ice Age) times, and their remains have been found in Alaska, in the high mountain plateaus in the west, on the Great Plains and as far south as Mexico, but rarely in eastern Canada. Similarities in cultural traits, on which further comment will be made, serve further to strengthen this view of an Asiatic-American link.

Glacial Age.—The probabilities as to when this migration took place are broadly framed within the terms of glacial advance and recession across the top of North America. The so-called Ice Age consisted of four intervals of maximum glaciation and three intervening nonglacial periods, or possibly two pairs of maximum glaciated periods with a long, middle, ice-free interval, in a total time span of about 250,000 years. The exact boundaries of these glacial patterns cannot be plotted in all areas; neither can the timing be stated too precisely. Geologists believe, however, that the central plain of Alaska (south of the Brooks range and east of the Coast range), and also the lowlands bordering the Bering sea and the Arctic ocean, were at no time glaciated. The great ice barriers formed, instead, on the Pacific slope of the Coast range and poured through mountain passes for some distance. A second (Keewatin) ice sheet spread eastward from the Hudson bay area and, during the last maximum, joined with the Pacific (Cordilleran) glacier across southern Canada and the northern part of the United States. The problem of chronology, then, is to determine during what years the last maximum glaciation endured and during what intervals openings or corridors between the two ice sheets were available for southward travel. Generally it is agreed that an ice-free land route extended along the arctic coast to the Mackenzie river and southward into what is now the United States as long ago as 20,000 years. This route may also have been open for a brief period about 40,000 years ago. The next prior ice-free period would have occurred during the Sangamon interglacial epoch about 75,000 years ago. The relation of sea level to land is another factor which may have a bearing on the time and manner of migration between the two continents. At the time of the last maximum glaciation, sea level in the vicinity of Bering strait was probably lowered by as much as 240 ft., as water was converted into ice. A certain amount of sinking of the land under the tremendous weight of ice was coincident with the dropping water level. As temperatures warmed and ice returned to water. both the land and the sea level began rising, but not at the same rate. Enormous quantities of water would be needed to make an appreciable difference in the level of the sea, while pressures within the earth would respond promptly to lessening weight. This leaves the possibility that a bridge of dry land actually existed during several millenia following the last glacial epoch. Modern coast survey charts reveal that much of the bottom between the continents does not exceed 20 fathoms (120 ft.). The pattern of glaciation on the Asiatic side of Bering strait is not clear in detail, but there seems to be a certain degree of correspondence between the phases as these developed east and west of the strait. It seems likely, then, that an open land route, extending from central Asia into central North America, existed 20,000 years ago. At a later time the Yukon river valley offered an ice-free route, and still later (10,000–8,000 years ago), the Liard and Peace river systems were available for transmontane travel. The Pacific coast slope was probably available for travel at about the same time. Some migrations may also have occurred by way of the Aleutian Islands, but this would have taken place at a considerably later date.

New World Contrasts.—The data offered by physical anthropology do not preclude the possibility that as long ago as the last (Sangamon) interglacial period there were in the old world human types capable of carrying out long intercontinental treks, if such did not involve sea voyages. It dues not follow from this that migration into the new world did take place at so remote a time, but neither should the possibility be ruled out in view of an increasing number of discoveries of human occupation which are difficult to explain in terms of postglacial time. The problem of assigning dates to occupation sites and to human artifacts in the Americas has been complicated by certain apparent basic inconsistencies between European and American prehistory. In Europe the so-called Neolithic (New Stone) Age did not occur until about 8,000 B.C., whereas in the western hemisphere, if geological evidence can be accepted, man was producing equivalent stone tools and implements as many as 12,000 years before that time. In Europe, also, the comparatively primitive Neanderthal men continued until rather late, perhaps 25,000 years ago, and the assumption has persisted that men predating such a period must be at least as primitive. No skeletal material had been found by mid-20th century in conjunction with the earliest occupation sites in the Americas, but the view had become widely accepted that Neanderthal is not the progenitor of modern man in either Europe or America. According to this view, it is quite possible that men of essentially modem anatomical structure could have migrated into the new world as long ago as the Sangamon interglacial period.

Folsom Culture.—The chronological data derived from European palaeontology formerly dominated American age estimates. Beginning in 1926, however, a series of discoveries of human artifacts associated with the bones of extinct species of mammals and with identifiable geological age elements began to alter the time reference material for American prehistory. The situation was still far from clear at mid-century, since the causes and dates of disappearance of such mammals as the mammoth, archaic bison and horse and a score of others was yet to be worked out. The first important discovery was made in northeastern New Mexico near the little town of Folsom, the name of which became associated with a specific type of projectile point, three types of implements and two kinds of stone knives. Facial fluting of the projectile points and one type of knife, together with very careful chipping of the outer edges, are the characteristic identifying marks. A more generalized type of artifact is likely to be larger and to lack the additional chipping of the working edges. It is the workmanship displayed in the manufacture of these stone points and of another series designated as Yuma that resulted in a rather thorough re-examination of the comparative archaeology of the old and new worlds. By European systems of classification, the Folsom and Yuma points belonged in the Neolithic series; yet the geologic evidence of the site at which the original Folsom material was found indicated a greater antiquity than the European Neolithic. The dramatic touch which, as much as anything else, brought notoriety to the Folsom discovery was the apparent lodgment of one of the projectile points between the ribs of an extinct species of bison. In later finds, the fossilized bones of the American camel, extinct and living forms of musk ox, the giant sloth and the native horse, as well as species whose descendants are found today, are associated with the human material. After the original Folsom discovery, similar sites were located between the towns of Portales and Clovis, S.M., and at the Lindenmeier ranch near Fort Collins, in northern Colorado. At each of these sites the deposits were located under a dark soil stratum which was formed during a wet cycle, indicative of the climatic conditions prevailing near the close of the Pleistocene, or late glacial, period. Following the initial discoveries of the Folsom culture complex, a number of other sites were identified as containing comparable material, while earlier discoveries which previously had not been classified mere recognized as belonging to the same general type. Most of the Folsom material was recovered in a region bounded by the Rocky mountains, from Alberta and Saskatchewan in Canada to southern New Mexico; on the east by the western boundary of the Dakotas, western Nebraska, Kansas,

Oklahoma and Texas, where it turns eastward to the Mississippi river. Some scattered evidences are reported west of the Rockies in the Great Basin in Utah and Nevada, and one site appears to occur in southeastern California.

The so-called Yuma projectile point was found also in Colorado for the first time, and takes its name from the county of that name where the discovery was first made. The craftsmanship displayed is also of a high order, the chief identifying characteristic being a long, slender blade with finely chipped diagonal grooves. The geology of the established sites indicates that Folsom and Yuma occurred contemporaneously over at least part of their range, but the Yuma people may have survived until more recently.

Older Strata. — The Folsom material probably is not the earliest record of human occupation in the new world. Near Albuquerque, N.M., a cave in the Sandia mountains was excavated beginning in 1939 and resulted in uncovering three levels of occupation. The top layer contained artifacts belonging to the modern Pueblo culture, though the material was in fact pre-Columbian. At the bottom of this first layer occurred a hard calcium carbonate deposit. Once this intact crust was removed, the excavators found a second level of habitation, containing Folsom artifacts, along with the bones of bison, mammoth, giant sloth, camel, native horse and wolf. A stratum of yellow ochre occurred, devoid of cultural material, and at first this was thought to be the true floor of the cave. Additional digging, however, disclosed a third layer containing man-made implements, together with bones of bison. camel, mammoth, mastodon and horse. Hearth places outlined in small stones brought from outside the cave were found at this layer, with charcoal and fragments of burned bones. The Sandia type of point is cruder than Folsom work; yet it has a characteristic general outline and a notch always on one side of the base. The association of materials in horizontal strata indicates a greater age for the Sandia material, though it is not possible to determine how much older than Folsom. The yellow ochre was probably deposited at a time when moist. cool conditions prevailed in the area, again suggesting a period falling at the end of the Pleistocene, or Ice Age.

Food Gatherers. — The Sandia discovery is not the only evidence of occupation by man prior to Folsom. Near Abilene in north central Texas, occupation levels at various depths ranging from 4 to 30 ft. beneath the surface were uncovered. The lowest (Abilene complex) level produced charcoal and crude tools, including scrapers, axes and leaf-shaped points somewhat comparable with the Sandia points. The bed on which this material was deposited is thought to date from the middle of the last glacial stage, or later. At a higher level occur implements and projectiles of a type to which the name Clear Fork was given. Resemblances to Folsom types are seen in this material. The top stratum, as at Sandia, contains remains of pre-Columbian Indians of the Texas area. The Abilene. Sandia and Folsom material are all suggestive of a hunting economy. and it is usually assumed that the men crossing over from Asia were hunters pursuing game and constantly searching for a more plentiful supply. Certainly the weapons and implements of this early man confirm this picture. In at least one instance, however, material was recovered from deposits of some antiquity which indicates that the people were seed gatherers and grinders rather than hunters. This is the so-called Cochise culture, the original site of which was discovered near Douglas, Ariz. The area was thoroughly explored and a record of occupation covering a very long period was reconstructed.

While an exact date could not be given at mid-20th century for the original entry of man into the new world, certain archaeological sites had been tentatively dated and these provided some clues to the possible antiquity of human occupation. As already indicated, a thoroughfare extending from southeast Asia and continuing through Alaska and out to the great central plain of North America was probably available to man 20,000 years ago; a similar corridor may have been open 20,000 years earlier. Speculation beyond that point seemed unwarranted. The Lindenmeier (Folsom) site in northern Colorado had been given a date of 10,000 to 25,000 years, with archaeologists favouring one or the other extreme. The Sandia site, assuming it to be older than Folsom, might well be placed at or near the upper range of the 10,000–25,000-year span. The Abilene culture was correlated with Sandia, while Cochise appeared to be at least 10,000 years old.

With the announcement in 1947 of successful tests to measure quantitatively the residual amounts of radiocarbon present in nonliving organic materials, a wholly new method of arriving at age determinations became possible. Subsequently the technique was applied to organic substances recovered from various archaeological sites, in collaboration with a committee composed of anthropologists and geologists.

THE PEOPLE

Physical Types. — The American Indian appears not to represent a homogeneous racial stock, though it has been customary so to describe him. This can be explained perhaps by the fact that certain outward characteristics seemed to be fairly uniformly present among the living Indians with whom Europeans came into contact. Thus, the reddish-brown skin, straight black hair, dark brown eyes, high cheekbones and scant beard and body hair generally observed among the various Indian tribes came to be accepted by the casual observer as the Indian type par excellence. Skeletal material from the earliest levels of occupation has been largely lacking and absence of comparative data tended to prolong the view of uniformity. Also, as there came to light skeletal material such as the Lagoa Santa skulls in Brazil, the Punin skull in Ecuador and the so-called Minnesota man, it was analyzed more with a view to determining what information it might provide with regard to the antiquity of the race than its place in a system of classification. In course of time all students came to remark one pronounced distinction between the earliest and later crania: the earliest are invariably longheaded (dolichocephalic), while the skulls which date from about the time of the development of agriculture or slightly before are broad (brachycephalic). It is thought that two waves of longheaded people moved into the new world, and that the earliest of the two might be termed a hyperdolichocephalic, or extra-longheaded specimen. It is even suggested that a line drawn between San Francisco, Calif., and the Gulf of Mexico would divide this earlier, or extra-longheaded, man from the later and less longheaded arrival; and moreover, such a line would divide seed gatherers and grinders such as characterized the Cochise culture of southeastern Arizona from the predominantly hunting culture typified, presumably, by Folsom remains. This may oversimplify the underlying situation, but it serves to emphasize the lack of homogeneity in this earliest material.

It is likely that the peopling of the American continents was accomplished over a long period of time, in successive waves of migration. Moreover, these succeeding waves were doubtless composed of people of different points of origin, quite likely of different language stocks, and certainly of nonhomogeneous physical types. In the first wave or series of waves moving over a considerable period of time, groups of people crossed into the new world, bringing with them such cultural elements as the bow, harpoon, atlatl (spear thrower), clubs, spears, perhaps daggers of stone and bone, chipped and flaked stone implements, bone awls, twisted cords and twined or woven baskets and nets, cooking with heated stones in vessels of bark, wood or skin, and the domesticated dog. In physical type, these first people represented a blend of three racial strains, all longheaded: (1) one resembling the stock called "Mediterranean"; (2) a more primitive form with heavy brow ridges, broad face and wide nose, usually identified as "Australoid"; and (3) a Negroid strain. The mixing of these types occurred before the movement into the new world got under way, and the migration occurred before people of Mongoloid features reached northeast Asia. The latter people are predominantly roundheaded, with relatively low head height, and flat nosed. These features are not found among skeletal remains identified with the earliest occupation levels. Eventually, a second wave of migration, composed of a Mongoloid people, crowded the earlier longheads into the peripheral areas of the new

TABLE I.—Aboriginal Indian Population, North of Mexico

Area	Date	Estimated Population
North Atlantic: (New England, New York, New Jersey, Pennsylvania)	1600	55,600
South Atlantic: (Delaware, Maryland, Virginia, West Virginia, the Carolinas, except Cherokee country)	1600	52,200
Gulf states: (Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Tennessee, Cherokee country)	1650	114,400
Central states: (Ohio valley from Alleghenies to Mississippi, Chippewa in Canada)	1650	75,300
The Plains (Canada to Gulf):		
Northern	1780	100,800
Southern	1690	41,000
Columbia River basin: (Washington, most of Oregon, northern half of Idaho)	1780	80,200
California	1769	260,000
Central mountain: [Nevada, Utah, parts of surrounding states)	1845	19,300
New Mexico and Arizona	1680	72,000
British America: (Eastern Canada, central Canada, British Columbia)	1600–1780	190,950
Alaska	1740	72,600
Greenland	1721	10,000
Total		1,153,450

Source: James Mooney, "The Aboriginal Population of America North of Mexico," Smithsonian Miscellaneous Collection, Vol. 80, No. 7 (1928).

Analysis of these figures according to modern political divisions yields roughly the following subtotals as of dates given above:

United States (except Alaska)	849,000
Alaska	73,000
British America	221,000
Greenland	10,000

world.

In reconstructing the prehistory of the American Indians, the roundheads are identified with the development of the high material cultures, indicating a greater capacity for invention and adaptation or perhaps indicating only that these later comers brought with them technologies which had not yet been developed at the time of the first migrations. The Eskimo people were the last to move into the new world, most estimates placing the time of their migration at about 2,000 years ago. In spite of their close resemblance to the Mongoloid type (narrow, flat nose, smoothness over the brow ridge and epicanthus fold at the inner eye), the Eskimos are essentially longheaded. This probably resulted from crossing with the earlier dolichocephalic Indian strains which preceded the Eskimos into the arctic area.

Population. — Estimates of the aboriginal population are inevitably based on information supplied by explorers. traders, missionaries and other early reporters. Any so-called estimate of the population as of the time of Christopher Columbus can be only a fictitious figure. Moreover: estimates based on first contacts are only as good as the reporter's observations are trustworthy. A more serious impediment to a completely accurate count is that some tribes, by the time the explorers. traders or missionaries caught up with them, had already been depopulated by epidemics reaching them from tribes in contact with Europeans or by enemy tribes obtaining more efficient killing weapons ahead of them. The estimates supplied by James Mooney in Table I, it should be noted, are given an approximate dating.

A. L. Kroeber submitted an almost identical total for the area north of Mexico, though he subgrouped the material to accord with subsistence areas rather than geographic boundaries. In addition, he ranked the areas according to population densities, expressed in numbers of persons per square kilometre: California area 43.40; northwest coast 28.30; southwestern United States 10.70; Columbia-Fraser river area 7.15; eastern area 6.95; arctic coast 4.02; Great Basin 2.47; and northern area 1.35. While the agricultural areas of the east and southwest contained the greater population (about 405,000 in all), Kroeber believed the predominantly fishing economy of the Pacific coast (Bering strait to southern California) had greater relative density of population, His estimates were: Pacific coast 25.2 persons per square kilometre; agricultural areas 10.1; remaining area north of Mexico 2.2.

Estimates of population for the entire hemisphere have fluctuated between wide ranges, running as high as 50,000,000 to 75,000,000 for the period A.D. 1200. Kroeber estimated the total at 8,400,000, divided about equally between the two continents, with 200,000 in the West Indies.

Language. — The wide distribution of a few major languages is thought to be a development of comparatively late times in human history; contrariwise, it is believed that in ancient times a great number of languages flourished, each confined to a limited geographical area and to a small population. Such a condition describes to a large extent the linguistic situation among the American Indians. The first identification of American languages and relationships between languages was accomplished by comparing vocabularies, and while this method may have resulted in overlooking many resemblances which later were discovered when grammatical structures were examined, nevertheless, the work of J. W. Powell, who first published a complete classification of the languages of the United States and Canada, remained the foundation work. His system of nomenclature, adding the adjective termination "-an^x or "-in" to a tribal name! was still followed at mid-20th century. All related Sioux languages, for example, are grouped under "Siouan," the Shoshone languages under "Shoshonean," etc. Powell's classification and distribution map, as published in 1891, contained 58 language stocks, of which 3 (Beothukan, Esselenian and Karankawan) were already extinct, and 2 others (Adaizan and Palaihnihanj were subsequently combined with other stocks. This left a net of 53 living linguistic stocks in the Powell classification. Other students identified 29 linguistic stocks for Mexico and Central America, and 84 for South America.

These, it should be noted, are not separate languages; each is actually a language family with from 1 to as many as 50 component languages.

Subsequent workers in the area north of Mexico (Roland B. Dixon and Kroeber for California) began to study the morphology of the Indian languages and to discover relationships where none had appeared before. Edward Sapir then found that methods developed in the study of Indo-European languages could be applied equally to the unwritten American languages. Such linguistic phenomena as borrowing from other languages, grammatical developments, dialectic blending and social differentiation of speech all operated in the primitive language as in more sophisticated tongues. Sapir in 1929 suggested a regrouping of Powell's so-odd language stocks into six major divisions according to type. This involved shifting some stocks under new headings, creating some descriptive titles and demonstrating relationships not previously recognized. Sapir's principal contributions consisted of: (1) proposing the Nadene stock, to combine Athabaskan, Haida and Tlingit, each of which had been classified separately by Powell; (2) extension of the term Hokan (first used by Dixon and Kroeber for certain California languages) to include the Coahuiltecan languages of Texas and a Central American group; (3) the Uto-Aztekan division, in which were brought together Piman, Shoshonean and Nahuatl; and (4) the Algonkin-Ritwan stock, grouping the extensive Algonkin languages with the Wiyot and Yurok of California.

The six linguistic groups proposed by Sapir, with brief descriptions of the salient features of each, are as follows:

1. *Eskimo-Aleut;* Polysynthetic and inflective; suffixes employed, but never prefixes; verb modified principally as regards mode and person and to distinguish between the transitive and intransitive actions.

2. *Algonkin-Wakashan:* Also polysynthetic; Algonkin employs inflection; suffixes, prefixes to a lesser extent; weak development of case; noun and verb stems markedly subject to suffixing with instrumental, adverbial and specifying elements.

3. *Nadene:* Strongly characterized as "tone" language, in which pitch of the voice is used to shade meanings. Monosyllabic elements, prevailingly nominal and having fixed order with reference to each other, are combined into loose word forms; emphasizes voice and aspect rather than tense; distinguishes carefully between active and static verb forms.

4. *Penutian:* More tightly knit than preceding three, analogies with Indo-European languages; uses suffixes more formally; many types of inner stem changes; true nominal cases.

5. *Hokan-Siouan:* Prevailingly agglutinative; tendency to use prefixes rather than suffixes for formal elements; distinguishes active **and**

TABLE 11.—*Tribal List*
(Linguistic Stocks North of Mexico)

Powell classification (1891)	Sapir arrangement (1929)	Still spoken (Voegelin list)		
Language family	Type and component stocks	Type, stock and language	Population	Location
ADAIZAN (Combined with CADDOAN)	I. ESKIMO-ALEUT	I. ESKIMO-ALEUT A. Eskimo 1. Greenland 1. Central 2. Alaskan B. Aleut (possibly two languages)	 20,000 7,700 16,000 5,700	 Greenland Canadian arctic, north of Yukon South and west of Yukon Aleutian Islands to Prince William sound
ALGONKM ATHABASCAN ATTACAPAN BEOTHUKAN (Extinct) CADDOAN CHIMAKUAN CHIMARIKAN CHIMMESYAN CHINOOKAN CHITIMACHAN CHUMASHAN COAHUILTECAN COPEHAN COSTANOAN ESKIMAUAN ESSELENIAN (Extinct) IROQUOIAN KALAPOOIAN KARANKAWAN (Extinct) KERESAN KIOWAN RITUNAHAN KOLUSCHAN KULUNAPAN KUSAN LUTUAMIAN MARIPOSAN MOQUELUMNAN	II. ALGONKIN-WAKASHAN A. Algonkin-Ritwan 1. Algonkin 2. Beothuk 3. Ritwan a. Wiyot b. Yurok B. Kootenay C. Mosan (Wakashan-Salish) 1. Wakashan (Kwakiutl-Nootka) 2. Chimakuan 3. Salish	II. ALGONKIN-WAKASHAN A. Algonkin 1. Cree 2. Montagnais 3. Naskapi 4. Menominee 5. Sauk and Fox 6. Kickapoo 7. Shawnee 8. Potawatomi 9. Chippewa (U.S.) or Ojibwa (Canada) 10. Ottawa 11. Algonkin 12. Delaware (including Munsee) 13. Penobscot 14. Abnaki 15. Malecite 16. Passamaquoddy 17. Micmac 18. Piegan, Blood, Blackfeet (Siksika) 19. Cheyenne (northern and southern) 20. Arapaho, Atsina B. Wiyot C. Yurok D. Kutenai E. Quileute F. Wakashan 1. Nootka 2. Nitinat 3. Makah 4. Kwakiutl 5. Bella Bella 6. Kitamat G. Salish 1. Lilloet 2. Shuswap 3. Thompson 4. Okanagon 5. Flathead, Pend d'Oreille, Kalispel, Spokan 6. Coeur d'Alene 7. Wenatchi 8. Tillamook 9. Chehalis, Cowlitz, Quinault 10. Lummi, Songish, Clallam 11. Nanaimo 12. Squamish 13. Comox-Sishiatl 14. Bella Coola	 15,000 1,550 ... 2,500 1,500 650 730 5,500 32,000 1,000 ... 1,000 250 250 150 385 3,800 7,500 4,000 3,775 236 960 1,000 280 1,600 160 450 1,100 350 300 60 45 130 900 3,000 600 100 (identity lost) 1,100 1,700 225 200 35 250	 James bay westward to Peace river North shore of St. Lawrence river from mouth of Saguenay river Interior of Labrador Wisconsin Iowa and Oklahoma Kansas and Oklahoma Oklahoma Oklahoma, Kansas, Wisconsin, Michigan, Ontario Minnesota, Wisconsin, Michigan, North Dakota, Montana, across southern Canada Oklahoma, Michigan, Lake Huron St. Lawrence river valley Oklahoma, Wisconsin, Ontario Maine Lower St. Lawrence Lower St. Lawrence Maine Nova Scotia, New Brunswick, Quebec Montana and Alberta Montana and Oklahoma Wyoming and Oklahoma Northern California Northern California Montana, Idaho, British Columbia Washington Vancouver Island Vancouver Island Cape Flattery Vancouver Island and coast of British Columbia ... ... Fraser river Okanagon lake Western Montana, northern Idaho, eastern Washington Northern Idaho Eastern Washington Grand Ronde reservation, Ore. Western Washington Northwestern Washington Lower Fraser river Hood canal, Wash. British Columbia
	III. NADENE A. Haida B. Continental Nadene 1. Tlingit 2. Athabascan	III. NADENE A. Athabascan 1. Sorthern group a. Dogrib, Hare, Bear Lake b. Chipewyan, Yellowknife, Slave c. Kutchin d. Tanana, Koyukon, Han, Tutchone e. Sekani, Sarsi, Beaver, Stonies f. Carrier, Chilcotin g. Tahltan, Kaska h. Tanaina, Ingalik 2. Pacific group a. Hupa b. Kuta, Wailaki c. Chasta-Costa d. Mattole e. Tolowa 3. Southern group a. Jicarilla b. Lipan c. Kiowa Apache d. San Carlos Apache e. Chiricahua, Mescalero f. Navaho B. Eyak C. Tlingit D. Haida	 1,600 1,620 1,260 1,200 960 1,000 760 600 636 190 20 20 115 935 (identity lost with Mescalero Apaches [q.v.]) 388 3,690 1,065 65,000 300 4,000 1,000	 Mackenzie river and Great Bear lake Athabasca lake and Great Slave lake Upper Yukon, Mackenzie rivers Interior of Alaska East of Rockies, on Peace and Saskatchewan rivers Upper Fraser river Stikine river Keuai peninsula Hoopa reservation, Calif. Round Valley reservation, Calif. Siletz reservation Ore. Humboldt count; Calif. Del Norte county: Calif. Jicarilla reservation, N.M. Kiowa reservation Okla. San Carlos reserva'tion, Ariz. Mescalero reservation, N.M. Navaho reservation, Ariz., N.M., Utah Prince William sound, Alaska Southeastern Alaska Southeastern Alaska
	IV. PENUTIAN A. California Penutian 1. Miwok-Costanoan 2. Yokuts 3. Maidu 4. Wintun	IV. PENUTIAN A. Yokuts 1. Buena Vista 2. Chukchansi 3. Chauchila	50	East central California

TABLE II. *Tribal List* ***(continued)***
(Linguistic Stocks North of Mexico)

Powell classification (1891)	Sapir arrangement (1929)	Still spoken (Voegelin list)		
Language family	Type and component stocks	Type, stock and language	Population	Location
	IV. PENUTIAN *(Continued)*	IV. PENUTIAN (Continued)		
	B. Oregon Penutian	B. Maidu		
	1. Takelma	Nisenan (Valley, Foothill, Mountain)	170	North central California
MUSKHOGEAN	2. Coast Oregon	C. Miwok		
	a. Coos	1. Coast Range	110	North central California
	b. Siuslaw	2. Sierra		
NATCHESAN	*c.* Yakonan	D. Wintun		
	3. Kalapuya	1. Wintu-Wintu	225	North central California
	C. Chinook	2. Patwin		
PALAIHNIHAN (Combined with SASTEAN)	D. Tsimshian	E. Klamath-Modoc	1,260	Klamath reservation, Ore.
	E. Plateau Penutian	F. Molale	...	...
	1. Sahaptin	G. Sahaptin		
	2. Waiilatpuan (Molala-Cayuse)	1. Tenino, Wallawalla, Umatilla, Palus, Yakima, Pswanwapam, Wanapam, Klikitat, Upper Cowlitz, Upper Nisqually	5,225	Oregon and Washington
	3. Lutuami (Klamath-Modoc)	2. Nez Perce	1,530	Idaho
PIMAN	F. Mexican Penutian	H. Takelma	(identity lost)	Rogue river, Ore.
	1. Mixe-Zoque	I. Lower Umpqua-Siuslaw	(identity lost)	Siletz reservation Ore.
	a. Huave	J. Alsea	(identity lost)	Siletz reservation: Ore.
PUJUNAN		K. coos	230	Oregon coast
		L. Kalapuya	...	Grand Ronde reservation, Ore.
		M. Chinook		
QUORATEAN		1. Lower	50	Dalles, Ore.
		2. Upper: Cascade, Multnomah, Wasco, Wishram	540	Oregon and Washington
		N. Tsimshian	700	Annette Island, Alaska
SALINAN	V. HOKAN-SIOUAN	V. HOKAN-SIOUAN		
	A. Hokan-Coahuiltecan	A. Washo	520	Douglas county, Nev.
SALISHAN	1. Hokan	B. Pomo		
	a. Northern Hokan	1. Clear Lake	860	[California coast, north of San Francisco
	(1.) Karok, Chimariko, Shasta-Achomawai	2. Southwestern coast		
SASTEAN	(2.) Yana	C. Yuki		
	(3.) Pomo	1. Yuki	60	Round Valley reservation, Calif.
	b. Washo	2. Wappo	50	Sonoma county, Calif.
SHAHAPTIAN	*c.* Esselen-Yuman	D. Shasta-Achumawi		
	(1.) Esselen	1. Achumawi	275	Northeastern California
	(2.) Yuman	2. Atsuwegi	...	...
SHOSHONEAN	d. Salinan-Seri	3. Shasta	120	Northwestern California
	(1.) Salinan	E. Karok	90	Northwestern California
	(2.) Chumash	F. Yuman		
	(3.) Seri	1. Havasupai, Walapai, Yavapai	1,265	Arizona reservations
SIOUAN	e. Tequistlatecan (Chontal)	2. Mohave, Yuma, Maricopa, Kaveltchadom, Halchidhoma	2,275	Arizona reservations
	2. Subtiaba-Tlappanec	3. Kohuana, Halyikwamai, Cocopa	110	Arizona reservations
	3. Coahuiltecan	4. Diegueno, Kamia, Akwaala	1,040	San Diego county, Calif.
SKITTAGETAN	*a.* Tonkawa	G. Iroquoian		
	b. Coahuilteco	1. Seneca, Cayuga, Onandaga	4,500	Reservations in New York and Oklahoma
	c. Karankawa	2. Mohawk	1,820	Saint Regis, N.Y.
TAKILMAN	B. Yuki	3. Oneida	3,800	Reservations in New York and Wisconsin
	C. Keres	4. Wyandot	900	Oklahoma
	D. Tunican	5. Tuscarora	430	New York
TANOAN	1. Tunica-Atakapa	6. Cherokee	51,000	Oklahoma and North Carolina
	2. Chitimacha	H. Siouan		
	E. Iroquois-Caddoan	1. Catawba	375	South Carolina
TIMUQUANAN	1. Iroquoian	2. Iowa, Oto	1,535	Kansas and Oklahoma
	2. Caddoan	3. Winnebago	3,000	Wisconsin and Nebraska
	F. Eastern group	4. Omaha, Ponca, Osage, Kansa, Quapaw	9,560	Nebraska and Oklahoma
TONIKAN	1. Siouan-Yuchi	5. Dakota, Assiniboin	42,730	Minnesota, North and South Dakota, Montana, Nebraska
	a. Siouan	6. Mandan	390	Fort Berthold, N.D.
	b. Yuchi	7. Hidatsa	930	Fort Berthold, N.D.
TONKAWAN	2. Natchez-Muskogian	8. Crow	2,780	Montana
	a. Natchez	I. Caddoan		
	b. Muskogian	1. Caddo	1,184	Oklahoma
UCHEAN	*c.* Timucua	2. Wichita	460	Oklahoma
		3. Arikara	682	North Dakota
		4. Pawnee	1,150	Oklahoma
WAILATPUAN		J. Keresan: Acoma, Cochiti, Laguna, San Felipe, Santa Ana, Santo Domingo, Zia		
		K. Muskogean		
WAKASHAN		1. Choctaw, Chickasaw	24,350	Oklahoma
		2. Alabama-Koasati	395	Texas
		3. Mikasuki, Hitchiti	(identity lost)	
WASHOAN		4. Creek, Seminole	11,900	Oklahoma and Florida
		L. Tunica	(few survivors)	Louisiana
		M. Natchez	(few survivors)	Merged with Creeks
WEITSPEKAN		N. Chitimacha	128	Louisiana
		O. Yuchi	...	Merged with Creeks
		P. Tonkawa	60	Oklahoma
WISHOSKAN	VI. AZTEC-TANOAN	VI. AZTEC-TANOAN		
	A. Uto-Aztekan	A. Uto-Aztecan		
	1. Nahuatl	1. Luiseno	1,100	San Diego county, Calif.
	2. Pima	2. Cahuilla	470	Riverside and San Diego counties, ,Calif.
YAKONAN	3. Shoshonean	3. Serrano	310	San Bernardino county, Calif.
	B. Tanoan-Kiowa	4. Cupeno	225	San Diego county, Calif.
	1. Tanoan	5. Tubatulabal	...	Kern river, Calif.
	2. Kiowa	6. Pima, Papago	12,400	Reservations in Arizona
YANAN	C. Zuni	7. Hopi	3,700	Hopi reservation, Ariz.
		8. Ute, Southern Paiute, Chemehuevi, Kawaiisu	5,400	Utah, Nevada, California, Arizona
YUKIAN		9. Shoshoni, Comanche, Gosiute, Wind River, Pznamint	6,200	Wyoming, Nevada, Utah, California, Oklahoma
		10. Mono, Bannock, Snake, Northern Paiute	3,150	Idaho, Nevada, California
YUMAN		B. Tanoan		
		1. Tiwa (southern), Isleta, Sandia	1,650	Rio Grande valley
ZUNIAN		a. Tiwa (northern), Taos, Picuris	1,070	Rio Grande valley
		3. Tewa: San Juan, Santa Clara, San Ildefonso, Tesuque, Nambe, Hano	2,450	Rio Grande valley, Hopi reservation, Ariz.
		C. Kiowa	2,700	Oklahoma
		D. Zuni	2,760	Zuni reservation, N.M.

Sources: ***See*** Bibliography.

static verbs.

6. *Aztec-Tanoan:* Moderately polysynthetic; many formal elements suffixed;sharp distinction between noun and verb; free use of reduplication, compounding of stems and nominal incorporation; many postpositions; pronominal elements differentiated by subject and object, but not for transitive and intransitive constructions.

Table II contains Powell's classification by linguistic stocks; Sapir's organization of the same material by major types; and C. F. Voegelin's arrangement of the languages north of Mexico still spoken. The latter writer estimates that more than half (slightly less than 150) of the aboriginal languages survived.

A notable feature of this linguistic situation was the preponderance of languages on the Pacific side of the continent. Of Powell's original list of 53 stocks, 37 were in territory draining into the Pacific and 22 were actually on that coast, while only 7 were found on the Atlantic coast. In terms of population, more than 70% of the population north of Mexico was comprised in eight language stocks. These stocks, with respective populations (after Mooney) were: Algonkin 192,400; Eskimo-Aleut 89,700; Siouan 88,500; Iroquian 71,700; Muskogian 66,500; Uto-Aztekan 63,100; Athabaskan 60,500; and Salish 57,900. Eighteen other language stocks had an average population of about 12,000, while 29 were spoken by from 5,000 to 500 people, with an average of 2,000. (See also AMERICAN ABORIGINAL LANGUAGES.)

CULTURE PROVINCES

Distributions. — Reconstruction of American prehistory had not yet succeeded at mid-20th century in filling in the details of dispersal and development that must have taken place during the long interval between the earliest occupation levels and the first evidences of sedentary cultures. Moreover, as new discoveries tended to push the first human horizons further back into antiquity, the more precise dating made possible by tree-ring chronology and by radiocarbon disintegration tended to lessen the age of later occurrences and thus the gap between the two known limits grew further apart and the difficulty increased. The year 1000 B.C. has been postulated as marking the beginning of civilization in the western hemisphere, this being the approximate time when agriculture was substituted for hunting in the middle regions of the new world and when the series of cultural advances which culminated in Maya architecture and the Maya calendar began. The beginnings of agriculture may actually belong to a more remote period, as will be discussed below, but in any case an interval of from 10,000 to 15,000 years must somehow be explained. In the opinion of some authorities, a time span of 25,000 years might be required to account for ecological adjustment to the numerous climatic belts represented in the two continents. As suggested by R. H. Lowie, man in the long interval was pushing forward the innumerable qualitative social and individual choices which finally brought him to a stage characterized by agriculture and pottery making. In the process, not one but a score of hunting and gathering societies may have evolved. Agriculture, which in the new world is assumed to start with maize culture, may actually have been the outgrowth of experimental plantings carried out independently in different areas of the new world and with different plants, such as manioc in the tropical lowlands and the potato in the Andes. Adjustments, strivings and solutions in a world of limited theory and scant technology necessarily consumed great time lapses.

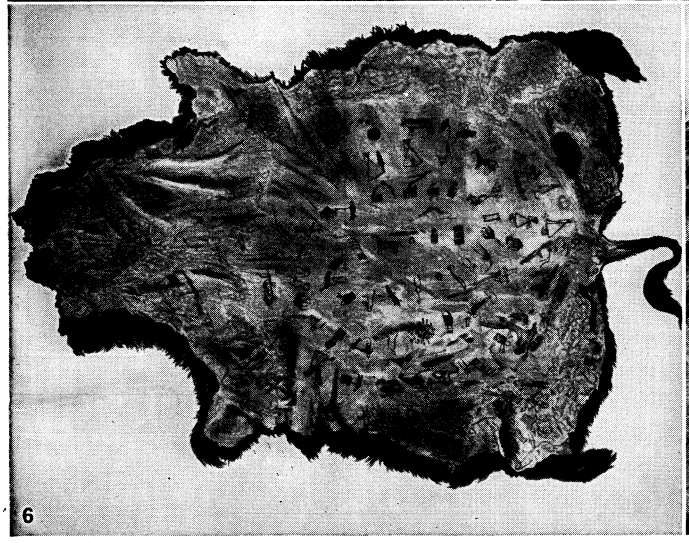
There are indications of a solution to the problem by means other than speculation. The Cochise culture of southern Arizona, mentioned above, may be the interval which, for the southwestern area at least, spans the period under scrutiny. Three stages have been distinguished for the Cochise development, the oldest of which, the Sulphur Springs stage, was tentatively dated at 10.000 or more years ago. The climate was then wetter and colder and the bones of extinct animals — mammoth, camel, dire nolf, bison and horse — were directly associated with man-made implements. These were not the implements of a hunting people, however; they were grinding tools consisting of flat milling stones and small handstones, and implements for cutting. chopping and scraping — no blades or projectile points. A second stage, occurring between 8,000 and 3.000 B.c., is designated Chiricahua. The grinding tools and chipped implements suggest an evolutionary development out of the earlier types, though found in younger strata in the same general area. The culture as a whole was first thought to have disappeared in the third, San Pedro, stage about 500 B.C. Pottery and presumably agriculture entered the southwest at about that time, but the original Cochise sites yielded no evidence of either. Ventana cave, on the Papago Indian reservation, seemed to suggest that the people responsible for this culture did not disappear. Three levels of occupation occurred in Ventana cave, the oldest of which contained flaked implements having possible relationship to the Folsom culture, together with the bones of both modern and extinct animals. The next upward layer, in addition to animal remains, had a great number of grinding stones and flaked implements. The grinding stones resemble those identified with the Chiricahua stage, while the flaked instruments have some resemblance to types established for the early cultures of the Pinto and Mohave basins in California. The upper part of this second stratum contained a number of projectile points of the type ascribed to the San Pedro stage. The third and top layer contained pottery of the modern Papago Indians as well as of the antedating Hohokam culture (see below). Types of grinding tools present in the Cochise culture persisted there, but in addition a type of mano (handstone) associated with maize grinding and flour making appeared. The inference is that pottery and agriculture arrived in the area during the last stage of occupation at Ventana cave and were taken over by a living people who continued into modern times. The southmest, with its arid climate extending back over several thousand years and with numerous caves and rock shelters, offers the greatest likelihood of preserving the full story. Actually. many aspects of the story are already known.

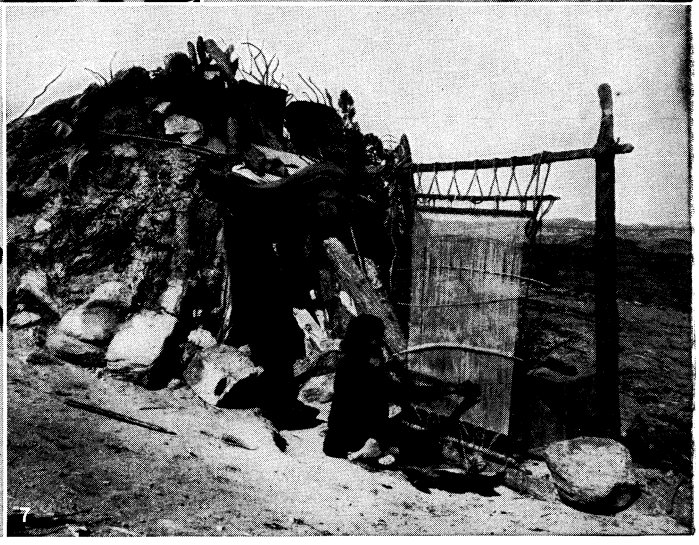
The Southwest. — The southwest, including the southern portion of Colorado, most of Utah, Arizona and New Mexico and northwestern Mexico, consists of several culture provinces, sharing a certain contemporaneity and the same general geographical region. At least two, and possibly three, agricultural peoples are included, and these in turn are surrounded in a great arc by various peoples of a marginal agricultural and hunting economy. The area divides into three climatic zones: (1) high, moist (22–40 in. annual rainfall) and cool; (2) high, dry and cool; and (3) low, dry and hot.

Best known of the southwestern groups are the Pueblo Indians, whose ancestors built the great cliff villages now seen in ruins and the equally remarkable multiple apartment houses of adobe and stone masonry. Some of the latter are still occupied, while the Pueblo Indian inhabitants speak languages and observe ceremonies, the origins of which are at least pre-Spanish. The Pueblo culture was preceded in the same general area by a people to whom the term Basket Maker has been applied; and, because the history of occupation continues without interruption in a kind of evolutionary process. it has become customary to refer to the two as the Anasazi culture. The word is derived from a Navaho language term meaning "the ancient ones." The central focus of this Anasazi culture was in the northeastern part of Arizona and northwestern New Mexico, with those portions of Colorado and Utah immediately contiguous. In time, however, Anasazi traits ranged as far as the Idaho line, westward into Nevada and considerably southward and eastward from the points of beginning.

The origin of the Basket Maker Indians is not precisely known. When first settled in the northern portion of that province, they were already excellent weavers of baskets. though not potters, and they were already supplementing hunting with agriculture, growing maize and pumpkins. They were predominantly longheaded, though some a ere roundheaded and some were apparently crossed between the two head types. They sometimes sheltered in caves, and when they built shelters in the open, the houses were partly below ground and were roofed over with poles and mud. Storage pits for food. often lined with stone slabs set on edge, were characteristic. The basic pattern continued into a following period, designated Modified Basket Maker, when agriculture occupied major interest, though hunting and nild seed gathering were not abandoned. Beans had been introduced as an additional food crop.

INDIAN, NORTH AMERICAN



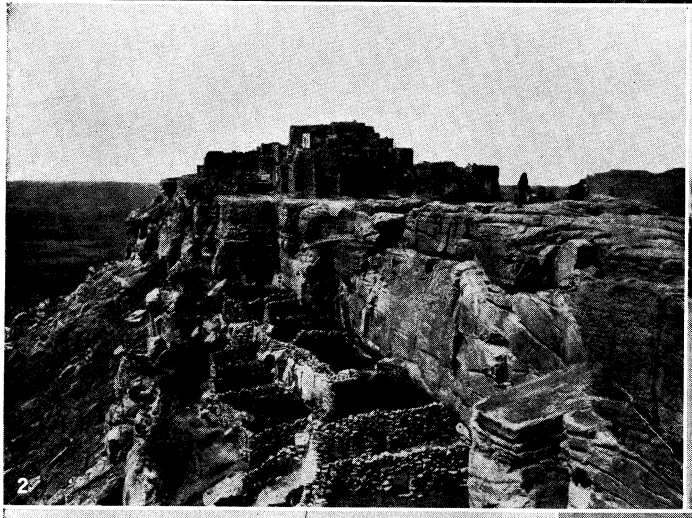


PHOTOGRAPHS, THE SMITHSONIAN INSTITUTION

SOME FEATURES OF 19TH-CENTURY INDIAN LIFE

1. Arikara Indians of North Dakota at a grass dance, about **1850**
2. Incident in the life of Jaw, a Teton Sioux of Standing Rock **reservation** in the Dakotas. He made the drawing himself, on white muslin, to recount the story of a successful war expedition
3. Paiute Indian woman weaving a basket before her brush shelter which consisted of a framework of poles covered with boughs, about **1873**
4. Umatilla Indian child of Oregon, about **1900.** The flat cradle was made on a basketry or wickerwork base, covered with buckskin and cloth. The floral designs on the headboard were probably not aboriginal in style
5. Hair dressing among Hopi Indian women in the village of Walpi, Ariz., **1879.** The pueblo tribes used a stiff brush of spear grass for combing and dressing the hair
6. "Lone Dog's Winter Count," dating from **1800,** painted on buffalo hide by a Yanktonai Indian of Montana. A winter count is an **extended** calendar history. Each sign depicted some outstanding event or circumstance **used** to distinguish each year as **it** passed
7. Navaho woman at her loom before an earth lodge, or hogan, on the Navaho reservation, Arizona, **1880**

INDIAN, NORTH AMERICAN



PHOTOGRAPHS, THE SMITHSONIAN INSTITUTION

19TH-CENTURY INDIAN DWELLINGS

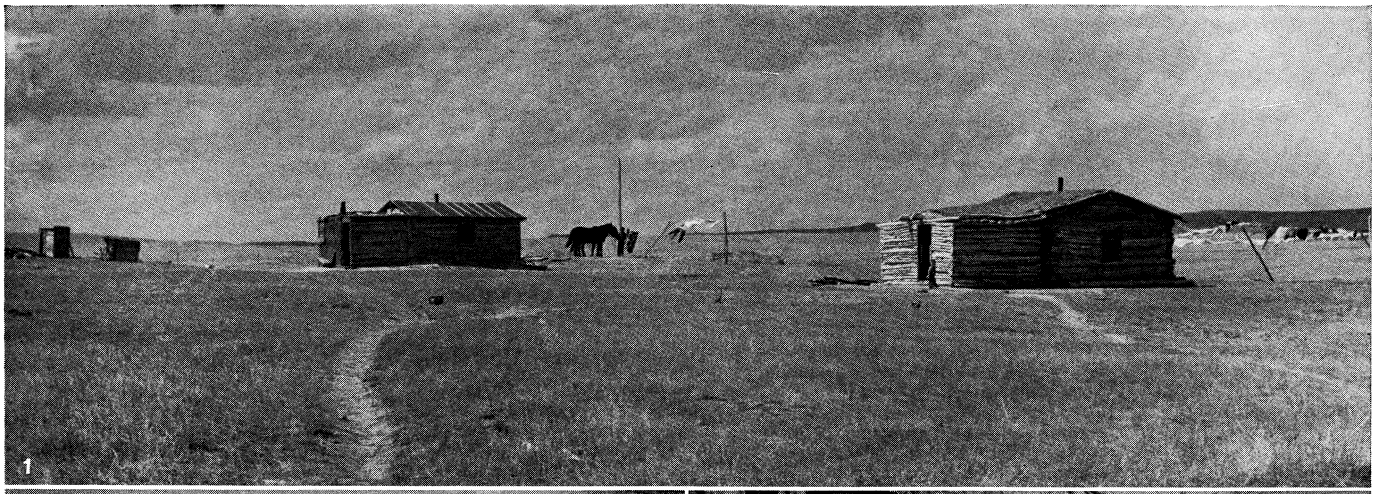
1. Canvas tepees in a village on the Umatilla reservation, Oregon
2. First (or east) mesa in a Hooi village at Walpi, Ariz., about 1872; typical multistoried pueblo apartment dwellings made of stone and adobe
3. Indian brush lodge, 1894
4. Cold Creek Indians in bivouac on Severe river, Utah, 1873. The Indians were probably on a hunting trip when they set up the improvised shelter
5. House of the Hopi captain of Shongopovi in Arizona, about 1870. The three-story terraced dwelling was built of stone with adobe or mud mortar to hold the stones in place, and also plastered with mud on the outside. Roofs at the various levels were flat and were used as dooryards for the upper-story rooms

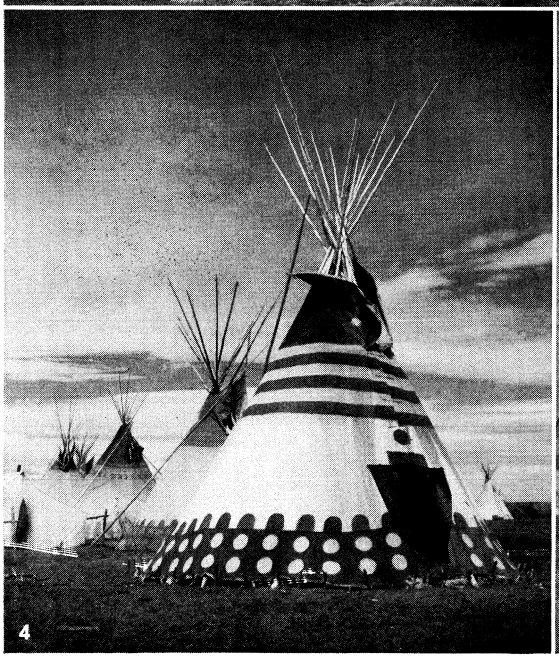
BY COURTESY OF (1.5) U.S. BUREAU OF INDIAN AFFAIRS, (6) SMITHSONIAN INSTITUTION PHOTOGRAPH, (2) WILCOX

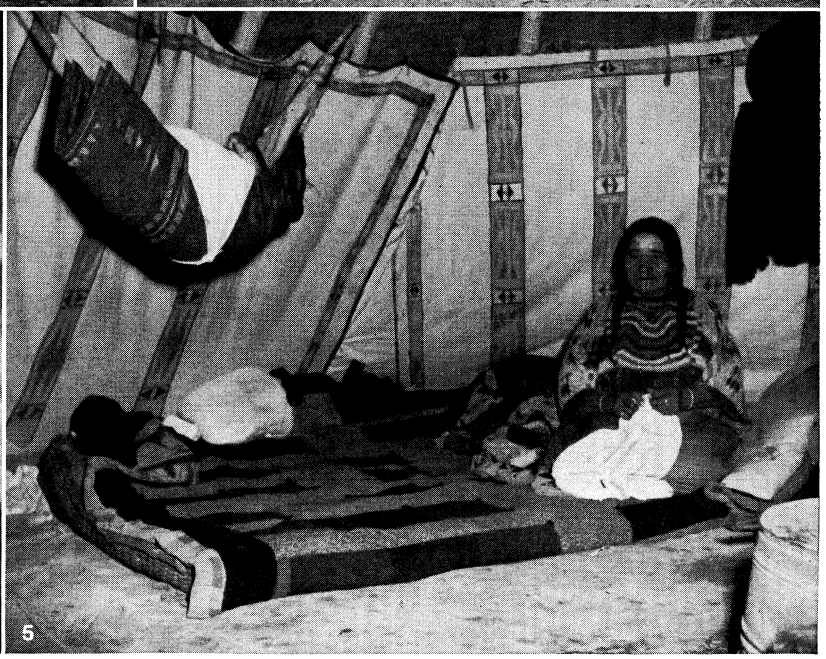
INDIAN CUSTOMS, CEREMONIES AND TRIBAL LIFE

1. Pueblo ceremonial dance
2. Chippewa burial ground
3. Tribal meeting in Oklahoma attended by Kiowa, Comanche and Apache Indians
4. Apache devil dancers
5. Navaho medicine man seeking a cure for an ailing child
6. Sand-painting altar for the male shooting-arrow chant, part of the Navaho ceremony of the mountain chant

INDIAN, NORTH AMERICAN



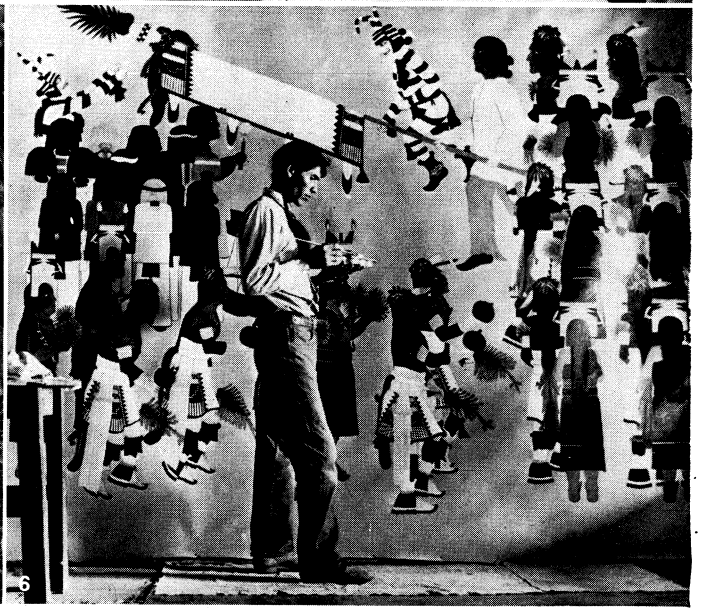




BY COURTESY OF U.S BUREAU OF INDIAN AFFAIRS; PHOTOGRAPHS, (1) KYLLINGSTAD, (2-5) MORROW

CONTEMPORARY INDIAN DWELLINGS AND CEREMONIAL QUARTERS

1. Sioux cabins at the Standing Rock reservation, Kenei, S.D.
2. Typical Indian farm home on the Fort Hall reservation, Idaho. Shoshone Bannock tribe
3. Indian family beside their tent home on the Uintah and Ouray reservation, Utah
4. Part of an encampment at Browning, Mont., for the Blackfeet sun dance ceremonial. In foreground is a "striped" painted lodge, behind it a "mountain" painted lodge
5. Interior of a tepee at the Blackfeet sun dance encampment



BY COURTESY OF (1-3, 4-6) U.S. BUREAU OF INDIAN AFFAIRS: PHOTOGRAPHS, (1) KYLLINGSTAD (2, 4) MILTON SNOW. (3) GEORGE A. DALE. (5) GORDON SOMMERS

INDIAN SKILLS AND HANDICRAFTS

1. Pottery in the Sioux Arts and Crafts museum and salesroom, Pine Ridge, S.D.
2. Navaho Indian making silver ornaments
3. Eskimo children of Hooper bay, Alaska, playing with an inflated seal skin meant for use in storing seal oil. They wear reindeer or bird skin parkas which they like to cover with gay calico snow parka:
4. Shop class at Intermountain Indian school, Brigham City, Utah
5. Chippewa Indians grinding corn in the ancient manner
6. Pueblo painter

BY COURTESY OF (1, 3) U.S. BUREAU OF INDIAN AFFAIRS, (2, 4, 6-8) THE SMITHSONIAN INSTITUTION, (5) FARM SECURITY ADMINISTRATION, PHOTO BY MYDANS

NORTH AMERICAN INDIAN TYPES

1. Flathead Indian, Montana
2. Stock: Sioux, Yankton group. Tribe: Yankton
3. Stock: Tewa. Tribe: Santa Clara Pueblo
4. Stock: Shoshone. Tribe: Ute
5. Stock: Muskhogean. Tribe: Seminole
6. Stock: Sioux, Dhegiha group. Tribe: Osage
7. Stock: Athabascan. Tribe: Apache
8. Stock: Yuma. Tribe: Yuma

BY COURTESY OF (1-3, 5, 6, 8) THE SMITHSONIAN INSTITUTION, (4, 7) U.S. BUREAU OF INDIAN AFFAIRS

NORTH AMERICAN INDIAN TYPES

1. Stock: Shoshone. Tribe: Comanche
2. Stock: Eskimo. Tribe: Kiñugumiut
3. Stock: Zuni. Tribe: Zuni
4. Navaho youth, New Mexico
5. Stock: Caddo. Tribe: Pawnee
6. Stock: Shahaptian. Tribe: Nez Percé
7. Blackfeet Indian
8. Stock: Algonkin. Tribe: Sauk and Fox

Houses were joined together in straight lines or in crescents, and a new type of building began to appear. This was a circular room, built partly underground. It was an enlargement of the old storage pit, but now was evidently used for ceremonial purposes, and was probably the precursor of the "kiva" found in modern pueblos. The word kiva is derived from the Hopi language and means "old house." The most notable change from the previous period is the introduction of pottery, sun dried at first, and sometimes made in basket moulds. Soon, however, true pottery was being made.

The beginnings of Pueblo culture, as in the case of the early Basket Maker, are obscure. Some movement westward and northward occurred, and some new traits began to appear. The number of roundheaded people increased noticeably. In addition, the practice of flattening the back of the head became general, achieved evidently in infancy by fastening the child to a hard cradleboard. The same type of above-ground, straight-line or crescent-shaped multiple house was built, two rooms wide. However, stone masonry began to replace the pole-and-mud and adobe construction of the earlier period. Agriculture, including several varieties of corn, may have been augmented at that time by the cultivation of a native long-staple cotton. Pottery was not much improved, but it included a greater variety of shapes and decoration. Basketry was much less common. The early phases of Pueblo culture are termed Developmental Pueblo, and in that period are included the emerging features which in an earlier classification were designated Pueblo I and Pueblo II. Throughout that early period, the area of occupation continued to expand. The kiva became larger and eventually was built entirely underground. Entrance was gained through an opening in the ground-level roof. Domiciliary houses became larger but the basic character remained about the same. Pottery varied according to shapes, finishes and methods of decoration.

The great Pueblo period (Pueblo III) followed (A.D. 1050–1300), sometimes called Classic Pueblo, a period which most people probably associate with the term Pueblo. It was the time of the great cliff houses, such as Mesa Verde (Cliff palace and Spruce Tree house), and the large apartmentlike structures in Chaco canyon (Pueblo Bonita) and elsewhere. An actual shrinking in area took place as people from the outer fringes of the occupied region moved in to build the large dwelling units. Also, since a number of the outstanding structures were built in quite inaccessible canyons and mesa walls, there is the possibility that hostile strangers had reached the outlying districts. The physical type remained the same, except for increased predominance of roundheadedness. Artificial head flattening continued to be practised. The most notable advance over previous periods was in architecture and pottery. The arch was not discovered; but masonry walls were greatly thickened, dressed stones being used in many localities, to bear the greater weight of massive structures. Houses varied from 20 to as many as 1,000 rooms, and from one to four stories in height. Each of the larger houses mas in effect a single village. Windows and doors were quite small, and usually no openings were made in the lowest level of rooms, which were entered by means of a ladder through the roof. Floors were terraced or set back, and these terraces were much used as outdoor living space. Roofs were constructed to carry great weights by laying a series of heavy beams, covering these with a mat of smaller poles and brush, then laying on a coat of adobe six to eight inches thick. Kivas were greatly enlarged in some areas, ranging from 50 to as much as 80 ft. in diameter. Craftsmanship in pottery reached a high level of excellence. Specialization became so pronounced in the different centres, as in Chaco canyon, Mesa Verde, Kayenta and a number of others. that the style of each can be recognized easily, once the basic patterns of construction and design are learned. The earlier black-on-white and red-on-white designs were still used, but polychromes of three or more colours were produced and decoration was applied more lavishly. Cotton cloth, blankets and bags were woven, and yucca fibre also entered into various articles of clothing and utility objects such as mats. Feather-cloth robes were worn in cold weather.

Abandonment of the cliff houses and large community buildings marked the close of the great Pueblo period. No single reason is adequate to explain this abandonment and the subsequent moving away of the builders. Probably several forces were at work, among them incursion into the northern part of the territory by nomadic Athabascans (Navaho and Apache [*q.v.*]) and a prolonged drought, which examination of tree rings in the area shows to have existed from A.D. 1276 to 1299. It is also possible that lack of central leadership, such as characterizes the modern Hopi (*q.v.*) Indians, led to internal dissensions and splitting up of the families brought into close association in the large community centres.

Pueblo IV period (A.D. 1300–1700), also called Regressive Pueblo, was characterized by a general movement southward and eastward and new villages, some as large as or larger than those of Pueblo III, were built on the Little Colorado. Puerco. Verde. San Francisco. Rio Grande, Pecos, Upper Gila and Salt rivers. The great pueblo of Pecos dates from that period, as does Tyuonyi in Bandelier National monument. Pottery showed new developments, both as to technical construction and decoration. Geometric patterns were largely replaced by naturalistic representations of birds, animals, insects and the human figure Glazing was frequently used. The modern period, Pueblo V, is usually dated from the beginning of permanent Spanish settlement at the close of the 17th century. During the interval from 1540, when the Spaniards first entered the Pueblo country, and the recapture of the country by Diego de Vargas in 1692–94, the number of Pueblo settlements declined from about 80 to 25 or 30. Much of the culture and many of the skills in agriculture and crafts continued down to modern times.

Beginnings of Agriculture.— The beginnings of this Anasazi culture are not too clearly established. As mentioned above, the Basket Maker people were already practising agriculture when they first appeared. It is usually assumed that a prior, or nonagricultural, stage preceded, but no physical evidence of such a stage had been discovered by mid-20th century. Believing that agriculture was introduced in the southwest at about the beginning of the Christian era, writers have generally placed the beginnings of the Basket Maker culture at a time just prior to A.D. 1. New evidence discovered at Bat cave, N.M., in 1948 seemed to promise considerable revision of these dates. At that site, located on the shores of prehistoric Lake San Augustin, six levels of human occupation were identified. The top, or most recent, layer contained pottery fragments ranging in date between A.D. 500 and 1000. Geological evidence for the beginning period of occupation is 2500 B.C. Maize, including shelled cobs, separate kernels and other parts of the plant, was found at all levels, beginning at the bottom. Analyzed botanically, the maize found at Bat cave contained specimens of the most primitive form of corn yet discovered, and incidentally provided data in support of the Mangelsdorf-Reeves theory of maize origins The age estimates were partly confirmed by the radiocarbon disintegration test. A report published in 1951 indicated an age of 3,000 to 3,500 years for the oldest material.

Tree-ring chronology, developed in the southwest, proved invaluable in establishing guideposts in time. The method was an indirect outgrowth of research carried out by A. E. Douglass, of the University of Arizona, Tucson, to discover what effect sunspots have on climatic conditions. This led to a study of annular growth rings of trees seen in cross section, and eventually Douglass and his associates developed a chart of growth patterns against which he could compare specimens of logs from any area in the southwest. The earliest date on this time chart is A D. 11.

Hohokam.—The term Hohokam is derived from the Pima language (meaning "those who have gone") and is applied, like Anasazi, to a cultural development the origins of which are obscure and which covered a long period of time The area in general is south of that occupied by the Basket Maker-Pueblo people, extending into northern Mexico. It is primarily a desert area of high temperatures, sparse rainfall and xerophytic vegetation. The Hohokam were already practising agriculturists when their remains are first encountered. In later stages, irrigation canals were built and river water was brought to the fields. The absence of such canals in the first (Pioneer) Hohokam period leaves the assumption that planting was confined to river bottoms and that flood irrigation was relied upon. Pottery was also made in that first period. Dwelling houses were partly excavated, but separate walls of poles and brush matting were erected within the pit, and similar material formed the roof. The Hohokam never built large community houses such as characterized the Anasazi people; their villages instead consisted of separate individual houses. The physical type cannot be ascertained, since the Hohokam practised cremation. The beginning date for this culture has generally been given as 300 B.C., based on tree-ring chronology, as far as such evidence goes, supplemented by stratigraphic analysis of pottery remains.

In the succeeding Colonial period, a general expansion of the culture occurred until it occupied most of the southern half of Arizona. The first irrigation canal, diverting water out of the Gila river near modern Sacaton, Ariz., was dug during that period (c. A.D. 500–900). Also at that period occurred for the first time large excavated areas (maximum size 180 x 61 ft.) thought to be ball courts similar to those found frequently among the Mayas of Central America. The Mayan ball game, described fully by early Spanish colonists, was played with a solid rubber ball; and a similar ball was found in a Hohokam site.

Such a relatively specialized trait helped confirm the impression that agriculture, perhaps pottery, and other material culture features of the southwest derived from Middle America and even from South America. The Hohokam people on the Gila river and their relatives in the modern Mexican state of Sonora were on an ancient trade route which followed the coastal strip along the Gulf of Lower California until it reached the Rio Grande de Santiago, ascended that stream to modern Guadalajara and thence passed into the Valley of Mexico.

Hohokam pottery, even at the lowest level, reveals great technical skill The finishing process was the so-called paddle-and-anvil, by which the walls are brought to the desired thickness by pounding or pressing. A round stone anvil is held inside the vessel to support the clay wall while a scraping tool works on the outside. Among the Anasazi, the prevailing technique was the coil method, in which the fingers press the walls to the approximate thickness while the clay is still wet, and afterward a sharp stone is used to scrape off excess thickness when the clay has become leathery. Also, the Hohokam as early as the Colonial period began to use freehand drawing of birds, human beings, insects, snakes and other animals in pottery decoration, while the Anasazi did not depart from geometric designs until Pueblo IV, some centuries later.

The Sedentary period (*c.* A.D. goo–1100) added clay human figurines to the list of Hohokam traits. A more startling development, however, was that of copper bells cast in wax moulds. The copper appears to have been mined in the general area, but the derivation of the casting technique is obscure, and no other copper objects were found among the Hohokam. Casting of metals was practised in Central America and again in the Andean region of South America, but nowhere in North America outside the Hohokam area.

The Classic, or final, period of Hohokam culture (A.D. 1100–1400) is notable ior the peaceful intrusion of the Salado Indians, a branch of the Anasazi culture. The shifting of the Pueblo people southward from the great cliff dwellings and community houses in the north, because of drought or the pressure of other people coming in from the north, had the evident effect of displacing populations throughout the southwest. The Salado people came from the upper reaches of the Salt river, occupying an area within the modern Fort Apache Indian reservation until about the year A.D. 1200. They were in the Hohokam territory from about that time, lived there for several decades then withdrew and disappeared from sight. There is no evidence of hostility and every evidence of amicable relations between the two peoples. The principal effect of the presence of this Pueblo people in the Hohokdm country is revealed in architecture. Single-type houses clustered in villages continued to be built until the advent of the Salado people Presently great community houses with massive walls of adobe (building stone was not available in the area) began to be built. The Casa Grande National monument near Coolidge, Ariz., is a survival of that period.

After the Salado Indians disappeared, the Hohokam culture seemingly declined immediately. Deeper invasions into the southern area by nomadic Athabaskans may have precipitated the change. In historic times the Pima Indians occupying the Hohokam area were much harassed by marauding Apache bands. Possibly the concentrations of people, with dependence on nearby lands, proved too vulnerable to raiding parties. By scattering over a wider area, the safety factor would be increased for the group as a whole. The Pima Indians and their kinsmen, the Papagoes, who are presumed to be the direct descendants of the Hohokam, were living in just such scattered small villages when the Spaniards first encountered them.

Mogollon.—This third southwestern area was formerly considered a local variation of the Anasazi culture. Investigation, however, demonstrated that it is distinct from both the Basket Maker-Pueblo and the Hohokam areal developments The view is now held that Mogollon represents one line of descent from the San Pedro stage of the Cochise culture (see above), the other line being the Hohokam. In other words, Mogollon and Hohokam share a common origin in the old seed-gathering complex of southwestern New Mexico and southeastern Arizona. The Mogollon occupied the eastern half of that old region, which is in part at least a mountainous country, lying east of the San Pedro river in Arizona.

The relationship to the San Pedro material is reflected particularly in stone implements found in the earliest Mogollon sites. Subsistence was obtained principally from wild seeds, roots and nuts, although some evidence of beginning agriculture exists. Hunting was probably not important since arrow and spear points are rare and even animal bones are not often found. Pottery was already being made in the earliest Mogollon period, designated Pine Lawn (C. A.D. 400–500), and it differs in type from either Anasazi or Hohokam. The people lived in small villages of separate circular houses, the floors of which were from 1 to 3 it, below ground level. The houses lacked fireplaces and the entrance was through a kind of tunnel. In these features the houses were peculiar to the area. Other periods for which diagnostic material was catalogued include the Georgetown, San Francisco River, Three Circle and Mimbres, each estimated to have a span of about zoo years in ascending order. Masonry walls began to appear in the houses of the Three Circle period, although the floors of these continued to be below the outside ground level. In the succeeding, Mimbres, period the pit house disappeared and all-masonry houses were built aboveground. The villages were greatly expanded. Mimbres pottery, among the finest found in the south est, is especially notable for the excellence of the freehand drawing of the human, animal and insect forms used as decorative elements. The presumption is that Anasazi people entered the area during the Mimbres period (C. A.D. 1050–1200). Thereafter, for reasons not yet understood at mid-20th century, the dwellings on the Mimbres river were deserted and the people apparently drifted southward into northern Mexico. In Chihuahua state, Mimbres-type pottery was produced. Eventually community houses oi several stories, built with massive adobe walls, echo the late development in the Hohokam country. It seems possible, therefore, that the Mogollon and Anasazi (Salado) people moved together into Chihuahua and contributed their skills to the local culture.

Southwest Periphery.— The Anasazi, Hohokam and Mogollon peoples were surrounded on three sides, and at different times, by tribes practising a marginal agriculture or no agriculture at all. On the fourth side, the south, were sedentary cultures not unlike their own. Whether the Athabascan Navaho and Apache people entered the area as a disruptive force or as peaceful neighbours is not definitely known. It is possible that hostility characterized the early relations, but in time the Pueblos and their Navaho-Apache neighbours accommodated to each other. The Navahos evidently joined the Pueblos in driving the Spanish out of New Mexico in 1680, and following that event some Rio Grande Pueblo families joined the Navahos and were incorporated into the tribe. It is believed that these Athabascans came down from the north, possibly from as far north as Canada, where the bulk of the linguistic stock is located today. They were already in the southwest when Francisco de Coronado entered the region in 1540, and the assumption is that the original immigration occurred at the close of the 13th century, coincidental with the abandonment of the great Pueblo communities in the San Juan river area. When they reached the southwest, the Navahos were nomadic hunters and food gatherers, but in course oi time they adopted agriculture from the Pueblos and made some pottery. By the beginning of the 18th century, agriculture was the basic economy and livestock raising (sheep and goats) had become established. Weaving of woollen blankets had also begun by that time. The Apache bands, with the exception of the Jicarilla, seem to have borrowed less from the sedentary peoples of the southwest and more from the Plains tribes.

On the Colorado river, a group of tribes belonging to the Yuman language family combined agriculture with wild seed gathering and hunting. Three oi these tribes were in the vicinity of the Grand canyon: Yavapai, Havasupai and Walapai. Of these the Havasupai derived at least half its subsistence from agriculture, and the others a lesser amount. The tribes at the lower end of the Colorado river, Cocopa, Yuma, Mohave and Maricopa (the latter tribe joined the Pima Indians on the Gila river before 1700), were primarily agriculturists, utilizing flood irrigation in the river bottom. Their excellent pottery was derived from Hohokam types.

Intermountain.— The Great Basin and adjoining portions of plateau country north and south were more fertile and hospitable in glacial and postglacial times than in modern times and probably served as one of the corridors for the later migrating people seeking the interior of the continent. Archaeological exploration brought to light a number of locations where occupation occurred at very early times. Gypsum cave in extreme southern Nevada, Lake Mohave and Silver lake in southern California are among the most ancient. Other caves in the Bonneville basin (which includes modern Great Salt lake) and Lake Lahontan basin (western Nevada) are considered to be quite old, ranging in age between 3,000 and 15,000 years. Projectile puints found in the Great Basin resemble rather closely the Folsom points found east of the Rocky mountains, and this suggests that a related culture may have occupied the intermountain area at about the same time. Classification oi the culture found in the Great Basin area proved rather difficult. Earlier writers were inclined to deny the existence of a separate culture for that area and to explain what was found there in historic times as the result of borrowing from neighbouring regions; *e.g.,* California, the Plains, the southwest and the northwest. The later view was that a basic generalized culture obtained in the area in ancient times, and afterward spread and specialized in outlying areas like California. The problem of properly characterizing the basic culture for the area was intensified by the scarcity of materials. The many scattered remains, as those from the early sites mentioned, did not provide a sufficient range of associated types to allow qualitative judgment. Where stratigraphy occurs, the earliest material is Anasazi (Basket Maker period), suggesting that, as to certain characteristics at least (basketry, maize), the origins of intermontane culture derive from the southwest. Other characteristics, however, such as hunting with traps, nets and snares, the atlatl and possibly the bow, may have reached the region from the north! and then diffused to the Basket Maker people. Pueblo culture traits spread over the area somewhat later, reaching the southern boundary of Idaho, westward into eastern Nevada and even crossing the Colorado river into southern California. This diffusion of Anasazi culture into the Great Basin began probably as early as A.D. 500 and persisted until some time after AD. 1200.

Toward the end of that period, a non-Puebloid hunting people designated Promontory (from Promontory point in Great Salt lake) appeared in the Salt lake basin. Various traits, such as moccasins, iur mittens, beaver teeth dice and the sinew-backed bow were suggestive of

a northern origin. They were a nonagricultural people, although they produced pottery of a type iound among some northern Plains tribes. Other traits were subsequently borrowed irom the Puebloid people occupying the area Both peoples soon vanished and were succeeded by Shoshonean tribes, the modern occupants of the Great Basin and contiguous areas These tribes, it is thought, expanded from locations previously occupied in western and southwestern Nevada. They continued to expand their territory somewhat, crossing the Continental Divide into Montana and Wyoming. After 1700 the Comanche split off from the Wyoming branch and presently were harassing other tribes in the southern plains. The Shoshoneans, following their appearance in the historic territory, began to borrow traits from neighbouring areas, such as salmon fishing irom the north, twined basketry, pottery, Plains-type skin garments and, eventually, the horse. This reconstruction is somewhat more complex than earlier descriptions, but it offers a reasonable accommodation of the known facts.

California. — The California area was marked by a great complexity of individual languages (about 20 in Powell's classification) and separate tribal groups. In some instances, groups oi not more than 500 people, speaking a distinct language, lived in the immediate proximity of another group of no greater size, speaking a quite different language, and neither seemed to impinge upon the other. If a multiplicity of separate languages is symptomatic of the condition that prevailed in very early times, then Caliiornia settlement should reflect great antiquity. The earliest migrating Asiatics, it might be assumed, found themselves brushed aside by later and larger aggregates speaking a common tongue, and found in Caliiornia a haven apart irom the main stream of traffic. There is practically no archaeological evidence in support of such a hypothesis, however. Mention has previously been made of the sites explored at Lake Mohave and Pinto basin in southern California. Unfortunately in these cases, while the geological features involved can be dated with reasonable assurance at 10,000 to 15,000 years ago, there is reason to doubt in each case whether the human remains are contemporaneous. On the coast of southern California, campsites of a people designated San Dieguito have been found. These were tentatively dated at 2000 B.C. In central Caliiornia (valleys of the Sacramento and San Joaquin rivers), the earliest sites are: Borax lake, probably antedating 1000 B.C.; early Buena Vista, on the lake of that name, and Oak Grove, in the Santa Barbara area, both dating from about 1000 B.C. At mid-20th century, northern Caliiornia had not yet yielded archaeological material of value. In spite of the great complexity of linguistic and demographic factors, the Caliiornia culture area presents no striking deviations. Agriculture was not practised except along the Colorado river, since throughout the vast central portion of the area and southward along the coast an ingenious method of leaching acorn pulp and converting it into flour supplied abundant and constant food. Along the coast, fisheries, including the hunting of sea mammals in the Santa Barbara region, supplied the basic diet. Pottery making was restricted to the desert area east of the Coast range in southern California until rather late in the prehistoric period, when it appears on the southern coast and in the upper San Joaquin valley. Basketry, however, was widely distributed and attained distinctive skills and designs. Those produced by the Pomo Indians in the central region are especially notable.

Northwest Coast. — In the absence oi any archaeological evidence of antiquity, the *Northwest Coast culture* must be regarded as of recent iormation. It was, in iact, a culture still expanding and diversifying when Europeans first came into contact with it. Another general observation is the apparent lack oi influence oi culture traits derived irom Middle America and Mexico. On the other hand, influences from Asia are noticeable; *e.g.,* armour made of closely articulated wooden rods, and hats. The area falls into three subdivisions, the defining of which depends on identiiying the sources of certain characteristic traits rather than on any strong differences in the traits themselves. The major trends and patterns were shared in common. The over-all region extends irom northwestern Caliiornia to the head oi the inland waterway along the coast of southeastern Alaska, and within the general area the following aspects or geographical divisions occur: *Northern,* including territories occupied by Tlingit, Haida and Tsimshian Indians; *Central,* the Milbanke-Queen Charlotte sound region, occupied by the Kwakiutl and perhaps Bella Coola; and *Southern,* the Straits of Georgia and Puget sound, occupied by the coast Salish. The Columbia-Fraser river and adjacent interior regions are somewhat apart from this classification since they are, indeed, partly transitional between the northwest coast and the plateau, or intermontane, areas. Economic dependence was almost entirely upon fisheries, particularly salmon, though every kind of fish, sea mammal, shellfish, seaweed and birds feeding upon the sea were used. To a lesser extent, food resources of the land were used. So intensively was this natural iood habitat utilized that the density of population, as calculated by Kroeber, was greater in the northwest coast area than in any other part of prehistoric America north of Mexico. Great use was made oi cedar and other woods in building plank houses, great dugout canoes, food vessels, boxes for storage and cooking, and in carving masks and various ceremonial paraphernalia. Clothing and other fabrics were made of the inner bark oi spruce and cypress. By combining mountain goat wool with this bark fibre, yarn was produced ior weaving into blankets and robes. Organization was on a village rather than a tribal basis. Each village had a permanent winter site but moved seasonally as the people went from salmon stream to halibut grounds, to hunt sea mammals or to follow other pursuits in the course of the year. The potlatch ceremony, with its emphasis on giving away wealth to acquire public standing, was perhaps the most distinctive trait in the entire culture.

Arctic Coast. — The Eskimo people quite likely represent the latest ethnic stock to migrate into the new world, probably about the beginning of the Christian era. In physical type, the Eskimo resembled the earliest immigrants in that he was noticeably longheaded. Since roundheaded men are known to have iollowed the earlier longheads, the Eskimos coming at a still later time should have had a broad cephalic index. The fact that they contradict this expectation is acknowledged but not explained. The origins of the culture are not clearly defined, though exploration carried out aiter about 1940 suggested certain lines of development. The earliest remains are found in the Bering strait and immediately adjoining Arctic ocean areas. The designation Old *Bering Sea* is used in describing these earliest remains, which are those of an already highly specialized Eskimo culture. A partly contemporaneous, and possibly partly older, culture identified as *Ipiutak* centred at Point Hope on the arctic coast. and shared a number of traits with the Old Bering Sea phase of Eskimo, but also included some features which point to other comparisons. In stone work, particularly, including types of projectile points and cutting and thrusting implements equipped with stone blades inserted in bone and ivory heads, the Ipiutak material finds close parallels with related types of implements belonging to the Neolithic horizons across all of northern Eurasia. The possibility of establishing relationships between the Bering sea artiiacts and lines of diffusion spreading from Lake Baikal in Siberia at a time prior to the Christian era is thus suggested. It must also be concluded, however, that this Siberian Neolithic is not the prototype oi new world lithic industries, or at any rate that the Eskimos could not have been the carriers oi the oldest stages of that culture. Bering strait and vicinity appear as the beginning point, and from there Eskimo traits spread through successive stages identified as *Punuk, Birnirk, Post-Punuk, Dorset* and *Thule,* eastward across the northern shelf of the American continent and on to Greenland.

Eskimo culture is notable for the versatility it has shown in adapting to a changing environment. In some areas seals are the main staple, and a variety of hunting methods was devised. In caribou country, Eskimos came to depend entirely on upland hunting and never went near the sea. Elsewhere they became expert whale and walrus hunters and devised tools and equipment accordingly. They built housing out of materials at hand — driftwood, whalebone, sod or snow blocks. The latter structures were limited to the eastern areas (Coronation gulf, Baffinland) and to occasions of seals being hunted on ice at great distances irom shore. Among the most typical Eskimo inventions should be listed two types of skin boats, the umiak, a heavy boat used in whaling, and the lighter kayak; the harpoon with detachable head and bladder or inflated skin float; snow goggles; stone oil lamp; tailored clothing; dog traction. The adaptation to environment is still further emphasized by the Eskimos of southwestern Alaska, the Alaska peninsula, Kodiak Island and Cook inlet, and by the *Aleuts.* The latter speak an Eskimoid language which is not intelligible to a Bering sea Eskimo, for example, but otherwise they are the same people. The beginnings of the Cook inlet and Aleutian settlements are approximately contemporaneous with the Bering sea Eskimos. The region is one of heavy rainfall. Hence, transportation is entirely by boat, and the economy is limited to hunting of sea mammals, fishing and taking oi birds.

Subarctic.—Below the arctic basin occupied by the Eskimo people, an area of tundra, giving way at last to extensive coniferous forests and great inland waterways, was utilized by tribes of hunters. Their specializations were not so striking as those worked out by the Eskimos, but they served their purpose. The climate being subarctic and wholly unadapted to agriculture, the population was severely limited by the animal carrying capacity oi the area. Subsistence was obtained principally irom the caribou herds, though moose and deer and fish taken in rivers and lakes were also in the diet. Because of the rigorous environment, the people were not able to adopt or absorb cultural developments which might reach them either from the Eskimo north or irom the agriculturist-hunter tribes speaking similar languages in the south. Because snow in the interior was deeper and drier, the toboggan was substituted for the Eskimo's runner sledge, and snowshoes were distinctive traits. Extensive birch forests provided bark ior canoes, cooking and eating vessels, and covering ior the conical houses and shelters. The area divides roughly into two linguistic groups: (1) the Algonkin-speaking Cree (*q.v.*) (various divisions), Naskapi, Ojibwa' (*q.v.*), Ottawa and Algonkin, occupying the region north of the Great Lakes and east of the Nelson and Churchill rivers; and (2) the Athabascan-speaking Hare, Yellowknife, Dogrib, Slavey and Chipewyan on the Mackenzie river; the Loucheux, Sekani, Carrier and Babine in the western mountain area; several tribes along the Yukon river; and the Beaver and other tribes in British Columbia.

Eastern North America. — The agricultural practices of the aboriginal population of the eastern part oi the continent (approximately east of the 100th meridian) diiier so markedly irom those of the southwestern tribes as to suggest a diiierent source of origin. The western practice was to grind corn on a stone metate by means of a mano, a cylindrical or rectangular stone rubbed against the metate. The re-

sulting meal was then fashioned into flat tortillas or wafers and baked on hot stone. In the eastern area, corn was pounded in a mortar made of wood or stone, or made into hominy, and the product was boiled rather than baked. In the west, moreover, agriculture tended to absorb the full attention of the people, and ceremonial life more or less revolved around the incidents of planting and assuring a good crop. In the eastern zone, something less than 1% of potential crop land was actually cultivated, and the impression is obtained that agriculture was regarded as a supplementary means of livelihood rather than the mainstay. Surplus agricultural foods, moreover, seem to have encouraged warfare rather than the peaceful arts. The contrast in dietary practices suggests that the southwest derived its tradition and technology from the central valley of Mexico, since metate grinding is continuous between the two regions. No immediate answer is advanced to the question of origin in the case of eastern practices. Three possible routes are: (1) eastward from the Pueblo area; (2) northeastward out of Middle America, following the Gulf of Mexico into Texas; or (3) across the sea from the Antilles. There are strong objections to all three explanations. Possibly agriculture came late into the area as part of a complex which included the considerable social organization that must have gone into the great mound structures. Withdrawal or termination of that original stimulus, and consequent decline of mound-builder societies, would have removed the incentive for a strong agricultural development.

While a definite time period cannot be given for the earliest occupation of the eastern area, remains discovered up to mid-20th century were suggestive of the Folsom-Yuma artiiacts of the Rocky mountain region. The first skeletal remains are those of a longheaded race. Settlement doubtless occurred, as in the west, in early postglacial times, and the earliest settlers were probably hunters accustomed to a nomadic type of existence. By about A.D. 500, according to tangible evidence, agriculture and pottery making had been introduced, and the building of burial mounds was spreading over the country. The earliest examples of eastern pottery were found in Florida, Georgia and Alabama, and in certain northeastern sites. Pottery from the two regions differs in style and technical construction and apparently had different origins. Immediately preceding the introduction of agriculture into the eastern area, dependence for livelihood was centred on fishing, and the densest population was along the ocean shores, the rivers and fresh-water lakes. This would account for the great shell mounds underlying the sites occupied later by farming groups.

The most spectacular culture oi the eastern area is the *Hopewell,* which flourished approximately A.D. goo–1300. The name is derived from the Hopewell farm in Hamilton county, Ohio, where the first site was explored. It was to this culture that the term mound builders was at one time widely applied. The term is considered a misnomer, however, for later investigations revealed that the practice of constructing earth mounds was widespread in area and in time, and the purposes served by the mounds differed greatly.

Characteristics of the Hopewell culture, which centred in southern Ohio but reached also into Indiana, Illinois, Wisconsin, Michigan, Iowa, Kansas, Tennessee. Pennsylvania and New York, are those of a farming population still relying to a certain extent upon hunting and fishing and the gathering of wild nuts, fruits, seeds and roots. The amount of pottery and ornamental stone work and metalwork iound in association with Hopewell villages suggests that some division of labour may have taken place. In addition, the nature and size of the earthworks at many sites inevitably suggests that forms of public labour, whether voluntary or conscripted, may have been employed. The earthworks are sometimes of a type to suggest deiensive purposes, but more often they served as burial mounds or apparently formed the bases of temples or other structures. The best pottery was well made, with decoration applied by incised or stamped lines, often in naturalistic outlines. Even more notable are the effigy pipes, carved in stone and polished, representing birds, fish and various other animals. The metalwork has been called the finest in North America in pre-Columbian times. Copper in sheet forms was used extensively; some silver and meteoric iron, and occasionally gold, entered into various ornaments and utility pieces. Metal casting was not known, and the processing was limited to beating and annealing of raw ores. Sheets of mica were also employed and help to characterize the culture. Trade routes were evidently well developed, ior material irom as far away as the Rocky mountains and the Atlantic coast was iound in Hopewell sites, and articles identified as manuiactured by the Hopewell people were iound in localities as far distant.

The Hopewell culture represents the climax of a widely diffused pattern of agriculture, pottery and mound building to which the term *Mississippi* is attached. In its later manifestations, the culture is characterized by highly sedentary peoples living in fairly concentrated population centres. The influences which built up the culture seem to have arisen in the southeast and in the Lower Mississippi valley. Earlier levels of occupation in both regions contain traits which were later elaborated by the Hopewell and other groups. Throughout the area this Mississippi pattern was preceded by an earlier pattern of culture which lingered and absorbed traits irom the later culture. These earlier people were less sedentary in their habits, more loosely organized; they made a simple potter), depended on hunting but practised a limited agriculture. This ruder culture, to which the term *Woodland* is applied, appears to be of northern origin, and it has been suggested that Algonkin peoples were the carriers. The Muskhogean tribes, on the other hand, were probably responsible for the Mississippi culture. These historic tribes, whose territories reached from the Lower Mississippi river to Florida, are identified with important prehistoric sites.

As these eastern cultures flourished, they extended their influences northward and westward, and movements of people were partly responsible ior the diffusion. The Plains area in this manner absorbed and adapted to local conditions many traits irom the east.

Plains Area.— The underlying pattern in the Plains, as elsewhere in aboriginal America, was that of a hunting culture. In the high Plains, the basic material was identified as Folsom (Lindenmeier site). A somewhat later level of occupation (*c.* 3000 B.C.) occurred at Signal Butte in western Nebraska, but this too was a hunting, prepottery culture. By about A.D. 1000 a less nomadic, though still primarily hunting, economy appeared in the Nebraska region, along with rude, grit-tempered pottery. Agriculture may have been limited to squash and gourds, as neither beans nor maize was found. The tools and other remains are similar to the so-called Woodland traits of the eastern area. Evidences of this stage of culture are found in numerous sites in Nebraska, Iowa, Missouri, Kansas and (less certainly) Oklahoma. Scattered pottery remnants indicating Woodland influence have been found as far west as Colorado and the Yellowstone river, though the greatest concentration is east of the Missouri river.

At a later time, but still prior to Columbus' voyages, a second wave of people moved into the Plains, again probably irom the east. Traces of this second migration are widely dispersed, suggesting a fairly long interval of settlement. By this time horticulture, including the growing of maize and beans, had become the principal means of subsistence. Permanent buildings occur; the house type was a rectangular, semi-subterranean, earth-covered lodge. Pottery was abundant and better made than in the previous stage. Decoration was confined to incised lines around the neck or rim of the vessel. Regional variations have been found and identified by local place names. The first to be studied was the *Upper Republican* (river) *culture* in southern Nebraska and related sites on the Loup river in central Nebraska. Characteristic are small villages, built in the open along river terraces, housing 50 to roo inhabitants. Agricultural tools consisted of planting sticks and hoes made from the shoulder blade of a bison. Surplus corn was stored in underground storage pits. Complete absence of the metate, or grinding slab,. of the southwest suggests that maize was milled in a wooden mortar. Hunting was not abandoned since weapons and skin-working tools are still found. Various sites in Kansas closely parallel the Upper Republican material, traces of which are found as far away as the Texas panhandle, eastern Colorado and Wyoming, and perhaps the Dakotas. A further variant, found in the Missouri river bluffs of eastern Nebraska and northeastern Kansas, is designated the *Nebraska culture.* No basic differences occur, but the sites yield a richer array of pottery types, ornamentation and tools. Cannibalism may have been practised, though the evidence is not conclusive. The inference here is that Upper Republican and Nebraska were both regional specializations of a generalized culture which bad spread over a rather wide area. The complete absence of any traces of an earlier underlying culture in either area suggests, moreover, that the basic elements were brought in by a migrating people moving out of an older cultural environment.

One possible route of diffusion from the southeast into the Plains was through the Natchez (*q.v.*) people on the Lower Mississippi and the Caddo and affiliated tribes along the Red river in Texas. Near there also were the Pawnee and their affiliates, the Arikara, who eventually in historic times drifted northward and became associated with the Mandan in North Dakota. The Red river pattern was based on agriculture. The pottery was excellent in design and finish, with intricate patterns of broad and fine incised lines. Tempering to ensure evenness of firing was accomplished by adding grit, sand, crushed shells and other materials. Villages abounded, composed of domed circular houses made of thatch, such as Coronado reported seeing in Kansas. This basic house type eventually spread throughout the central and northern Plains, though brush and earth were substituted as a covering as people moved away from regions where palmetto, reeds or other thatching material grew. This inferred route finds some confirmation near the mouth of the Platte river in northwestern Missouri. There, in association with house types resembling those of the Nebraska culture, were iound quantities oi pottery sherds in which shell tempering was used, instead of grit or crushed rock such as was used by the people of the Nebraska and Upper Republican cultures

Entry into the Plains area by Europeans occurred in 1541, when Coronado marched from Pecos Pueblo (east of the Rio Grande) into the region near modern Wichita, Kan. The party reported meeting two types of natives: one nomadic (probably Apache), and the other dwelling in villages of round straw houses and raising maize, beans and melons. The latter were probably Wichita Indians, of the Caddoan linguistic stock. Following that initial contact, the Plains area remained relatively obscure, and Europeans were not aware of the profound changes and movements that took place. The acquisition of the domesticated horse in the decades following the establishment of a permanent Spanish outpost at Santa Fe, N.M., in 1605 was responsible for the major displacements, though intruders from outlying regions supplied the initial incentive to move and to consolidate. Large vil-

lages, occupying as many as 100 ac., had come into existence on the Loup and Platte rivers in east central Nebraska in prehorse times. These villages were situated on river bluffs for defensive purposes, and their inhabitants were probably ancestors of the modern Pawnee. Other concentrations took place in central Kansas and in the westward extensions of the Oneota *culture* (identified with Chiwere Sioux), which moved from the Wisconsin area into eastern Nebraska, Kansas and southwestern Missouri.

The horse inevitably speeded up the process and in many cases brought about complete abandonment of previous pursuits. Thus, the Comanche and Kiowa, erupting out of the northwest at the beginning of the 18th century as mounted horsemen, started dislocations of sedentary tribes and European settlers alike. The Cheyenne (*q.v.*) and Arapaho (*q.v.*), abandoning earth-covered lodges in Minnesota and North Dakota, gave up horticulture about 1700. Behind them, possibly crowding these two tribes into the northern Plains, were various bands of Dakota (Sioux), who had also been living a sedentary village existence. They in their turn had been dislodged from the Great Lakes region by Chippewa Indians, who had obtained European firearms from the French at an earlier date. Thus, most of the tribes which in the minds of later-coming white men were typical nomadic horse Indians, were newcomers to the area and in some cases had been farmers and village dwellers not many generations before their first contacts with Europeans. Still other tribes, starting from a tradition of agriculture, made a kind of unhappy compromise with the changed conditions. Among these were the Pawnee and their kinsmen the Arikara, and the Siouan-speaking Mandan, Santee, Omaha and Oto. The tribes which apparently took to the horse culture with the greatest alacrity were those which came into the Plains as northern hunters: the Blackfeet (see BLACKFOOT), Gros Ventres, Sarsi, Assiniboin, Comanche and Kiowa.

INDIANS IN CONTEMPORARY LIFE

The great diversity which marked Indian cultures persisted in modern times. Some tribes disappeared by amalgamation with other tribes or by wars and epidemics, and some languages perished. The process of acculturation worked at varying rates within the Indian societies, transforming and devitalizing segments of custom and practice. Notwithstanding these factors, Indian populations north of Mexico continued to manifest an unexpected viability. It is estimated that more than half the languages spoken in that area at the time of discovery were still in use in the 20th century (see Table II).

A discussion of contemporary Indian population is complicated by lack of a consistent definition of the term Indian, a condition that prevails throughout the western hemisphere. In the United States, a person is an Indian if he is an enrolled member of an Indian tribe or a descendant of such an enrolled member and recognized by the tribe, regardless of degree of Indian blood. The situation in Canada is basically similar. In both countries, many persons of varying degrees of Indian ancestry are not counted as Indians because they are not affiliated with a tribe. The United States government in 1950 recognized as Indians approximately 400,000 persons in the 48 states and an additional 35,000 Indians, Eskimos and Aleuts in Alaska. In Canada the 1950 estimate, including Eskimos, was about 140,000. The population of Greenland, about 22,000 in 1946, is predominantly Eskimo, with a European component of not more than 500 persons. On the basis of Mooney's figures for the dates indicated, it will be noted that the Indian population north of Mexico at mid-century was approximately one-half what it was at the time of the first white contacts. In the United States, at least, this population was increasing faster than the general population. The annual net increment of the Indian population in Canada was 1,500, or better than 1%. It is not possible, obviously, to state in quantitative terms the extent to which Indian attitudes, customs or values had continued to function. Neither is it possible to deny the existence of attitudes, customs and values identifiably Indian after the lapse of several centuries.

The modern position occupied by Indians in the United States and Canada is not readily understood without some explanation of prior events. In both countries Indians are considered wards of the nation, but the term does not elucidate itself as a reference to the usual relations of guardian and ward. In the United States, for instance, Indians are full citizens and may vote in every state of the union. In Canada individual Indians may be enfranchised by meeting certain legal requirements; and many took advantage of the opportunity.

The beginnings of the relationship are to be found in some of the earliest pronouncements of the Spanish crown. The discovery of the continents in the western hemisphere was an unforeseen event. Columbus, it will be recalled, was searching for a western, and shorter, route to the Indies, as Asia was then called. Europe was quite unprepared for the problem of admitting into world society, as it then existed, a human population not previously known. Questions were seriously raised as to whether these people, on rational as well as moral grounds, had the capacity to govern themselves or to own property.

Luckily for the new world inhabitants, the questions fell to the Spanish theologian Francisco de Vitoria to answer. His lectures, delivered at the University of Salamanca in 1539, voiced a humanistic view of conquest and the rights of subject peoples which in time became the prevailing view in international law. More immediately, his opinion was reflected in the promulgation of the Laws of the Indies in 1542, which decreed that Indians were free persons and were not to be taken as slaves; that disputes among Indians should be settled according to their own customs; and that property should not be taken from them except in fair trade. Vitoria denied that either the emperor of Spain or the pope was lord of the universe; even if the contrary were true, this would still not deny to Indians the right to hold property. Elsewhere he reasoned, if it be argued that Spain must administer in behalf of the Indians because of their lack of intelligence and experience, two limitations must still be imposed: the administration must be temporary, until Indians were capable of governing themselves; and the administrator must work, not for his own profit, but for the welfare of the Indians. This, in essence, could be the justification given by the modern administrator of Indian affairs.

It does not detract from the importance of Vitoria's utterances to remark that Spain in pursuing its colonial aims ignored him and the Laws of the Indies as well. Reformers such as Bartolome de las Casas made the world aware of the wrongs visited upon the Indians. In time, a large part of western Europe was enthralled by the concept of the "Noble Savage," a phrase evidently first used by John Dryden in his Conquest of Granada. The moral views of such men as Vitoria in the Spanish world and William Penn and others in the English sphere were the safeguards which in time brought public policy to erect barriers against racial injustice.

Colonial Policies.—The formulation of this public policy was a subject of concern to each of the major European colonizing powers. The Spanish tried assiduously to Christianize the natives by mass methods and to remake their living patterns. Orders were issued to congregate scattered Indian villages in orderly, well-placed centres, assuring the Indians at the same time that by moving to such centres they would not lose their outlying lands. This was the first attempt to create Indian reservations. The plan failed to protect the Indians in their land, according to Father Torquemada, who reported about 1599 that there was hardly "a palm of land" that the Spaniards did not possess. Many Indians who did not join the congregations for fear of losing what they owned, escaped into remote mountain places and lost their lands anyway.

The Russians never undertook seriously to colonize in the new world. When Peter the Great sent Adm. Vitus Bering into the northern sea which bears his name, the interest was in scientific discovery, not overseas territory. Later, when the problem of protecting and perhaps expanding Russian occupation was placed before Catherine, she declared (1769): "It is for traders to traffic where they please. I will furnish neither men, nor ships, nor money, and I renounce forever all lands and possessions in the East Indies and in America." In keeping with her thinking that it was "for traders to barter and for kings to govern," Catherine granted monopolistic trading privileges to the Russian American company, and the Russian government never thereafter seriously reconsidered its position.

The Swedish and Dutch attempts to colonization lasted so short a time that neither left a permanent imprint on new world practices. The Dutch government, however, was probably the first of the European powers to enter into a formal treaty with an Indian tribe, the Mohawks (see MOHAWK) (1643). Thus began a relationship, inherited by the British, which ultimately determined the ascendancy of the English over the French in North America.

France handicapped its colonial venture at the start by transporting to the new world a modified feudal system of land tenure which discouraged permanent settlement. The first royal commission, issued to the marquis de la Roche in 1598, recited: "We have given him power, to grant lands . . . to gentlemen and to those whom he shall consider persons of merit, in the form of fiefs, seigniories, chatellenies, countships . . . and other dignities." The first effort failed entirely, and while permanent establishment of the French in North America was effected by Samuel de Champlain in 1608, he is said to have issued only three seigniorial grants in the succeeding 20 years. Throughout the period of French occupation, the emphasis was on trade rather than on land acquisition and development. So general was the failure of the holders of large grants to encourage development that royal orders were issued in 1711 to provide that "at the expiration of a year, all seigniors who have shown conspicuous failure in developing and settling their seigniories should be deprived of their grants." Thus, France, by trying unsuccessfully to transplant a system of land tenure which at the very time was falling out of use in Europe, made no contribution to the formulation of an aboriginal land policy.

French administration did, however, establish practices in trade relations with the various tribes which can be traced through many subsequent events. The French instituted the custom of inviting the headmen of all the tribes with uhom they carried on trade to come once a year to Montreal, where the governor of Canada himself met the tribesmen in council, gave out presents and talked of friendship. The governor of Louisiana met the southern Indians at Mobile. The English, reluctantly, found themselves competing on the same basis of annual gifts. Still later, U.S. peace commissioners were to find it expedient to offer permanent annuities in exchange for tribal concessions of land or other interests.

The various English colonies established along the Atlantic seaboard were from the beginning a threat to continued Indian occupation of the area. Realization of this fact fired King Philip, the

Wampanoag leader, to his vain attempt to annihilate the northern colonists in 1675. The English were interested in land and permanent settlements. At the same time, the English, beginning quite early in their occupation, felt an obligation to bargain with the Indians and to conclude formal agreements, with compensation to Indian owners. The Plymouth settlers, coming without royal sanction, thought it incumbent upon them to make terms with the Massachusetts Indians. Lord Baltimore in 1635 and William Penn in 1682, while possessing royal grants, nevertheless took pains to purchase occupancy rights from the Indians. It became the practice of most of the colonies to prohibit indiscriminate and unauthorized appropriations of Indian land. The usual requirement was that purchases could be consummated only by agreement with the tribal headman, followed by approval of the governor or other official of the colony. At an early date also, specific areas were set aside for exclusive Indian use. Virginia in 1656 and commissioners for the United Colonies in 16 j8 agreed to the creation of such reserved areas. Plymouth Colony in 1685 designated separate tracts for individual Indians which could not be alienated without their consent.

Proclamation of 1763.—In spite of these efforts by the separate colonies and by the English ministers to protect Indian lands, unauthorized entry and use continued as a source of constant friction through the colonial period. Rivalry with the French, who lost no opportunity to point out to the Indians how their lands were being encroached upon by the English; the activity of land speculators, who succeeded in obtaining large grants beyond the settled frontiers; and finally the startling success of Pontiac in capturing English strongholds in the old northwest as a protest against this westward movement, together prompted the king's ministers to issue a proclamation which had been under discussion for some time. This royal proclamation of Oct. 7, 1763, formalized the concept of Indian land titles for the first time in the history oi European colonization in the new world. The document prohibited issuance of patents to any lands claimed by an Indian tribe unless the Indian title had first been extinguished by purchase or treaty cession. More particularly, in response to demands of Indians tbat their lands be respected, the proclamation reserved for the use of the tribes "all the Lands and Territories lying to the Westward of the sources of the Rivers which fall into the Sea from the West and Northwest." Land west of the Appalachians might not be purchased or entered upon by private persons, but purchases might be made in the narne of the king or one of the colonies, at a council meeting of the Indians.

This policy of quieting title continued in effect up to the termination of British rule in the American colonies and, in substance, was adopted by the United States as its official policy. The Appalachian barrier was soon passed—thousands of settlers crossed the mountains during the American Revolution—but both the Articles of Confederation and the federal constitution reserved either to the president or to congress sole authority in Indian affairs, including authority to extinguish Indian title by treaty. When French dominion in Canada capitulated in 1760, provision was made that "The Savages or Indian Allies of his most Christian Majesty, shall be maintained in the lands they inhabit, if they choose to remain there." Thereafter the proclamation of 1763 applied equally well in that country and was embodied in the practices of the dominion government. (The British North America act of 1867, which created modern Canada, provided that the parliament of Canada should have exclusive legislative authority with respect to "Indians, and lands reserved for the Indians." Thus, both countries made control over Indian matters a national concern.)

United States Policy.—The first full declaration of United States policy was embodied in the so-called Northwest Territory ordinance of July 13, 1787, which stated: "The utmost good faith shall always be observed towards the Indians, their lands and property shall never be taken from them without their consent; and in their property, rights, and liberty, they shall never be invaded or disturbed, unless in just and lawful wars authorized by Congress; but laws founded in justice and humanity shall from time to time be made, for preventing wrongs being done to them, and for preserving peace and friendship with them." This doctrine was embodied in the act of Aug. 7, 1789, as one of the first declarations of congress under the constitution.

The final shaping of these several statements of the legal and political rights of the Indian tribes is found in the opinions of Chief Justice John Marshall, notably in the decision written by him in the case of Worcester v. Georgia, where he held: "The Indian nations had always been considered as distinct, independent, political communities, retaining their original natural rights, as the undisputed possessors of the land, from time immemorial . . . The settled doctrine of the law of nations is, that a weaker power does not surrender its independence—its right to self-government—by associating with a stronger, and taking its protection. A weak state, in order to provide for its safety, may place itself under the protection of one more powerful, without stripping itscli of the right of government, and ceasing to be a state."

The first major departure from the oft-repeated policy of respecting Indian rights of property and political self-rule came with the Indian Removal act of May 28, 1830. For the first time coercion was resorted to by the United States, in the cases particularly of the Cherokee and Seminole tribes, as a means of securing compliance. The Removal act was not in itself a coercive measure, since it authorized the president only to negotiate with the Indian tribes east of the Mississippi on a basis of payment for their lands and improvements in the east and a grant of land west of the river, to which perpetual title would be attached. In carrying out the law, however, resistance was met with military force. In the decade following, almost the entire population of perhaps 100,000 Indians was moved westward. The episode moved the comte de Tocqueville to remark in 1831: "Whilst the savages were endeavouring to civilize themselves, the Europeans continued to surround them on every side, and to confine them within narrower limits . . . and the Indians have been ruined by a competition which they had not the means of sustaining. They were isolated in their own country, and their race only constituted a little colony of troublesome strangers in the midst of a numerous and dominant people."

The territory west of the Mississippi, it turned out, was not so remote as had been supposed. The discovery of gold in California at the midpoint of the 19th century started a new sequence of treaties, designed to extinguish Indian title to lands lying in the pathway of the various overland routes to the Pacific. The sudden surge of thousands of wagon trains through the last of the Indian country and the consequent slaughtering of the prairie and mountain game which provided subsistence for the Indians brought on the most serious Indian wars the country had experienced. For three decades, beginning in the 1850s, raiding parties and sporadic pitched fighting took place up and down the western plains, high lighted by such incidents as the Custer massacre by Sioux and Cheyenne Indians (1876), Chief Joseph's running battle in the same year against superior U.S. army forces and Geronimo's long duel with military and civil authorities in the southwest, resulting in his capture and imprisonment in 1887.

Toward the close of that period, the Ghost Dance religion, arising out of the dream revelations of a young Paiute Indian, Wovoka, promised the Indians a return to the old life and reunion with their departed kinsmen. The songs and ceremonies born of this revelation swept across the northern Plains. The movement came to an abrupt end Dec. 29, 1890, at Wounded Knee creek, South Dakota. Believing that the Ghost Dance was disturbing an uneasy peace, government agents moved to arrest ringleaders. Sitting Bull mas killed (Dec. 15) while being taken into custody, and two weeks later units of the 7th cavalry shot down more than 200 men, women and children who bad already agreed to return to their homes.

A further major shift of policy had occurred in 1871 after congressional discussions lasting several years. The president, with the advice and consent of the senate, had continued to make treaties with the Indian tribes and to commit the United States to the payment of sums of money. The lower house protested, since a number of congressmen had come to the view that treaties with Indian tribes were an absurdity (a view earlier held by Andrew Jackson). The senate yielded, and the act of March 3, 1871, declared that "hereafter no Indian nation or tribe" would be recognized "as an independent power with whom the United States may contract by treaty." Following this declaration, Indian affairs were brought under the legislative control of the congress to an extent that had not been attempted previously. Tribal authority with respect to criminal offenses committed by members within the tribe was reduced to the extent that murder and six other major crimes were placed under the jurisdiction of the federal courts. The list of crimes was later extended to ten.

The Allotment Act.—The most radical undertaking of the new legislative policy was the General Allotment act of Feb. 8, 1887. By that time the Indian tribes had been moved out of the main streams of traffic and were settled on lands which they had chosen out of the larger areas they had formerly occupied. Their choice in most cases had been confirmed by treaty, agreement, act of congress or executive order of the president. The tribes which had obtained subsistence from hunting over wide areas found reservation confinement a threat to their existence. Generally they had insisted on annuity payments or rations, or both, and the peace commissioners in behalf of the United States had been willing to offer such a price in return for important land cessions. In time, the view came to be held that reservation life fostered indolence and perpetuated Indian customs and attitudes which held Indians back from assimilation. The strategy offered by proponents of this theory was the Allotment act, which authorized the president to divide the reservations into individual parcels and to give every Indian, whether he wanted it or not, a particular piece of the tribally owned land. In order not to make the transition from Indian custom too abrupt, the land would be held in trust for a period of 25 years, after which a patent in fee simple would devolve upon the individual. With it would go all the rights and duties of citizenship. Reservation land remaining aiter all living members of the tribes had been provided with allotments, was declared surplus, and the president was authorized to open it for entry by non-Indian homesteaders, the Indians being paid the homestead price.

A total of 118 reservations was allotted in this manner. The result was not what had been anticipated. Through the alienation of surplus lands (making no allowance for children to be born) and through patenting bf individual holdings, the Indians of thrse reservations lost 86,000,000 ac. out of a total of 138,000,000 in Indian ownership prior to 1887. A generation oi landless Indians resulted, with no vocational training to relieve them of dependence upon land. The strategy iailed additionally in that ownership of land did not effect an automatic acculturation in those Indians who received individual parcels. Through

scattering of individuals and families, moreover, social cohesiveness tended to break down. The result was a weakening of native institutions and cultural practices with nothing offered in substitution. What was intended as transition proved to be a blind alley.

The trend in Indian population had been perceptibly downward through the decades after mid-19th century. The California Indians alone, according to Mooney's estimates, dropped from 100.000 in 1853 to not more than 30,000 in 1864 and 19,000 in 1906. Cholera in the central Plains in 1849 struck the Pawnee. As late as 1870–71 an epidemic of smallpox brought disaster to the Blackfeet, Assiniboin and Cree. Reports of declining population were widespread and gave currency to the concept of the Indian as "The Vanishing American." The decision of 1871 to discontinue treaty-making and the Allotment act of 1887 were both founded in the common belief that the Indians would not long survive and hence it did not much matter whether their views were sought in advance of legislation or whether lands mere provided for oncoming generations. When, therefore, it became obvious after about 1920 that the Indians, whose numbers had remained static for some years, were surely increasing, the United States found itself without a policy for advancing the interests of a living people.

A survey requested by Secretary of the Interior Hubert Work in 1926 and carried out by the Institute for Government Research, with Lewis Meriam in charge, brought into clear focus the failings of the previous 40 years. The investigators found most Indians "extremely poor," in bad health, without education and lacking adjustment to the dominant culture around them. Under the impetus of these findings and other pressures for reform, congress adopted the Indian Reorganization act of June 18, 1934, which contemplated an orderly decrease of federal control and a concomitant increase of self-government and responsibility in the Indians.

The essentials of the new law were as follows: (1) allotment of tribal lands was prohibited in the future, but tribes might assign use rights to individuals; (2) so-called surplus lands not pre-empted by homesteaders might be returned to the tribes; (3) tribes might adopt written constitutions and charters of incorporation embodying their continuing inherent powers to manage internal affairs; and (4) funds were authorized for the establishment of a revolving credit program, for land purchases, for educational assistance and for aiding the tribes in forming organizations. Moreover, the act could be rejected on any reservation by referendum of the eligible voters.

The response of the Indian population to the opportunities opened by the 1934 act was indicative of their ability to rise above adversity. About 160 tribes, bands and Alaska villages adopted written constitutions, some of which combined traditional practices with modern parliamentary methods. The revolving credit fund helped the Indians build up their herds and improve their economic position in many other ways. Beef cattle owned by Indians increased from about 170,000 head in 1932 to around 390,000 head in 1950, the number fluctuating with the market. On a number of reservations the carrying capacity of the land was reached, or passed, and no further increase was possible. It was estimated that about 12,000 Indian families were wholly or partly rehabilitated. The repayment record was especially outstanding. Borrowers from the fund were tribal corporations, credit associations and co-operative groups, which, in turn, loaned to individual Indians and to group enterprises. The total amount of money in the revolving credit pool, including sums which the tribes advanced from their trust fund accounts, amounted to about $20,000,000 by the 1950s. Of the amount falling due in 1942, 91.9% was repaid on schedule, 2.9% was extended and 5.2% was classed as delinquent. The record thereafter improved steadily. In 1949, for example, 96.7% was repaid on schedule, 2.26% was extended, 0.05% was cancelled and 0.99% was delinquent. In that year, of the $12,000,000 which had been loaned and on which payment was due, only $3,627 was cancelled as uncollectible.

Land purchase funds authorized by the 1934 act were used to buy 395,500 ac., and tribes used their own moneys to acquire an additional 390,000 ac. By other means, such as the restoration of unentered Indian lands and the transfer of parcels of public domain, Indian land holdings were increased by an additional 3,000,000 ac.

The gains were not limited to the economic area. In education and health, increased professionalization of staffs, improved methods, modernization of plants and larger operating funds resulted in services more nearly comparable with those available to the general population. In these fields especially, one of the outstanding developments was the extent to which other agencies began serving the Indian population. Thus, at mid-century, more than half of all Indian children in school were attending public schools, under contract arrangements by which the federal government compensated the school district (because of loss of revenue from tax-exempt Indian lands). Many contracts in the health field were made with private and public institutions, including medical and hospital care and public health work. The bureau of Indian affairs completed an arrangement with the United States public health service by which the latter agency supplied expert medical personnel and consultants.

Originally, the United States exercised no guardianship over the person of the Indian; when John Marshall first used the term, he was making an analogy that the relation of the United States to the Indian tribes was like that of guardian to ward. After 1871, when internal tribal matters became the subject of national legislation, the number and variety of regulatory measures multiplied rapidly. In the same year that the Indian Reorganization act was passed, congress significantly repealed 12 statutes which in an earlier day had made it possible to hold Indians as virtual prisoners on their reservations. Controls of that nature ceased to exist. Indians might come and go as freely as all other persons. The act of June 15, 1924, which extended citizenship to all Indians born within the United States, opened the door to full participation. Not many Indians took advantage of the law, and because of their lack of interest a number of states excluded Indians from the franchise. Organization of tribal governments following the Reorganization act seemed to auaken an interest in civic affairs beyond tribal boundaries, and as Indians asked for the franchise, state officials usually found that an order of the governor or an opinion of the attorney general was sufficient to reverse prior interpretations. In only two states, Arizona and New Mexico, was court action necessary, with decisions favouring the Indians in 1948.

The courts of the United States consistently upheld the sanctity of treaties made with Indian tribes, and with equal justice the courts also held that property may not be taken from Indians, whether or not a treaty exists, "except in fair trade," as Vitoria had maintained in 1539. The latter contention was offered by the Walapai Indians against the Sante Fe railroad. The company was required by the courts in 1944 to relinquish about 500,000 ac. which it thought had been granted to it by the United States. The lands had been occupied from time immemorial by the Indians, without benefit of treaty recognition, and the supreme court held that, if the occupancy could be proved, as it subsequently was, the Indians were entitled to have their lands restored. In 1950 the Ute Indians of Utah and Colorado were awarded a judgment against the United States of $31,750,000 for lands taken without adequate compensation where the land had previously been recognized and defined in a treaty.

Indian tribes were long precluded from bringing action against the United States unless congress approved in a special jurisdictional act. This procedure resulted in so burdening the Indian affairs committees of house and senate with requests for separate bills, some of which remained on legislative calendars year after year, that a special Indian claims commission was created by the act of Aug. 13, 1946. This legislation provided that all tribes must file their petitions within five years, and the commission must reach a finding on all cases filed with it in another five-year period.

The troubled history of Indian affairs administration in the United States had been anticipated by Henry Knox in a letter addressed to George Washington on July 7, 1789. As first secretary of war, Knox was the first federal official having general charge of Indian affairs. After remarking that certain individuals were of the opinion that it would prove impractical to civilize the red man (the argument was intended to rationalize a policy of forceful seizure of Indian lands), Knox wrote: "That the civilization of the Indians would be an operation of complicated difficulty, that it would require the highest knowledge of the human character, and a steady perseverance in a wise system for a series of years, cannot be doubted. While it is contended that the object is practicable, under a proper system, it is admitted in the fullest force, to be impracticable according to the ordinary course of things, and that it could not be effected in a short period."

BIBLIOGRAPHY.—Generalized publications are: Bureau of American Ethnology, "Handbook of the American Indians," *Bulletin 30,* 2 vol. (1907–10); Paul S. Martin, George I. Quimby and Donald Collier, *Indians before Columbus* (1947); A. L. Kroeber, *Cultural and Natural Areas of Native North America,* vol. 38 of University of California Publications in American Archaeology and Ethnology (1939); Felix S. Cohen, *Handbook of Federal Indian Law* (1945); Clark Wissler, *The American Indian, an Introduction to the Anthropology of the New World,* 3rd ed. (Oxford, 1938); and four collections of papers by various authors: D. Jenness (ed.), *The American Aborigines* (Oxford, 1933); G. G. MacCurdy (ed.), *Early Man* (1937); American Philosophical Society, *Recent Advances in American Archaeology,* vol. 86, no. 2 of Proceedings (1943); Smithsonian Institution, *Essays* in *Historical Anthropology of North America* (1940).

Prehistory.—A. C. Anderson *et al.,* "Natural Radiocarbon from Cosmic Radiation," *Physical Review,* vol. 72, no. 10 (Nov. 15, 1947); Ernst Antevs, "Climate and Early Man in North America," in G. G. MacCurdy (ed.), *Early Man* (1937), "The Spread of Aboriginal Man to North America," *Geographical Review,* vol. 25, no. 2 (1935); J. R. Arnold and W. F. Libby, "Age Determinations by Radiocarbon Content: Checks with Samples of Known Age," *Science,* 110: 678-680 (Dec. 23, 1949), "Radiocarbon Dates," *Science,* 113: 111-120 (Feb. a, 1951); Marius Barbeau, "The Aleutian Route into America," *Geographical Review,* vol. 35, no. 3 (1945); Franz Boas, "Relationships between North-West America and North-East Asia," in D. Jenness (ed.), *The American Aborigines* (Oxford, 1933); Kirk Bryan, "Geology of the Folsom Deposits in New Mexico and Colorado," in G. G. MacCurdy (ed.), *Early Man* (1937); Henry B. Collins, Jr., "Eskimo Archaeology and Its Bearing on the Problem of Man's Antiquity in America," in American Philosophical Society, *Recent Advances in American Archaeology,* vol. 86, no. 2 of Proceedings (1943); H. S. Gladwin, *Excavations at Snaketown,* Medallion Papers, no. 25-26 (1937), "The Significance of Early Cultures in Texas and Southeastern Arizona," in G. G. MacCurdy (ed.), *Early Man* (1937); Emil W. Haury, "A Possible Cochise-Mogollon-Hohokam Sequence," in Ameri-

can Philosophical Society, *Recent Advances in American Archaeology,* vol 86, no. 2 of Proceedings (1943); Frank C. Hibben, "Discoveries in Sandia Cave and Early Horizons in the Southwest," in American Philosophical Society, *Recent Advances in American Archaeology,* vol. 86, no. 2 of Proceedings (1943); Edgar B. Howard, "Folsom and Yuma Problems," in American Philosophical Society, *Recent Advances in American Archaeology,* vol. 86, no. 2 of Proceedings (1943), "An Outline of the Problem of Man's Antiquity in North America," *Amer. Anthrop.,* n.s., vol. 38, no. 3, part 1 (1936); Aleš Hrdlička, "The Coming of Man from Asia in the Light of Recent Discoveries," Smithsonian Institution *Annual Report for 1935;* W. A. Johnston, "Quaternary Geology of North America in Relation to the Migration of Man," in D Jenness (ed.), *The American Aborigines* (Oxford, 1933); Paul MacClintock, "Pleistocene Glacial Stratigraphy of North America," in G. G. MacCurdy (ed.), *Early Man* (1937); N. C. Nelson, "The Antiquity of Man in America in the Light of Archaeology," Smithsonian Institution *Annual Report for 1935;* Frank H. H. Roberts, Jr., "Developments in the Problem of the North American Paleo-Indian," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940), "The Folsom Problem in American Archaeology," in G. G. MacCurdy (ed.), *Early Man* (1937), "The New World Paleo-Indian," Smithsonian Institution *Annual Report for 1944;* Carl O. Sauer, "A Geographic Sketch of Early Man in America," *Geographical Review,* vol. 34, no. 4 (1944); E. B. Sayles and Ernst Antevs, *The Cochise Culture,* Medallion Papers, no. 29 (1941); E. H. Sellards, "Early Man in America," *Bulletin Geological Society of America,* vol. 51, no. 3 (1940); Philip S. Smith, "Certain Relations between Northwestern America and Northeastern Asia," in G. G. MacCurdy (ed.), *Early Man* (1937); Helmut de Terra, Javier Romero and T. D. Stewart, *Tepexpan Man,* no. 11 *in* Viking Fund, Inc., Publications in Anthropology, ed. by Ralph Linton (1949).

Physical Types.—Roland B. Dixon, *Racial History of Man* (1923); Ernest A. Hooton, *The Indians of Pecos Pueblo* (1930), "Racial Types in America and Their Relations to Old World Types," in D. Jenness (ed.), *The American Aborigines* (Oxford, 1933); J. Millott, "Blood Groups and Race," Smithsonian Institution *Annual Report for 1937;* T. D. Stewart, "Some Historical Implications of Physical Anthropology in North America," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); T. D. Stewart and Marshall T. Newman, "An Historical Resume of the Concept of Differences in Indian Types," *Amer. Anthrop.,* n.s., vol. 53, no. 1 (1951).

Population and Language.—*Franz* Boas, *Race, Language, and Culture* (chapter, "A Classification of American Languages") (1940); V. Borum, "Greenland," *Danish Foreign Office Journal,* no. 1 and 2 (1948); Roland B. Dixon and A. L. Kroeber, *Linguistic Families of California,* vol. 61, no. 3 of University of California Publications in American Archaeology and Ethnology (1919); Harry Hoijer, "Methods in the Classification of American Indian Languages," in L. Spier, A. I. Hallowell and S. S. Newman (eds.), *Language, Culture, and Personality* (1941); A. L. Kroeber, *Cultural and Natural Areas of Native North America,* vol. 38 of University of California Publications in American Archaeology and Ethnology (1939); James Mooney, Smithsonian Institution, *The Aboriginal Population of America North of Mexico* (1928); J. W. Powell, "Indian Linguistic Families of America North of Mexico," Bureau of American Ethnology *Seventh Annual Report* (1891); Gladys A. Reichard, "Language and Cultural Patterns," *Amer. Anthrop.,* n.s., vol. 52, no. 2 (1950); Edward Sapir, *Selected Writings,* ed. by David G. Mandelbaum (1949); C. F. Voegelin, "North American Indian Languages Still Spoken and Their Genetic Relationships," in L. Spier, A. I. Hallowell and S. S. Newman (eds.), *Language, Culture, and Personality* (1941), "Relative Chronology of North American Linguistic Types," *Amer. Anthrop.,* n.s., vol. 47, no. 2 (1945).

Culture Provinces.—*Kaj* Birket-Smith, "Eskimo Cultures of North America and Eurasia," in G. G. MacCurdy (ed.), *Early Man* (1937); Franz Boas, "The Decorative Art of the Indians of the Korth Pacific Coast," *Bull. Amer. Mus. Nat. Hist.,* vol. 9, art. 10 (1897); Henry B. Collins, Jr., "Eskimo Archaeology and Its Bearing on the Problem of Man's Antiquity in America," in Amer. Philosophical Soc., *Recent Advances in American Archaeology,* vol. 86, no. z of Proceedings (1943), "Outline of Eskimo Prehistory," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); Harold S. Colton, "Reconstruction of Anasazi History," in American Philosophical Society, *Recent Advances in American Archaeology,* vol. 86, no. 2 of Proceedings (1943); L. S. Cressman *et al., Archaeological Researches in the Northern Great Basin,* Carnegie Institution of Washington, pub. 538 (1942); Philip Drucker, "Archaeological Survey of the Northern Northwest Coast," Bureau of American Ethnology *Bulletin 133* (1943); William N. Fenton, "Problems Arising from the Historic Northeastern Position of the Iroquois," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); J. R. Ford and Gordon R. Willey, "An Interpretation of the Prehistory of the Eastern United States," *Amer. Anthrop.,* n.s., vol. 43, no. 3, part 1 (1941); H. S. Gladwin, *Excavations at Snaketown,* Medallion Papers, no. 25-26 (1937); James B. Griffin, *The Fort Ancient Aspect* (1943); George Bird Grinnell, *The Cheyenne Indians* (1923); F. Haines, "The Northward Spread of Horses among the Plains Indians," *Amer. Anthrop.,* n.s., vol. 40, no. 3 (1938); Emil. W. Haury, "A Possible Cochise-Mogollon-Hohokam Sequence," in American Philosophical Society, *Recent Advances in American Archaeology,* vol. 86, no. 2 of Proceedings (1943). *The Mogollon Culture of Southwestern New Mexico,* Medallion Papers, no. 20 (1936); W. W. Hill, "Some Navajo Culture Changes during Two Centuries," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); Diamond Jenness (ed.), *The American Aborigines* (chapter, "The Problem of the Eskimo") (1933); A. V. Kidder, *An Introduction to the Study of Southwestern Archaeology,* Papers of the Phillips Academy Southwestern Expedition, no. 1 (1924), "Speculations on New World Prehistory," in Robert H. Lowie (ed.), *Essays in Anthropology* (1936); A. L. Kroeber, *Cultural and Natural Areas of Native North America* (1939); T. M. N. Lewis and Madeline Kneberg, *The Prehistory of the Chickamauga Basin in Tennessee* (1941); Robert H. Lowie, "American Culture History," *Amer. Anthrop.,* n.s., vol. 42, no. 3 (1940); Paul C. Mangelsdorf and C. Earle Smith, Jr., *New Archaeological Evidence on the Evolution of Maize,* vol. 13, no. 8 of Harvard University Botanical Museum Leaflets (March 4, 1949); Paul S. Martin, George I. Quimby and Donald Collier, *Indians before Columbus* (1947); Willard Z. Park, "Culture Succession in the Great Basin," in L. Spier, A. I. Hallowell and S. S. Newman (eds.), *Language, Culture, and Personality* (1941); Frank H. H. Roberts, Jr., "Survey of Southwestern Archaeology," Smithsonian Institution *Annual Report for 1935;* Frank M. Setzler, "Archaeological Perspectives in the Northern Mississippi Valley," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); Julian H. Steward, "Native Cultures of the Intermontane Area," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); William D. Strong, Smithsonian Institution, *An Introduction to Nebraska Archaeology* (1935), "From History to Prehistory in the Northern Great Plains," in Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940); John R. Swanton, "Aboriginal Cultures of the Southeast," Bureau of American Ethnology *42nd Annual Report* (1928), "The Indians of the Southeastern United States," Bureau of American Ethnology *Bulletin 137* (1946); William S. Webb, "An Archaeological Survey of the Norris Basin in Eastern Tennessee," Bureau of American Ethnology *Bulletin 118* (1938); Waldo R. Wedel, "Culture Sequence in the Central Great Plains," Smithsonian Institution, *Essays in Historical Anthropology of North America* (1940), "An Introduction to Pawnee Archaeology," Bureau of American Ethnology *Bulletin 112* (1936).

Indians in Contemporary Life.—General documents include: S. D. Aberle, "The Pueblo Indians of New Mexico, Their Land, Economy, and Civil Organization," *Amer. Anthrop.,* n.s., vol. 50, no. 4, part 2 (1918); Canadian Joint Committee on the Indian Act, *Minutes* (1946); Bureau of American Ethnology, "Handbook of the American Indians," *Bulletin 30,* 2 vol. (1907–10); George D. Harmon, *Sixty Years of Indian Affairs* (1941); Edna Kenton (ed.), *Jesuit Relations and Allied Documents* (1927); D'Arcy McNickle, *They Came Here First,* in "Peoples of America Series" (1949); U.S. Commissioner of Indian Affairs, *Annual Reports* (population data in *Statistical Supplement, 1945)* (1849 *et seq.)*; U.S. House of Representatives, Subcommittee on Indian Affairs of the committee on Public Lands, *Compilation of Material Relating to the Indians of the United States and the Territory of Alaska* (1950); U.S. Senate, Committee on the Interior and Insular Affairs, *Statement of the Acting Commissioner of Indian Affairs* (1949).

Sources for Table II.—J. W. Powell, "Indian Linguistic Families of America North of Mexico," Bureau of American Ethnology *Seventh Annual Report* (1891); Bureau of American Ethnology, "Handbook of the American Indians," *Bulletin 30,* 2 vol. (1907–10); U.S. Commissioner of Indian Affairs, *Statistical Supplement to Annual Report* (1945); U.S. House of Representatives, Subcommittee on Indian Affairs of the Committee on Public Lands, *Compilation of Material Relating to the Indians of the United States and the Territory of Alaska* (1950); Frederick W. Hodges (ed.), *Handbook of Indians of Canada,* Geologic Board of Canada (1913); Department of Indian Affairs, Canada, *Census of Indians in Canada, 1929* (1930); Edward Sapir, *Selected Writings in Language, Culture, and Personality,* ed. by David G. Mandelbaum (1949); C. F. Voegelin, "North American Indian Languages Still Spoken and Their Genetic Relationships," in L. Spier, A. I. Hallowell and S. S. Newman (eds.), *Language, Culture, and Personality* (1941). (D'A. Mc.)

INDIANA, one of the middle western states of the United States, is popularly known as the "Hoosier state," a term of uncertain origin. The second state to be carved out of the Northwest territory, Indiana entered the union as the 19th state on Dec. 11, 1816. The state capital is Indianapolis. Indiana is bounded on the north by Michigan, on the east by Ohio, on the south by Kentucky (from which it is separated by the Ohio river) and on the west by Illinois. In size it ranks 38th among the states, its total area being 36,291 sq.mi., of which about 106 sq.mi. is water. The tulip tree has been designated the state's official tree and the peony is the state flower. The state bird is the cardinal. The state flag is blue with a yellow border. In the flag's centre is a torch with six rays extending out from it. In a circle around this design are 13 stars; 5 other stars, representing the first 5 states to be admitted after the original 13, are grouped around

the base of the torch. A large star above the flaming torch represents Indiana.

PHYSICAL GEOGRAPHY

Physical Features and Soils.—Indiana is located principally within the east central lowland (approximately between latitude 37" 47' and 41° 46' north, and longitude 84° 49' and 88" 2' west). Although from the air its surface would appear quite level, the state is actually an undulating plain, which reaches its peak altitude of about 1,250 ft. above sea level in Randolph county, in the east-central area of the state, and its lowest altitude of slightly more than 300 ft. in Posey county where the Ohio and Wabash rivers merge. About 90% of the surface of the state is between 500 and 1,000 ft. above sea level. In general, the surface slopes toward the west, but also toward the south.

Most of Indiana's major rivers flow in a southwesterly direction. The longest river, the Wabash, with a total length of about 475 mi., flows from west-central Ohio northwest, then southwest and south across the state to its junction with the Ohio; it forms much of the boundary between Indiana and Illinois. The principal tributaries of the Wabash are the Salamonie, Mississinewa, Eel, Tippecanoe and White rivers. Of these the White river, with its east and west forks, is the most important. The Whitewater, in southeastern Indiana, is another important river. All of these rivers, as well as the Kankakee, which has its source near South Bend and flows southwest into Illinois and eventually into the Mississippi river, are within the Mississippi basin. Part of northern Indiana, however, is drained by the St. Lawrence-Great Lakes basin; the Maumee, for example, flows northeast from Fort Wayne into Lake Erie and the St. Joseph flows from north-central Indiana into Lake Michigan.

The northern third of the state, with the exception of the sand dunes along Lake Michigan, is a generally rolling area in which the soil is mainly an extremely fertile loam with much humus. The northern region has numerous moraines and lakes of glacial origin. Among the largest and better known lakes are Lake James, Lake Wawasee, Lake Winona, Lake Maxinkuckee, Bass lake, and Lake Shafer. Most of central Indiana is flat with glaciated soil which is principally a fertile loam. The southern third of the state, most of which was not leveled by the glaciers, has varied surface features. Except for the generally flat Wabash lowlands, next to the Illinois border, the soil is mainly clay which is much less fertile than the soil of central and northern Indiana. The central part of southern Indiana is scenic and hilly country. Southern Indiana has limestone formations which have resulted in sinkholes, lost streams and beautiful caves such as Marengo and Wyandotte, the latter among the most beautiful in the United States. There are also many mineral springs, the best known being those at French Lick and Martinsville.

Climate.—The climate of Indiana is invigorating; there is variety without harsh extremes. The mean annual temperature is about 53° F., varying from 50° in the north to 55° in the south. The coldest months are Dec. and Jan., during which period the mean monthly temperature is about 30°. July and August are the warmest months, at which time the mean monthly temperature is about 75°. The prevailing winds are from the west. The mean annual rainfall is about 40 in., varying from about 35 in. in the north to about 46 in. in the south. The growing season averages approximately 160 days in the north to approximately 180 days in the south.

Plants and Animals.—When the pioneers first arrived in Indiana the greater portion of the state was covered by forests. Oak, hickory, walnut, tulip, butternut, beech, elm, maple, mulberry, cherry, sassafras: sycamore and other trees were common. Important areas, notably in the northwest and around Vincennes, were prairies consisting largely of grasses and reeds. In places prairies and forest were intermingled.

Wild berries, fruits and flowers were abundant in the early days though they were unevenly distributed over the state. Strawberries, blackberries, raspberries, cranberries and huckleberries were gathered by the pioneers, as were grapes, persimmons, apples and plums. Wild flowers were numerous and widely scattered. Among the commonest were marigold, cowslip, sweet william, cyclamen, Indian paintbrush and buttercup.

There were many kinds of game and fur-bearing animals in the early days, beaver, fox, deer, otter, bear, raccoon, rabbit, squirrel and muskrat being among the most valuable. Among the birds there were pigeons, blue jays, whippoorwills, ducks, geese, turkeys, grouse, quail and other song and game birds.

Some of the native trees, berries, fruits, flowers, animals, fish and birds have disappeared, Most of them remain, however, though in smaller numbers than in the early days.

State Parks.—In 1919 the Indiana conservation department was established and the development of the state parks became one of its principal responsibilities. In addition to the parks, this department developed historical memorials, game preserves and sanctuaries, fish hatcheries, state forests and nurseries, and promoted conservation. The oldest state park, McCormick's Creek, was opened near Spencer in Owen county in 1916; later that year Turkey Run state park was opened in Parke county. During the 1920s the following state parks were established: Clifty Falls, overlooking the meandering Ohio river; the Dunes, along the southern shore of Lake Michigan; Pokagon, adjacent to Lake James in northeastern Indiana; Spring Mill in Lawrence county notable for its scenery and restored pioneer village; picturesque Brown County with its rustic surroundings; and Shakamak, which includes parts of Clay, Sullivan and Green counties. Additional parks were added in later years.

HISTORY

Earliest **Inhabitants.**—Successive groups of Indians had lived in Indiana before the arrival of Europeans in the 17th century. Some of them were mound builders, and study of their remaining mounds has resulted in an ever-increasing knowledge of the life led by these early inhabitants. They were followed by others before Europeans appeared in Indiana. In 1800 various tribes of Indians lived in the area, the three leading tribes being the Delaware. Potawatomi and Miami; others included the Piankashaw, Kickapoo and Wea. The Indians were dependent upon crops, especially corn and vegetables, as well as upon hunting and fishing for their food. In 1820 most of the Delaware left Indiana for new homes west of the Mississippi. Most of the Potawatomi left during the late 1830s and early 1840s, and most of the Miami during the 1840s. The lesser tribes meanwhile had left the state; individual Indians from various tribes, however, remained in Indiana. In fact, the descendants of some of them still reside there, notably in the upper Wabash valley and along the tributaries of the river.

Exploration and Settlement.—The earliest Europeans to reach Indiana probably were anonymous and unlicensed French fur traders. Their penetration of the area was a part of the larger movement of French fur traders up the St. Lawrence river and into the vast region, rich with furs, including and surrounding the Great Lakes. Doubtless, the fur traders visited northern Indiana in increasing numbers during the last half of the 17th century.

Jesuit and other Roman Catholic missionaries soon followed the fur traders into the interior of North America. Father Claude Jean Allouez, who served the Miami Indians in the valley of the St. Joseph river in Michigan, possibly crossed into northern Indiana during the 1660s. Both trader Louis Jolliet and Father Jacques Marquette may have traversed the southern shore of Lake Michigan soon after their voyage of discovery down the Mississippi in 1673. In Dec. 1679 René Robert Cavalier, sieur de La Salle, and his party used the St. Joseph-Kankakee portage at South Bend in crossing from the Great Lakes to the Mississippi river. Some historians think that a decade earlier La Salle had proceeded from Lake Erie to the Ohio river and then descended this river at least to the falls at Louisville, but this possible early discovery of the southern boundary of Indiana remains doubtful.

The Maumee-Wabash route, with its short portage at Fort Wayne, proved more useful to the French than the St. Joseph-Kankakee route. Between 1700 and 1735 the French had established outposts at Miami (Fort Wayne), Ouiatenon (near Lafayette) and Vincennes. Vincennes became the leading French settlement in Indiana. Although some agriculture was engaged in

at these centres, they were mainly outposts in the widely diffused fur empire of France.

Geographical location made Indiana an important link between French interests in the St. Lawrence and Mississippi basins. The portages at South Bend and Fort Wayne were astride the continental divide between these basins. The three centres on the Wabash-Maumee were located on perhaps the most desirable water route between the French colonies of Quebec and Louisiana. The St. Lawrence and Mississippi outlets indeed have always been important to inhabitants of Indiana; the completion of the St. Lawrence seaway in 1959 strengthened the state's interest.

During most of the 17th century, distance and the Appalachian barrier deterred conflict between the French colonies and those of the English along the Atlantic seaboard. But during the French and Indian Wars (1689–1763) colonies and trade of both countries expanded as the conflict expanded in scope and intensity. By the treaty of Paris in 1763, most of Canada and all of continental United States east of the Mississippi were ceded to England, and France lost all its mainland possessions. Thus the Indiana area, along with the entire region that soon came to be known as the Old Northwest, passed from France to England.

Most of the Indians had either been neutral or else had sided with the French. Their resentment of the English occupation resulted in Pontiac's War in 1763 during which the English garrisons at Ouiatenon and Miami were taken by the Indians, although the uprising was soon quelled. In the proclamation of 1763 the English reserved the Old Northwest for the Indians and forbade further white settlement, though the French already there were not to be molested. In 1774 parliament passed the Quebec act which annexed the territory to Quebec. This act supported religious freedom and other privileges for the native French, nearly all of whom were Roman Catholic.

Many persons in the English seaboard colonies, especially in Virginia, regarded both the proclamation of 1763 and the Quebec act as contrary to their charter claims to the land as well as to their interests in the fur trade of the region. English occupation of the Old Northwest was nominal; troops were not sent even to Vincennes until 1777. During the American Revolution, forces led by George Rogers Clark of Virginia captured Vincennes in 1778. It was recaptured by the English a few months later, but retaken by Clark's forces in Feb. 1779 as a result of Clark's remarkable march from Kaskaskia.

Territorial Period. — By the treaty of Paris of 1783 title to the Old Northwest territory passed from Great Britain to the United States and the first authorized U.S. settlement was made at Clarksville, between the present cities of Jeffersonville and New Albany, at the falls of the Ohio (opposite Louisville), in 1784.

From 1783 until 1816 the Indiana area was a territory of the United States. At first both the United States and several states, especially Virginia, claimed all or part of the territory. The question of who owned the region was soon decided in favour of the United States, which had promised to dispose of it for the common good and eventually to carve from it equal states.

During the 1780s the United States established the following policies which were first tested in Ohio and Indiana: only the federal government was authorized to buy land from the Indians; such land must be surveyed by the federal government before it went on sale; land would be sold only by the federal government but it would be sold to individuals or to companies; and it was illegal to settle on land which belonged to the Indians or the federal government.

Following Clark's conquest of Kaskaskia and Vincennes, Virginia, the principal state claimant to the Old Northwest, organized the county of Illinois to include residents of these and other settlements. But there was little civil government in the region until the ordinance of 1787 became effective. This ordinance promised that 3 to 5 states would be carved out of the territory, and guaranteed new states equality with the original 13. The ordinance required that a territory pass through two successive territorial stages of government and have at least 60,000 residents before it would be eligible for statehood.

The Northwest territory was organized in 1787; the second, or representative, stage of territorial government was organized in 1799. The benefits of this second stage accrued mainly to the residents in the eastern area, which became Ohio. The residents of the remainder of the territory, who were largely French, preferred the return of the first, or nonrepresentative, stage of government. When the Northwest territory was divided in 1800 the larger western area became the Indiana territory and was thus returned to the first stage.

Indian opposition to American encroachments continued during the 1780s when various tribes unsuccessfully attempted to keep American settlers south of the Ohio river. As settlements north of the Ohio increased, Indian resistance stiffened and congress sent various expeditions to break it. Defeats were suffered by Gen. Josiah Harmar in what is now northwestern Ohio and northeastern Indiana (1790) and by Gen. Arthur St. Clair near Ft. Recovery, O. (1791). Stung by these defeats, the United States sent Gen. Anthony Wayne into the area. At Fallen Timbers in northwestern Ohio in 1794 Wayne defeated the Indians, and the next year, by the treaty of Greenville (O.), the greater portion of Ohio and a wedge-shaped slice known as the Gore, located along what was soon to be the Ohio-Indiana boundary, as well as scattered tracts of land were ceded to the United States.

Only about 2,500 whites lived in the present Indiana area in 1800, though about twice that number lived in the Indiana territory which then included nearly all of the present states of Indiana, Illinois and Wisconsin, a part of Minnesota and the western half of Michigan. When Ohio became a state in 1803 the eastern half of Michigan and the Gore were added to Indiana territory. In 1805 a separate Michigan territory was organized and in 1809 Illinois territory was also detached; Indiana's present boundaries were not established, however, until statehood was attained.

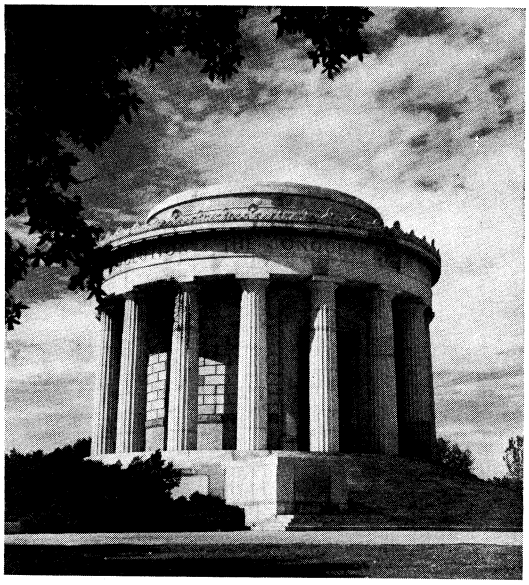
Between 1801 and 1809 William Henry Harrison (*q.v.*), as first territorial governor of Indiana, obtained the surrender of Indian claims to approximately the southern third of Indiana and to even more of Illinois. After 1809, under the leadership of the Shawnee Tecumseh (*q.v.*), Indian resistance again stiffened against the advancing Americans. In 1811, however, the Indians were defeated by Harrison at the battle of Tippecanoe, near Lafayette, and in 1814 another treaty of Greenville confirmed the cessions obtained prior to the War of 1812 with Great Britain. By 1815 the Indians had ceased to be a major obstacle to white settlement.

Statehood. — The first general assembly of Indiana territory had convened at Vincennes in 1805. Indiana's population continued to increase, even during the War of 1812, and in 1816 it became the 19th state. In 1813 Corydon had succeeded Vincennes as the territorial capital, and in 1825 Indianapolis became the permanent state capital.

Political democracy in Indiana had increased greatly during the years of territorial government. Membership in the council or upper house of the general assembly had been made elective, as was the office of territorial delegate to congress. Also, the property requirement for voting had been modified so that persons could vote either on the basis of property ownership or by paying a territorial tax.

Pioneer Life and Politics. — The half century from 1800 to 1850 was the pioneer period in Indiana. Settlement moved across the state mainly from south to north, but a large majority of settlers lived in the southern half of the state. The pioneer era was one of beginnings not only of homes, clearings, gardens and farms, but also of newspapers, churches, schools and libraries and of roads, bridges, streets, canals, steamboats, stages, railroads, the telegraph, household industries, trades and crafts, mills and shops. Equally important, the era witnessed the beginnings of town, township and county government, of political parties and party machinery and of state government. Indiana has had two state constitutions, both products of the pioneer era.

The pioneer period was characterized by extreme self-sufficiency and isolation. Not only were Hoosiers largely detached from older parts of the United States, but even neighbourhoods within the state were mainly self-sufficient and isolated from one another. Under these conditions the pioneers established the foundations from which Hoosier life and institutions developed, though they

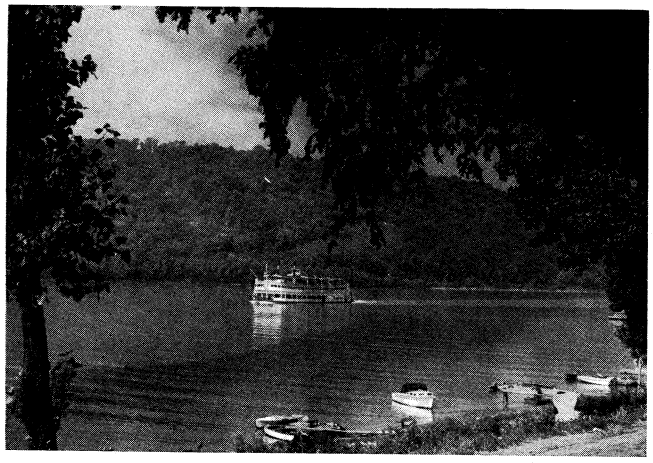


Memorial at Vincennes to George Rogers Clark (1752–1818) and his troops, who captured a nearby British fort during the American Revolution

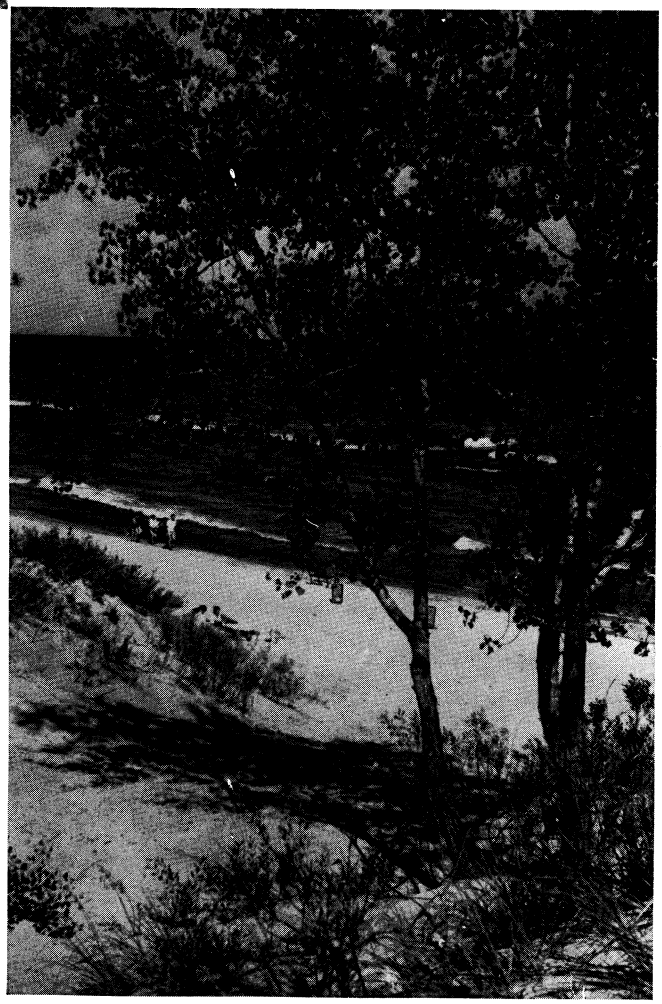
SCENES IN INDIANA

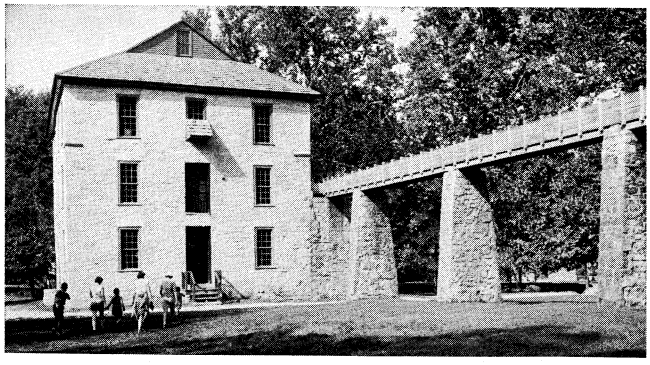
Left: Monument circle, centre of business district of Indianapolis. The 284-ft. monument is dedicated to the veterans of the Civil War

Below: View of the Indiana dunes along the south shore of Lake Michigan



Stern-wheel boat on the Ohio river near Madison, southeastern Indiana

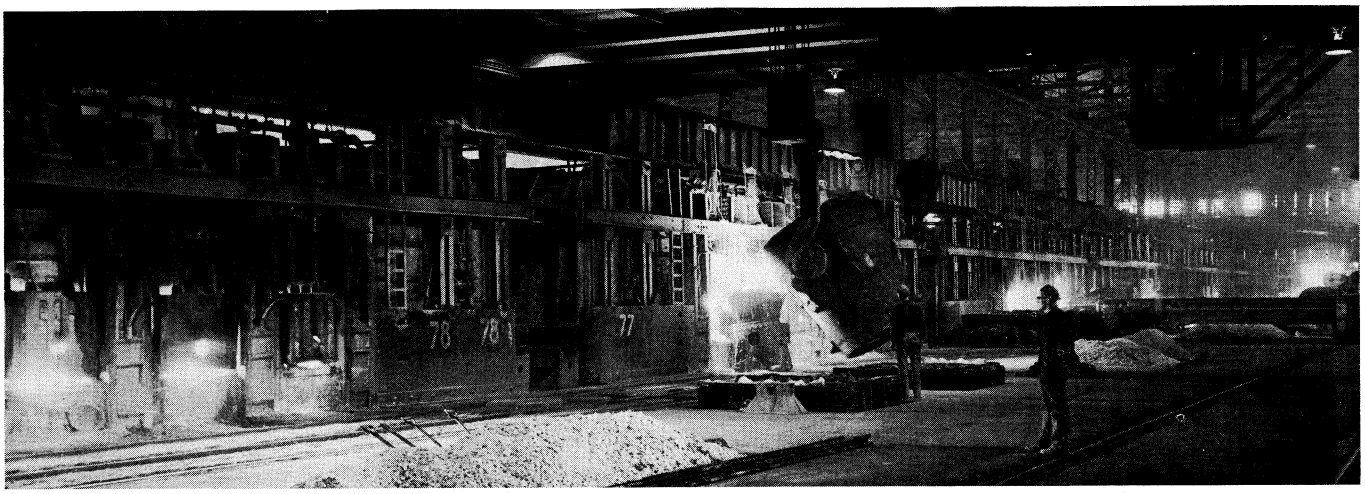




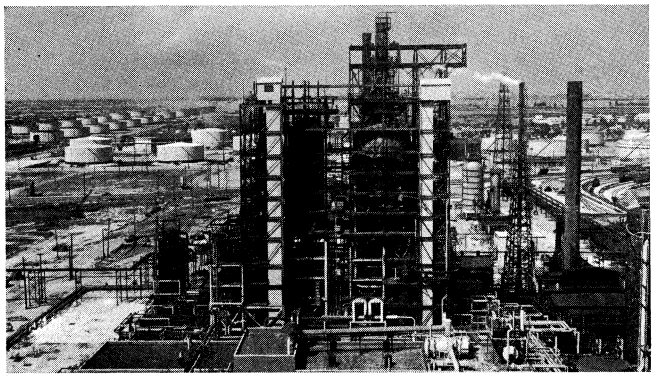
Gristmill and flume at Spring Mill State park, near Bedford. In addition to the mill, the park has reconstructions of other buildings used by early settlers of the area

BY COURTESY OF (TOP RIGHT, CENTRE LEFT. BOTTOM RIGHT) INDIANA DEPARTMENT OF CONSERVATION; PHOTOGRAPHS, (TOP LEFT) FAIRCHILD AERIAL SURVEYS, INC., (BOTTOM LEFT) HARTLEY ALLEY

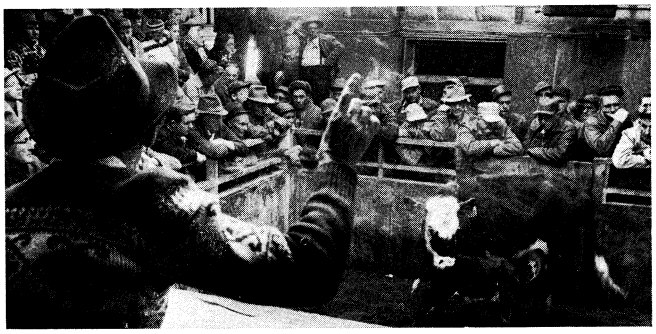
INDIANA



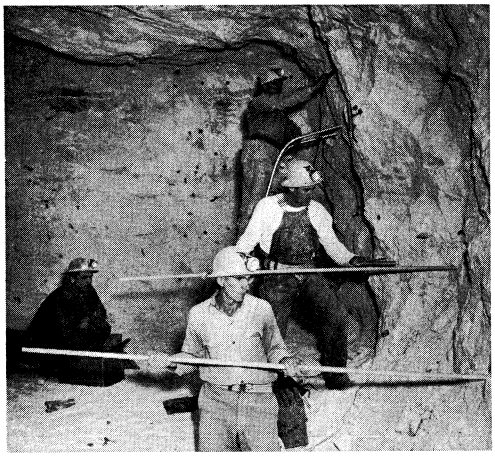
Pouring molten iron into one of the open-hearth furnaces of the U.S. Steel works at Gary. Metal production is the state's leading industry



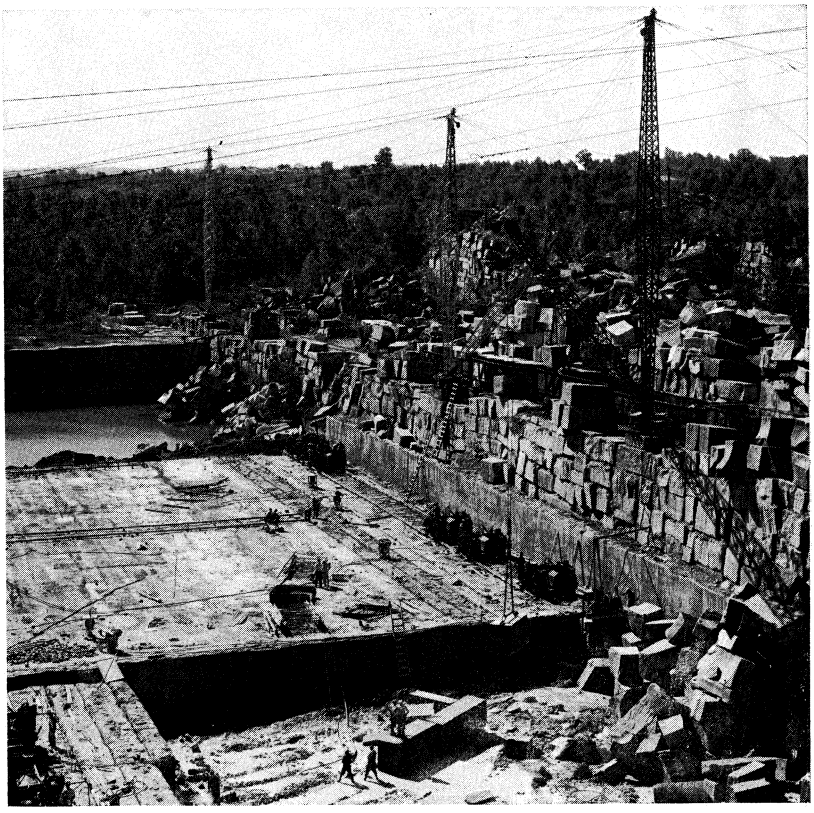
Cracking unit for the conversion of gas oil into high-octane automobile gasoline at a Whiting refinery, part of the heavy concentration of industry in northern Indiana near the Lake Michigan shore



Cattle auction at a sale barn in Bloomington. Indiana is chiefly a farm state, its total farm receipts ranking among the highest in the nation



Miners packing explosive charges into a gypsum deposit in Martin county. Exploitation of the mineral was one of the post-World War II industrial developments of the state



Cutting and loading limestone at the quarries near Oolitic, southwestern Indiana. A particularly fine grade of rock, Oolitic limestone is shipped to all parts of the U.S. and to foreign markets as well

INDUSTRY AND OTHER ECONOMIC ACTIVITIES OF INDIANA

BY COURTESY OF (TOP) UNITED STATES STEEL CORP., (CENTRE LEFT) STANDARD OIL COMPANY—INDIANA, (BOTTOM LEFT) UNITED STATES GYPSUM COMPANY, (BOTTOM RIGHT) STONE SALES AND SERVICE, INC.; PHOTOGRAPH, (CENTPE RIGHT) HARTLEY ALLEY

built mainly upon Anglo-Saxon ideas and practices which, like the English language, were an accepted and valued part of their heritage.

One of the more interesting American experiments in communal living flourished at New Harmony (*q.v.*), on the Wabash river in Posey county, a village originally settled by the followers of George Rapp in 1815. Rapp, a German, was a religious ascetic who, with his followers, was interested in forming a community patterned after the primitive Christian church. Remaining in Indiana, however, only about ten years, Rapp sold his holdings to Robert Owen (*q.v.*) of New Lanark, Scot., who interested several well-known scientists in his settlement and with them went to New Harmony in 1826. Although the community had become a failure by 1827, its influence was great. Among the persons who lived at New Harmony were Owen's three sons; William Maclure, founder of the Academy of Natural Sciences in Philadelphia; and Thomas Say, the "father of descriptive entomology in America." Parts of the colony have been restored.

During the first quarter of the 19th century almost all Hoosiers were Jeffersonian Democrats (popularly known as Republicans up to about 1825). The state constitution of 1816 was a liberal Jeffersonian document. Between 1825 and 1850, however, political power in Indiana was disputed between the Democrats and the National Republicans (1825–34) and then the Democrats and the Whigs (1834–54). Although Indiana supported Democrat Andrew Jackson for the presidency in 1824, 1828 and 1832, the National Republican-Whig party was usually the majority party in state politics from 1825 to 1843. In the later year the Democrats elected their first governor and from that time until 1860 largely controlled the state.

During the 1820s and 1830s the problem of internal improvements became an absorbing issue in Ohio, Illinois and Indiana. This resulted in bipartisan support within Indiana for the internal improvements system of 1836. The subsequent failure of the system resulted in temporary bankruptcy for Indiana and contributed greatly to the Whig defeat in 1843. Previously the Whigs had chartered the second state bank (1834), which was successful until its closing in 1859. A new state constitution was adopted in 1851.

Later **19th** Century. — From the prosperous 1850s until World War I agriculture was the leading pursuit of Hoosiers, though factories and mills grew in size and rapidly increased their output. In these decades, and especially the early ones, agriculture had an importance in Indiana which it never had before or after.

In 1854 the new Republican party was organized, succeeding the Whig party, but Indiana was one of the last of the northern states in which it gained support. In 1860 the Republicans elected Henry S. Lane as their first governor. They also elected their state ticket, a majority in both houses of the general assembly and 7 of the 11 congressmen. Shortly after the election, Lane was sent to the U.S. senate, and Oliver P. Morton succeeded him as governor.

When the Civil War began in April 1861, Indiana offered many more volunteers than could be accepted by the Union. About 200,000 Indiana men, mostly volunteers, served in the Union military forces. Morton was one of the most loyal of the war governors of the north, but his partisan zeal and occasional use of arbitrary methods helped to widen the gap between Indiana Republicans and Democrats. Very few Hoosiers were disloyal to the Union, though numerous Democrats and even some Republicans honestly disagreed with Morton's methods. But narrow partisanship, obstructionism and failure to vote needed appropriations can be charged against the Democrats. Morton's efforts to pin the label of treason on the Democratic party, however, by the so-called "treason trials" in the midst of the 1864 campaign were inconsistent with the support which Democrats generally gave the war. Certainly southern Indiana, the Democratic stronghold, vigorously opposed Gen. John H. Morgan, the Confederate raider, during his 1863 invasion. Moreover, Democratic counties did their part in supplying the men who did the actual fighting.

During the last half of the 1860s and most of the 1870s issues concerning reconstruction, the status of the Negro (both in Indiana and in the south) and related problems dominated state politics. Indiana was one of the first of the northern states to return the Democrats to power following the Civil War. In 1872 Democrat Thomas **A.** Hendricks (*q.v.*) was elected governor, and from then until the campaign of 1896 the contest between Republicans and the Democrats was usually very close. From 1896 until 1908 Indiana gave the Republicans large majorities in both state and national elections. Though reforms were limited during the period 1865–1910, the Australian ballot was adopted in 1889 and state laws were enacted to improve working conditions, especially those governing the employment of women and children.

The influence of the Progressive party movement began to be felt about 1901. This bipartisan movement, especially championed in Indiana by Albert J. Beveridge, a Republican, permeated both major parties. Between 1901 and 1917 Indiana established a railroad commission and then expanded it into a utilities commission; adopted the direct primary for state and local nominations; supported the amendments to the federal constitution which resulted in the direct election of United States senators and federal taxes on personal as well as corporation income; expanded public education, especially vocational education; increased state regulation of banks, loan and insurance companies and the sale of stocks; created a legislative reference bureau and initiated the state board of accounts. An unsuccessful effort to revise the constitution of 1851 was also made.

Modern Times. — By the time of World War I the value added to goods by the manufacturing process exceeded the value of farm products, and thereafter the disparity rapidly increased in favour of manufacturing. With the increase in manufacturing, Indiana became more urban than rural. Central and northern Indiana, which had surpassed southern Indiana in population and wealth before World War I, widened their lead over the region which had led in population and manufacturing in pioneer days.

The Republicans, who won control in Indiana in 1916, maintained it through the 1920s. Though agriculture was economically depressed, business prospered and the prevailing mood of the people was conservative. Racial and religious prejudice engendered by the Ku Klux Klan reached a peak during the period, and one governor was sent to a federal penitentiary while another pleaded the statute of limitations to escape what might have been a similar fate.

The economic depression which began in 1929 was a decisive factor in returning the Democrats to power with a wide margin of victory in 1932. During the administration of Gov. Paul V. McNutt (1933–37) a gross income tax was enacted, welfare and pension legislation was adopted and state aid to schools was substantially increased.

From 1940 until 1958 Indiana was controlled mainly by the Republicans, though the personal popularity of Henry F. Schricker, a Democrat, resulted in his serving as governor during 1941–45 and 1949–53; he was the only chief executive ever elected to two terms under the constitution of 1851. In the 1940s the welfare and pension legislation of the 1930s was expanded. The victory of the Democrats in the state and congressional elections of 1958 suggested that Indiana was still a "doubtful state" politically.

GOVERNMENT

The constitution of 1851, though frequently amended, remains the basic document of Indiana government. Written under the influence of Jacksonian democracy, it restricted the power of the general assembly and provided for the popular election of many state and local officials. Because of Indiana's costly experience with state loans for internal improvements during the 1830s and 1840s, the constitution prohibited state borrowing except for certain emergencies. An amendment to the constitution may be proposed by either branch of the general assembly; if a majority of both houses vote in favour of an amendment and it is favourably voted upon by the general assembly chosen at the next general election, the amendment is submitted to the people; a majority of the popular vote is necessary for ratification.

Although suffrage for white males had been attained in territorial days, it was not until 1881 that the barriers against Negro voting were removed from the constitution of 1851. All Indiana voters must be properly registered, be at least 21 years of age,

be citizens of the United Staies and have been residents of Indiana for a minimum of six months and of their voting unit for no less than 60 days. General state elections are held on the first Tuesday after the first Monday in November in even-numbered years.

Executive. — The executive and administrative department of the state government is divided among elective officials and numerous boards and commissions. The governor, lieutenant governor and attorney general, as well as the clerk and reporter of the supreme and appellate courts, are popularly elected in presidential years for four-year terms. The secretary of state, treasurer, state auditor and superintendent of public instruction are elected for two-year terms. No governor may immediately succeed himself, and neither the secretary, treasurer nor auditor may serve for more than four in any period of six years. The governor has the veto power, but laws may be passed over his veto by majority vote of the assembly. Administrative agencies having important responsibilities include the state board of accounts, the public service commission, the alcoholic beverage commission, the state highway department, the state board of education and the state budget commission.

Legislative. — Indiana's general assembly has a senate of 50 members and a house of representatives of 100 members. Senators serve four-year and representatives two-year terms. The biennial sessions of the assembly begin on the first Thursday after the first Monday in January of odd-numbered years. Regular sessions are limited to 61 days and special sessions to 40. Two-thirds of the members must be present to make a quorum, and an actual majority of the members of each house is required to pass legislation. Although the state constitution requires reapportionment every six years, the districts from which senators and representatives are elected were last reapportioned in 1921.

Judiciary. — The state's judicial department embraces a supreme court of five judges elected by districts by the state at large; an appellate court with northern and southern divisions, which virtually results in two appellate courts; and a system of local circuit courts. Supreme and circuit judges are elected for six years and appellate judges for four. Special courts, such as probate and juvenile courts, exist in some localities, and justices of the peace are elected in the townships.

Finance. — In the second half of the 20th century, the state's general revenue from all sources amounted to more than $475,000,000 annually. Of this sum, about 12% was derived from the federal government and about 75% from state tax sources. Revenue was provided mostly by general property taxes, motor fuels taxes, gross income taxes and the sale of motor vehicle and operators' licences. The state's expenditures totaled more than $43'0,000,000; Indiana's constitution prohibits the accumulation of a state debt. Approximately 38% of the state's revenues were being spent on education, about 30% on highways, slightly over 9% on health and hospitals and nearly 5.5% on public welfare. The state's income was nearly 3.5 times greater than it had been at the beginning of World War II; Indiana's per capita income ranked it 16th among the states in 1950.

Local **Government.**—Counties, townships, cities and towns are important units of local government within the state. Counties are governed by elected commissioners, various elected officials and a number of boards and commissions. Townships are governed mainly by township trustees and local advisory boards. Cities are divided into five classes or categories. The mayor-council type of government prevailed after a 1921 law, that would have permitted cities to adopt a commission or commission-manager form of government, was declared unconstitutional in 1929. Small towns are governed mainly by local boards. Special school, health, drainage and various other districts also exist as local governmental units.

POPULATION

That part of Indiana territory which became the state of Indiana had a population of about 2,500 inhabitants in 1800 and 147,178 in 1820, four years after statehood was achieved. Its population ranked 18th among the 27 states and territories that then composed the union and was classified as 100% rural. When the pioneer period ended in 1850 there were 988,416 people, making Indiana the seventh most populous state. At the beginning of the 20th century, the state was eighth in rank of population with a total of 2,516,462 persons by the census of 1900. The slowest population growth occurred between 1930 and 1940; in 1940 the population was only 5.8% greater than it had been in 1930. The 1950 population showed a total of 3,934,224 persons living within the state, making Indiana 12th among the states. There were part or all of eight standard metropolitan areas (Anderson, Evansville, Fort Wayne, Indianapolis, Louisville, Muncie, South Bend, Terre Haute) in 1959 and, together with Lake and Porter counties (which in 1959 were separated from the Chicago standard metropolitan statistical area as the Gary-East Chicago-Hammond stand-

*Indiana: Places of 5,000 or More Population (1960 Census)**

Place	Population				
	1960	1950	1940	1920	1900
Total state	4,662,498	3,934,224	3,427,796	2,930,390	2,516,462
Alexandria	5,582	5,147	4,801	4,172	7,221
Anderson	49,061	46,820	41,572	29,767	20,178
Auburn	6,350	5,879	5,415	4,650	3,396
Bedford	13,024	12,562	12,514	9,076	6,115
Beech Grove	10,973	5,685	3,907	1,459	—
Bloomington	31,357	28,163	20,870	11,595	6,460
Bluffton	6,238	6,076	5,417	5,391	4,479
Brazil	8,853	8,434	8,126	9,293	7,786
Cedar Lake	5,766	3,907	—	—	—
Charlestown	5,726	4,785	939	820	915
Clarksville	8,088	5,905	2,386	2,322	2,370
Clinton	5,843	6,462	7,092	10,962	2,918
Columbus	20,778	18,370	11,738	8,990	8,130
Connersville	17,698	15,550	12,898	9,901	6,836
Crawfordsville	14,231	12,851	11,089	10,139	6,649
Crown Point	8,443	5,839	4,643	3,232	2,336
Decatur	8,327	7,271	5,861	4,762	4,142
East Chicago	57,669	54,263	54,637	35,967	3,411
East Gary	9,309	5,635	3,401	813	—
Elkhart	40,274	35,646	33,434	24,277	15,184
Elwood	11,793	11,362	10,913	10,790	12,950
Evansville	141,543	128,636	97,062	85,264	59,007
Fort Wayne	161,776	133,607	118,410	86,549	45,115
Frankfort	15,302	15,028	13,706	11,585	7,100
Franklin	9,453	7,316	6,264	4,909	4,005
Gary	178,320	133,911	111,719	55,378	—
Goshen	13,718	13,003	11,375	9,525	7,810
Greencastle	8,506	6,888	4,872	3,780	3,661
Greenfield	9,049	6,159	4,821	4,168	4,489
Greensburg	6,605	6,619	6,065	5,345	5,034
Greenwood	7,169	3,066	2,499	1,907	1,503
Griffith	9,483	4,470	2,116	630	—
Hammond	111,698	87,594	70,184	36,004	12,376
Hartford City	8,053	7,253	6,946	6,183	5,912
Highland	16,284	5,878	2,723	542	—
Hobart	18,680	10,244	7,166	3,450	1,390
Huntington	16,185	15,079	13,903	14,000	9,491
Indianapolis	476,258	427,173	386,972	314,194	169,164
Jasper	6,737	5,215	5,041	2,539	1,863
Jeffersonville	19,522	14,685	11,493	10,098	10,774
Kendallville	6,765	6,119	5,431	5,273	3,354
Kokomo	47,197	38,672	33,795	30,067	10,609
Lafayette	42,330	35,568	28,798	22,486	18,116
La Porte	21,157	17,882	16,180	15,158	7,113
Lawrence	10,103	1,951	1,087	—	—
Lawrenceburg	5,004	4,806	4,413	3,466	4,326
Lebanon	9,523	7,631	6,529	6,257	4,465
Linton	5,736	5,973	6,263	5,856	3,071
Logansport	21,106	21,031	20,177	21,626	16,204
Madison	10,097	7,506	6,923	6,711	7,835
Marion	37,854	30,081	26,767	23,747	17,337
Martinsville	7,525	5,991	5,009	4,895	4,038
Michigan City	36,653	28,395	26,476	19,457	14,850
Mishawaka	33,361	32,913	28,298	15,195	5,560
Mount Vernon	5,970	6,150	5,638	5,284	5,132
Muncie	68,603	58,479	49,720	36,524	20,942
Munster	10,313	4,753	1,751	605	—
New Albany	37,812	29,346	25,414	22,992	20,628
New Castle	20,349	18,271	16,620	14,458	3,406
Noblesville	7,664	6,567	5,575	4,758	4,792
Peru	14,453	13,308	12,432	12,410	8,463
Plainfield	5,460	2,585	1,811	1,373	—
Plymouth	7,558	6,704	5,713	4,338	3,656
Portage	11,822	—	—	—	—
Portland	6,999	7,064	6,362	5,958	4,798
Princeton	7,906	7,673	7,786	7,132	6,041
Richmond	44,149	39,539	35,147	26,765	18,226
Rushville	7,264	6,761	5,960	5,498	4,541
Seymour	11,629	9,629	8,620	7,348	6,445
Shelbyville	14,317	11,734	10,791	9,701	7,169
South Bend	132,445	115,911	101,268	70,983	35,999
Speedway	9,624	5,498	2,325	—	—
Tell City	6,609	5,735	5,395	4,086	2,680
Terre Haute	72,500	64,214	62,693	66,083	36,673
Tipton	5,604	5,633	5,101	4,507	3,764
Valparaiso	15,227	12,028	8,736	6,518	6,280
Vincennes	18,046	18,831	18,228	17,160	10,249
Wabash	12,621	10,621	9,653	9,872	8,618
Warsaw	7,234	6,625	6,378	5,478	3,987
Washington	10,846	10,987	9,312	8,743	8,551
West Lafayette	12,680	11,873	6,270	3,830	2,302
Whiting	8,137	9,669	10,307	10,145	3,983
Winchester	5,742	5,467	5,303	4,021	3,705

*Populations are reported as constituted at date of each census.
Note: Dash indicates place did not exist during reported census, or data not available.

ard metropolitan statistical area), they contained more than one-third of the total population. By 1960 these metropolitan areas housed nearly 50% of the total population. In 1960 Indiana had a population of 4,662,498, an increase of 728,274 or 18.5% over 1950.

No urban centres (that is, towns having at least 2,500 residents) were reported until the census of 1840, when New Albany, Madison and Indianapolis appeared. In 1850 these three towns were joined by Lafayette, Fort Wayne, Terre Haute, Evansville and Lawrenceburg as urban places, but each had fewer than 10,000 residents. In 1900 Indiana had 80 urban places, and in 1950 119. In 1850 between 4 and 5 of every 100 persons lived in urban centres; in 1900 the figure was about 34 and in 1950 60.

Indiana's urban population has always been widely diffused. No city except Indianapolis exceeded 100,000 residents until after 1900. Even Indianapolis, the largest city in the state, had not reached 500,000 inhabitants in 1960. At that time Gary, Fort Wayne, Evansville, South Bend and Hammond each had more than 100,000 inhabitants. Urbanization was especially rapid along the southern shore of Lake Michigan after 1900; Gary, second largest city in Indiana in 1960, was not founded until 1906. Much the greater portion of the population increase between 1850 and 1950 was in the urban element.

The population per square mile in 1950 was 108.7, as compared with 50.7 for the U.S. as a whole. The 1950 urban population was 59.9% of the total. In line with the rest of the U.S. the percentage of persons 65 years old or over was increasing (9.2% in 1950).

The pioneers of Indiana came principally from Virginia, Maryland, North and South Carolina, Kentucky, Tennessee, Ohio, Pennsylvania and New York, but more came from southern or slave states than from northern or free states. Only a limited number came from New England.

Immigration from other countries was not large during pioneer days (before 1850); of those who immigrated Germans and Irish were most numerous. After pioneer days these continued to be the leading immigrant groups, but beginning in the 1880s a considerable number also arrived from Italy, Poland, Belgium, Austria, Hungary and other parts of southern and east-central Europe. Immigration from other countries reached its peak in the generation immediately preceding World War I. There were 11,262 Negroes in Indiana in 1850, 57,505 in 1900, and 174,168 in 1950.

EDUCATION

Public Schools. — The constitution of 1816 made it "the duty of the General Assembly, as soon as circumstances will permit, to provide, by law, for a general system of education, ascending in a regular gradation, from township schools to a state university, wherein tuition shall be gratis and equally open to all." Although this mandate was much ahead of its time, Indiana had had public schools in pioneer days, but they existed on a local-option basis and generally had tuition charges. Most schools, at all levels, were under private or church sponsorship at that time.

The constitution of 1851 emphasized the importance of elementary or common schools, and the free school law of 1852 established the foundation for a state wide system of free elementary schools. Progress was slow, however, and school attendance was not made compulsory until 1897. In the 1850s elementary schools were often limited to annual terms of about 3 months; 100 years later, the minimum annual term was 8 months, though terms were often 9 to 9½ months, especially in the cities.

Dozens of academies and seminaries, generally short-lived, were founded in the pioneer era; except for county seminaries, these institutions were under private or church auspices. All of them received most of their support from tuition payments.

A few free public high schools were established in the 1850s, and they increased in number during the last half of the 19th century. Most of these at first offered only two or three pears of instruction, but they developed with the free elementary schools and were regarded as part of the common school system. In 1900 relatively few elementary school graduates also completed high school; by 1950 more than half did so.

The Indiana school system is administered by a state superintendent, elected biennially, various state commissions and committees; by local superintendents and boards in the cities; and principally by township trustees in the township schools. Under permissive legislation passed in the 1940s and 1950s some towns and rural areas formed consolidated school units administered by superintendents and boards as in the city school system. In the late 1950s Indiana was spending $291 annually per pupil or slightly less than the U.S. average. This was about three times the amount spent prior to World War II.

Higher Education. — Indiana University. — Indiana university, located at Bloomington in the southern part of the state, was chartered as a seminary in 1820 and its first instruction was given about 1524. By the second half of the 20th century the university's annual enrollment approached 25,000 and its teaching staff numbered more than 2,500, On the 1,850-ac. campus at Bloomington are located the college of arts and sciences, junior (freshman) division, school of education, school of business, graduate school, school of law, school of music, school of health, physical education and recreation, division of university extension and division of optometry. The schools of medicine, dentistry and nursing, divisions of medical technology, dental hygiene, medical record librarianship, graduate dietetics, X-ray technology and occupational and physical therapy are at Indianapolis. University centres are found at Indianapolis, Gary, East Chicago, South Bend-Mishawaka, Fort Wayne, Kokomo, Jeffersonville-New Albany, Richmond (with Earlham college), Vincennes (with Vincennes university) and Evansville (with Evansville college).

The university is goyerned by a board of trustees of eight members, five of whom are appointed by the governor on recommendation of the state board of education and three of whom are elected by alumni.

Other State Institutions. — Purdue university, the state university of agriculture and mechanical arts, organized in 1869, is located at West Lafayette (see LAFAYETTE). The state-supported institutions for the training of teachers are Indiana State Teachers college (organized in 1870 as the State Normal school) at Terre Haute and the Ball State Teachers college (1918) at Muncie.

Private Institutions. — Other educational institutions of Indiana include Anderson College and Theological seminary at Anderson (Church of God; 1917); Butler university, Indianapolis (Disciples of Christ; 1850); DePauw university, Greencastle (Methodist; 1837); Earlham college, Richmond (Society of Friends; 1847); Evansville college, Evansville (Methodist; 1854); Franklin College of Indiana, Franklin (Baptist; 1834); Goshen college, Goshen (Mennonite; 1894); Hanover college, Hanover (Presbyterian; 1827); Indiana Central college, Indianapolis (Evangelical United Brethren; 1902); Manchester college, North Manchester (Church of the Brethren; 1889); Marian college, Indianapolis (Roman Catholic; 1937); Rose Polytechnic institute, Terre Haute (nonsectarian; 1874); St. Francis college, Fort Wayne (Roman Catholic; 1890); St. Joseph's college, Rensselaer (Roman Catholic; 1889); St. Mary-of-the-Woods college, Terre Haute (Roman Catholic; 1840); St. Mary's college (1844) and the University of Notre Dame (1842), the latter one of the leading Roman Catholic universities in the United States (both Roman Catholic, near South Bend); Taylor university, Upland (nonsectarian; 1846); Valparaiso university, Valparaiso (Lutheran; 1859); and Wabash college, Crawfordsville (nonsectarian; 1832).

HEALTH AND WELFARE

Indiana was one of the first states to establish schools for the deaf and the blind. The state school for the deaf, the school for the blind and the first state hospital for the insane were all opened in Indianapolis during the 1840s. The last became the Central State hospital in 1883; other similar institutions are the Logansport State hospital, the Richmond State hospital, the Woodmere State hospital, Evansville, and the Madison State hospital (North Madison). Norman M. Beatty Memorial hospital at Westville and the Larue D. Carter Memorial hospital at Indianapolis were built in mid-20th century. Institutions for the feeble-minded include the Fort Wayne State school and the Muscatatuck colony

at Butlerville. Another hospital is the Village for Epileptics at New Castle. There is a state soldiers' home at Lafayette, a soldiers' and sailors' orphans' home at Knightstown, a state sanatorium at Rockville and the Indiana university hospitals at Indianapolis.

There are six correctional and penal institutions: the boys' school at Plainfield, the girls' school at Clermont, the prison for women at Indianapolis, the state reformatory at Pendleton, the state prison at Michigan City and the state farm at Putnamville. Indiana has a habitual-criminal law and a law providing for the sterilization of mental degenerates, confirmed criminals and rapists.

Relief for the poor is under township trustees. Welfare work is under county welfare boards and the state department of public welfare with its divisions of public assistance, services for crippled children, corrections and children's divisions.

THE ECONOMY

Agriculture. — Until about the time of World War I, agriculture remained the principal occupation in Indiana. The leading field crops in the early days were corn, wheat and oats, but especially corn. Minor crops included tobacco, rye, barley, buckwheat and flax, though most of the pioneers also raised various vegetables. The principal farm animals were hogs, horses, cattle and sheep, and most early farms also had chickens, ducks or geese. The combination of corn and hogs has always been the mainstay of Indiana agriculture.

The leading field crops of pioneer days have continued as the main crops. Corn retained its primacy, but beginning in the 1940s soybeans succeeded wheat as the second most valuable field crop. Until pushed into third place by soybeans, wheat ranked second in value, followed by oats, though oat production was often larger than that of wheat. Since the 1880s tomatoes have been a crop of considerable value. Minor field crops include tobacco, rye, barley, buckwheat, popcorn, melons, onions, Irish potatoes, strawberries and mint. Vegetables, berries and fruits have achieved commercial importance, as have clovers and grasses.

Hogs have always been the most valuable farm animal in Indiana, but cattle have increased in importance since pioneer days. Sheep decreased in importance during the 20th century, and horses have been displaced by machinery on most Indiana farms; in the 1950s the number of horses and mules was smaller than that of oxen in the 1850s. The value of poultry and poultry products exceeds the combined value of horses and sheep, including their products.

In the second half of the 20th century Indiana annually produced approximately 250,000,000 bu. of corn; 40,000,000 bu. of soybeans; 35,000,000 bu. of wheat; and 50,000,000 bu. of oats. On the farms there were about 4,480,000 hogs, 2,200,000 head of cattle and 547,000 sheep. The state had approximately 154,000 farms, about 94,000 of which were owned by their operators with an additional 31,000 partly so owned. Farm tenants totaled only 18.3% of the total. The average farm comprised 125.2 ac. The aggregate value of farm products surpassed $1,000,000,000 during most years. The value of crops greatly exceeded the value of products from livestock and poultry.

Manufacturing. — Pioneer manufacturing was limited in quantity, consisting almost exclusively of products of farms and forests such as clothing, food, utensils and furniture. Small factories began to increase in numbers during the 1850s, and by 1860 Indiana ranked tenth among the states in the value of its manufactured goods. In 1900 it had advanced to eighth place and had 18,000 plants producing goods aggregating $378,100,000 in value. In both intervals the four leading industries were meat processing, flour and grain milling, lumbering and liquor distilling. In 1900 the iron and steel industry ranked fifth in value of products, the manufacture of railroad cars sixth and foundry and machine products seventh.

In the second half of the 20th century Indiana remained high in place among the states in the value of manufactured products; it then had about 6,400 plants producing goods valued at $4,625,000,000. Indiana's leading manufacturing industries were primary metal products, transportation equipment, electrical machinery, machinery other than electrical, food and related products, chemicals and related products, fabricated metal products, stone, clay and glass products, petroleum and coal products and printing and publishing.

The steel industry, concentrated in the Calumet region along the shores of Lake Michigan in northern Indiana, is by far the state's leading industry, and the region is one of the most important centres of steel manufacturing in the world. The industry got its start in Indiana when a mill was established at East Chicago (*q.v.*) in 1893; in 1906 at Gary the industry began an expansion that had not ceased in the 1960s. Steel became the leading industry of the state about 1929. One of the world's largest oil refineries is located at Whiting, near Gary. East Chicago developed into a leading industrial centre and one of the greatest shipping points in the nation.

Other leading manufacturing cities are Indianapolis, South Bend, Fort Wayne, Evansville, Hammond, Anderson, Muncie, Michigan City, Mishawaka, Elkhart, Kokomo, Marion, La Porte and Terre Haute (*qq.v.*). Indianapolis is a centre of the slaughtering and meat-packing industry and the printing and publishing of newspapers and periodicals; it is also an important centre of the motor-vehicle, furniture and foundry industries. Elkhart is a manufacturing centre for musical instruments, La Porte for harvesting machinery and South Bend for automobiles. Fort Wayne produces gasoline dispensing pumps, tractors, trailers and electrical apparatus. Evansville manufactures automobile bodies, refrigerators and excavating machinery. Muncie is noted for its glass fruit-jar industry and Mishawaka for its rubber, woolen and leather goods.

Mining. — Much outranked by agriculture and manufacturing, mining contribution to the economy nevertheless has been significant and in some counties has exceeded agriculture and manufacturing in the value of its products. In the second half of the 20th century Indiana ranked about 20th among the states in the value of its minerals, coal, oil, stone and clay being the principal mineral products.

During the 1830s geological surveys indicated that the state had large quantities of stone and coal and a limited quantity of low-grade iron ore. Coal and stone production attained commercial importance during the last half of the 19th century. Indiana coal is of the bituminous type and of only fair quality, but Indiana limestone was widely used for public buildings because of the stone's beauty, workability and durability.

From about the time of the Civil War efforts to find oil resulted in occasional discoveries of natural gas, but the period 1886–1906 represented the height of the gas boom in Indiana. As the supply of gas waned that of oil gradually increased so that by 1950 oil ranked second to coal in importance.

Commercial manufacturing of pottery and other clay products early became significant. During the 20th century products such as crushed stone, sand, gravel, cement, peat, marl and gypsum gained in commercial importance.

Transportation. — During the early period the Ohio-Mississippi waterway was the principal route for exports and later, with the advent of steamboats, for imports. The internal improvements system of 1836 was an ambitious but unsuccessful effort to solve the transportation problem and end the isolation of east from west. The completion during the 1830s of the national road, which traversed the state, greatly aided internal improvement. Canals, which served an important purpose in their day, began to be replaced by railroads by 1850. About 2,000 mi. of railroads were built during the 1850s and mileage increased until the time of World War I when the state had approximately 7,400 mi. of track. After the war the railroads began to lose much of their traffic to trucks, buses, automobiles, pipelines and airplanes; revival of water transportation on the Ohio river and the continued increase of traffic on the Great Lakes also affected the railroads. By 1950 mileage had dropped to about 6,600 mi. and it continued to drop thereafter.

At mid-20th century Indiana had more than 11,000 mi. of improved state and federal highways and nearly 75,000 mi. of county

roads. Though the state refused federal grants-in-aid for certain welfare programs, it obtained substantial federal funds for highway construction under the national highway program initiated in 1956. There were more than 100 commercial and 75 public but privately owned airports. There were also several heliports and military air fields.

BIBLIOGRAPHY.—The newest and most comprehensive history of Indiana is that by John D. Barnhart and Donald F. Carmony, *Indiana, From Frontier to Industrial Commonwealth,* 2 vol. (1954), including a comprehensive bibliography. Other general histories include Logan Esarey, *A History of Indiana, 2* vol. *(1922 et seq.),* and Charles Roll, *Indiana, One Hundred and Fifty Years of American Development,* 2 vol. *(1931).* For an informative account of pioneer life in Indiana *see* Logan Esarey, *The Indiana Home (1943*; illustrated ed., *1953).* Much information about Indiana is available in the files of the *Indiana Magazine of History (1905 et seq.),* the Indiana Historical Society publications *(1897 et seq.),* and in the Indiana Historical collections *(1916 et seq.).*

Current statistics on production, employment, industry, etc., may he obtained from the pertinent state departments; the principal figures, together with the current history, are summarized annually in the *Britannica Book of the Year,* American edition. (D. F. CA.)

INDIANAPOLIS, the capital and largest city of Indiana. U.S., a port of entry and the seat of Marion county, is situated on the White river near the geographical centre of the state. One of the most populous cities in the world not located on navigable water, Indianapolis has exceptionally good facilities for other forms of transportation. It is the focal point of six federal and seven state highways, has an excellent municipal airport and several supplemental fields, and has long been a rail centre. Pop. (1960) city 476,258, standard metropolitan statistical area (Marion county) 697,567. (For comparative population figures *see* table in INDIANA: Population.)

The city is built on a level plain surrounded by low, gently sloping hills. It has wide, well-planned streets, winding streams, trees, lawns, gardens and shrubbery. In the exact centre of the original tract of four sections, surrounded by a circular walk, is Monument circle with the soldiers' and sailors' monument in the centre. It rises to a height of 284.5 ft. above the street level and is surmounted by a figure called Miss Indiana. An elevator runs to a balcony at the top, which commands a panoramic view of the city and many miles of surrounding country. At the base of the monument are fountains. From the downtown area four avenues radiate diagonally to the four corners of the city. The other streets run at right angles to one another. The main east-west street (Washington) is 120 ft. wide; most of the others are 90 ft. There are more than 30 public parks and about 50 playgrounds; boulevards include a 60-ft. driveway on the top of the concrete levee (40 ft. high), which was constructed (1914–16) along the west bank of the White river.

EWING GALLOWAY

SOLDIERS' AND SAILORS' MONUMENT, MONUMENT CIRCLE, INDIANAPOLIS. DESIGNED BY BRUNO SCHMITZ. IT WAS COMPLETED IN 1902. IN THE BACKGROUND IS THE STATE CAPITOL BUILDING

North of the circle is the World War I memorial plaza covering five blocks given by city, county and state and containing, among other public buildings, the national headquarters of the American Legion. The state house, constructed in 1881–88, in a square of eight acres, has a ground area of two acres and a central tower and dome 240 ft. high. Many of the public and business buildings are constructed of the famous Indiana limestone from the Bedford district in the southern part of the state. Northwest of the city is the motor speedway, where the 500 mi. race is held annually on Memorial day. A crowd of about 175,000 is attracted each year from all parts of the United States. The home of James Whitcomb Riley is a literary shrine.

Indianapolis was one of the first cities in America to adopt electric street lighting, in Nov. 1881. A city-plan commission (1919) and a zoning ordinance, adopted in 1922, outlined a scheme for residential, commercial and industrial districts.

The city has an excellent public library and is also headquarters of the state library. In the second half of the 20th century there were three daily newspapers: the *News* (1869) and the Star (1883) being jointly owned; and the *Times* (1888). Indianapolis also has an excellent symphony orchestra, a fine arts museum and a children's museum.

Indianapolis is the seat of the schools of medicine, dentistry and nursing of Indiana university and of a part of that institution's school of law, school of health, physical education and recreation, and division of adult education and public service. The city is also the home of Butler university (chartered 1850), related to the Disciples of Christ Church; Indiana Central college (1902) supervised by the Evangelical United Brethren church; the John Herron Art institute and school; and Marian college (1937), a Roman Catholic institution. Also located there are the Central State hospital for the insane, the state schools for the blind and deaf, the state prison for women (the first in the United States, opened in 1873), and (at Clermont, 10 mi. outside the city) the state reformatory school for girls, which was a department of the prison until 1899. Ten miles northeast of the centre of the city is Ft. Benjamin Harrison, a United States army post, named after President Harrison, whose home was in Indianapolis. The state fairgrounds and the state fish hatcheries are within the city limits.

Around the Indiana university school of medicine developed one of the important medical centres of the country. The school itself was formed in 1908 by the union of the Indiana Medical college of Purdue university and the earlier medical department of Indiana university, which together incorporated six institutions founded between 1869 and 1906 at several different points in the state. Its building is conveniently located on the spacious grounds of the Robert W. Long hospital (completed 1914) which is a part of the school's equipment. Nearby is the James Whitcomb Riley Memorial hospital for children, built by private subscription and conveyed to the university on the day it was dedicated (1924); and the William H. Coleman hospital for women (opened 1927), also under the university's management.

The transportation facilities of Indianapolis and its position in the midst of the corn belt, near large coal fields, and with populous markets in every direction, have combined to make it an important commercial and industrial centre. It has a large trade in grain. In the early 1960s there were more than 1,100 industrial plants in the city, some of them the largest of their kind in the world, which produced approximately 1,200 different commodities. Chemicals and allied products, transportation equipment and elec-

trical machinery were major products. Among the other items produced on a large scale were airplane and truck engines; pharmaceuticals and biologicals; ferrous and nonferrous castings; phonograph records; radio and television sets; sound, electronic and electrical equipment; food products; canning and meat packing; power transmission devices; rubber products; road building and earth moving machinery; truck bodies; saws; wood products; heating and ventilating equipment; paper products; transportation equipment; and clothing.

History.—When Indiana was admitted to the union in 1816 congress gave it four sections of public land for its capital. The commissioners appointed to select the site placed it in 1820 almost exactly in the geographical centre of the state, at the cabin of John McCormick, on the White river, in the midst of dense forests and without any means of communication with the rest of the state. A town was laid out in 1821 (the "original mile square," bounded by North, East, South and West streets) and some activity in land speculation followed; but when the seat of government was moved there from Corydon in 1825, there was but a single street and 600 inhabitants. The legislature met in Indianapolis for the first time in 1825. It mas incorporated as a town in 1832, with a population of 1,000; the name is from Indiana and Gr. *polis,* "city." The first state capitol was completed in 1835.

Some impetus was given to the city's growth by the opening of the National road to that point in 1827, and later, beginning in 1847, by the coming of the railways, but development was slow until after the Civil War. The city was chartered in 1847, and in the same year a free public school system was inaugurated. In 1850 the population was only 8,091. By 1860 it had grown to 18,611, and in the following decade it increased to 48,244. In the next 20 years (1870–90), and again between 1890 and 1910, the increase was considerably more than 100%, and in the years 1910–30 it amounted to 56%. The increase from 1940 (386,972) to 1960 was 21.2%. The remarkably rapid expansion of the city after World War II led the Indiana general assembly in 1959 to authorize further growth by annexation across county lines.

In the years following World War I, Indianapolis, like many other midwestern communities, suffered from the influence of the Ku Klux Klan on political affairs. In the middle 1920s exposure of the Klan's methods (largely through the initiative of the Indianapolis *Times*) led to its collapse. While Indianapolis, like most industrial cities, was adversely affected by the depression of the 1930s, its recovery was facilitated by the diversification of its industry and its strategic location. The city's economy expanded greatly during World War II and this expansion continued steadily in the postwar era.

BIBLIOGRAPHY.—L. Burns, *Indianapolis: the Old Town and the New* (1923); *B. J.* T. Jeup, *Survey of the Municipal Government of Indianapolis* (1932); Indianapolis News, *Into its Second Hundred Years* (1936); Jeannette Covert Nolan, *Hoosier City* (1943); Board of School Commissioners, *Educational Services to the Community by the Indianapolis Public Schools and Libraries* (1947); *Indiana; a Guide to the Hoosier State* in the "American Guide Series" (1941).

(R. W.S.; D. RI.; H. H. HA.)

INDIAN ARCHITECTURE, in this article, refers to the Buddhist, Hindu and Jain architecture of the Asian subcontinent of India, Ceylon, Malaysia and Indonesia, from earliest times to the 20th century. The architecture of this area created under Islamic rule is discussed in ISLAMIC ARCHITECTURE; MOSQUE; and TAJ MAHAL. The art of this area is treated in INDIAN ART; INDONESIAN ARCHAEOLOGY and INDONESIAN ART. This article is organized as follows:

I. Introduction
  1. Origins
  2. Arches and Domes
  3. Special Forms
  4. Doors and Windows
  5. Columns
  6. Walls
  7. Influences of Indian Architecture
  8. Technical Literature
II. India
  A. Indus Valley Culture Through the Gupta Period (c. 2500 B.C.–A.D. 600)
    1. Pre-Maurya
    2. Maurya (322–185 B.C.)
    3. Sunga, Kushan and Andhra (185 B.C.–A.D. 320)
    4. Gupta (*c.* A.D. 320–600)
  B. Period of the Hindu Dynasties (7th–19th Century)
    1. Nagara
    2. Vesara
    3. Dravida
    4. Kashmir
    5. Rajput Civil Architecture
III. Ceylon
IV. Malaysia
  A. Burma
  B. Cambodia
    1. Pre-Khmer or Khmer Primitive (jth–8th Century A.D.)
    2. Classic Period, Khmer (9th–I5th Century)
  C. Thailand
  D. Champa
V. Indonesia
  A. Sumatra
  B. Java
  C. Bali

I INTRODUCTION

1. Origins.—Indian architecture, like Indian sculpture, is essentially of native origin, belonging to the Dravidian rather than the Aryan race. Although the Vedic ritual required neither images nor temples, the non-Vedic cults, such as those of the dragons (Nagas), the tree spirits (yakshas) and the goddesses, may have had permanent shrines with images and wooden temples. References to images and temples begin to appear in the literature from about the 4th century B.C., and numerous types are represented in the reliefs from the 1st century B.C. In Hindu worship (puja, the service of a personal deity with offerings of food, lights, incense, etc., as distinguished from Yajna, the Vedic sacrificial ritual) the first essential is an altar, with or without a symbol or image, serving to receive offerings of flowers. Such an altar beneath a sacred tree, for example, constitutes a yaksha chaitya. The term chaitya denotes a shrine of any kind. The next step is a god's house (devalaya, devagara, ayatana, etc.), a simple roofed enclosure containing the altar and symbol or image.

The fundamental elements of temple architecture are indigenous and of great antiquity. Early Indian architecture was almost entirely of wooden construction, and the forms thus established were later closely imitated in brick and stone. The various forms of domed and barrel-vaulted roofs, gabled windows and roof ends, pillars and cornices were developed from wooden prototypes; the Toda hut. for example, even in the 20th century presents a striking likeness to a barrel-vaulted, gable-ended temple.

A part of Indian architecture, especially at an early period when the use of impermanent building material was otherwise still general, may be described as monolithic; that is to say, the shrine was excavated in solid rock, either by hollowing out the necessary chambers (so that only an internal architecture was brought into being), or by cutting away the exterior rock so as to leave an entire temple of solid rock. Remarkable works of both kinds exist. The former, the cave temple type, is best illustrated by the early Buddhist chaitya halls (Karli. Nasik, Ajanta, Bagh, etc.), in which the interior of an apsidal temple of wooden construction was reproduced in stone in every detail, and by such great Hindu excavations as those of Elephanta, near Bombay. Examples of the latter are the famous Kailasanatha at Ellora, near Aurangabad, the Masrur temple in Kangra. the "Seven Pagodas" at Mamallapuram south of Madras and the Vettuvankoyil at Kalugamalai in the far south. (See TEMPLE ARCHITECTURE.)

2. Arches and Domes.—As both the arch and dome were known to the Sumerian builder in the 4th millennium B.C., there is nothing surprising in the fact that both appeared in India long before the Islamic period, and in fact from the Maurya period onward. One of the earliest temple types is that of a square or circular domed structure, with a roll cornice below the dome. (See ARCH AND VAULT; DOME.)

3. Special Forms.—Some special forms characteristic of Buddhist and Jain usage should be briefly described. The most familiar of these is the stupa (tope. dagoba), an elaboration of the old Indian funeral mound. later carried out in solid masonry, provided aith enclosing walls or railings and decorated uith sculp-

tures. The essential parts of the stupa are the dome (anda or garbha), solid but for a small relic chamber near the ground level in the centre. and inaccessible after completion; one or more platforms, supporting the dome. sometimes provided nith stairways for access and serving for circumambulation; a small pavilion (harmika) on the summit, and rising from this a mast (yashti) bearing one or more symbolic umbrellas (chattavalis); one or more railings (vedikas) surrounding the dome or the whole structure. The stupa is almost exclusively of Buddhist or Jain significance, and as a symbol represents the death or final release of the great teacher, the Buddha or Mahavira. In the earliest types of Buddhist stupa the dome was hemispherical; but a more aspiring type was gradually developed. until there evolved such tall pointed forms as that of the beautiful Burmese Shwe Dagon. In some Burmese forms the basement was extended to a great height. and was provided with chapels within its mass. for which an Indian prototype can be cited at Mirpur Khas in Sind. At Borobudur in Java the basement platforms are seven in number, forming a massive pyramid; this plan in a somewhat simpler form occurred earlier in the Punjab, Kashmir and Turkistan.

Another characteristic form is the aisled apsidal worship hall best known from the early Buddhist rock-cut chaitya halls, but also represented by structural examples in brick or stone of Gupta and later date (Ter, Chezarla, Aihole; and in Pallava and later Dravida architecture, where the number of stories is increased, as the crowning member of a tower).

Also peculiar to India is the hypaethral tree temple, usually a pillared hall, square or circular, with a gallery and vaulted roof, but open in the centre and surrounding a sacred tree; nearly a dozen examples are represented in Buddhist reliefs, where the tree is the bodhi tree, the symbol of the Buddha's Great Enlightenment, but there is every reason to suppose that the type was a very ancient one, developed in connection with the worship of yakshas or tree spirits.

4. Doors and **Windows.**—Doorways of early buildings were provided nith decorated tyrnpanums, reproducing m-ooden forms, and with a gable or ogee arch above. Entrances to sacred areas were provided with toranas (resembling Japanese *torii*, nhere there may be a genetic connection); these consist of upright pillars bearing one or more architraves. of which the elaborate examples at Sanchi afford the best instances, though many others are represented in reliefs. Applied to a wall surface, the same form was used in rock-cut or structural shrines (*e.g.*, Nasik, cave 111), the pillars becoming jambs, the lower architrave the lintel, brackets still being represented, though no longer functional. In later southern architecture the gateway of the enclosing walls became an immense structural tower, called a gopuram, often completely dwarfing the main shrine.

The gable or dormer windows (gavakshas, kudus) which are found to be most characteristic as constructional elements in the early architecture and as ornament in the later, have been commonly designated "horseshoe arches from the form and chaitya windows from the large and conspicuous examples that pierce the faqades of the early excavated churches. In many cases the two ends of the arch spring from a pair of makaras (crocodiles), situated immediately over the capitals of the supporting pilasters and constituting a makara torana. The summit of the arch may be pointed, making it an ogee arch. This dormer arch is not confined to India, but reappears in the earlier architecture of Cambodia and Java. Cusped forms were developed early and survive in Islamic usage.

5. Columns.—Indian columns are of two kinds according to use, either single pillars (stambhas or lats), each bearing a symbol appropriate to the deity of the temple beside which it was placed, or structural pillars (khambhas) of temples or secular buildings. Both occur in a great variety of forms, but as regards the shaft, chamfering and an octagonal section are highly characteristic. All types are monolithic. Capitals, too, are varied. The typical early form has three members: below, an inverted lotus bell; in the middle, four addorsed animals (generally bulls or lions); and above, a trapezoidal cushion with small corner volutes (Assyrian rather than Greek in character). Typical of later northern medieval types is a ribbed cushion capital like an amalaka. Another common form mould be rectangular, with the lower outer angle rounded and sometimes ribbed. A usual form in medieval art is that of the brimming vase or jar with overflowing foliage, often developed into arabesque. Brackets. often decorated with figures of yakshis, are characteristic at all times.

6. Walls.—A sacred structure was usually enclosed by a wall (pakara) or railing. Such a wall consisting of plain slabs mortised into pilasters has been found in connection with a Vaishnavite shrine of Sunga date at Besnagar; and others. similar but sculptured, and of the same period, are represented by fragments from Amaravati and Jagayyapeta. The railings of the early Buddhist and Jain monuments are remarkable; these consisted of plinth, upright pillars, crossbars and coping, evidently based on wooden forms; the best preserved are those of the topes at Sanchi and that at Buddh Gaya, both of about roo B.C.; the most elaborate was that of Amaravati represented by remains now mostly in the British and Madras museums.

7. Influences of Indian Architecture.—The architecture of Malaysia and Indonesia is largely of Indian origin, and this is particularly evident in the earlier phases (pre-Khmer, etc.); but the forms appear to have been developed from older Indian types, rather than directly imitated from those of the Gupta and Pallava styles. Indian architectural forms are recognizable also in Gandhara, central Asia, China and Japan.

8. Technical Literature.—Before proceeding to a description of the architecture of successive periods and styles, it should be mentioned that there exists in India a vast technical literature (known as silpa shastra) on the subject. Such technical works date back in part to the Gupta period, perhaps much earlier; the medieval compilations are still in use by Indian architects, the sthapatis of modern buildings using either the Sanskrit originals or vernacular versions. No more valuable contribution to the study of architecture as a practical art could be made than a detailed description of building methods still in use in India. It has been shown that the Indian silpa shastras must have been used by Indian architects in Java and Cambodia.

II. INDIA

A. Indus Valley Culture Through the Gupta Period (*c.* 2500 B.C.–A.D. 600)

1. Pre-Maurya.—The oldest architectural remains in India are the remains of cities at Mohenjo-Daro and Harappa, dating from the middle of the 3rd millennium B.C. There the buildings are of well-burned brick, laid in mud or gypsum mortar. They include temples; a sacred tank lined with bitumen and provided with a drain over six feet high, with a corbel-vaulted roof; and substantially built and well-drained dwelling houses and shops.

The only surviving monuments that have been attributed to the Vedic period and culture (1500–800 B.C.) are the burial mounds at Lauriya-Nandangarh and certain ancient rock-cut tombs in Malabar.

There is every reason to suppose that the forms which are represented so admirably in the reliefs of Bharhut, Sanchi and Amaravati were already current during many centuries before the Maurya period. The special forms, indeed, are nearer to those of western Asia of the 6th or 7th century B.C. than they are to those of contemporary Persia, and it can hardly be doubted that they represent the Indian development of a widespread early Asian tradition. The forms include storied buildings supported on pillars with volute capitals resting on addorsed animals (bulls or lions), often with pot-shaped bases, and having barrel-vaulted roofs with gabled or arched ends and windows; battlemented brick walls; circular shrines with double-domed roofs; pillared barred-vaulted apsidal temples; hypaethral tree temples; monasteries of cells arranged around a central court; burial or memorial mounds (stupas) on platforms; monolithic pillars; and walls and railings.

2. Maurya **(322–185 B.C.).**—The most ancient excavated cave shrines. those of the Barabar hills, which are finely polished, date from the time of the emperor Asoka (*q.v.*). The entrance faqade of the Lomas Rsi (Rishi) cave is the earliest example of a dec-

orated tympanum with ogee arch, finial, curved beams, and resting on sloping jambs, all in imitation of purely wooden forms.

The remains of Asoka's capital at Pataliputra (Patna) have a rather special character, and perhaps reflect contemporary Persian influences. There have been excavated parts of a massive wooden city wall; a timbered flooring extending for 350 ft.; a series of wooden platforms apparently intended to support a stupendous superstructure; evidences of a pillared hall with 80 polished stone columns; a magnificent stone capital. a stone voussoir from an arch, a stone griffin bracket and other fragments. It is thought that the plan of the palace was identical with that of the Achaemenid palaces at Persepolis. Arrian speaks of Asoka's palace as no less magnificent than those of Susa and Ecbatana.

3. Sunga, Kushan and Andhra (185 **B.C.–A.D. 320**).— Numerous reliefs from Bharhut. Mathura (mod. Muttra) and Amaravati, foundations of ruined buildings and excavated churches (chaitya halls) and monasteries (viharas) prove the existence of an architecture advanced in scale and magnificence. The most remarkable examples illustrated in reliefs are the Sudhamma Sabha and Vaijayanta palace from Bharhut, the exquisite early shrine from Jaggayyapeta, the tree temples from Bharhut, Sanchi, Mathura and Amaravati and a little structural domed shrine from Amaravati.

Noted caves are the chaitya hall and vihara at Bhaja, the great chaitya halls at Karli and Nasik and the Jain monasteries of Udayagiri and Khandagiri in Orissa. Of stupas, those of Bharhut, Sanchi and Amaravati are notable; while in Gandhara, both at Taxila and in Afghanistan (extending thence to Turkistan a little later). there are countless remains of stupas richly decorated with Greco-Buddhist sculpture, and many ruined monasteries. Connected with the stupas are their railings and gateways, of which those at Sanchi are perfectly preserved and those of Amaravati are well known from the British museum series. A seal discovered at Patna, with a Kharosthi inscription of not later than the 2nd century A.D.. represents a tall straight-edged sikhara (tower) shrine, doubtless of brick construction. A true arch above the entrance doorway is clearly shown. and the cella contains a seated image of Buddha. The representation closely resembles the well-known Buddhist temple at Buddh Gaya, and may be it.

A famous structure often referred to at a later date by the Chinese pilgrims was the stupa of Kanishka near Peshawar. According to the Chinese account the basement rose in five stages to a height of 150 ft.. the wooden superstructure to 400 more and the iron mast with 25 copper umbrellas *88* ft. more.

4. Gupta (*c.* A.D. **320–600**).—Of this period both Buddhist and Hindu buildings in stone or brick and excavated shrines are characteristic. The most distinctive temple type is that consisting of a square cella, with plain walls and flat roof, and either surrounded by a pillared hall, as at Bhumara, or preceded by a small and graceful pillared porch as at Sanchi, Tigowa, Pithaora and Nachna-Kuthhara. The little temple at Sanchi well illustrates the fine proportions and appropriate use of ornament characteristic of the early Gupta period. The most important related groups of excavated shrines are those of Udayagiri in Gwalior state (Hindu), Ellora (Visvakarma chaitya hall) and Bagh and Ajanta (caves XVI, XVII and XIX, especially the last with its well-known magnificent façade). Farther south, at Badami, Aihole and Pattadkal, three of the earliest Chalukyan buildings are of Gupta date or a little later. The Ladh Khan, *c.* A.D. 450, was constructed of slabs and pilasters in archaic style; the Durga temple, about 100 years later, is apsidal like a chaitya hall, combined with a northern Nagara sikhara. Very interesting apsidal brick temples survive at Ter in Sholapur district and Chezarla in Kistna district.

The northern sikhara shrines, usually brick towers with stone doorways, began to appear during this period. For the most part the earliest examples are straight edged, or nearly so, and with angle amalakas at every course or every second or third course. The example at Deogarh is entirely of stone; not less important is the brick tower at Bhitargaon, with a recessed frieze of carved brick and terra-cotta panels of Brahmanical subjects. A little later than the Gupta period, but suitably mentioned here, is the brick tower at Sirpur, probably the most exquisite example of a richly decorated brick structure to be found in all India. The monastic university of Nalanda was founded by Baladitya at the close of the 5th century. Hsuan Tsang saw there a great brick temple over 300 ft. in height. The great Hindu temple at Konch, near Buddh Gaya and similar in many details, though the spire is curvilinear, may well be of Gupta date.

B. Period of the Hindu Dynasties (7th–19th Century)

From the Gupta period onward it is convenient to describe the architecture in terms of the three great styles: Nagara (northern or Indo-Aryan); Vesara (later Chalukya, Hoysala and Solanki, of the Deccan. Mysore and Gujarat); and Dravida (southern Dravidian). Separate mention is made of Kashmir and the civil architecture of Rajputana.

1. Nagara.—Here the most conspicuous feature is the curved outline of the sikhara. which is composed, as in the south, of many stories representing reduplicated cornices and roofs. Because of the great compression of each story. the vertical lines of the whole form are far more conspicuous, at least in the later types, than are the horizontal lines of the successive cornices. The tower, usually square, rarely circular in plan, is corbeled inward until the sides nearly meet, the whole is crowned by a huge ribbed lenticular stone, the amalaka which supports the usual vase finial.

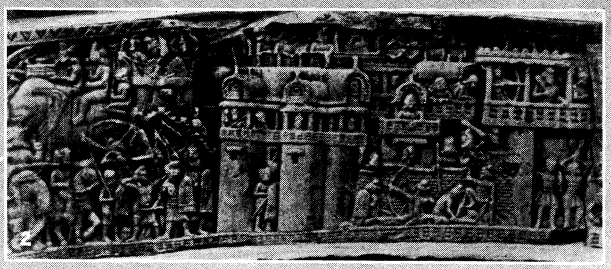
At successive stages along the edges of the tower will be found quarter or angle amalakas. one at each stage in early types, more widely separated later. These angle amalakas are clear evidence of the rooflike character of each stage; and indeed, nothing is more characteristic of Indian architecture or more valuable for the elucidation of its history than that the ornamentation consists essentially of reduced, simplified or archaic forms closely related to those of the whole building. The porch or mandapa is usually open and pillared, sometimes roofed with a dome, more often with a pyramidal roof composed of repeated cornices. In the Nagara style a barrel-vaulted roof is very rare, but examples are to be seen at Gwalior (Teli-ka-Mandir) and in Orissa (Vaital Deul at Puri).

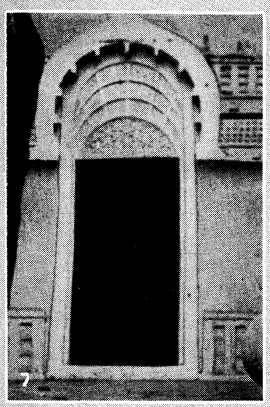
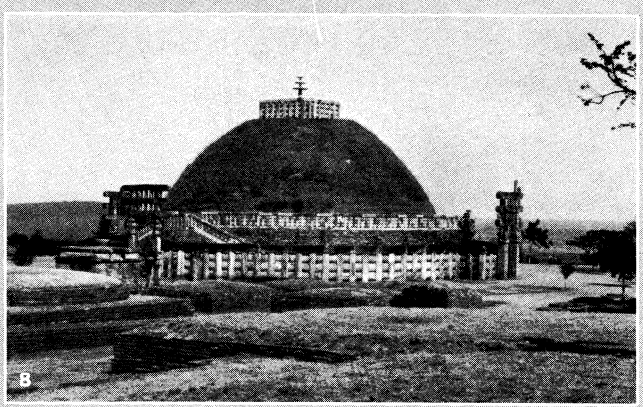
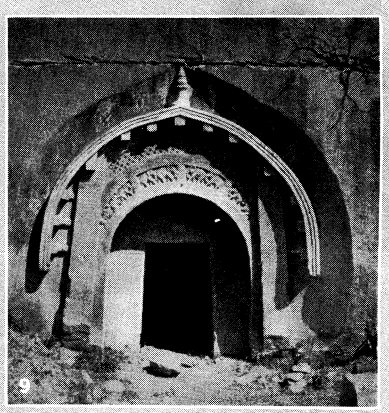
The early capital with addorsed animals disappears after the Gupta period, to be replaced by square cushion capitals of various kinds or by a development of the pot-shaped capital into a brimming vase (purna kalasa) with lotus flowers and foliage falling from the mouth onto the four corners; in cave temples, *e.g.*, the great Saiva shrines at Elephanta, near Bombay, a globular amalaka capital is highly characteristic.

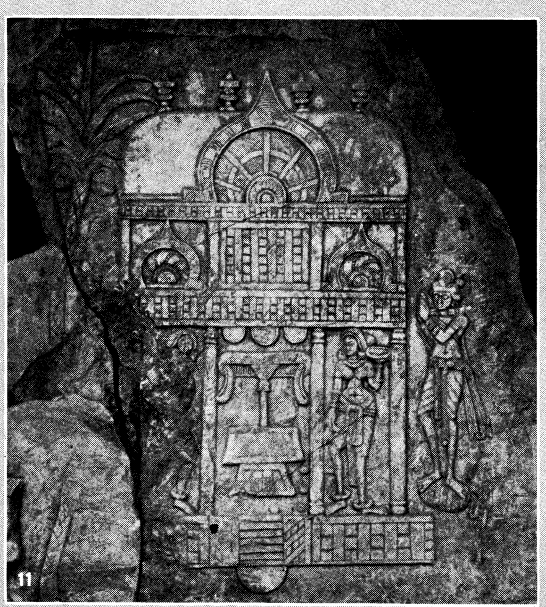
The most southerly extension of the style is found at Badami, where the apsidal Durga temple, perhaps of Gupta date, already has a northern sikhara. There, and in several other places, the two styles can be seen side by side. It is however in Orissa, Bundelkhand and Rajputana that the finest and most continuous series is to be found. In Orissa the series shows a continuous development from the 8th to the 13th century; the Parasuramesvara and Lingaraja temples at Bhuvaneshwar, the Sun temple at Konarak and the Jagannatha at Puri are most remarkable, and the beauty and grandeur of most of these would be difficult to exaggerate.

At Khajuraho in Bundelkhand there is another magnificent series, dating between 950 and 1050. The Kandarya Mahadeo temple is the finest; the effect of height, actually 116 ft. over-all, is increased by the great depth of the basement and by the vertical lines of the reduplications of the main form upon itself. There, as well as in Orissa and elsewhere, the temples are covered with figure sculpture.

From Bengal and Bundelkhand the style extends through Rajputana (where the Siddhesvara at Nemawar, Indore state, is of prime importance and one of the best preserved medieval monuments extant) to the Punjab (Amb and Kafir Kot), Rangra and Kulu (Baijnath, Masrur and Bajaura). Modern temples in the Nagara style include the Visvesvara at Benares, the funeral chapels at Gwalior. the Jugal Kisor and Madan Mohan at Brindaban and, among the many alms halls, ghats. wells and temples built by Queen Ahalya Bai (1765–95), the Grstanesvara temple at Ellora.



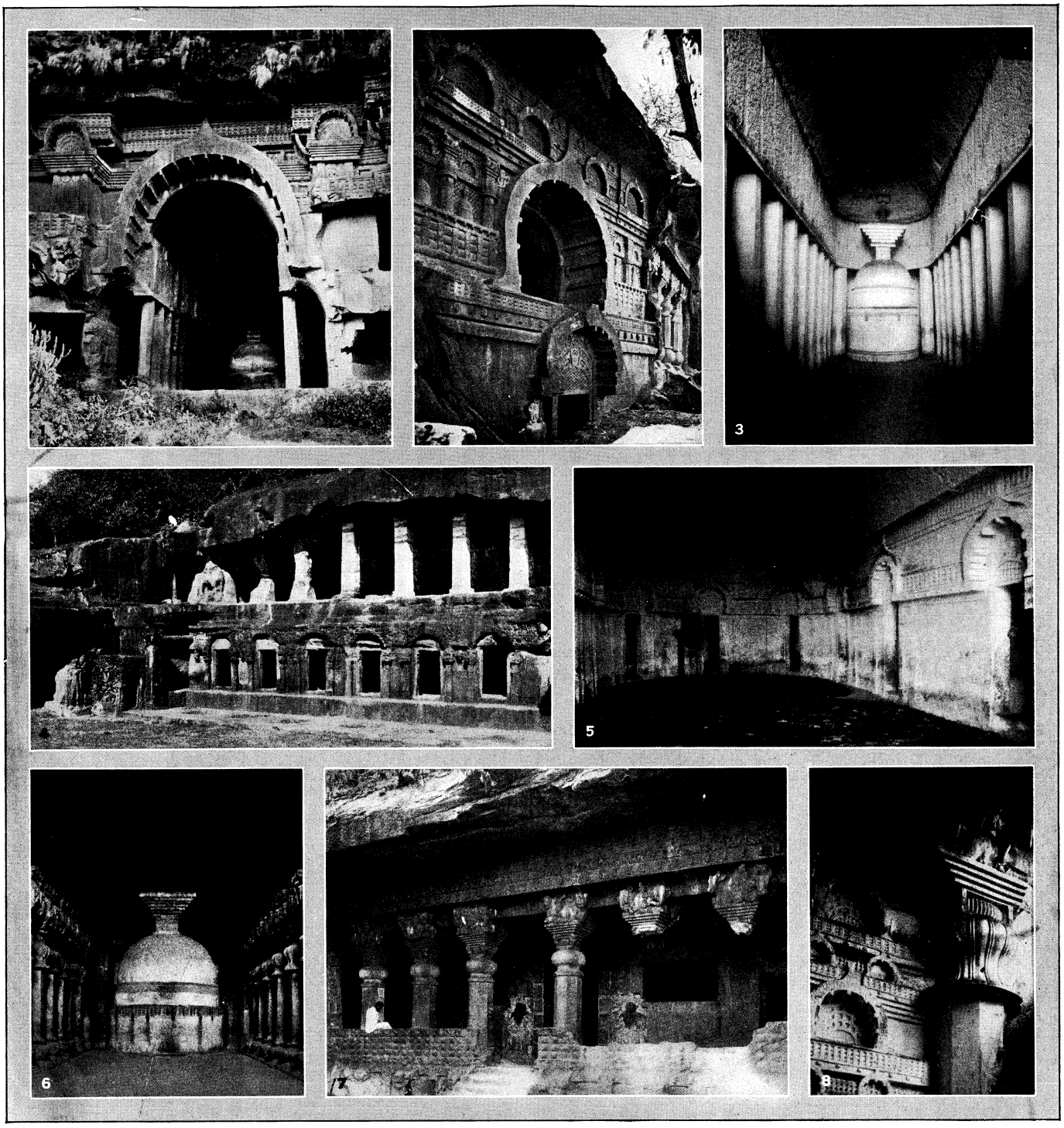


BY CCURTESY OF (8) A. K. COOMARASWAMY; PHOTOGRAPHS, (1, 5, 10) THE ARCHAEOLOGICAL SURVEY OF INDIA, (3) JOHNSTON AND HOFFMANN

INDIAN ARCHITECTURE FROM THE 3RD CENTURY B.C. TO THE 2ND CENTURY A.D.

1. War of the Relics. Architrave detail, Mathura, c. 1st century A.D. 2. War of the Relics (siege of **Kapilavastu**). Architrave detail, Sanchi, south torana, **early** 1st century A.D. 3. A Buddhist shrine (chaitya ghara). Railing pillar detail, Buddh Gaya, c. 100 B.C. 4. Festival of the Buddha's Crest relic **(cuda-maha)**; above left, the **Sudhamma** Sabha; right, the **Vaijayanta** palace of **Indra**; below, **apsarases** dancing. Detail of railing pillar from Bharhut, 100–50 B.C. 5. Jain votive slab **(ayagapata)** with **stupa,** worshipers and angels. Mathura, late 1st century B.C. 6. A Buddhist shrine (chaitya ghara). Architrave detail, Bharhut, 100–50 B.C. 7. Doorway of rock-cut Buddhist chaitya ghara. Bedsa, 1st century B.C. **8.** The Great **Stupa,** Sanchi, 3rd to 1st centuries B.C. (gates, early 1st century **A.D.**). 9. The **Lomas** Rsi **(Rishi), Ajivika** shrine, Barabar Hills, late 3rd century B.C. 10. Railing pillar, with Buddhist shrines, Buddh **Gaya,** c. 100 B.C. **11.** Structural three-storied Buddhist shrine. **Jagayapeta,** 1st century B.C. 12. Domed pillared three-storied Buddhist shrine. Detail from a pillar **(cetiya-khabha)** Amaravati, 2nd century A.D. **13.** Representation of a stupa, pillar with lion capital to left, in a sacred grove. Railing pillar detail, Bharhut, 100–50 B.C.

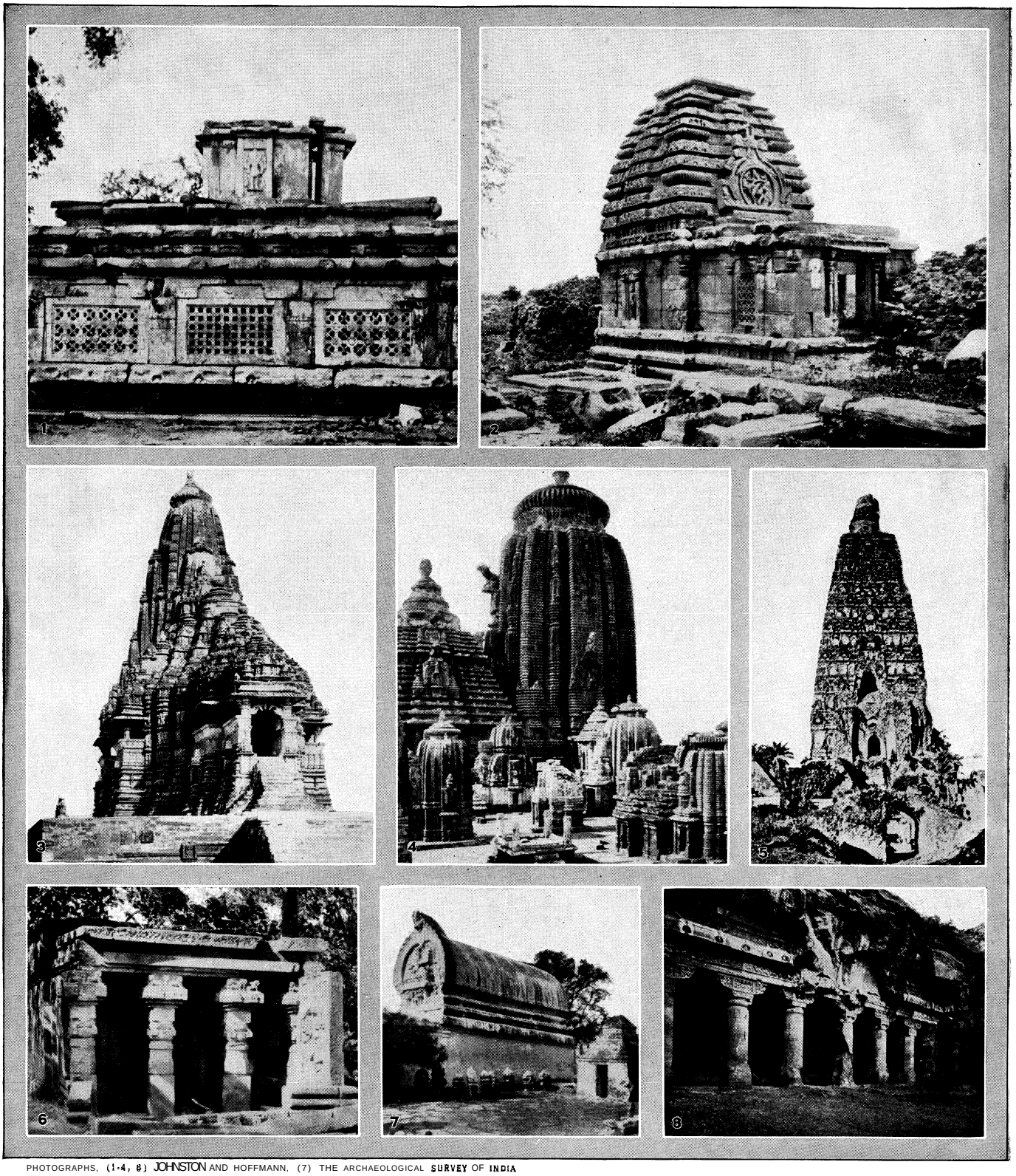
INDIAN ARCHITECTURE



PHOTOGRAPHS, (3, 4, 5, 6, 8) JOHNSTON AND HOFFMANN, (7) THE ARCHAEOLOGICAL SURVEY OF INDIA

ROCK-CUT SHRINES AND MONASTERIES OF THE 1ST CENTURY B.C. TO THE 2ND CENTURY A.D.

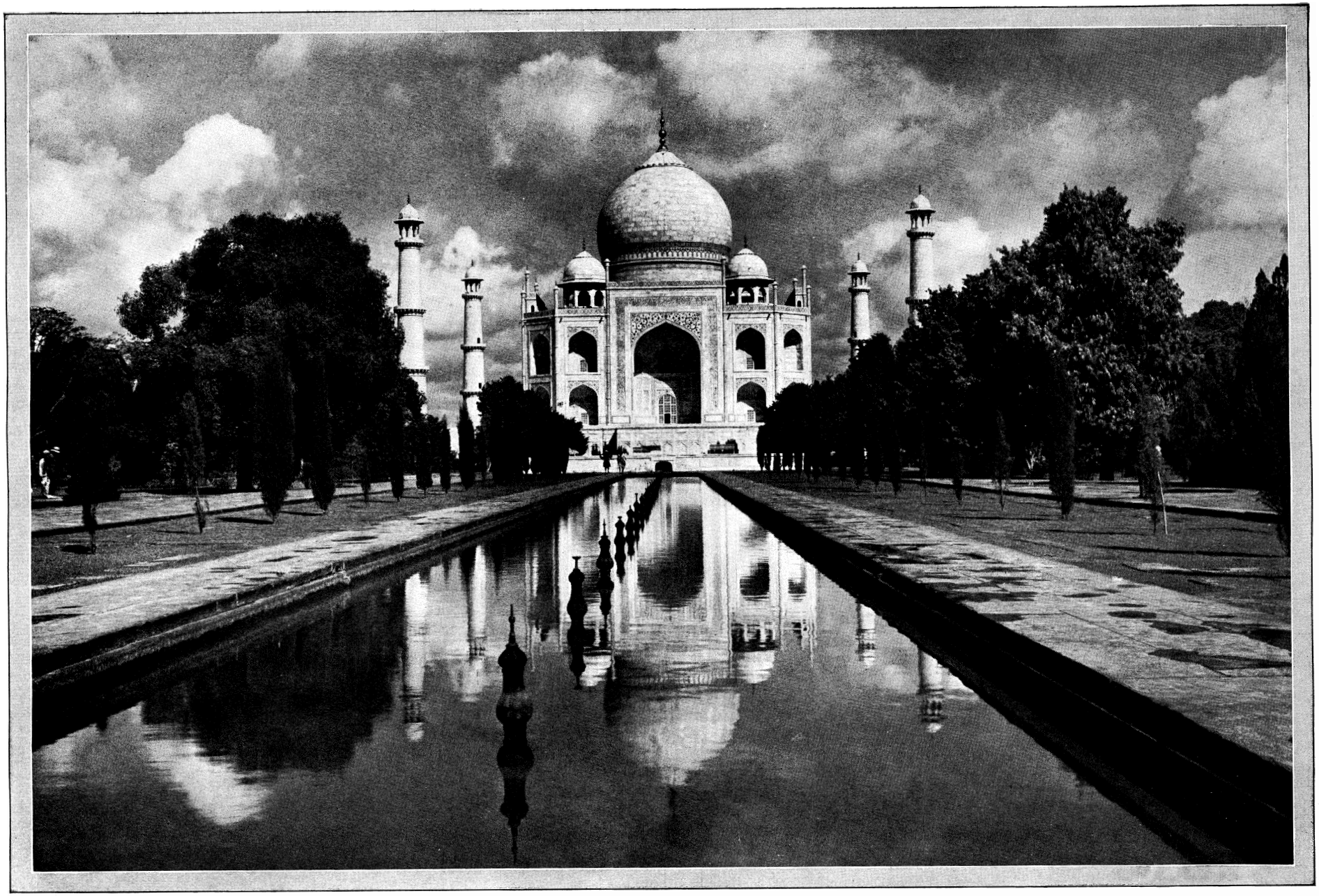
1. Rock-cut Buddhist shrine (chaitya ghara) at Bhaja. c. 50 B.C.
2. Buddhist shrine at Nasik. Early 1st century **A.D.**
3. Interior in the Buddhist shrine at Bedsa. 1st century B.C.
4. Jaina monastery, Rani Gumpha Khandagiri, Orissa. 1st century **A.D.**
5. Interior in the Buddhist monastery at Bedsa. 1st century B.C.
6. Buddhist shrine at Karli, 100–125 **A.D.** It is 126 ft. long and has a ribbed teak roof
7. Cave III at Nasik, a Buddhist shrine of the 2nd century **A.D.**
8. Buddhist shrine at Nasik (detail) c. 100 **A.D.**



PHOTOGRAPHS, (1·4, 8) JOHNSTON AND HOFFMANN, (7) THE ARCHAEOLOGICAL SURVEY OF INDIA

TEMPLE ARCHITECTURE

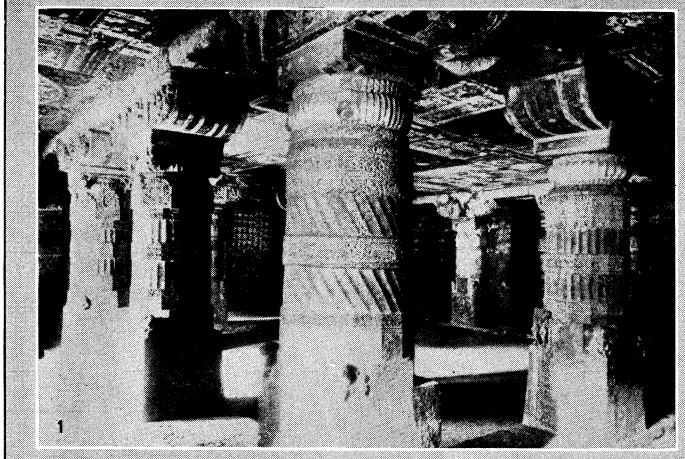
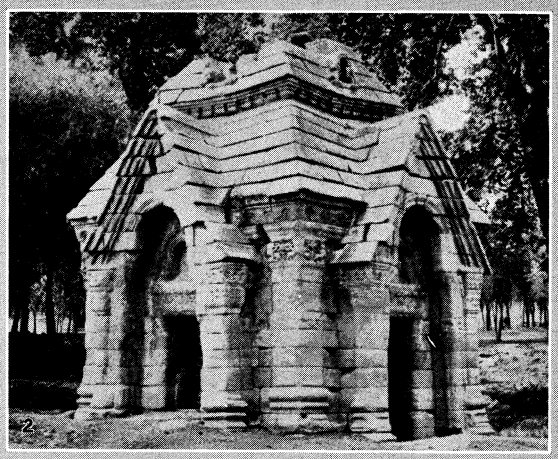
1. Lid Khin's temple, Aihole. Early Cāḷukya. c. 450 B.C.
2. Jambulinga temple, Pattadkal. Rāstrakūta period. 9th century
3. Kandārya Mahadeva temple, Khajuraho. Candel. A.D. 950–1050
4. Lingaraja temple, Bhuvaneśvara, Orissā. c. 1000 A.D.
5. Buddhist temple (gandhakufi *pasâda*) at Bodhgayi, before modern restoration. In essentials it probably dates from the 2d century A.D.
6. Temple of Kaṅkālī Devi, Tigowā. Early Gupta. c. 5th century A.D.
7. Kapoteśvara temple, Chezirii. c. 4th century A.D.
8. The verandah of Cave I. (vihāra) at Ajaṇṭā, one of a group of about 30 caves cut in the bank of a ravine and used as a kind of college monastery. They were excavated between 200 B.C. and the 7th century A.D., Cave I. dating from c. 600–650 A.D.

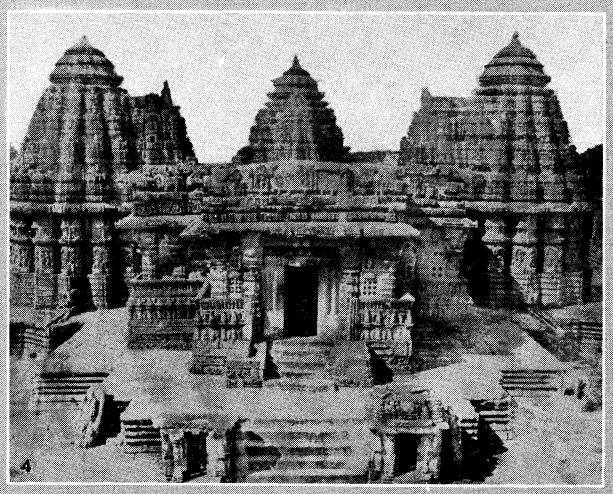
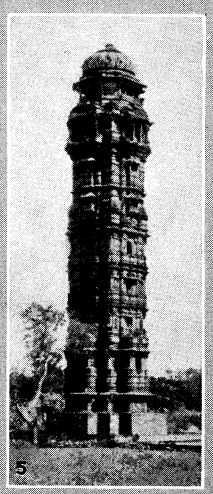


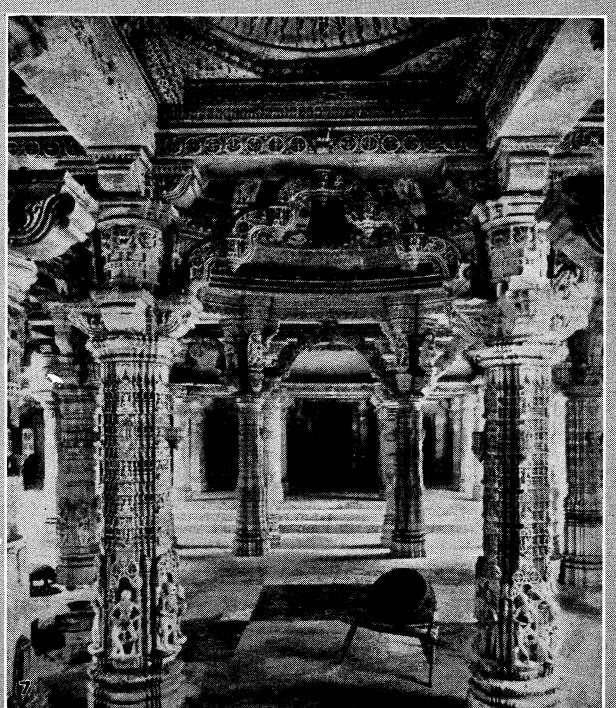
BY COURTESY OF HERBERT G. PONTING, F.R.P.S.

THE TAJ MAHAL, SUPREME ACHIEVEMENT OF INDIAN ARCHITECTURE

This mausoleum of white marble was built (1632–1650) near Agra, India, by Shah Jahan as the burial place for his favourite wife, Mumtaz Mahal. The magnificent exterior is covered with arabesques and passages from the Koran in inlays of precious stones

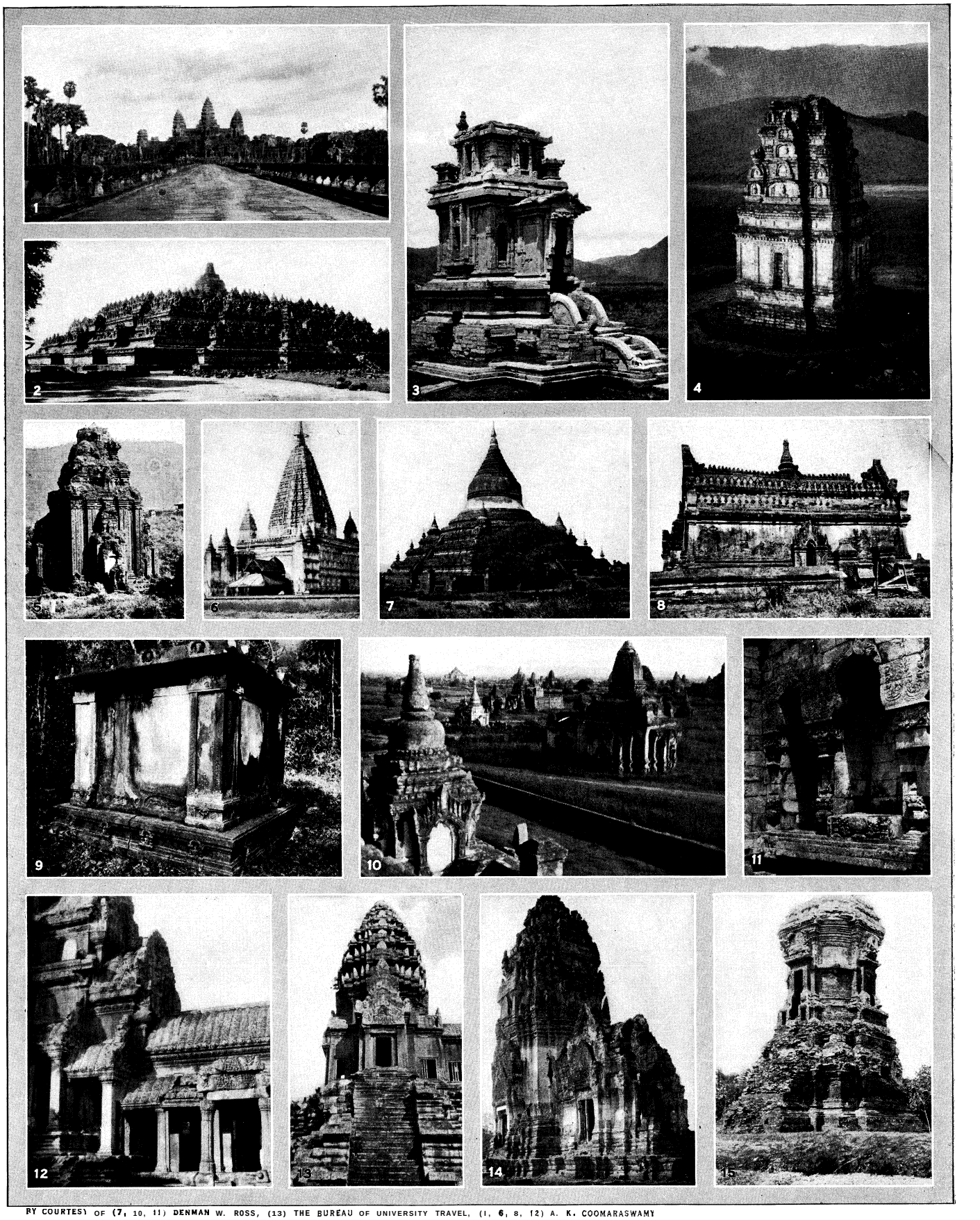


PHOTOGRAPHS, (1, 6, 7) JOHNSTON AND HOFFMANN, (2, 4, 5) THE ARCHAEOLOGICAL SURVEY OF INDIA

INDIAN ARCHITECTURE FROM THE 7TH TO THE 13TH CENTURY

1. Interior of Cave II., Ajaṇṭā, showing pillars and painting. Early 7th century. 2. Meruvardhanasvāmin temple, Pāndreṇthan, Kashmir. Early 10th century. 3. The city gate at Dabhoi, Gujarat, c. 100 A.D. 4. Kesava temple at Somnāthpur, Mysore, built in typical Vesara (later Cāḷukya) style. A.D. 1268. 5. Kīrttistambha, raised at Chitor; 1440–1448 A.D. to commemorate the erection of the Kumbhasvarnin temple. 6 and 7. Ceiling and porch of Tejahpāla's temple (Jaina) at Dilwārā on Mt. Abū, Rajputana, A.D. 1232

INDIAN ARCHITECTURE



BY COURTESY OF (7, 10, 11) DENMAN W. ROSS, (13) THE BUREAU OF UNIVERSITY TRAVEL, (1, 6, 8, 12) A. K. COOMARASWAMY

EXAMPLES OF FURTHER INDIAN AND INDONESIAN ARCHITECTURE

CAMBODIA: 1. Angkor **Wāt (Vāt),** 12th cent. 9. **Slab-built** shrine, Prei Kuk, **early** Khmer, 7th cent. 12. Angkor Wit **(Vāt), galleries, early** 12th cent. 13. Angkor Wit **(Vāt),** Tower, **early** 12th cent. JAVA: 2. Borobudur, 8th cent. 3. Candi Puntadewa, Dieng, 8th cent. 4. **Candi** Bima, Dieng **Plateau, early** 8th cent. **11.** Porch at **Caṇḍi Sewu, 10th** cent. 15. **Caṇḍi Jābung,** A.D. 1354. BURMA: 6. **Mahābodhi temple, Pagān,** 13th **cent.** 7. **Mingalazedi** pagoda, **Pagān,** A.D. 1274. **8.** Ordination **Hall, Pagān,** 13th cent. 10. **Temples** at **Pagān, 11th** cent. and **later. ANNAM:** 5. **Temple** at **Mison, Campā,** 7th cent. THAILAND **(SIAM).** 14. **Temple** at Lopburi, **11th** cent.

2. Vesara.—After the recovery of the old Chalukyan territory by a later branch of Chalukyas or Solankis in 973, a new style of architecture came into being in the Deccan and flourished during the 11th and 12th centuries. Another branch of the Solanki family held Gujarat from the 11th to the end of the 13th century. During the 12th and 13th centuries the Hoysala dynasty ruled Mysore.

The Vesara style of architecture is found throughout the area. Conspicuous features are low elevations (contrasting with those of the high Nagara and Dravida sikharas) and wide extension. the star-shaped plan of the cella, the grouping of three shrines about a central hall. low pyramidal towers, elaborated pierced windows, elevated basements with richly decorated courses and. in general, an excess of ornament. In the Dharwar district. the Dodda Vasavanna is perhaps the most elaborate building in western India. In Mysore the most celebrated shrines are those of Dodda Gadavalli, Somnathpur, Belur, Balagami and Halebid and the Jain bastis at Sravana Belgola.

In Gujarat the most famous temple was that of Somnath (Kathiawar), wrecked by Mahmud of Ghazni in 1024. At Anahilpattana the greatest royal builder was Siddha-raj (1093–1143). There as at Vadnagar and Mudhera are the ruins of important shrines. A special characteristic of the local style is the erection of kirttistambhas. or "towers of glory"; the finest of these, in the Chittoor fort, was built in 1440–48 to commemorate the erection of the Kumbhasvami temple.

More famous are the Jain temples at Mt. Abu in Rajputana, particularly those of Vimala Shah and Tejahpala, about A.D. 1032 and 1232 respectively. These are domed shrines with pillared halls, built entirely of white marble, carried with infinite labour up the mountain from the plains below. The most remarkable features are the domed ceilings, with deeply undercut. fretted marble which has been compared to "frozen lace," with a central pendant.

Deservedly famous too are the Jain temple cities of Girnar and Satrunjaya, with buildings ranging from the 13th to the 19th century. These cities of temples built on hilltops were exclusively places of pilgrimage, never otherwise inhabited. Of ordinary cities there are nell-preserved remains at Dabhoi and Jhinjuvad. At the later capital of Ahmedabad the architecture is almost entirely Moslem. but it was executed in the same style and by the local craftsmen, adapted only to Moslem necessities by omission of figure work from the niches.

3. Dravida.—In southern India, according to the Mandagapattu inscription of the great Pallava king Mahendra-varman I (600–625), temples had been built of brick or timber, reinforced by metal and mortar; only from the 7th century onward are excavated monolithic and structural temples found in stone. It is difficult to characterize the style in detail because of the continuous development. Markedly contrasting with the Nagara style of the north are the conspicuous horizontal lines of the towers or spires, produced by a repetition of heavy roll cornices, dividing one story from the next; each story is decorated with little pavilions (pancarams) or dormer windows The walls are often plain, with narrow pilasters, gradually elaborated as the style develops. The pillars are at first supported by lions, and polygonal in section, with a thin flat abacus and roll brackets. later a pendent lotus. The summit of the roof is always a square, circular or polygonal dome (stupika), or barrel vaulted and apsidal, in the latter case appropriately designated as gajaprstha ("elephant's back"). The temple is always enclosed by a high nall or nalls pierced by four gateways (gopuram); in some cases, as at Madura, the enclosure becomes a veritable sacred temple city wherein all the activities of life are carried on.

The early Dravidian style (Pallava and early Chalukya) is admirably illustrated in the Pallava temples of Mamallapuram (the "Seven Pagodas") and Kanchipuram in the east and early Chalukya shrines at Badami. Aihole and Pattadkal in the west. The earliest monuments are cave temples at Undavalla; then come the "Seven Pagodas ` and cave temples in the 7th century and, in the 8th. the structural temples of Kanchipuram and the Shore temple at Mamallapuram, after which the style passes gradually into that of the Chola period.

In the west. at Badami and Aihole, there are six cave temples, two Jain and four Brahmanical, one dated 578. The structural Malegitti Sivalaya, c. 625, magnificently situated on the summit of a hill is perhaps the purest and best example of the style; it is small and massive. but finely proportioned. Much larger and magnificent both in design and execution are the two great temples due to the queens of Vikramaditya II, dated about 740. Of these the Virupaksha, still very massive, was probably built by workmen brought from Kanchipuram, where the Rajasimhesvara (or Kailasanatha) temple had been built not long before the city fell to the Chalukyan invaders; it is known from an inscription that Vikramaditya nas so much impressed by that great shrine that he not only refrained from destruction, but himself made offerings and overlaid the images with gold. In A.D. 753 the Rashtrakutas invaded and occupied the Chalukya territory. No doubt as a result of this invasion workmen mere carried off, and this probably explains the form of the great Kailasanatha rock-cut shrine at Ellora which is evidently modeled closely on that of the Virupaksha at Badami. This wonderful temple, cut out of the side of a hill. is a complete model of a structural building and, together with the someuhat later and very similar Jain Indrasabha, also at Ellora, marks the farthest limit of the northward extension of the Dravida style. The Bhoganandesvara temple at Nandi, C. A.D. 800, affords another important example of a Rashtrakuta building in Dravida style.

In the Chola (c. 907–1053) period the tower of the central shrine is typically developed to a great height by a reduplication of the corniced stories, as in the great vimanas at Tanjore, the centre of Chola power, and at Gangaikondapuram, both of the early 11th century. The former is 190 ft in height. There are also good examples of the style at Polonnaruwa in Ceylon, built during the Chola domination. The Pandya period (1251–1310) is characterized by the development of the great gateways. with a lower story of stone and superstructure of brick, covered mith brick and stucco images plastered and painted. They have the aspect of veritable skyscrapers, and completely dwarf the main shrines.

These later phases of the southern style are characterized by the development of the great pillared halls (mandapam). The monolithic pillars are cut into groups of slender columns. or are provided with elaborate brackets, nearly the full size of the pillar itself and representing leogriffs (yalis) or horsemen on rearing horses attacking leopards or consisting of dancers, deities or effigies of founders.

Of the earlier series, the great shrines at Vijayanagar, Avadaiyar Koyil and Tadpatri are the most remarkable; of the later, the great buildings of the Kayaks of Madura, dating from the 17th century, are well known to all travelers in India. It is perhaps rather anfortunate that the Dravida style is best known by one of the latest examples. the Minakshi shrine at Madura; the whole complex is indeed impressive, but it gives little idea of the earlier purity of Dravida design.

4. **Kashmir.**—In Kashmir, which had been a dependency of the Kushan empire and later an independent kingdom, the prolific building period extended from the 8th to the 13th century. The style has local peculiarities: the double-pointed pyramidal roof, pediments enclosing a trefoil niche. lantern ceilings, fluted columns with Doric or Ionic capitals and large peristyles are very characteristic. The architecture here preserves a certain quasi-classical character derived from Gandhara and not seen in the rest of India, though often recognizable in central Asia. At Parihasapura a large Buddhist stupa with a double platform and stairways on each side is contemporary with the Javanese Borobudur; there are temples of extraordinarily massive construction, one flooring stone consisting of a single block 14×12×6 ft. The court of the Martand Sun temple is about 220×142 ft.; that of the Pandu-kund in Jammu about 191×121 ft. Related architectural forms are found at Malot in the Punjab and at, Gop and some other places in Kathiawar. The trefoil arch, derived from the section of a chaitya hall. while confined to Kashmir as an important architectural form, occurs also at Sarnath, Sirpur and elsewhere.

5. Rajput Civil Architecture.— Twenty or thirty royal resi-

dences, a number of cities and ghats, surviving from the 15th century, show a civil architecture of extraordinary grandeur and beauty. The Rajput style is less intricately ornamented but of more monumental dignity than the better known Moslem palaces of the 17th century.

The earliest well-preserved palaces are those of Chittoor and Gwalior, the latter magnificently situated on the edge of a great flat-topped hill, with several great gateways guarding the approach and a small palace, the Gujari Mahal, at the foot of the hill. Begun under Man Singh in the 15th century, it was completed during the Mughal (Mogul) occupation in the 17th century. Bir Singh Deva's 17th-century palaces at Datia and Orchha are almost equally splendid. The palace at Amber is more nearly like Mughal nork, and so too the lovely marble pavilions by the lake at Ajmer. The whole city, palaces and island palaces of Gdaipur (c. 1600–1740) are of romantic beauty. The Jodhpur palace, 17th century, is situated on the top of a rock dominating the city below and guarded by bastions of tremendous size. The modern city of Jaipur, the Benares ghats (with buildings mainly of the 18th century), the ghats at Maheshwar and Ujjain, the modern work at Bulandshahr, Mathura (mod. Muttra), etc., and the cenotaphs of Rajput princes in many capitals are all evidences of an architecture by no means lost, but still practised. The little modern railway station at Alwar shows how this tradition has been adapted to present-day requirements; the new city at Delhi is a monument to the neglect of indigenous resources. (*See* DELHI: New *Delhi.*)

III. CEYLON

Among the oldest surviving structures in Ceylon are the great stupas or dagobas of Anuradhapura, the capital of the island kingdom from the middle of the 3rd century B.C. to the end of the 10th century A.D. In Ceylon stupas are classified according to the shape of the dome, characterized as bubble shaped. bell shaped, lotus shaped, heap-of-paddy shaped, and are conspicuously simple in architectural form. The typical Sinhalese stupa is comprised of a threefold circular base, a dome and a superstructure of harmika and yashti. The strictest ritual governed the laying of the magical foundation stones and rigid systems of proportion fixed every dimension.

All of the ancient dagobas were built of brick and stone over a rubble core: and were covered with chunam plaster painted white. The main approach was always from the south, the direction associated with the sun at its zenith and with the supreme moment of the enlightenment of the mortal Buddha. The most important of the colossal stupas of the ancient capital is the Ruanveli dagoba whose dimensions are as great as all but the largest of the Egyptian pyramids. It was conceived as a giant replica of the universe and enshrined the largest collection of the relics of Buddha in the island.

A unique and typical element of Sinhalese stupa design is seen in the four sculptured platforms (vahalkada) fixed around the base of this monument at the four cardinal points.

The Thupnrama, built on a smaller scale, is surrounded by three consecutive rings of carved stone pillars which were once used to support a wood and metal dome, sustained by wooden rafters and completely enclosing the stupa. Structures of this type were designated as thupa-ghara and are related to ancient circular shrines in India proper, no longer extant. The temples associated with all of the great dagobas and known as vihares were characteristically rectangular in plan and usually had a single entrance on one long side. A single chamber was enclosed by walls of brick which, together with the pillars inside, supported a roof of wood and metal.

The Lohapasada or "Brazen palace," built by King Duttha Gamani as a royal monastery, was supported by 1,600 monolithic granite pillars standing in an area 250 ft. square. Originally a nine-storied pyramidal structure built of wood with fittings of precious jewels and ivory, it was destroyed by fire in the 4th century and rebuilt with five stories. It received its name from the roof. which was sheathed in copper.

In the 6th century the capital was temporarily moved to Sigiriya, a great natural rock fortress, where a parricide king installed himself as a demigod in a splendid complex of palaces. apartments, galleries and pleasure gardens with which he clothed the entire summit and face of the cliff.

Repeated raids by the Tamil armies of south India forced the final abandonment of Xnuradhapura late in the 10th century. After a brief period of Chola occupation, a new capital was established at Polonnaruna. The greatest periods of building at the new site coincide with the reigns of the greatest of the Polonnaruwa sovereigns, Vijayabahu I (1059–1114), Parakramabahu I (1164–97 or 11j3–86) and Nissamka Malla (1198–1207).

The most notable group of architectural monuments is that collection of shrines located in the Great Quadrangle, an area which at one time must have been the centre of the capital. There are found some of the most beautiful and perfectly realized buildings in all of the Indian norld. The Sat Mahal Pasada. a seven-storied brick pyramid, conforms in shape to the imagined structure of the norld mountain, Meru, and was thought of as a variant of the stupa. The Hata-da-ge, a rectangular structure built entirely of finely cut ashlar masonry, and the Wata-da-ge, a sublime circular shrine of stone and brick, face each other and share a common axis. The beauty of each derives from the subtlety of its proportions and from the sensitive contrasts of the plain and decorated surfaces. Nearby, a stone railing encompasses a unique cluster of granite columns carved in the shape of curling lotus stems with capitals formed like lotus buds.

The tiny pavilion, once canopied in wood, is called the Nissamka Lata Mandapaya, and was probably used as a shrine for the offering of flowers. Great rectangular Buddha halls, vaulted and decorated throughout with frescoes and stucco sculpture, and circular buildings of varying sizes are also among the dedications of the Polonnaruwa kings. A number of Hindu temples, built by the Tamils during the Chola occupation, display an exclusively south Indian character.

Later. the capital had to be moved again, finally, to Kandy, where an independent monarchy survived until 1815. No monument worthy of serious consideration, however, seems to have remained from the later periods. Some of the old architectural forms were continued in the wooden style of the Kandyan era and a certain feeling for complex ornamentation developed; yet few buildings of real artistic quality seem to have been produced after the final renascence under the Polonnaruwa kings.

IV. MALAYSIA

There can be traced in each area of Malaysia and Indonesia, first of all. an Indianesque period. when the local art is closely related to that of India and the forms of Indian art were reproduced; then a classical period (AD. 800–1200) in which local national formulas are evolved and crystallized; and finally a local national phase no longer in direct contact with India, and passing into a stage of folk art which has survived up to the present day. It is at all times an injustice to apply to the local schools the name of Indian colonial art, for although the structural and decorative elements are all originally of Indian origin, the originality and energy of the local forms derive from indigenous sources, and the expression of local ethnic character is everywhere apparent.

A. BURMA

Ruined buildings and sculptures of a Gupta type have been found at Tagaung, Prome, Thaton and elsewhere. Farther north, remains of the old city and a gateway dating from the 9th century can be seen at old Pagan. Among other structures dating from the 10th century at Pagan are the Nat Hlaung Gyaung Vishnuite temple (A.D. 931) and the cylindrical Ngakywe Nadaung, a stupa recalling the Dhamekh at Sarnath.

But it is only with the unification of Burma, accomplished by Ananrata (1040–77), that a great building era was initiated. Remains of no less than 5,000 "pagodas." mainly stupas but also Buddhist temples, can be traced in the Pagan area. Two types are especially characteristic. In one the basement terraces of the chapel or stupa are developed to a great height, giving a cubical effect, and provided with chapels and galleries in their mass, for

which an early Indian parallel is afforded by the stupa at Mirpur Khas in Sind; the Ananda, Thatbinnyu and Shwegugyi pagodas are examples. The other is that of a stupa supported by a high pyramidal terraced basement provided with four median stairways as a means of access, and often with smaller stupas at the angles, thus repeating a type already established at Borobudur, which in turn derives from the terraced stupas of the Punjab, Kashmir and Turkistan.

Other structures exhibit special peculiarities, for Anawarata and his successors were in touch with all parts of the Buddhist world of that time, and built in various manners. Connections with northern India, Bengal and Nepal were especially close. The Mahabodhi stupa is clearly a direct imitation of the ancient Indian shrine of the same type at Buddh Gaya, described above, which was itself in turn restored by pious Burmese Buddhists in the 12th century. Active construction at Pagan continued well into the 13th century. after which the unity of the country was for a time destroyed by Shan invasion.

The unfinished Mingun pagoda, begun in the 18th century, was to have been the largest in Burma, and what remains is still over 140 ft in height, though this represents only a third of the proposed elevation. It is highly characteristic that ancient stupas of small size were again and again enclosed within larger structures and thus lost to view, so that huge pagodas like those at Prome and Pegu, while really representing ancient foundations, are in their present aspect comparatively modern.

Mandalay was founded only in 1857, and occupied by Mindon, the last great royal patron of Buddhism in Burma. The palace. a wooden structure in which material from an older palace at Amarapura (the previous capital, near Pagan) was employed. like most wooden palaces consists of connected halls, pavilions and galleries within a walled enclosure. The main features of the style are the use of immense teak columns, lacquered and gilt multiple roofs and spires with flamboyant crockets, and an interior decoration in which glass mosaic plays an important part. Other fine examples of late Burmese wooden architecture are afforded by monasteries such as the Myadaung Kyaung and the Sangyaung at Mandalay, monuments to the piety of various queens. Still more modern is the famous Shwe Dagon pagoda (stupa) at Rangoon; its tapering form. the outline of the spire almost continuous with that of the body, contrasts conspicuously with the more monumental hemispherical and cylindrical types of early Indian art. There is a general tendency to the development of more refined and aspiring. less massive types in all the later stages of Indian architecture wherever it is found. *(See* BURMA.)

B. CAMBODIA

1. Pre-Khmer or Khmer Primitive (5th–8th Century A.D.).—The history of Indian architecture in southeastern Asia can be followed in Cambodia better than anywhere else; there, despite the disappearance of wooden architecture, once more abundant than that in stone, the sequence is relatively complete. In the Khmer primitive or pre-Khmer (as different authors interpret it) architecture of southern Cambodia. dating from the 6th and 7th centuries (when permanent materials such as brick, laterite and stone were just coming into use), are found a series of buildings which exhibit striking analogies with those of the early Chalukyas of the western Deccan, as well as with those of the Pallavas and even with the earlier style of the Andhras.

A slab-built cella at Hanchei recalls the small shrine on the roof of the Ladh Khan at Aihole; it was once perhaps surrounded by a pillared hall as at Bhumara. Another very elegant square cella at Prei Kuk has shallow pilasters and characteristic Indian cornices with dormer arches framing Gandharva heads, and is quite Pallava in appearance. There also, and at Bayang, there are high brick towers suggesting such Gupta types as Deogarh or Bhitargaon; at Maha Rosei there is a granite shrine of Pallava type.

2. Classic Period, Khmer (9th–15th Century).—From the 9th to the 12th century and even later. Cambodian architecture develops still in brick and laterite. but more characteristically in stone. Indian forms are abandoned or freely modified, and local features appear, so that a truly national architecture comes into being. Unlike anything in India are the half-vaulted arches with curved stone sloping roofs imitating tiles, and so too the huge faces or masks on the sides of the early towers of the Bayon and Angkor Thom gateways. On the other hand the later towers develop as in India by a reduplication of stories, vertically compressed, and many motifs. seemingly novel, for example the Garuda caryatids of the Prah Khan walls and the Angkor Thom terrace, have really older Indian prototypes.

The classic Khmer architecture is widely distributed in northern Cambodia, perhaps the original seat of the Khmers. The best-known monuments, out of hundreds still in existence, are the city of Angkor Thom and the neighbouring temple of Angkor Wat (Angkor is a corruption of Sanskrit *nagnra,* "city" or "capital"; *wat* or *vat,* a later Siamese term for any Buddhist monument).

The city, occupied about A.D. 900, is of great extent, and contained within a moat, crossed by four causeways with parapets consisting of gods and giants holding the body of a giant Naga; these causeways lead to triple gateways large enough for the passage of elephants, and from these proceed four roads to the heart of the city. Near the city are the previous capital of Prah Khan, and other shrines such as the Neak Pean, Phnom Bakeng and Angkor Wat, and many artificial lakes. The city is situated in the plains, among the rice fields and near the great lake, both necessary sources of food supply for a great population. Its most important structures are the temple of Phnom Bakheng, the Bayon, the Baphuon and the Phimeanakas. The Bayon, intended to be Buddhist, was adapted to Saiva usage before its completion, and ultimately contained the statues of Hindu and Buddhist deities, the Deva Raja (a linga representing the king's divinity) and statues of deified royal ancestors. Its most conspicuous feature consists of the towers with enormous masks (representing Lokesvara) on each face; but equally interesting are the reliefs in which almost every aspect of contemporary life is depicted. The Baphuon, *c.* A.D. 1000, is a typical terraced, pyramidal structure (prang), with median stairways leading to a stone gallery above.

Of the many other temples built in less accessible sites, the Prah Vihear may be mentioned; it is magnificently situated on a spur of the Dangrek range. overlooking a rolling panorama of uninhabited jungle. Angkor Wat is the later Siamese designation of the most famous and most beautiful of Cambodian shrines, of which the true name is unknown, though there is reason to think the dedication was to Vishnu. The date is the early 12th century.

The 14th-century temple of Isvarapura at Bantei Srei is proof that the capacities of the Khmers were not destroyed by the earlier Siamese invasions. But the country had certainly been devastated and Angkor Thom abandoned by the 15th century, and when later inscriptions appear they belong to the Siamese period. Hinayana Buddhism replaced the mixed Mahayana Buddhism and Hinduism which formed the state religion of the Khmers in the classical period.

C. THAILAND

Siamese architecture. in its earliest periods, was little more than a provincial reflection of the Indian style. It subsequently came under the influences of Khmer, Burmese and Sinhalese modes of building, and finally developed in the direction of a richness of detail and an ornamentalism of form that is distinctively Siamese. Wat Mahadatu at Lop Buri is a typical example of the Siamese temple of the Khmer period. In plan, it repeats the usual Indian formula of a sikhara with a closed mandapa, and in elevation it is strongly reminiscent of the 10th- and 11th-century buildings at Angkor.

Wat Kukut at Muang Lamphun, erected in the 12th century, takes the form of a terraced pyramid, with niches holding Buddha images, and thus recalls the Sat Mahal Pasada in Polonnaruwa. Wat Chet Yot, a dedication of the Thai period, is a copy of the Mahabodhi temple at Pagan and ultimately derives from the great temple at Buddh Gaya as it appeared in the Pala period. Among the ruins of Ayutthaya (Ayudhya), the capital from 1350 to 1767, are a number of examples of the typical Siamese stupa. Round, with multiringed bases and bell domes, they climax in tapering

onionlike finials of peculiarly pointed form. The last phase of Siamese architecture is typified by the many shrines and palaces set up in Bangkok after 1782. These structures are built almost entirely of wood and are elaborately decorated with a mixture of forms borrowed from ancient Siamese and modern Chinese sources. They are characterized by an ornateness which produces an artificial splendour seldom equaled.

D. Champa

Eastern Indochina, once the seat of great Cham (*q.v.*) kingdoms, must have been hinduized at an early date, for there are traces of Hindu kingdoms both in the north and south as early as the end of the 2nd century A.D. All the early and much of the later architecture was wooden. The remains are of two periods, one classic, from the 7th century to about 1100, the other that of the decadence.

The sacred city of Mi-son was founded about A.D. 400, but the great brick tower non surviving was built on the site of the original wooden shrine soon after 600. The plan is square, but the cella is twice as high as it is wide, and the effect of height is increased by the narrow decorated pilasters which emphasize the vertical lines; the pyramidal roof consists of three diminishing stories, repeating the form of the cella on a smaller scale. The decorative motifs include makara niches, geese with extended wings, both old Indian motifs, and acroteria silhouetted against the sky. The whole is reminiscent of Indian Gupta toners and the pre-Khmer towers of Cambodia. In addition to this main shrine there are six great halls for the accommodation of pilgrims, for Mi-son was a sacred city rather than a place of habitation. Later, about 800, a great temple and monastery, the only important Buddhist buildings in Champa, were erected at Dong-duong by Indravarman II; but the place was soon ravaged by the Annamites. who were continually pressing downward from the north and ultimately accomplished the ruin of Cham civilization. Sanctuaries were built again near the new capital of Binh Dinh at the beginning of the 11th century; the colossal towers of Duong-long, and those known as the Towers of Gold, Silver and Copper, are striking monuments. But it was no longer possible to build up great temple cities in honour of the gods.

V. INDONESIA

A. Sumatra

Sumatra, Suvarnabhumi, the "Land of Gold," Yavadvipa of early Indian literature. received Indian colonists probably before the Christian era; in the 5th century Mahayana Buddhism was officially adopted as a result of a royal mission from Kashmir. I Ching passed by Palembang about 690 and found there a great centre of Sanskritic Buddhist learning.

Before this time the great Malay kingdom of Srivijaya, held for many centuries by the Sailendra dynasty, had been established with the capital at Palembang, controling the Malay peninsula and probably Siam as far as Prapathom. This was the greatest maritime power in southeastern Asia (Madagascar had been colonized by hinduized Malays early in the Christian era).

An inscription at Vien Srah in the northern part of the Malay peninsula records the erection there of brick towers and stupas. That of Kota Kapur in Bangka speaks of a military expedition to Java and in fact from before the middle of the 8th century the whole of central Java was subject to the Sailendras. The buildings there erected, however, will be discussed under Java *(see* below); in Sumatra proper the architectural remains are little knonn and not well preserved. *(See* Sumatra.)

B. Java

The old Hindu kingdom of Taruma in western Java is known only by inscriptions of 4th- and 5th-century date. The earliest architectural remains are those of the Dieng plateau, where in the 7th or early 8th century stone was employed in Java as a building material for the first time. The plateau was not an inhabited city. but a place of pilgrimage. a temple city comparable with Girnar and Mi-son. Out of many more, eight temples survive; they are known by the names of the heroes of the *Ramayana,* but these appellations have nothing to do with their original dedication to Siva. The Indian character of the architecture is conspicuous, and in all probability Indian architects were at work there. The construction is generally cubic, with strongly emphasized vertical and horizontal lines; the temples are two-storied, the roof repeating the form of the cella. The plan is square, and the walls are divided by pilasters into niches or panels with sculpture; a grotesque makara face crowns the doorways. This description applies to the four temples of the Arjuna group; but Candi Bhima is a pyramidal tower in the northern Indian Nagara style with successive horizontal stages repeating the fundamental forms, cornices with dormer arches framing Gandharva heads and angle amalakas at the fourth and fifth stages. A single amalaka crowned the now ruined summit. East and south of the plateau and at Mt. Ungaran there are numerous other small temples of the same period and style, but rather more freely and exquisitely decorated.

Among the great monuments of the Sailendra period is a lovely but ruined temple of Tara, at Candi Kalasan. It was the first Buddhist temple on Javanese soil and its date is A.D 778. This is a building of the Dieng Arjuna type, but the lateral niches are developed into side chapels. the ornament is more elaborate and there are delicate strips of floral tracery between the plain pilasters. Nearby is the three-storied rectangular Candi Sari. Candi Mendut, which is near Borobudur, is similar in plan, but there are no side chapels; on the other hand there is an open sculptured vestibule, and the exterior walls of the cella are richly decorated with figure reliefs. *(See* Java.)

Borobudur ("the Vihara of the Secret Aspect") is wonderfully situated on an eminence commanding an extensive view of rice fields and more distant towering volcanoes; it is a hill that has been terraced and clothed with stone. It is in fact a low pyramid composed of successively receding platforms with re-entrant angles. The structure is thus exactly analogous with that of contemporary buildings in Kashmir, of earlier stupas in the Punjab and Afghanistan and of the Rawak stupa in Turkistan, which are similarly provided with extensive basements having median stairways on one or four sides, though none of the Indian examples has more than two terraces, so that Borobudur represents a more developed type. (For the sculptures see Java: Archaeology.) Borobudur cannot be exactly dated, but it was probably built at the close of the 8th century.

Candi Sewu Prambanan is a Buddhist temple which dates from the early 9th century. The large central shrine represents a further development of the Candi Kalasan design, with side chapels open to the exterior and niches containing images. Around it, within the large area enclosed by the pakara. are two double series of small independent chapels, about 250 in number. The order and formality of the design are conspicuous.

After the "restoration," *c.* A.D. 860, the Hindu kings of central Java erected other great buildings at Prambanan. The Candi Loro Jongrang group consists of three large terraced temples dedicated to Brahma, Siva and Vishnu and some smaller shrines within the same enclosure. The Siva temple is typical; the actual shrine occupies the summit of a steep truncated terraced pyramid with median stairways on three sides leading directly to the main shrine and side chapels above. The whole site may have been a royal mausoleum as well as a place of ordinary worship. Nearby is the Buddhist Candi Plaosan.

These temples were no sooner built than abandoned, for about A.D. 915 central Java was deserted. and the further development of Javanese architecture must be studied in the east and in Bali.

At Candi Lalatunda and at Belahan there are sculptured bathing places built by Udayana and by his great son Erlanga. The best-known monuments. however, belong to the 13th and 14th centuries, the time of the great capitals at Singasari and Majapahit. At Singasari. Candi Kidal is a Saiva, and Candi Jago a Buddhist temple. but there is a mixture of the tno cults amounting almost to fusion, as was also the case in Cambodia; a like condition prevailed in Bali. In far eastern Java the great Buddhist shrine of Candi Jabung dates from 1354; the circular tower, unique in Java, stands on the usual high rectangular terraced basement, the transi-

tion from base to tower being skillfully effected. At Panataran near Blitar there is a large Saiva temple complex. recently excavated and partly restored; the basement of the main temple is square and terraced, with the usual recessed corners. The associated gates and the sculpture are already in a style forecasting that of Bali.

C. Bali

Bali, where alone in Indonesia Hinduism and Buddhism survived as practised cults, most probably had early and direct relations with India; but the migration of Javanese exiles to Bali at the close of the 1 jth century, by nhich time practically the nhole of Java had received Islam, must also be taken into account. In Bali the only important early remains are the royal tombs at Tampaksiring, dating from the 11th or 12th century, and the Pura ye Ganga temple, more or less in Panataran style, dating from the 14th or 15th century. The more modern temples of Sangsit, Bangli, Batur, Kesiman, Den Pasar, etc., consist of groups of small independent shrines enclosed by walls having high roofed gateways; with rich sculpture in limestone, in fantastic forms and high relief.

Bibliography.—P. K. Acharya, *A Dictionary of Indian Architecture* (1927), *Manasara on Architecture and Sculpture* (1933–34); Percy Brown, *History of Indian Architecture;* A K. Coomaraswamy, *History of Indian and Indonesian Art,* with a useful bibliography (1927); J. Fergusson, *History of Indian and Eastern Architecture* (1876); *O* C. Gangoly, *Indian Architecture,* "Little Books on Asiatic Art" (1928); E. B Havell, *Ancient and Medieval Architecture of India* (191 j); S Piggott, *Some Ancient Cities of India* (1945), Benjamin Rowland, *The Art and Architecture of India, Hindu, Buddhist, Jain,* The Pelican History of Art with excellent bibliography (1953); Sir R E M. Wheeler, *Fzve Thousand Years of Pakistan* (1950); H. R Zimmer, *Myths and Symbols in Indian Art and Civilisation* (1946), *The Art of Indian Asia,* 2 vol (19j;) (D K D.)

INDIAN ART, in this article, refers to the Buddhist, Hindu and Jain sculpture, painting and decorative art of the Asian subcontinent of India and of Ceylon, from earliest times to the present. The art of this area created under Islamic rule is discussed in Islamic Art. For the art of adjacent areas see Indonesia~Art and Archaeology; Persiax Art; and Tibetan Art. This article is organized as follows:

I. Introduction
  1. Indian Art and Western Art
  2. Significance and Character
  3. Hieratic Art
  4. Narrative and Decorative Art
  5. A Theory of Beauty
  6. The Artist

II. India
  A. Prehistoric (Before *c.* 1500 B.C.)
    1. Paleolithic and Neolithic
    2. Prehistoric Painting
    3. Chalcolithic Indus Valley Culture
  B. Vedic and Pre-Maurya (*c.* 1500–322 B.C.)
  C. Maurya, Sunga and Early Xndhra Periods (322 B.C.–*c.* A.D. 50)
    1 Maurya (322–185 B C.)
    2. Sunga (185–72 B C)
    3 Early Andhra (7j B.C.–A.D. 50)
  D. Kushan (*c.* A.D. 50–241)
    1. Buddha Types
    2. Hindu Types
    3 Gandhara (Greco-Buddhist) Sculpture
  E. Later Andhra (*c* A.D. 50–320)
  F. Gupta (A.D. 320–*c.* 600)
  G. Early Hindu Dynasties (*c.* 600–*c.* 850)
    1. Nalanda
    2. Pallavas
    3 Early Chalukyan
    4. Rashtrakuta
    j. Kashmir
  H. Later Hindu Dynasties (From c. 850 Onward)
    1. Northern and Eastern
    2 Bundelkhand and Rajputana
    3. South Central and Western
    4. Gujarati (Jain) Painting
    j. Rajput Painting
    6 Miniature Painting
    7. Later Developments

III. Ceylon
  1. Sculpture
  2. Painting

I. Introduction

1. Indian Art and Western Art.—It may be useful for western readers to begin the consideration of Indian art by examining a few likenesses and differences between Indian and western art. Some of the points will be dealt with at greater length below. Indian art may be described as theological or traditional, since, like the art of the middle ages in Europe, it was dedicated to revealing the divine nature of the gods and enhancing the dignity of the church. Its didactic purpose was to instruct men in the truths of religion. The function of art was the making of the objects of worship in a life given over to religion. The Indian artist was trained in canons of proportion and harmony calculated to produce images which, in their abstract perfection, would suggest the divine nature of the original. Indian images are abstractions of the human form. Unlike the Greek artist, who sought to suggest divinity by the idealized perfection of the physical anatomy, the Indian artist strove to create a supernatural ideal often presented in terms only abstractly related to an actual physical body or its proportions. The Indian artist composed his figure according to canons of proportion intended to endow his idol with more than mortal impressiveness and beauty. The nude is not used in Indian art for its own sake, as in the western tradition, but in order to suggest the sensuality of fertility spirits or the yogic control of the Jain ascetic by means appropriately specific and abstract. In every period of Indian art painters and sculptors suggested the warmth and fullness of the fleshly body and the presence of enlivening breath by abstracting the swelling planes of which the body is composed. Some Indian figures of the nude, such as those of Jain ascetics, have a certain superficial resemblance to such western types as the early Greek Apollo or Kouros in the very abstraction of the anatomical form. But it must be remembered that in the Indian image this abstraction is intended to represent the body as a symbol of spirit and an expression of withdrawal from material being, whereas in the Greek statues abstraction is employed to express youthful beauty throbbing with physical life. The real differences between Indian and western art are more apparent in the comparison of such characteristic types as the Aphrodite of Greek art and the yakshi or fertility goddess of India. In the classical statues the erotic charm and function of the goddess are suggested by the artist's literal imitation of a body in marble, while the Indian image achieves the same iconographic end by means that are essentially abstract and at the same time completely plastic and appropriate to the medium. It might be pointed out that in an exactly similar way, even in portraiture, there is a complete suppression of individuality. In Indian art, portraits, just as much as representations of gods, are symbols of general ideas, a point of view in which reference to the particular has no place. It could be said that the principal link between Indian and western art is the employment of the human figure to reveal the imagined shapes of the gods. The main difference between the Indian and western approach have already been mentioned. It might be added that, whereas the western artist in the Greco-Roman tradition sought to create an ideal with reference to the beauty of actual human models, the Indian artist worked in what might be described as a metaphorical mode; that is, a representation of parts of the body and features in shapes suggested by similar forms in the world of nature, such as the lotiform eyes of the deities—shapes regarded as more final and perfect than anything to be found in the merely transitory appearance of human models. It must be remembered that the Indian gods were always portrayed as supermen. Such attributes as the multiple heads and arms of Hindu divinities, which would seem monstrous according to the western classical tradition, were entirely necessary to display the manifold attributes of their power, and invariably these multiple arms are disposed in such a way as to enhance the, dynamic and rhythmic conception of the figure.

2. Significance and Character.—Indian religion and ritual exist in two forms. known to Indians as the Vedic and the Agamic traditions. but the Vedic is more often designated by western scholars as Aryan and Brahmanical, and the Agamic as Dravidian (southern) and popular. Vedic (Aryan) religion consisted in a

worship of the great powers of nature by means of hymns and sacrifices (Yajna). nithout any use of temples or images, or any devotional cult properly so described. On the other hand, the much older and quantitatively predominant element of the population worshiped local and tutelary deities, powers of nature conceived as personal beings; these deities included the yakshas (genii, tree spirits, sources of life and abundance), Nagas (dragons, spirits of springs and lakes) and innumerable goddesses of fecundity or dssease, the Shaktis of later Hinduism. To this Agamic tradition belonged an elaborate cosmology, many myths, the doctrines of reincarnation and acts (samsara and karma), the practice of asceticism (sannyasa) and ecstatic meditation (yoga), which appear only late in Vedic literature.

The indigenous divinities were worshiped with devotion (bhakti) as personal beings and with a ritual (puja, a non-Aryan word referring to the anointment of sacred objects) which included offerings of flowers, food. lights and incense; and for this ritual images and temples, though of impermanent materials. wood and clay, must have been in use from a very early period.

The Vedic culture was gradually penetrated by indigenous belief and closed with the reactionary teachings of the Upanishads and Buddhism. where Yajna is discounted, puja not considered; the goal is release, the means is knowledge. Meanwhile, there was developing a higher and inclusive devotional theism. in which the sndigenous deities were fused with those of the Vedas. and interpreted in the light of philosophic and psychological speculation. The great system (see HINDUISM) thus built up, sanctioned on the one hand by scripture and on the other by popular belief, became a truly national vehicle of thought; Hindu theology and myth, in verbal and visual expression, provided 'means of statement for all that was felt and thought about the soul of man and the nature of the universe. At the same time, new divinities came into being, among others the Buddha himself; for the prevailing tendency involved in iconolatry, cult and ritual even such systems as those of Buddhism and Jainism, which had originated as purely psychological and ascetic disciplines.

For several centuries before and after the beginning of the Christian era the dominant mode of creative thought was theological. All the arts were governed by a great enthusiasm like that of the cathedral builders of medieval Europe. and in all enduring aspects and in their greatest splendour, they were in the service of the churches, upon whose endowment and adornment enormous wealth was lavished.

Long after the first creative impulses had been crystallized in the medieval period, there were developments of thought and feeling and modifications and elaborations of the older iconography that can still be traced. India, despite the destruction wrought by Mohammedan invaders, is even today covered with magnificent temples and a wealth of sculpture in which the spiritual and material history of two millenniums is visibly recorded. Further, the same initial impulses, translated to other lands and molded by the imagination of other races, Pyu, Thai, Khmer. Malay and Polynesian. created other and scarcely less significant and varied cycles of art in southeast Asia and influenced profoundly the spiritual and artistic development of central Asia. China. Korea and Japan.

Thus, Indian art is essentially a hieratic art devoted to the exposition of the personality and acts of deities, and providing for their service. Authoritative texts declare that the making of images of deities leads to heaven, not the making of likenesses of men; that only that which accords with the canons is beautiful in the eyes of the discerning, not that which pleases individual fancy.

3. Hieratic Art.—But while Indian works evoke aesthetic experiences when beheld by alien eyes. Indian art and European art are not identical in kind; the intention is different. Nor is there identity of method. In its main development, sculpture and architecture, Indian art was not produced with a view to aesthetic experience, nor even regarded as "art." Images, in particular. were not regarded as works of art but as means (sadhana) of edification.

An image is a piece of apparatus (yantra) employed in personal devotions, the object of which is an identification in consciousness of worshiper and deity. In the words of a well-known text, the deity can be worshiped (in spirit and in truth) only insofar as the worshiper becomes the deity. For this spiritual exercise yantras of two kinds are employed, one purely geometrical and linear, the other three-dimensional and more or less anthropomorphic or theriomorphic. Both types are alike in kind;

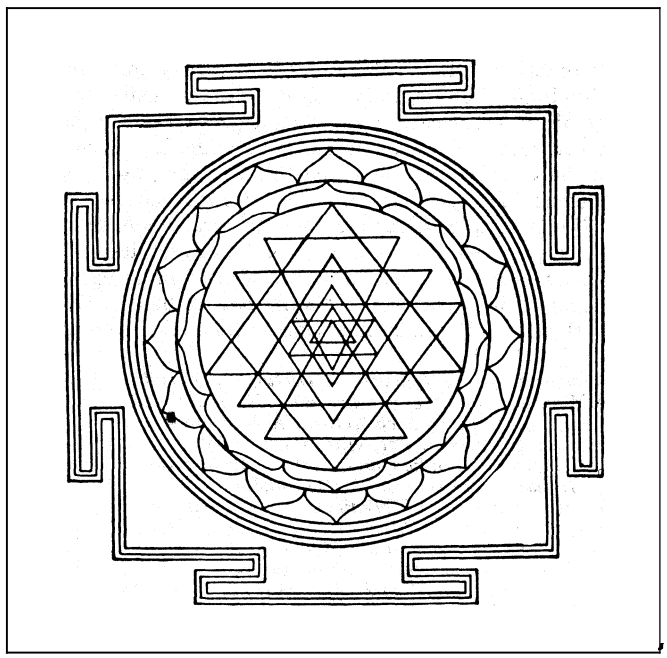


FIG. 1.— YANTRA. A DIAGRAM FOR WORSHIP

both are equally externalizations of mental visions evoked in dhyana (meditation) with a view to samadhi (superconsciousness).

The obtaining of this mental visualization (which is more essential than its material realization) is a process of yoga.

Such a visualization differs from those present in normal vision: it is more vivid; it fills the whole field of view; all parts are equally and simultaneously present; the relation of these parts is not organic. nor on the other hand accidental, but ideally determined; such an image can represent only a condition of being or. to use a more strictly Indian term, a type of activity.

Such an image is not a memory image. which is the foundation of all realistic art, inasmuch as time passes between the moment of vision and that of execution. What may at first sight look like the observation of nature at Amaravati or Ajanta is simply the most vital and the most felt part of Indian art; where the worshiper attains the most complete samadhi, the artist is most completely and literally identified with his subject. Critically examined, this art reveals no knowledge of anatomy, but rather a deep understanding of life, of emotion and of the language of gesture, long codified in the *Natya Shastra.* (*See* DANCE: *The* Orient: India *and* Pakistan.) Nor are its themes confined to those set forth in terms of human life; beside these are dogmatic and mythological forms unparalleled in nature.

4. Narrative and Decorative Art.—A part of Indian art is secular. There exist, beside the cult image, both narrative arts and an industrial art, or arts and crafts. The narrative art such as is used to illustrate Jatakas or the epics or the Krishna legend is not hieratic to the same degree as the cult image. hut is a dramatic presentation comparable to the stage. It is nevertheless governed by principles similar to those which determine the nature of the cult image: the use of formulas is general, and the part of the spectator quite distinct from that of mere perception. A typical peculiarity of Indian (and in general oriental) art is the kind of perspective known as vertical projection, whereby the landscape is presented as seen from a height, so that the horizon almost reaches the upper edge of the frame; the planes are differentiated in the sense that an object or figure behind another is represented as above it, while the atmosphere, apparently reduced

to the narrow space remaining above the horizon. is really brought forward to embrace the whole representation together with the spectator.

Although in Sanskrit literature much is heard of portraits of individuals recognized as likenesses, these are invariably drawn from memory, in the absence of the model, so far at least as the actual references inform us.

Further. Indian art reveals nothing like genre. The nude. for example, while sometimes represented with a frankness disconcerting to European eyes, is never studied or treated for its own sake, as in European art, and appears only as symbolism or narrative may require. In the same way landscape is never represented for its onn sake.

Thus, the narrative art of India is of the same kind as the purely hieratic art. All true pattern is of this kind; this is especially evident in its repetitive character and in a mathematical rather than organic relation of the parts. Accordingly. the industrial and "decorative ' arts in India cannot be sharply divided from the "higher" arts. In both, design and formula, rather than imitative shapes. are found; definite meanings are present in both. for oriental ornament is never originally without, and very rarely loses, a precise significance, and is never "merely" decorative.

5. A Theory **of** Beauty. — India developed. as a means of literary criticism, a theory of aesthetic experience of considerable importance in the history of aesthetic theory.

A nork of art is a statement informed by flavour (rasa); there are nine such flavours. the erotic, heroic, odious, furious, terrible, humorous. wondrous. pathetic and peaceful. The component elements of a work of art (physical stimulants of aesthetic experience) are determinants (vibhava, theme, etc.), consequents (anubhava. deliberate actions), moods (bhava. 33 transient [*e.g.*, joy, impatience] and 9 permanent [viz.. the 9 rasas listed above]) and involuntary emotional conditions (sattvabhava).

Aesthetic experience (rasasvadana) is the tasting of rasa. and depends mainly on the innate and acquired sensibility of the spectator (rasika).

6. The Artist. — A general term covering sculpture, reliefs and painting is citra; this word can also be used in a more restricted sense with reference to painting only. Silpa is the practical activity of the craftsman, rather than "art" in a modern sense. The artist or craftsman is designated as silpin. sthapati karmara, rupa-kara, citra-kara, etc. The higher craftsmen practise many arts: an architect. for example, will also be a sculptor, bronze founder and goldsmith. On the other hand workers in iron, weavers, potters and the like are restricted to a single craft. No artist is solely a designer, like a modern architect; the Indian architect is, during the greater part of his life, a manual worker.

II. INDIA

A. Prehistoric (Before *c.* 1500 B.C.)

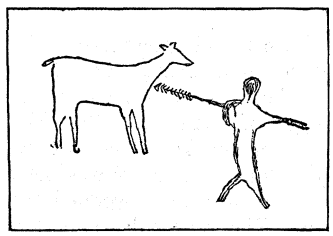
1. Paleolithic and Neolithic. — Rough chipped-stone implements have been found abundantly in southern India. But a great gap, ethnic and cultural, seems to separate them from those of the Neolithic period. Neolithic implements. both chipped and polished. some antedating and some coeval with the knowledge of copper have been found all over India. They exhibit a great variety of forms. including pygmy types. Most of the forms are identical nith those of western Asia and Europe; but a peculiar chisel-shaped, high-shouldered celt is found in Chota Nagpur, Assam and more abundantly in Burma. Indochina and the Malay peninsula. Indian culture must have had a continuous history from prehistoric times; this must be borne in mind in a discussion of the earlier history of Indian religion and art, especially in connection with the beginnings of sculpture and design.

2. Prehistoric Painting. — Primitive ruddle paintings have been found in natural caves in various parts of north central India. and have been regarded by some authors as of Neolithic or even Paleolithic date. Those from the Mirzapur district in the Vindhya hills include a representation of a rhinoceros hunt. This animal is non extinct in this area. The hunters are shown with barbed spears, suggesting certain of the ancient Indian copper

Cave paintings from the Hoshangabad district are said to include representations of a giraffe. Those from the Kaimur range (fig. 2) shon stag hunts. Those from Singanpur include an animal rather like a kangaroo and also some representations of a horse and of deer which present an extraordinary resemblance even in details to the Paleolithic paintings of Cogul in Spain.

The literature of the subject is cited by Herbert Kuhn. who discusses the Singanpur examples and their resemblance to Spanish drawings. Those from Hoshangabad are referred to in the Annual Report of the Archaeological Survey of India, part 1, p. 25 (1917–18).

3. Chalcolithic: Indus Valley Culture. — Excavations at Harappa in the Punjab and Mohenjo-Daro and Chanhu-Daro in Sind have revealed the existence of ancient city sites belonging to a Chalcolithic culture, known as the Indus Valley culture or. from its relation to the near east, the Indo-Sumerian period.



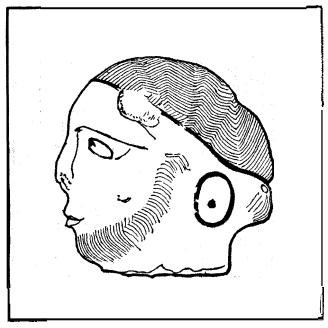
FROM JOURNAL OF THE ROYAL ASIATIC SOCIETY"

FIG. 2.—CAVE DRAWING, KAIMUR RANGE

The dating of the Indus civilization depends on compsrison with vestiges of similar architectural and sculptural remains in Mesopotamia and on the discovery of objects of Indian type in pre-Sargonid and Sargonid sites. Indic seals have been found at Ur, Kish and Tall al Asmar datable from about 2500 to 2350 B.C.. so that the beginnings of the Indus civilization have been fixed in the middle of the 3rd millennium B.C. This culture lasted until the 17th century B.C., when it was succeeded by an obscure and inferior culture known as the Jhukar which endured up to the time of the Aryan invasion of **1500** B.C.

The buildings at the Indus sites are of a well-burned brick. This method of construction and the existence of lofty citadels like the ziggurat platforms of Mesopotamia suggest a connection with the architecture of the ancient near east. Among the examples of sculpture, tno figures, one of a nude male from Harappa, the other a dancer, perhaps Siva, from Mohenjo-Daro, belong to a definitely Indian style of expression with their emphasis on the fullness and softness of the body suggested abstractly through the interlocking of the smooth convex planes of the surface.

Sculptures in marble include a bust of a man, possibly a shaman, and a bearded head wearing a skullcap (fig. 3). The masklike quality of these heads is distinctly Mesopotamian in character. In terra cotta. there are many figurines of a nude goddess with an elaborate headdress, girdle and the body ornament (channavira) characteristic of later Indian art; in terra cotta and in faïence, admirable figures of animals, including the bull, rhinoceros, dog and cock. All these are sculptures in the round. But the most abundant and not the least remarkable works of art are the square seals of faïence or ivory nhich bear in relief figures of animals, usually a bull, elephant or rhinoceros. with a cult object. apparently a wicker crib or manger, and pictographic signs. partly related to earlv Sumerian forms and even more similar to pre-Sumerian forms found at Kish but so far undecipherable. Some scholars believe that the later Indian Brahmi (Sanskrit') script was developed from this early pictographic type. One seal bears a seated cross-legged figure attended by snake-hooded Nagas, as in much later. Buddhist, art; another a sacred tree (the bo tree or pipal, *Ficus religiosa*, later a symbol of various deities. particularly the Buddha) with a horned dragon projecting from the trunk; another, a row of men bearing totem standards like



AFTER ARCHAEOLOGICAL SURVEY OF INDIA

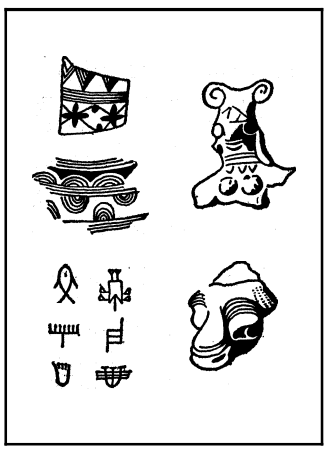
FIG. 3.— PREHISTORICSCULPTURE, INDUS VALLEY CULTURE

those of predynastic Egypt. One earlier seal from Harappa represents a tiger hunt.

Among personal ornaments are finely wrought gold, silver, and copper gilt jewelry, *chank* and carnelian beads, faience bangles. Other metals known included tin and lead, but not iron; some utensils and ornaments are made of bronze. India has no Bronze Age properly so-called but the alloy is found already at that early date and has remained in use to a limited extent ever since. though most of the so-called Indian bronzes are really of cast copper. A copper model of a hooded two-wheeled cart obtained from the lower strata at Harappa is evidence of the very early use of wheeled vehicles. Few weapons have been found.

The pottery is wheel made. and includes painted types; the shapes are varied, but types with handles are rare. The painted designs are usually in black on a dark red slip and consist of advanced geometrical patterns, foliar motifs and occasional figures of animals.

The dark red and black ware has been found abundantly at Nal in Baluchistan, associated with copper implements, also on the Waziristan frontier and in Seistan. The style bears some relation to that of Anau and of Susa II.



AFTER 'ARCHAEOLOGICAL SURVEY OF INDIA"

FIG. 4.—PREHISTORIC PAINTED TERRA COTTAS AND OF THE INDUS VALLEY CULTURE

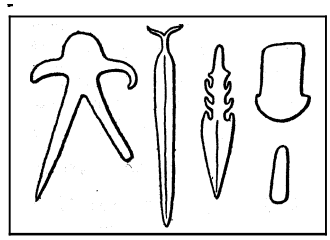
When the Indus culture was flourishing, the valley was better watered and more wooded than now. The same culture, perhaps in more provincial forms, 'may have extended to other parts of northern India, over an area reaching from Baluchistan to Kathiawar and through Rajputana to the Ganges valley, as indicated by the Gungeria hoard and other finds of copper and Neolithic implements.

The Indus Valley civilization and culture show close resemblances on the one hand with those of early Sumer and Babylonia (especially with the proto- or pre-Sumerian of Kish), and on the other with that of historic India. Apart from these archaeological evidences, there has gradually accumulated a mass of evidence tending to show that the early Indian and Mesopotamian cultures represent cognate developments. This applies especially to considerations derived from a study of the history of design (particularly in connection with the animal style and architecture), and to the analogies between Babylonian mythology and cult and those of the Dravidian (Agamic) tradition in India, such as the use of the same formulas in representing mountains, clouds and water; the motif of animals with long necks interlaced, and of heraldic and fabulous animals generally; the representation on Babylonian seals of dragons with serpentine bodies and human busts, like Indian Nagas; the cult of the waters connected with the symbol of the flowing vase in Babylonia and the brimming vessel or vase of plenty (purna kalasa) of India—the former significantly spoken of by Léon Heuzy as the marvelous symbol that was like the Holy Grail of the Chaldean epoch, and both of importance in connection with the origins of the Grail cult. To these may be added similarities of technical procedure, as in the process of decorating carnelian by calcining and in the similar composition of Indian and Assyrian glass.

AFTER ARCHAEOLOGICAL SURVEY OF INDIA

FIG 6 — TYPES OF PREHISTORIC PAINTED POTTERY FROM NAL. BALUCHISTAN

Neither the archaeological nor the mythological evidence suggests that the Mesopotamian and early Indian cultures were derived from each other, or that either borrowed extensively from the other at any one period, but rather that both developed in *situ,* though not without intercourse and contact, on the common basis of the early Chalcolithic culture which in the 5th and 4th millenniums B.C. extended from the Adriatic to Japan. It has been suggested that the numerous small cultures developed in Iran and Anatolia in the 5th millennium B.C. began to spread southward and southwestward into the plains of the great rivers. This movement produced Mesopotamian civilization in the late 4th millennium, and the Indus culture, not a Mesopotamian colony, was a later product of similar stimuli in the 3rd millennium. The original focus of this culture may have been Armenia, a country rich in metals and possibly the starting point for the many early race movements across the highlands of Iran—in one direction toward Elam and southern Mesopotamia, in the other toward central Asia and India. The Indus culture presumably ended with the Aryan invasions.



AFTER 'ARCHAEOLOGICAL SURVEY OF INDIA'

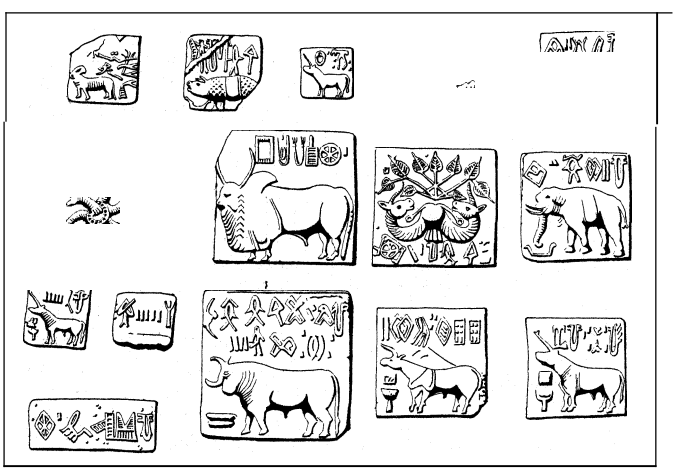
FIG. 7.— PREHISTORIC COPPER IMAGE (?) AND WEAPONS FROM GUNGERIA

B. VEDIC AND PRE-MAURYA

(C. 1500–322 B.C.)

It will be assumed that the Aryans entered India from the [illegible] about 1500 B.C. and occupying the Punjab, gradually passed on to the Ganges valley. They probably brought with them a knowledge of iron and a superior breed of horse, and it may have been these advantages that enabled them to subjugate the existing peoples uho already possessed cities and forts and a more developed material civilization. After the first period of conflict, the Aryans (as with the later invaders, Scythians, Huns and Mughals or Moguls) ceased to be foreigners and became Indians; long before 500 B.C. northern India had become the seat of a mixed culture in which—and especially in its art, both as regards motifs and technical achievement—the non-Aryan element predominated. The conguerors had been conquered by the conquered.

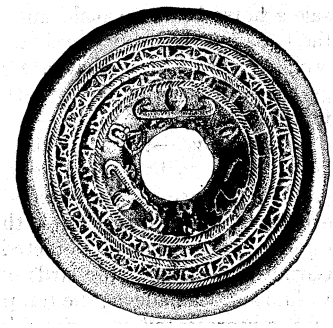
Vedic literature. mainly in the relatively later texts. reveals a knowledge of tin, lead, silver, gold and iron. of cotton, silk. linen and woolen garments, sometimes embroidered, vessels of gold and silver, iron needles. bedsteads, thrones, turbans, jewelry, earthenware, round and square huts and storied buildings and



AFTER ARCHAEOLOGICAL SURVEY OF INDIA

FIG. 8.— SIXTEENPREHISTORIC SEALS OF THE INDUS VALLEY CULTURE

wheeled vehicles. Some or all of these arts may have been known to the Aryans before they entered India, but probably the use of bricks, and certainly everything connected with maritime or purely Indian products (chank, ivory, cotton, pearls, indigenous dyestuffs. etc.), they must have found in India for the first time. The sulvasutras show a knowledge of principles now known as those of dynamic symmetry. Vedic culture shows little or no evidence of Babylonian or Semitic connections.



AFTER ARCHAEOLOGICAL SURVEY OF INDIA," BY PERMISSION OF THE HIGH COMMISSIONER OF INDIA

FIG. 8.— PRE-MAURYA STONE DISK FROM BHIR MOUND. TAXLLA

Some terra-cotta figurines. most of them of the mother-goddess type. from Mathura (mod. Muttra) and elsenhere have been dated in the pre-Maurya period. The greatest number of pre-Mauryan antiquities have been obtained at the Bhir mound, Taxila; most notable among these are the finely wrought polished sandstone disks, with bands of concentric ornament. in which are found cable, cross and bead and palmette motifs, the taurine symbol, elephants. fan palms and the nude goddess. It is also certain that the cutting and polishing of hard stones and the technique of glassmaking had attained. as early as the 4th and 5th centuries B.C., a perfection that was never afterward surpassed; and when in the Rlaurya period stone sculptures are first found, the surface of the hard stone is highly polished. One other important type of early art is represented by the punch-marked coin symbols; these coins were in use from about 600 B.C. to A.D. 100. The marks include several hundred types; among the commonest are the mountain (usually with three or more peaks—the so-called chaitya of older numismatists), river or tank with fish. sacred tree, elephant, horse. bull, sun, moon, caduceus and taurine; the lion, rhinoceros. makara (crocodile) and human figure are rarer. No linga (phallic symbol), thunderbolt, footmark or stupa is represented. These signs (rupa), forming an extensive symbolic repertory, appear to have been those of issuing and ratifying authorities. Many of the symbols are those of particular deities; for example, the three-peaked mountain with crescent moon is otherwise known to have been a symbol of Siva, and so also the bull. Few or none of the marks are exclusively Buddhist. Some are connected with particular cities, and in their day identified the issuing mints.

As regards design the same forms which are found in the reliefs of the Maurya, Sunga and Xndhra periods were already current during many centuries before the 4th B.C. These forms include meanders, palmettes, vases with flowers, sacred trees, diapers. spirals, frets. twists and the like. animals addorsed or affronted and fantastic animals of all kinds Many or all of these characteristic forms are clearly related to, but not identical nith, Mesopotamian types, Assyrian or older. They constitute a common ground of early Asian, and in India are cognates of the Mesopotamian forms, not late borrowings. The fact that they are found extant only in the stone sculpture when it first appears in the Maurya period is of course no proof of their late origin; some of the most ancient survive most characteristically in quite modern folk art, and may well have been current during three or four millenniums. Thus, the motif of animals with interlacing necks, knonn in Ceylon. where it is one of the commonest motifs of folk art, as puttuva. was already current in Sumerian art of the 4th millennium B.C., and many other instances of the same kind could be cited.

As regards sculpture, late Vedic literature, in nhich a large non-Aryan element had been absorbed, affords evidence for the making of images of popular deities in impermanent materials; and it is certain that the earliest known stone figures (after the Indus Valley types), viz., the yakshas of the Maurya and Sunga periods, despite their retention of primitive qualities (frontality, etc.), are not first efforts in any sense; they represent an already advanced stage in stylistic and technical development. There is also the evidence of pre-Maurya terra cottas representing the nude goddess and some other types. The latter are of very great importance for the history of art, for though they belong to a stylistic cycle older than that of the stone sculpture, and are still too little known, they provide connecting links in style. technique and costume between the oldest Indo-Sumerian art and that of the historical period. In their sense of the inseparability of beauty and fruitfulness, and in details of ornament (the body ornament later known as the channavira, and the broad auspicious girdle. the mekhala), as well as in some facial types, they are related to the earliest sculptures in stone.

C. Maurya, Sunga and Early Xndhra Periods (322 B.C.–*c.* A.D. 50)

1. Maurya (322–185 B.C.).—With the Maurya period, and especially the reign of Asoka (*q.v.*), from about 274 to 232 B.C., sculptural and architectural monuments in stone are found for the first time. These fall more or less definitely into two groups: (1) the court art of Asoka; and (2) the popular and perhaps more purely native art. The chief monuments of the court art are the remains of the great palace at Pataliputra (Patna) and the monolithic pillars on which Xsoka's well-known edicts are inscribed. The edict pillars, six in number, distributed over an area including Meerut, Allahabad. Benares and the Nepal Terai. have round polished monolithic shafts and are provided with elaborate capitals consisting of a lotus bell, an abacus decorated with geese, palmettes or Buddhist symbols and a crowning sculpture in the round consisting of one or more animals; they average from 40 to 50 ft. in height. The finest has been excavated at Sarnath, the old "Deer park" at Benares, where the "Turning of the Wheel of the Law" (the Buddha's first sermon) took place. There are four addorsed lions supporting a wheel (the Dharmacakra,

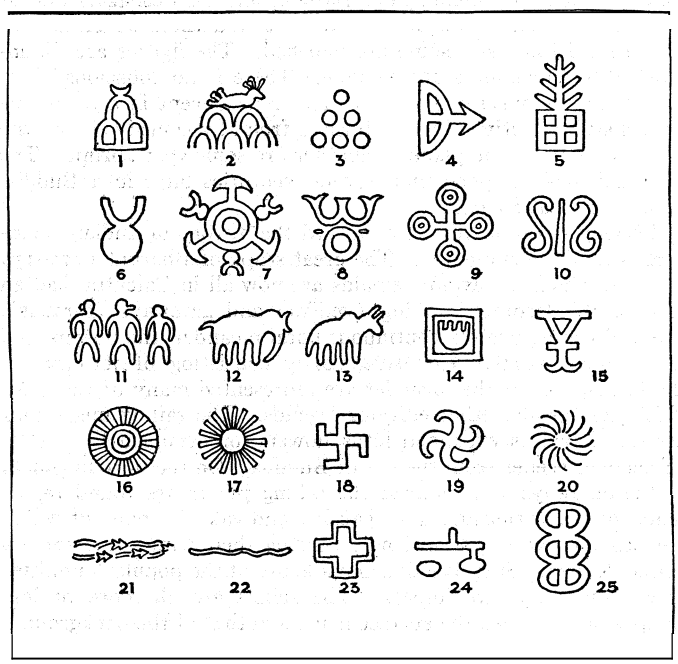


FIG 9 — SYMBOLS FROM PUNCH-MARKED COINS, 500 B C TO A D 100 (1, 2) Mountain; (5) railed tree; (6) taurine; (8) combined chakra and trisula; (9) Ujjain symbol; (10) Srivatsa; (16, 17, 20) solar; (21, 22) rivers; (24) steelyard; (25) tank

"Wheel of the Law and of Dominion"); the abacus is decorated with four smaller wheels and a bull, lion, elephant and horse. Other pillars bear a single lion, a bull or an elephant. The naturalistic treatment of these animals. the technical accomplishment of the work and the fact that this is evidently a stylistically late art all distinguish these sculptures from the contemporary religious sculptures to be referred to below. It has been argued that the court art of Asoka owes much to western sources. and even that it was produced by imported craftsmen. It is certain that close and friendly relations mere maintained between the Maurya and

Seleucid houses. The problem, however, is far from simple. All that is beyond doubt novel at that period is the use of stone to a limited extent for architectural purposes and probably the use of stone for large sculpture. Nor can the Maurya period. with its invaluable but very imperfect record, be considered alone; early Indian art as a whole and the folk art up to the present day bear an intimate relation to western Asian art. This relation is more obviously Babylonian-Assyrian than Persepolitan. Indian bell capitals, for example, are very different from those of Persia. Indian shafts are smooth or octagonal, and monolithic; Persian, fluted and segmented. The use of animal standards as symbols of deities is at once Indian, Chaldean and Assyrian, but not Achaemenid or Seleucid. The so-called Persepolitan capital with addorsed bulls (often horses, elephants or lions) again is so widely distributed and so much an integral part of the whole architectural style in the 2nd century that it could hardly have been introduced only a century earlier. So too with the civil architecture represented on the reliefs, showing walled cities with towers and battlements like those of Assyria, with the mythical monsters and with the elements of the decoration; in all, the relationship to western Asia is conspicuous, but the individual character is equally unmistakable. Nor is it possible to suppose that no art of any kind existed in India before Asoka, or that there existed some different sort of art just before Asoka, of which no trace can be found in the abundant reliefs just after him. Thus, Maurya and Sunga art directly continue the traditions of pre-Maurya art; Indian and early Persian art are both late phases of a tradition common to all western Asia.

2. Sunga (185–72 **B.C.**).—The early Indian stone sculpture in the round of Maurya and Sunga date is represented by a number of colossal figures in royal costume, apparently statues of independent or attendant yakshas and yakshis, two of these having been found at Parkham, near Baroda, and at Besnagar, one at Deoria near Allahabad, one in Mathura and three at Patna; all are in sandstone, and some are polished. The figures are distinguished by great mass and volume. There is no conscious effort toward grace, but a statement of an ideal concept in a technique that is still primitive; for the form is frontally conceived, and the transitions from one plane to another are somewhat abrupt. The style achieved its perfection several centuries later in a Buddha figure set up at Sarnath.

Bharhut.—From this time onward the history of Indian sculpture is richly documented. The great stupa of Bharhut (175–150 B.C.), of which the extant remains are now all in Calcutta. had an elaborately decorated railing (vedika) and gateways (toranas). The rail coping bears a continuous floral meander, the floaers and leaves being partly vegetative, partly consisting of jewelry; in the interspaces of the meander are represented many of the Buddhist Jatakas and other edifying legends. The railing medallions are developed as expanded lotus flowers, or occupied by Jataka subjects or scenes from the life of Buddha. On the upright pillars of the gateuays and some of the railing pillars are found representations of various devatas, yakshas and yakshis, many of which are provided with inscriptions recording their names, as, for example, Kubera; thus, Buddhism made use of the popular divinities as guardians and worshipers. The reliefs are all more or less compressed between the surface plane and that of the background, lacking equally the plastic volume of the Bhaja types and the technically more advanced relief of Sanchi; but the costumes. though modified, are closely related to those of Bhaja. The various decorative motifs, floral and geometrical, are indicative of a highly evolved art. Of the same date are some of the railing pillars of stupa II at Sanchi and the remains of early sculptured walls at Jaggayyapeta and Amaravati.

Bhaja.—To the same school of art belong the reliefs of the early vihara (monastery) at Bhaja—this is apparent in their volume and in details of the costume, particularly the enormous turbans and the pearl-fringed bracelets, which last are found also on some early Sunga terra cottas. One of the most remarkable of these reliefs seems to represent Indra, seated on his cloud-elephant Airavata. Sacred trees (chaityavrkshas), guarded by railings and adorned with garlands and umbrellas, are to be seen, and on one side a horse-headed yakshi and a man, perhaps with reference to the Padaku-salamanava Jataka. On the opposite side of the doorway, which divides what are evidently two parts of a single grandiose conception of earth and sky, is represented the sun in a four-horsed chariot.

Iconography.—Prior to the Sunga period the major Indian deities seem to have been represented mainly or exclusively by symbols. Since Asoka speaks of engraving edicts on already existing columns, it is possible that the Mauryan bull and elephant capitals were originally erected in honour of Siva and Indra. Garuda and makara standards of Sunga date at Besnagar refer to Vishnu and Kamadeva ; the fan-palm capitals. perhaps to Baladeva. Siva is represented on early coins by a bull or by a mountain of three peaks surmounted by a crescent; later. in the Kushan period, he appears in person together with the bull and other symbols; Indra and Agni appear on the coins of the Pancalas in the 2nd century B.C.; the abhiseka (lustration) of Sri-Lakshmi, on those of Azilises in the 1st (as well as on the earlier Bharhut reliefs and on terra cottas); other forms of Sri, on coins of Amoghabhuti. Indra and Brahma are freely represented in Buddhist art at Bharhut and Sanchi wherever the narrative requires; the former with his vajra (thunderbolt) and a vessel containing the "Water of Life" and usually with a cylindrical metal headdress (*q.v.*), the first appearance of any kind of crown in Indian art (the original royal headdress is a turban).

Patanjali, commenting on Panini, *c.* 200 B.C., refers to the public exhibition of images of Siva, Skanda and Visakha; and there is evidence enough in the later Brahmanas, lawbooks, epics and Buddhist and Jain literature to show that the use of images and temples (*q.v.*) had come into general prominence from about 400 B.C. onward. Probably the oldest surviving anthropomorphic representation of a deity, forming a cult image, is that of Siva on the Parasuramesvara linga, from Gudimallam in eastern India a little above Madras; there the deity stands on a dwarf yaksha vehicle, and in this respect and stylistically, though more developed, recalls the Kubera of Bharhut. This early figure of Siva is a great and powerful work, fortunately preserved from a period when a majority of Hindu images were still made of wood or clay. There is an interesting, though later, reference to such images in the Divyavadana, where Upagupta, worshiping an appearance of the Buddha created by Mara, explains that he is bowing, not to the object before him. but to the Master himself, "just as people venerating images of Gods do not revere the clay, but the immortal ones represented by them."

Orissa.—Datable in the 1st century A.D. are the excavated monasteries of Udayagiri and Khandagiri in Orissa. The best sculptures are reliefs forming a frieze in the upper story of the Rani Gumpha; the subject, which includes the hunting of a winged deer as a part, has not been identified. The monasteries there are, so far as can be determined, all Jain; but many of the motifs familiar to Buddhist art (*e.g.*, the lustration of Sri-Lakshmi and the sun drawn in a four-horsed chariot) are found. Above the arches of the cell doors are found three-headed serpents (Nagas), and below the frieze a series of small Garuda brackets, both features that were later on extensively developed in Khmer art.

3. Early Andhra (75 B.C.–A.D. 50).—*Sanchi*.—The most perfectly preserved Buddhist monument in India is the great stupa at Sanchi in Bhopal. Enclosed and hidden within it is an earlier brick stupa dating from the time of Asoka, but the stupa itseli, as enlarged and cased with masonry, dates from the 2nd century B.C., the plain railing from the same time and the gateways from the first half of the 1st century A.D. Stupa II at Sanchi is to be dated in the 2nd century B.C. and stupa III belongs to the 2nd century A.D.

The reliefs of the great gateways of the main stupa, occurring on the upright pillars and on the horizontal architraves, illustrate Buddhist legends, including Jatakas and scenes from the Buddha's ultimate incarnation. They are executed with a delicacy and wealth of detail suggestive of ivory carvings, and indeed a votive inscription records that some were carried out "by the ivory workers of Bhilsa." Apart from their original intention they afford a veritable encyclopaedia of manners, weapons, decoration

and symbolism. At the base of the upright pillars are beautiful figures of guardian yakshas; and the architrave brackets are yakshis represented as dryads clinging to their trees and leaning outward. On the tops of the uppermost architraves are Buddhist symbols guarded by cauri-bearing yakshas.

Just as at Bharhut, and in early Indian art generally, in the scenes from the Buddha's life: though they tell their story with perfect clarity. the Buddha himself is never represented in human fotm but only by symbols — footprints (padukas) and umbrella (chatta) or wheel (chakra) or tree. These symbols indicate the presence of the Buddha wherever required in the representation, and some refer to specific episodes in the life, including most of those which were afterward grouped together in panels illustrating the Four (or Eight) Great Events. Thus, the wheel designates the First Preaching of the Law; the sacred tree (Bodhi-druma) with its altar or railing. the Great Enlightenment. Where the tree is represented with guardian yakshas on either hand, the prototype of the later Buddha triads, where the Buddha is seated between a pair of attendant Bodhisattvas, can be recognized, for there is no doubt that the principal Bodhisattvas, especially Padmapani (Xvalokiteshvara) and Vajrapani, were originally guardian yakshas.

Further, the art of Sanchi, though Buddhist in theme, is scarcely Buddhistic in content: the legends illustrated are always edifying. but the manner of treating them and the feeling for the human form are far from ascetic or introspective. And this becomes especially evident in connection with the accessory figures, such as the dryads, filled as they are with the abundance and joy of life.

A very important school flourished at Mathura from the 2nd century B.C. to the 6th A.D. The early fragments are in a manner closely related to that of Bharhut. More important are those which cover the period of transition from the old aniconic to the later anthropomorphic representation of the Buddha figure: these are of Kushan and perhaps somewhat earlier (Indo-Parthian or Ksatrapa) date and will be discussed below.

D. Kushan (*c.* AD. 50–241)

Assuming a date of A.D. 50 for the invasion of the Kushans, it can safely be said that the first century and a half of the Christian era represents the most critical period in the history of art in India, the 2nd to the 4th century that of highest achievement. For the earlier period, and only to a somewhat lesser extent the later, the prolific school of Mathura is of primary importance, for types were evolved there that can be traced in all the later development. It must be remembered that at all times "Buddhist India" was equally and at the same time a Hindu India; the so-called Hindu renaissance of the Gupta period does not represent a reaction, but rather the flowering and culmination of a previous development. So far as cult and literature are concerned, this is self-evident; as regards the art. while Buddhist monuments are at first much more abundant and magnificent, this probably means that Hindu cults adhered longer to the use of impermanent materials such as wood and clay for buildings and images, as in southern India up to the beginning of the 7th century.

The period of florescence of Buddhist art at Mathura coincided with the period of the great Kushan dynasty. These Scythian invaders were established in northwestern India as early as the 1st century A.D. The dynasty came to an end in A.D. 241 with an invasion of Shapur I of Iran. The greatest ruler and patron of Buddhism was Kanishka, whose regnal dates are disputed: although some scholars believe his reign began as early as A.D. 78, others suggest a date as late as A.D. 144.

1. Buddha Types. — Within the first century and a half of the Christian era the Buddha figure for the first time replaced the old symbols, which nevertheless remained in use both in Gandhara and at Amaravati considerably later. Images of other deities had long existed. and the influence of current devotional tendencies acting on Buddhism and Jainism must have led to a similar development. The fixing of a date for the earliest images of Buddhas or jinas is more difficult. Paleographic evidence would seem to place those of jinas from the Kankali Tila, Mathura, as early as the middle of the 1st century. The only certain date for an early image of Buddha is that of the colossal image set up by Friar Bala at Sarnath in the third year of Kanishka's reign. It should be noted that this Buddha type is distinguished by certain peculiarities not found after the Kushan period (with one exception of 5th-century date), and rarely met even after the middle of the and century. The seated figure is always on a lion throne, never on a lotus. Many other images, both standing and seated, in the same vigorous style derived from that of the early yaksha types, have been found at Mathura or are of Mathura manufacture, exported and set up at sacred sites widely distributed in the Punjab and the Ganges valley.

The earliest Buddha (and jina) type shows the ends of the shorn hair forming a single conical spiral on the top of the head, bearing no resemblance to the ushnisha in the sense of a cranial protuberance such as characterizes the Buddha figure at Xmaravati, in the Gupta period, and subsequently both within and beyond the boundaries of India proper. When this cranial protuberance appears, it, together with the rest of the head, is covered with innumerable short and tight curls, curling to the right. According to the Buddha legend, the Bodhisattva, when first adopting the homeless life of an ascetic, cut off with one stroke of his sword both his long hair and the turban which covered it, and these were received by the gods and worshiped by them as the Great Crest relic (cuda maha); the remaining hair, two inches in length, curled tightly to the right, and so remained throughout the Buddha's life, never again needing to be shorn. This could have been understood to mean either a single curl or many curls; the ambiguity seems to be reflected in the two varieties of the Buddha type referred to above, the interpretation in the sense of many curls very soon supplanting the other. The question of the cranial protuberance is more involved. As in the case of other images of deities (the Buddha even in his own lifetime is more than man, he is recognized as "God of gods" when, at the Presentation, the tutelary yaksha of the Sakyas bows before him, and as the object of a cult he must be called a deity), the Buddha image represents a dogmatic conception; the essential element in this conception is that of the idea of the mahapurusha ("great male," also a designation of Vishnuj and chakravartin ("universal emperor" or, alternatively, "world teacher"). Buddhist texts take over from Brahmanical sources the lists of physical peculiarities which characterize such a being; for example, the soles of his feet and palms of his hands bear stigmata of the wheel, and there is a tuft of hair (urnaj between his eyebrows; all these peculiarities are commonly found in Buddha images. Most of the other marks are relatively inconspicuous or not externally visible. One is of particular importance for the present inquiry: the infant Bodhisattva is said to be unhisosiso, ushnisha headed. In interpreting this and other of the marks (in all 32 major lakshanas and 80 minor signs), it should be borne in mind that they must originally have been conceived as characterizing an adult. Now ushnisha in early Indian literature is the regular word used for the turban; which headdress is a mark of rank, worn by kings or by others on special occasions. Ushnisha headed can mean only: (1) having a head like a turban; or (2) having a turban on his head. Inasmuch as the 32 marks really characterize a chakravartin as an adult being, and as the turban is actually a mark of rank, the latter interpretation is to be preferred, in the sense "destined to wear the turban," as we have to do with a child. But as the Bodhisattva became not a universal emperor but a Buddha and abandoned his turban and long hair, he had to be, as always: represented (with the exception of certain crowned types which may be Dhyani Buddhas) as bareheaded. In the early Mathura figures the problem seems to be ignored. It would appear that after these had been in vogue for some time a necessity was felt to embody the unhisosiso idea in the canonical image, and this was done by making the ushnisha a cranial protuberance; this took place (in the 2nd century A.D.) at the same time that many curls were substituted for one.

The figure of Indra as Santi, of the Buddh Gaya railing (*c.* A.D. 100), has the hair represented in schematic curls, with the appearance of a cranial protuberance, and many representations of yakshas have curly hair; the existence of such prototypes may have contributed to the formation of the Buddha image as ulti-

mately accepted.

2. Hindu Types. — Next in abundance to the Buddhist remains are those of the Jains. The site of the Vodva stupa, founded in the 2nd century B.C., has yielded figures of jinas, similar to those of the Buddha except that in the case of Parsvanatha the jina's head is sheltered by the hoods of a Naga rising above it. Highly characteristic for Jain art are the ayagapatas, or votive slabs bearing reliefs representing stupas or elaborate designs, with a central seated jina, quadruple trisula symbol and the Eight Auspicious Symbols.

Figures of Hindu deities are found chiefly on the coins of Gondophares, Kadphises I and II, Kanishka, Huvishka and Vasudeva. The variety of types of Siva is especially noticeable. Many-armed and many-headed types appear for the first time in the 2nd century; Siva is then four armed and sometimes three headed (Mahesa), the latter type being evidently very popular since it spread quite early to Gandhara and central Asia, where it occurs in sculpture and painting. Many of the Yaudheya coins bear a six-headed Skanda. On coins of Kanishka a great variety of deities appears: Greek, Zoroastrian and Indian. The figure of the running nind-god is original and remarkable. The Buddha appears first on a coin from Ujjain, then in three types on coins of Kanishka. The Brahmanical temple site at Mat has yielded the famous inscribed statue of Kanishka and other royal effigies.

3. Gandhara (Greco-Buddhist) Sculpture. — The prolific Greco-Buddhist school of the former North-West Frontier (Afghanistan and part of the Punjab, including Peshawar and the site of Taxila) has always attracted the attention of archaeologists. Its subjects, as in Indian Buddhist art, are drawn from the Buddha legend, and there are countless images of Buddhas and Bodhisattvas and of other deities such as the Tutelary Pair, Kubera and Hariti. The influence of the school is widely extended in central Asia, affecting China. Korea and, to a lesser degree, Japan.

Very few Gandhara images bear dates, and no one of these dates is in a known era. According to some interpretations these dates indicate a beginning of the art in the 1st century B.C., but at Taxila, where excavations have been scientifically conducted, Greco-Buddhist art is entirely absent from the Scytho-Parthian and very early Kushan levels of the city of Sirkap, and appears only a little before the time of Kanishka. In any case the period of greatest production coincides with the reigns of Kanishka (A.D. 120) and Huvishka. in the 2nd century A.D. A. Grünwedel dates Kanishka A.D. 78 and makes the Gandhara school begin in the 2nd century, thus later than the establishment of the Mathura type. But the Buddha image may have come into use, as the result of a common religious necessity, simultaneously in both areas, though the priority for Gandhara, even if established, would not affect the fact that the Indian Buddha image of the Gupta period is derived directly from the early Mathura type, as this in turn is derived from that of the yaksha types of the earliest Indian school. It may be safely said that the influence of the Greco-Buddhist school in India has been much exaggerated.

The Gandharan type differs from Indian types in more than one way; iconographically by a different treatment of the hair, and in the seat, which in Gandhara is nearly always a lotus, in India at first always a lion throne, despite the fact that the lotus seat as a divine symbol had been long known. Stylistically. the differences are more profound. Gandharan is "late," and belongs to an age of aesthetic decadence in its own cycle; it is naturalistic by intention, although its appearance of realism is no longer based on any structural reality; its graces are deliberate and languid; the solid folds of the drapery are carefully represented. The Indian type still has all the energy and volume of primitive art; it makes no pretensions to grace. is without naturalistic intention, and the drapery is schematic and clinging. It would hardly be possible to juxtapose two contdmporary styles more distinct in kind.

The Gandharan art in its own environment is gradually indianized, and its productivity ends with the Hun invasions of the 5th century.

The finest, most "spiritual" examples of Gandharan sculpture are the stucco reliefs of the 3rd century and later.

E. Later Andhra (c. A.D. 50–320)

The reliefs of Amaravati, dating from the early and century A.D. and later, adorned a great stupa, with the largest and most richly decorated stone railing ever constructed, surrounding it. This stupa was one of numerous Buddhist monuments erected or enlarged by the later Andhra kings in the Kistna-Godavari delta, their seat of government. This later Andhra art is the most intimate and most enchanting of any in India. Just as in literature epic form was passing into "poetry" (kavya), so for the first time sculpture was becoming "art,"

The subject matter of the reliefs did not change, The principal compositions represent Jatakas and scenes from the life of Buddha (in accordance with traditions earlier than that of the Lalita Vistara). Vital monuments of the Buddha epic are more dramatically and emotionally conceived; the gestures, especially those of women, possess a peculiar poignancy, reminiscent of such contemporary Buddhist literature as the Bodhicaryavatara and the work of Santi Deva. This poignancy survives indeed at Ajanta, and Gupta art is very closely related to that of the Andhras in the 3rd century; but very soon, insofar as it belongs to life. it passes into the formalities of chivalry. and insofar as it belongs to art. into deliberate emphasis and even exaggeration. The same is true of the decorative motifs; a sense of organization already long perfected is applied there to traditional motifs, with an inimitable delicacy and firmness. The ornament, in fact, is of precisely the same quality, and has the same value as the reliefs with figures. An art which had been entirely corporeal now acquires a spiritual content, becoming Buddhist in a more than formal sense.

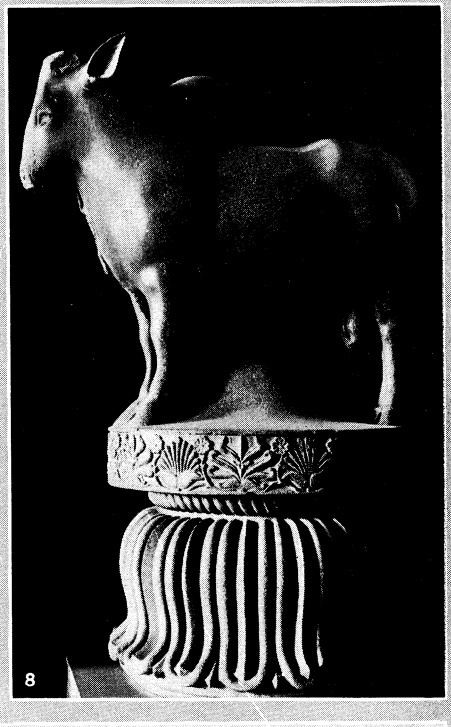
As regards the Buddha figure of Amaravati, and the similar early types found in Ceylon, the use of a cult image was still new, and the figure therefore retains more of the austerity and massive individuality of primitive art than do the reliefs and ornament.

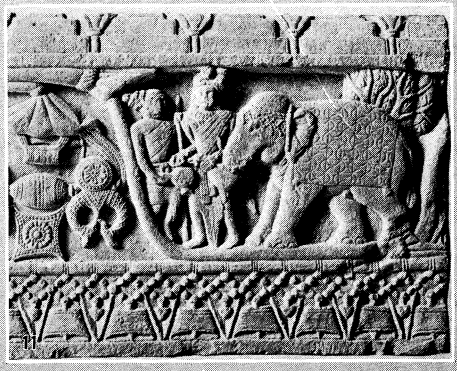
F. Gupta (A.D. 320–*c.* 600)

In early Gupta art the spirit is still at the height of its vitality, but maturer. more intellectually conscious, more introspective; at the same time the expression is less reserved. Gupta art is characteristically logical, sophisticated, gracious and sensuous. Early Gupta art is important in the history of Indian art as representing a completely unified national style within the limits of India proper. and at the same time embodying the types of which the influence predominated in the southeastern and far eastern developments of Indian iconography and architecture. The Gupta style is unmistakably recognizable in the sculpture and architecture of jth- to 7th-century date in Burma. Siam and Cambodia.

The Buddha figure of the Gupta period is characterized by its definition and refinement; the diaphanous robe covering one or both shoulders clings closely to the body, almost without folds ("wet drapery"); the hair is invariably arranged in short curls, the ushnisha is indicated as a cranial protuberance; and there is a lotus or lion pedestal. usually with figures of donors. The finest examples have been found at Sarnath and Mathura and in relief at Ajanta. One colossal copper figure, neighing more than a ton, found at Sultanganj, is in the Birmingham Museum and Art gallery. Brahmanical sculpture is represented by mukha lingas (Siva) of admirable workmanship from Bhumara, Khoh and other sites in Bundelkhand; reliefs of Vishnu, Narasimha and Durga. and the magnificent Varaha Avatar at Udayagiri, Gwalior; Ramayana scenes from the basement of the late Gupta temple at Deogarh; sculptures of the Ramesvara cave, Ellora; and the stucco reliefs of the Maniyar Matha at Rajagriha.

The famous paintings of Ajanta and Bagh, all on the walls of excavated Buddhist temples and monasteries, the so-called caves. belong for the most part to the Gupta period, though none appear to be immediate products of Gupta patronage. Those of caves IX and X date about the beginning of the Christian era or even later; those of caves XVI and XVII, about A.D. 500; those of cave XIX, about the middle of the 6th century. Those of caves I and II date from the 7th century, and thus are early medieval. The subjects are all Buddhist, representing Jatakas and scenes from the life



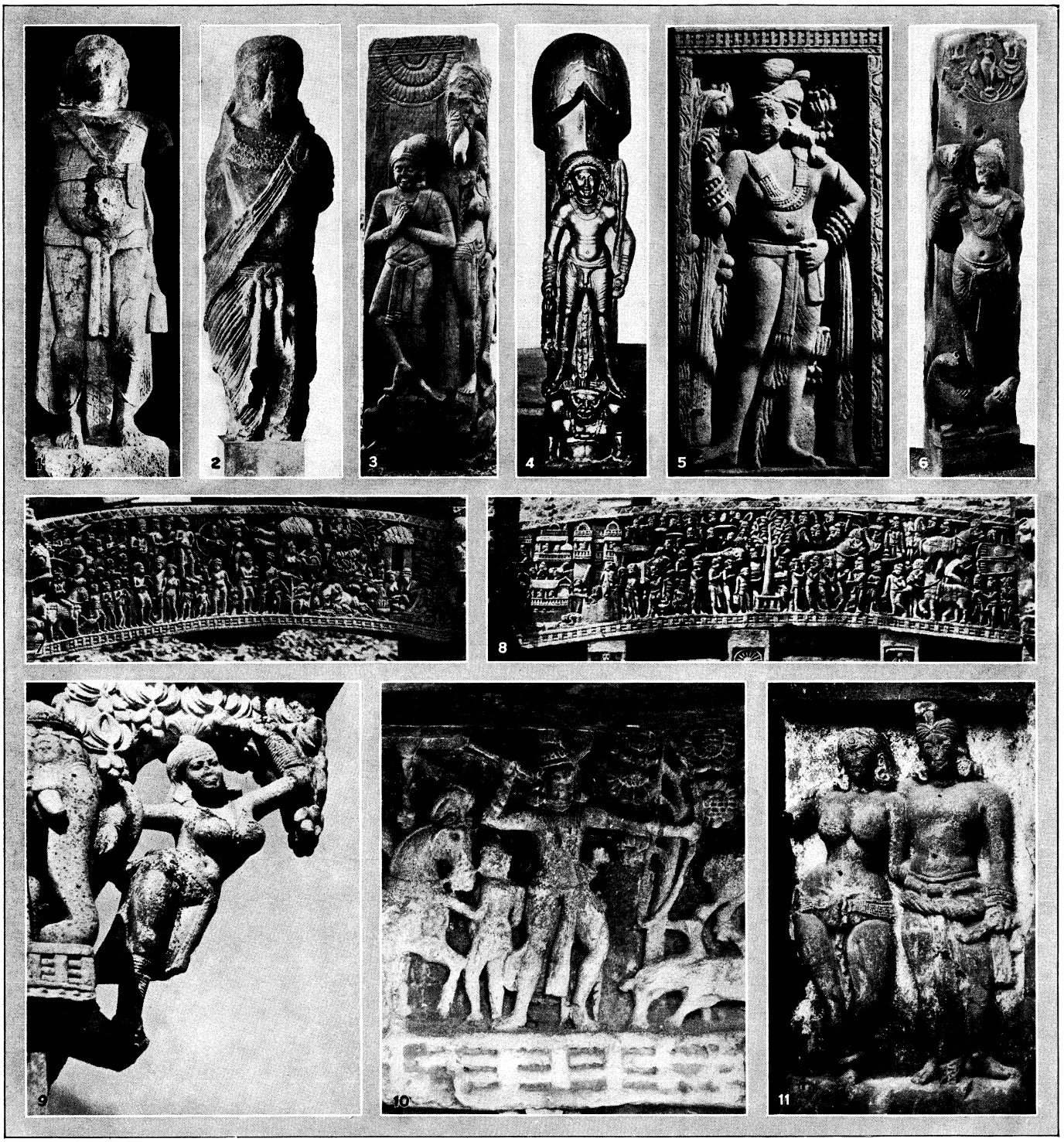


BY COURTESY OF (3, 4 5) THE MUSEUM OF FINE ARTS. BOSTON: PHOTOGRAPHS. (1, 2, 6, 8. 10) THE ARCHAEOLOGICAL SURVEY OF INDIA (7) JOHNSTON AND HOFFMANN

EARLY ART OF INDIA

1. Indus Valley seal. Steatite. 3000–2000 B.C. 2. Nude goddess; gold, Lauriya-Nandangarh. Pre-Maurya, (?) c. 800 B.C. 3. Nude goddess: Indus valley. Terra cotta. 3000–2000 B.C. Height 4". 4. Goddess; terra cotta Pre-Maurya, Height 7¾". 5. Goddess, terra cotta Sunga. c. 200–100 B.C. 6 and 8. Lion and bull capitals of Asoka edict. columns, polished sandstone. Maurya, 3rd century B.C. 7. indra: verandah relief, Vihara at Bhaja, c. 200 B.C. 9. Buddhist fable of the jackal hanged by an ox; railing medallion at the Bharhut stupa. c. 175 B.C. 10. Terra-cotta sealing from Bhita, Sunga, 2nd century B.C. 11. Vessantara Jataka: railing of Bharhut stupa, c. 175 B.C.

INDIAN ART



BY COURTESY OF (9) A. K. COOMARASWAMY, (2, 4, 6) THE ARCHAEOLOGICAL SURVEY OF INDIA; PHOTOGRAPHS, (1, 10, 11) JOHNSTON AND HOFFMANN

CARVINGS AND ARCHITECTURAL DETAIL

1. Yaksha; sandstone. Maurya-Sunga, 3rd–2nd century B.C., from Parkham, Besnager. Height 8′ 8″. In the Mathura Museum
2. Yaksha; sandstone, Sunga, 2nd century B.C. from Patna. Height c. 5′. Patna Museum
3. Kubera Yaksha; railing pillar, Sunga, Bharhut, c. 175 B.C. Calcutta Museum
4. Siva on the Parasuramesvara linga, Gudimallam, polished sandstone, 1st century B.C. Height 5″
5. Yaksha; from base of a torana pillar, Sanchi, Sunga, c. 100 B.C.
6. Indra as the Brahman Santi; and above, the abhiseka of Sri-Lakshmi, railing pillar, Buddh Gaya, c. 100 B.C.
7. Part of the Vessantara Jataka; architrave detail north torana, Sanchi, c. 50 B.C.
8. The Great Renunciation; architrave detail, east torana, Sanchi, c. 100 B.C.
9. Yakshi bracket (Salabhanjika) east torana, Sanchi, c. 100 B.C.
10. Frieze (subject unknown) in the upper gallery of Rani Gumpha Khandagiri, Orissa c. 100 B.C. (see Indian Architecture, Pl. II., fig. 4)
11. Effigies of donors (Andhra king and queen) verandah of chaitya hall at Karii, late 1st century B.C.

BY COURTESY OF THE ARCHAEOLOGICAL DEPARTMENT OF HYDERABAD

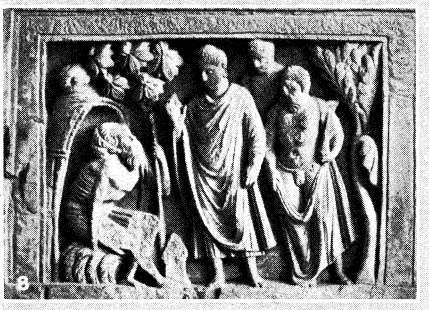
FRESCO PAINTING OF THE BODHISATTVA, VAJRAPANI, A DIVINE-HUMAN ARMED WITH A THUNDERBOLT, FROM THE CAVES OF AJANTA

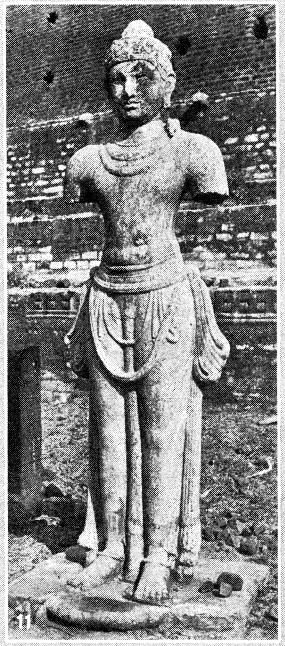
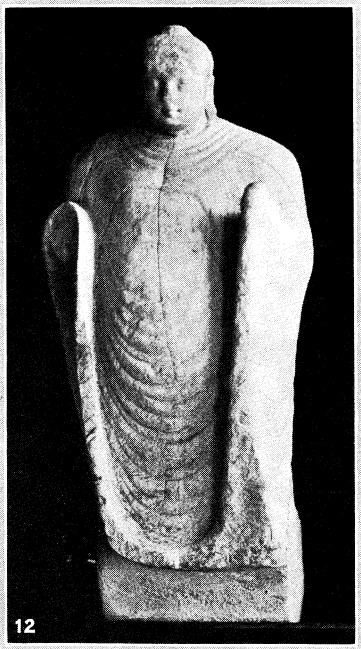
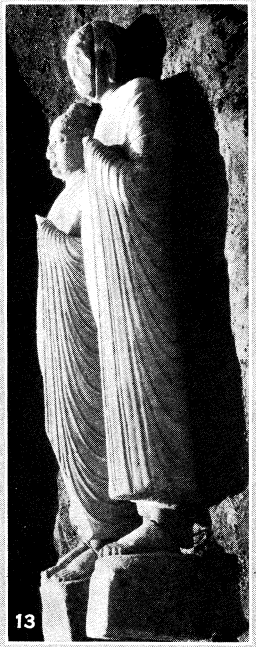
The Illustration was taken from Cave I. There are about 30 caves excavated in the south side of the bank of the ravine of the river Wagura, some three and a half miles from Ajanta, India, which were used as dwellings and meeting-halls by the Buddhist Order from 200 B.C. to the seventh century A.D. Many of the interior walls of these caves are covered with fresco paintings, which are very decorative. These have been preserved and form an important body of evidence of pre-Hindu art in India

BY COURTESY OF (3, 9) THE MUSEUM OF FINE ARTS, BOSTON, (8) A. K. COOMARASWAMY; PHOTOGRAPHS, (1, 4, 6, 10) THE ARCHAEOLOGICAL SURVEY OF INDIA, (2, 5) JOHNSTON AND HOFFMANN

RED SANDSTONE SCULPTURE OF MATHURA ORIGIN (KUSHAN PERIOD)

1. Parsvanatha, Jaina teacher, protected by a Naga. Late 1st–early 2nd century A.D. Height 5′ 4″. 2. Bodhisattva (Buddha), early Indian type. Height 2′ 3″. 3. Detail of tympanum: above, the Bowl-relic on an altar; below, the Bodhi-tree (representing the Buddha). Possibly pre-Kushan. 4. Yaksha. 5. Portrait statue of Kanishka (whose name is engraved on the skirt). Height 5′ 4″. 6. Bodhisattva (Buddha) set up by Friar Bala at Sarnath in the 3rd year of Kanishka; early Indian Buddha type. Height 8′ 1¼″. 7. Bodhisattva. 8. Naga, with flask in left hand (like the Bodhisattva Maitreya). 9. Yakshi, under tree, with *makara* vehicle; a railing pillar. Height 29¾″. 10. Woman or Yakshi with child; a railing pillar. Height 2′ 2″. 11. Goddess of Abundance, probably Sri-Lakshmi, bringing food and water; pillar support of bowl. Benares, Kala Parishad



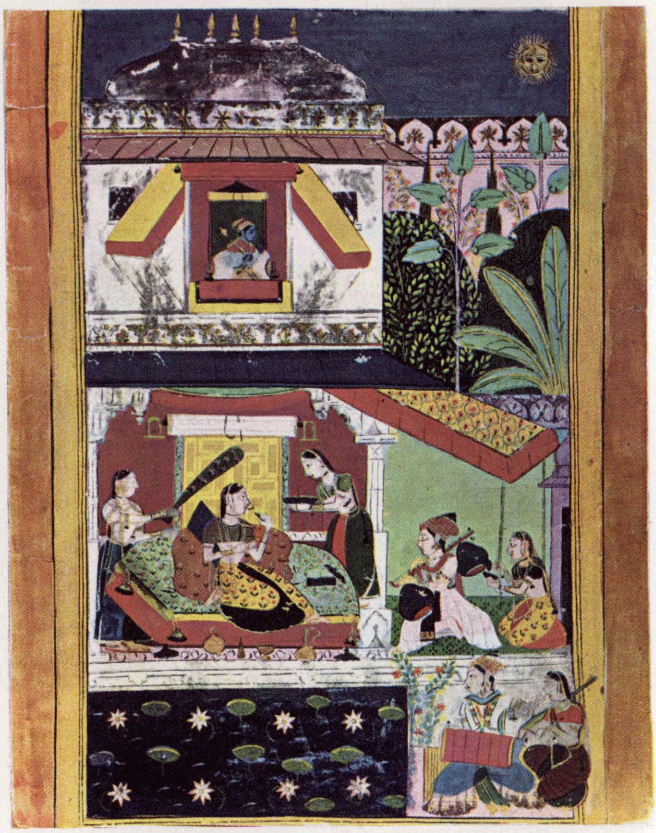




BY COURTESY OF (1, 10, 11) A. K. COOMARASWAMY, (7) THE CHICAGO NATURAL HISTORY MUSEUM; PHOTOGRAPHS, (2, 3, 4, 5, 6, 12, 13) THE ARCHAEOLOGICAL SURVEY OF INDIA

GRAECO–BUDDHIST AND OTHER ART OF THE 2ND AND 3RD CENTURIES

1. The Bimaran reliquary; Afghanistan, perhaps early 1st century A.D. Gold 2¾ in. 2. The Kanishka reliquary made by Agisala (Agesilaos), 7¾ in., c. A.D. 120–130. 3. Buddha preaching, Yakubai. Peshawar Museum. 4. Pancika (Kubera) and Hariti; from Sahribahlol. 5. Buddha. Gandhara. 6. Bodhisattva. From Sahribahlol. 7. Yakshi. Gandhara. 8. Visit of Buddha to a Brahmanical hermit. Gandhara. 9. Buddha's bath in the Nairanjana, by Gandhara. 10. Buddha, Ruwanweli Dagaba, Anuradhapura, Ceylon; marble, c. A.D. 200. 11. King Duttha-Gamani, or a Bodhisattva; as (10). 12, 13. Buddhas. Amaravati; marble, c. A.D. 200

INDIAN ART



BY COURTESY OF (1, 3, 4) THE MUSEUM OF FINE ARTS, BOSTON, (2) THE METROPOLITAN MUSEUM OF ART, NEW YORK

INDIAN PAINTINGS OF THE RAJPUT SCHOOL

These paintings, executed in the late 16th and early 17th centuries, are done In brilliant tempera colours on a paper surface and show no trace of Persian or Mughal influence. The one on the upper left Illustratw an episode of the Krlshna cycles showing Radha, supported by two companions, keeping an appointment with Krishna, who is seated at the trystlng place in a walled orchard. The three other paintings illustrate Ragas and Raginis, or musical modes, depicting emotional situations corresponding to the content of the music in accordance with established conventions

BY COURTESY OF THE MUSEUM OF FINE ARTS, BOSTON

RAJPUT PAINTINGS, 17TH AND 18TH CENTURIES

Above: Muhammad Shah in a garden, Rajasthani, early 18th century Below: Ramayana, the siege of Lanka, Pahari, Jamu, 17th century

BY COURTESY OF (3) A K COOMARASWAMY

MARBLE SCULPTURES OF THE LATE ANDHRA PERIOD (ABOUT A.D. 200) FROM AMARAVATI AND DISTRICT

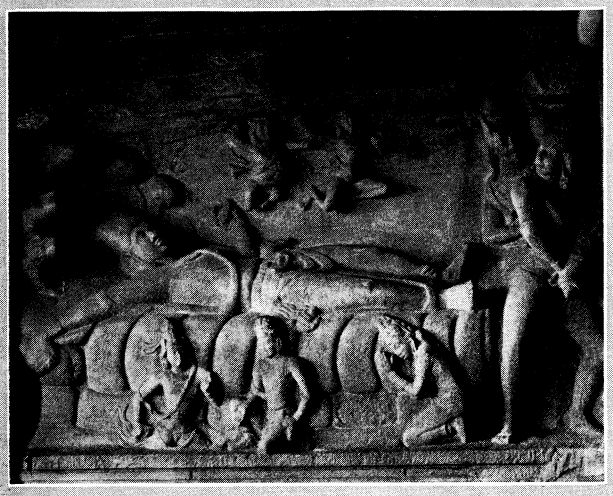
1. The assault and defeat of Mara, and temptation by the daughters of Mara. From Ghantasala. Musée Guimet, Paris. 2. Elevation of the Bowl-relic; railing medallion. At Amaravati. Madras Museum. 3. The nativity of Buddha. From right to left: above, the Dream of Maya and its Interpretation; below, the Miraculous Birth in the Lumbini garden, and the Presentation before the Yaksha Sakyavardhana. From Amaravati. British Museum. 4. Circle: visit of the gods to the Bodhisattva. Below: three scenes from a Jataka (in central compartment, an ideal world emperor). Amaravati, British Museum

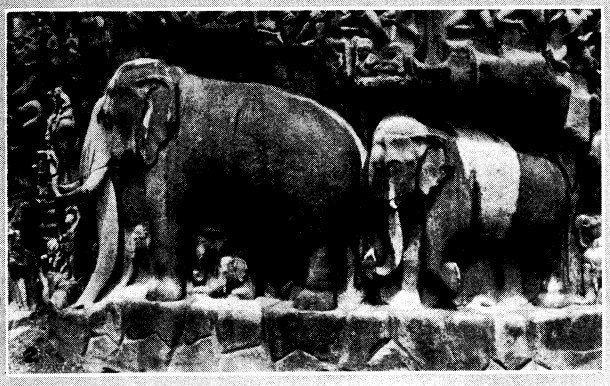
BY COURTESY OF (4) A. K. COOMARASWAMY; PHOTOGRAPHS, (3, 6, 7, 10) THE ARCHAEOLOGICAL SURVEY OF INDIA (8) JOHNSTON AND HOFFMANN

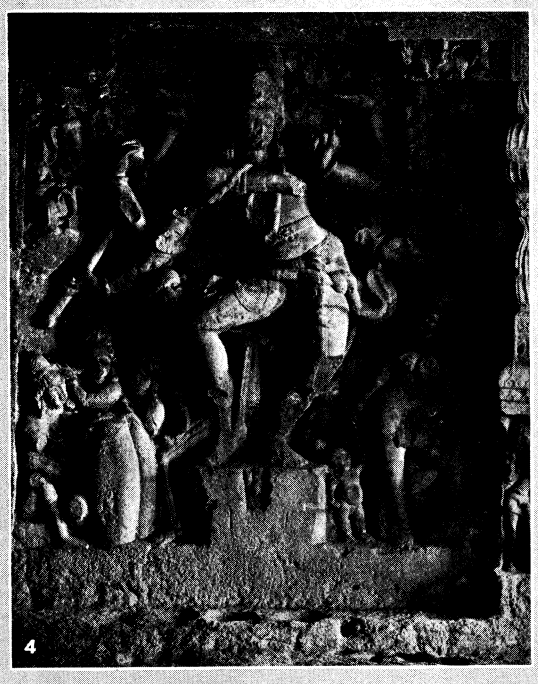
EXAMPLES OF GUPTA ART (A.D. 320–*c.* 600)

1. Varaha Avatar, Udayagiri, Gwalior. Sandstone, colossal. Gupta. c. A.D. 400. 2. Nagaraja and queen, of Cave XIX, at Ajanta. Late Gupta, 6th century. 3. Scene from the Ramayana, from the Gupta temple at Deogarh, 5th century. 4. Detail of a pair of flying figures (Gandharva and Apsaras). Sandstone. Gupta, 5th century. 5. Yaksha, Ataria Khera, Nagodh State. Sandstone. Gupta, 5th century. 6. Parasurama, Gwalior. Sandstone. Gupta, c. A.D. 400. 7. Brahma from near Mirpur Khas, Punjab. Bronze. Gupta, 6th century. 8. Buddha. Sandstone. Mathura. Height, 7' 2". 9. Verandah of Rameswara Saiva temple, Ellora. 7th century. 10. Mukh-linga (Siva) Bhumara. Sandstone. Gupta, 5th century

INDIAN ART



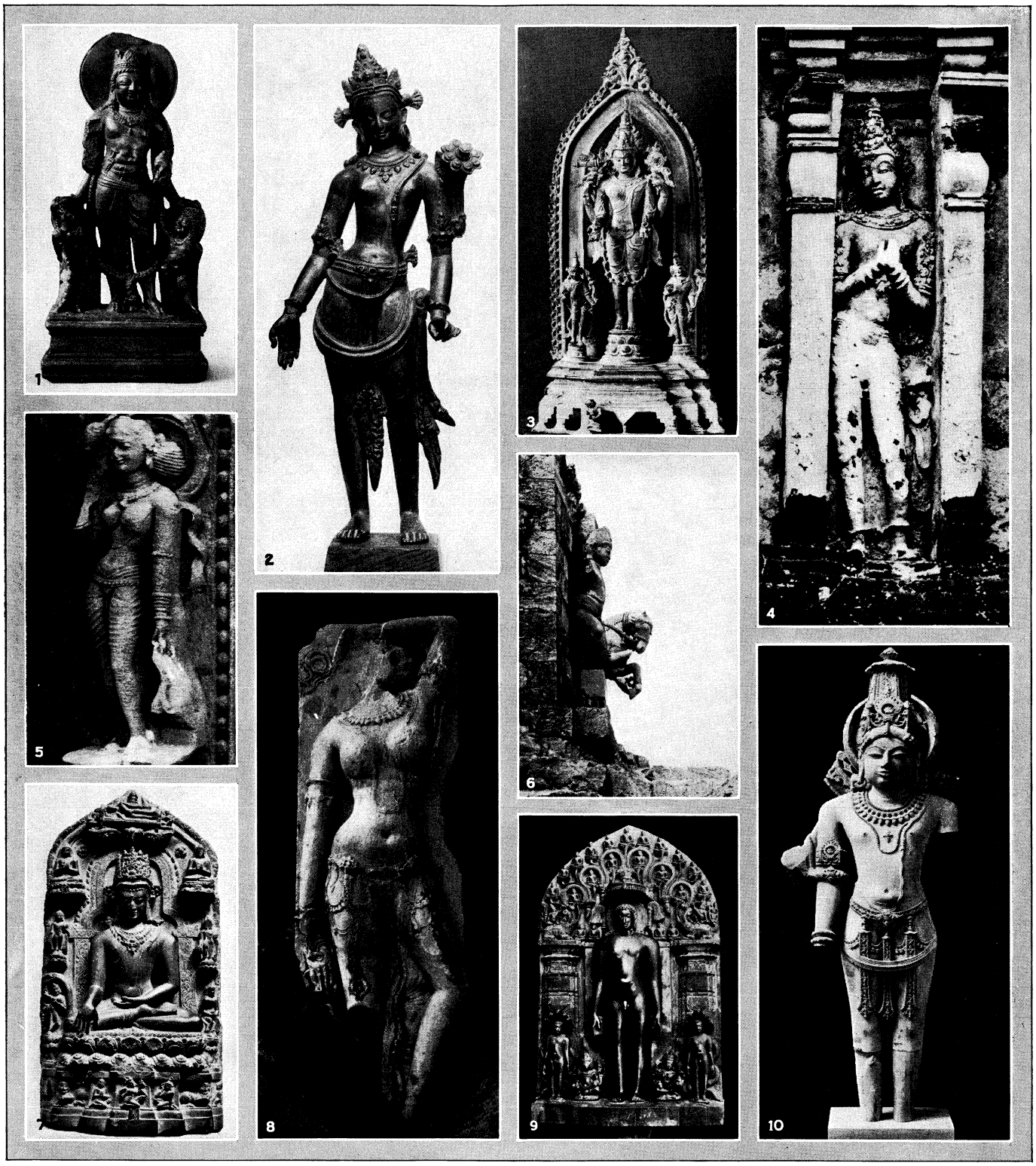




BY COURTESY OF (5) THE MUSEUM OF FINE ARTS. BOSTON

SCULPTURE OF THE PALLAVAS AND RASHTRAKUTAS

1. Vishnu reclining upon ananta, a relief in the Mahisa-mandapam, Mamallapuram. Pallava, 7th century
2. Detail from the Descent of the Ganges, a rock-cut relief at Marnallapuram. Pallava, 7th century
3. Siva and Parvati on Mt. Kailasa, with Ravana imprisoned below. In the rock-cut temple Kailasanatha at Ellora. Rashtrakuta, 8th century
4. Siva dancing, in Ravana ka Khai at Ellora. Rashtrakuta, 8th century
5. Durga, ten-armed, standing on the head of Mahisa. Pallava, 7th century
6. Right face of the rock cut triple bust of Mahesa (Siva), at Elephanta. Rashtrakuta, 8th century



BY COURTESY OF (1) THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA, (2, 7, 10) THE MUSEUM OF FINE ARTS, BOSTON, (3, 8, 9) THE ARCHAEOLOGICAL SURVEY OF INDIA, (6) A. K. COOMARASWAMY; PHOTOGRAPHS. (4, 5) JOHNSTON AND HOFFMANN

SCULPTURES AND SCULPTURAL DETAIL

1. Vishnu. Stone. Height 8¾ in. Kashmir, 9th century
2. Avaiokitesvara, Bodhisattva. Copper, gilt and jewelled. Height, 12⅜ in. c. 11th century
3. Vishnu. Copper. Height 25½ in. Bengal
4. Bodhisattva. Brick and stucco. Northern temple, Polonnaruwa, Ceylon. 12th century
5. Devata, detail from the Rajrani temple, Orissa, c. 1150 A.D.
6. Deity on horse, detail from the Surya Deul, Konarak, Orissa, 13th century
7. The Eight Great Events (in the Life of Buddha); Slate. Pala, 10th century. Bihar or Bengal
8. "Rukmini." Sandstone. Height 5 ft. 4½ in. Nokhas, Etah District, c. 10th century
9. Mahavira (founder of Jainism). Soft schist. Later Caiuyka. c. 11th century. Aminbhavi, Mysore
10. Vishnu. Sandstone. Height 4 ft. Etah District, c. 1000 A.D.

INDIAN ART

BY COURTESY OF (1, 2, 3) C. T. LOO, (4, 6) THE MUSEUM OF FINE ARTS, BOSTON; PHOTOGRAPHS, (7, 11) THE ARCHAEOLOGICAL SURVEY OF INDIA

1. **Siva** manifested in the **lingam,** Brahma seeking its summit, Vishnu its base. Tanjore district, southern India, **10th** century. 2. Siva, four armed, the two upper arms **holding** the **skull-club** and mendicant's drum. Tanjore district, southern **India, 10th** century. 3. One of the Seven Mothers, perhaps Brahmani. **Tanjore district, 10th** century. 4. **Avalokiteshvara,** Bodhisattva. Bronze. Height **3½** in. **Ceylon,** 8th **century.** 5. **Sundaramurti** Svami, devotee of **Siva.** Copper. Height **24½** in. From **Polonnaruwa,** c. 13th century. 6. Parvati. Copper. Height **23¼** in. South **Indian,** c. 17th century. 7. **Siva (Gajahamurti)** dancing on a **slain elephant,** the skin being behind him. Perur, c. 17th century. 8. Manikka Vacagar, Saiva saint. **Copper.** Height **21¼** in. From **Polonnaruwa,** c. 13th century. 9. Siva as Nataraja, Cosmic dancer. **Copper.** Height, about 4 in. South **Indian,** 16th–17th century. 10. Parvati. Copper. Height, **16½** in. South **Indian,** c. 15th century. **11.** Venkatapattiraya, **Vijayanagar** king, **early** 16th century. Copper. **Venkatesvara temple, Tirumala**

of Buddha, with the popular mythology of yakshas and Nagas as incorporated in Buddhism.

G. Early Hindu Dynasties (c. 600–c. 850)

1. **Nalanda.**—Harsha (q.v.) in the first half of the 7th century revived the glories of the diminished Gupta empire. He may be regarded as responsible for the restoration of the great monastery at Nalanda, and for the transition from Gupta to medieval art in Magadha generally. He also took possession of the Valabhi kingdoms of Kathiawar and Gujarat, but was defeated by the Chalukyan king Pulakesin II. A more detailed account can be given of early medieval art in the Deccan and the far south.

2. **Pallavas.**—The Pallavas originated in the Kistna-Godavari area inheriting the artistic tradition of the eastern Xndhras. and were forced to move southward about 600. The sudden appearance of architecture and sculpture in stone is due to the accomplished Mahendra-varman I (600–625); it is known from one of his inscriptions that up to that time structural temples had been built of brick, timber, copper and mortar, and the implied absence of stone construction corresponds to and explains the appearance of Pallava art already fully evolved in the 7th century. All the sculpture at Mamallapuram, including that of the excavated and monolithic temples (the "Seven Pagodas"), and also the great rock-cut relief representing Bhagiratha's penance and the Descent of the Ganges. belong to the first half of the 7th century. The sculpture there. Pauranik in theme for the Pallavas were Hindu kings. is of a very high order. In the early 8th century the sculpture develops in more strictly architectural application. in connection with the great structural temples at the Pallava capital. Kancheepuram, passing in the 9th into that of the Chola period. Painting which has been assigned to the time of Mahendra-varman I has been found in a Jain excavation at Pudukkottai.

3. Early **Chalukyan.**—Some temples nith sculptures at Badami antedate Pulakesin I (550–566), founder of the dynasty. Later artistic history shons a mixture of northern and southern elements. but is mainly a development of Pallava forms. The Brahmanical caves at Badami and Aihole (especially cave III, A.D. 578) contain a series of large and important reliefs illustrating Pauranik mythology and legend Worthy of special mention also are the sculptured roofing slabs from Aihole, dating from the early 7th century, in the Prince of Wales museum. Bombay. The Virupaksha, most important of the structural temples at Pattadkal, was built about 740, probably by architects and masons brought from Kancheepuram, and shows a corresponding Pallava character in the sculptured reliefs. The Buddhist caves at Aurangabad. dating from the late 6th and early 7th centuries, contain many important figures. At Ellora, the Das Avatara. Ravana ka Khai, Dhumar Lena and Ramesvara caves appear to range from 650 to 750.

4. **Rashtrakuta.**—The Rashtrakutas succeeded the Chalukyas in the western Deccan in 753. Their most important monuments are at Ellora and Elephanta; the latter are easily accessible from Bombay. At Ellora the famous rock-cut Kailasanatha temple, a huge and complete monolithic shrine excavated in the side of the hill, is in a purely Dravidian style, immediately derived from that of the Virupaksha at Badami. Of the very numerous sculptures illustrating Saiva subjects, the finest represents Siva and Parvati seated on Mt. Kailasa. with Ravana imprisoned within the mountain below, endeavouring to cast it down and succeeding in causing a tremor. This, and the Varaha Avatar of Udayagiri, alluded to above, are the finest examples of reliefs which deal with nhat may be described as cosmic or geotectonic themes. Remains of painting on the ceiling of the porch of the upper story are of two periods. in part no doubt of the 8th century and nearly contemporary with the actual shrine. These are the oldest surviving Brahmanical frescoes, but literary references show that painting had been practised both as a religious and secular art from time immemorial.

At Elephanta the most famous and perfectly preserved sculpture is a colossal relief in the main excavation, a three-headed bust which has often, though incorrectly, been called a Trimurti. It is actually an icon of Siva in the form known as Mahesa, and many other examples exist, of which one of the best is a later relief in the University of Pennsylvania museum. Philadelphia.

5. **Kashmir.**—The old town of S'ijrabror has yielded early sculptures in which the influence of the Greco-Buddhist art of Gandhara is still apparent. The most interesting of these are representations of the goddess of fortune, Lakshmi, seated with a cornucopia. and these types can be folloned well into medieval times, gradually becoming completely indianized. The remains of a tiled cockpit of about the 5th century at Harvan are unique. The devices on the molded tiles represent men seated and in balconies, equestrian archers in chain armour, deer, fighting cocks, lotuses and a fleur-de-lis motif; in technique they recall the so-called Han grave tiles of China.

The Vantipor temple sites of early 9th-century date have yielded small and admirably executed stone figures of Vishnu in a style peculiar to Rashmir and the neighbouring Chamba and Kulu. and with these there appear also Siva types. including a three-headed Mahesa and an Ardhanarisvara. Similar Vishnuite images of brass inlaid with sil er and copper have been found in Kulu, together with a Buddha image in the same technique but of earlier (late Gupta) date. Buddhist 'bronzes" found in Kashmir, and ranging from the 6th to the 11th century, show that Buddhism survived to a late date, although it had already declined by the end of the 8th century, all the foundations of Avantivarman in the 9th being Brahmanical. The stone sculpture architecturally associated mith the great temples in Kashmir is unfortunately almost all in a ruined state.

H. Later Hindu Dynasties (From c. 850 Onward)

Later Hindu art again falls into three main divisions. corresponding to the geographical classification of the architecture, as Nagara (northern and eastern). Vesara (south central and western) and Dravida (southern). The character of Indian art had by this time definitely changed and hardened. The sculpture is no longer distinguished by plastic volume, but has acquired a linear character; that is, the form appears to be conceived from the standpoint of outline, and all the features are sharply defined. Its application is primarily architectural and one might say decorative, were it not for the fact that it retains a precise significance in all its details. Its forms are more complicated, partly because the theological development has brought in a greater variety of many-armed forms (these appeared first in the 2nd century, and were already common in early medieval work), and partly because of the tendency, innate in all late art, toward great intricacy and elaboration of detail and an overvaluation of merely technical skill, displayed as an end in itself.

1. Northern and Eastern. — The main schools are those of Bihar and Bengal (Pala dynasty); Orissa; and Bundelkhand and Rajputana. Under the Palas (750–1200) the main centre of production was at the important monastery and university of Nalanda in Bihar. The characteristic Buddhist images. together with Buddhist and Brahmanical examples from other sites in Bihar and Bengal. are executed with the utmost technical proficiency in a kind of black slate, and are represented in all large collections. Numerous and exquisitely made copper images have been excavated there or found elsenhere in Bengal (Rangpur and Chittagong). The themes were at first Buddhist. but the Buddhism was greatly mixed with Hindu elements and acquired as time passed a more and more tantric character. The names of two painters and sculptors, Dhiman and Bitpalo, are mentioned by the historian Taranatha as having been masters in the eastern school in the 9th century. The Bihar school exercised a powerful iconographic and stylistic influence on Sepal. Tibet. Burma and Java and Sumatra. Not only sculpture but also painting was practised; a number of Buddhist palm-leaf manuscripts from Bengal and Nepal. with painted wooden covers and illustrations in the text, have been preserved from the 11rth and 12th centuries. The style is most closely related on the one hand to the slightly later painting of the Gujarati school. and on the other to the contemporary frescoes of Burma (Pagan). The Pala school of painting in the 12th century was known even to the Chinese.

Sculpture in Orissa is typically Brahmanical, and occurs in connection with the series of great temples at Bhuvaneshwar, Konarak, Puri, etc., ranging in date from the 8th to the 13th century. The monumental horses and elephants and the erotic architectural sculptures of the Sun temple at Konarak are especially noteworthy.

2. Bundelkhand and **Rajputana.**—The magnificent temples of Khajuraho are literally covered with Brahmanical sculpture in a hard creamy sandstone, and isolated fine examples have been found at Mahoba, another Chandel capital. Jain sculptures too occur in abundance, but Buddhist works are relatively rare. To enumerate the sculpture in Rajputana would be impossible; there is much of quality.

3. South Central and Western. — An enormous revival of building and sculpture took place in the Deccan under the later Chalukyas after 973, under the Hoysalas of Mysore in the 12th and 13th centuries and in Gujarat under the related Solanki dynasty (10th to 15th century). The sculpture of the Deccan and Mysore is executed in a fine-grained dark chloritic schist, which is comparatively soft when first quarried, and lends itself to an unlimited elaboration of detail more appropriate to metalwork than stone. Almost all the work is of architectural application, and unbelievably rich in quantity and detail. Especially characteristic are the elevated temple basements, with tier upon tier of sculptured friezes, and the huge turned cylindrical pillars of the porches, with luxuriously developed bracket figures of dancers. In Mysore, Belur, Halebid, Dodda Gadavalli, Somnathpur and Sravana Belgola are among the most famous sites. At the latter place there is a remarkable monolithic image of Gommatesvara (son of the first of the 24 jinas of the Jain mythology), one of the largest freestanding figures in the world, 57 ft. in height. This was carved *in situ* for Camunda Raja in A.D. 981. Another figure at Ilivala is more than 20 ft. in height.

In Gujarat, Kathiawar and parts of Rajputana there existed another extensive development in a related style. In Gujarat proper, most of the temples are in ruins. At Girnar, Palitana and Taranga, Jain temple cities and places of pilgrimage, there is much sculpture still in *situ.* The most remarkable examples of the style, however, are to be seen at Mt. Abu (Dilwara, in southern Rajputana), in the temples of Vimala Shah (c. 1032) and Tejahpala (c. 1232); these are domed shrines with pillared halls.

4. Gujarati (**Jain**) Painting. — A Gujarati school of manuscript illustration flourished from the 13th to the 17th century, after which it was more or less modified by Mughal and Rajput influences. One manuscript dated 1237 is on palm leaf, all others are on paper; the earliest date is 1427. The majority of the manuscripts are Jain scriptures, but there is one secular example, a Vasanta Vilasa, dated 1451. Although the colouring is brilliant, the style is really one of pure draftsmanship; the outline establishes all the facts and this outline, though very facile and almost careless. is extremely accomplished.

5. Rajput Painting. — The tradition of mural painting, exterior and interior, even at the present day survives sporadically all over India: a good deal may still be seen in Rajputana, for example in the old palace at Bikaner. Paintings on canvas and illustrated manuscripts are very rare, but as paper gradually came into use, the older methods of painting on walls and panels or cotton cloth were employed on the new material. The technique of Hindu painting on paper is in fact identical with that of the older mural art as seen at Ajanta and described in the technical treatises. The themes of Rajput painting are religious (dealing especially with the Krishna cycle, but also with Saiva and Vishnuite mythology in general), epic (*Mahabharata* and *Ramayana*), lyrical and rhetoric (Rag-malas) and, less typically, secular (portraiture). The Krishna cycle and themes illustrating treatises on rhetoric (classification of heroines and emotional analysis), given a contemporary environment in court and village life, permit an exquisite delineation of every phase of love. The epic subjects, especially in early Jammu works, are treated on a large and almost mural scale. Especially characteristic are the sets of illustrations of the Rag-malas, vernacular poems describing the situations which are appropriate to each of the Ragas, or musical modes; these are usually 36 in number, and each has its particular hour and specific sentiment (see INDIAN MUSIC). Stylistically, Rajput paintings can be classified both geographically and in historical sequence. Very few examples show any approximation to the Gujarati style. The early ones from Rajputana and/or Bundelkhand are most distinctive; they show a robust analytical method of drawing, an indication rather than a representation of forms and an intensely brilliant colouring, like that of enamel or stained glass, by which the planes are established. A modified tonality gradually appeared, partly the result of Mughal influences; but the work of Jaipur artists, even from the 18th century when the outline had become more meticulous, can be recognized by its brilliancy and by its marvelous decorative treatment, especially of flowers and trees. The earlier Jammu productions too are strongly coloured, while the drawing is more provincial throughout. In some respects the most exquisite. and certainly the most refined if not the most powerful, phase of Rajput painting is that of the Kangra school, developed in the latter half of the 18th century under Raja Samsara Cand. Connected with this school are its offshoot in Tehri Garhwal and its early 19th-century secular development in Sikh portraiture. The Kangra school declined during the 19th century and became to all intents and purposes extinct. Related schools existed in Bengal and Orissa. By far the finest collection in the world is in Boston, Mass.; other examples are in the Lahore and British museums. and in private collections.

6. Miniature Painting. — It is highly likely that miniature painting in India is as old as the tradition of monumental painting. The earliest examples of Indian miniatures belong to the Pala period (8th–13th century). The technique and composition of these Buddhist illuminations reveal a perpetuation of classical prototypes such as Ajanta wall paintings. The Jain manuscripts of Gujarat, of the 13th century, have charm in wiry drawing and gay colouring, but are generally stereotyped in execution.

Rajput miniature painting is the work of artists attached to the courts of the Rajput princes from the 16th to the 19th century. Geographically it may be divided into a number of local schools in Rajputana, the Deccan. the Punjab, the Himalayas and Garhwal. The themes painted by the artists include Raginis or the personifications of musical modes connected with phases of love, illustrations of Indian epics and the romantic legends of the gods Vishnu and Krishna. Rajput painting is a combination of folk art and hieratic classic traditions and, more often than not, a reduction of the themes and techniques of mural painting to an intimate scale. Whereas the early miniatures of Rajasthan are primitive in conceptual presentation and decorative pattern, some of the later painting, like the 18th-century illuminations of the Kangra school in the Punjab, display a sophisticated combination of realism and lyric grace. Invariably, as in monumental painting, sacred legend is presented as contemporary experience.

The styles of illumination that flourished under the patronage of the Mughal emperors, from the 16th to the 19th century, differ from Rajput work in the complete absence of mystical and religious elements and in their emphasis on the picturesque and the natural. Although early Mughal painting was an outgro th of the Persian miniature style, in the great period under the emperors Jahangir and Shah Jahan the artists produced illuminations of an extraordinarily realistic character — perhaps under European influence — blended uith elements of Persian and Indian origin. In Mughal painting it is possible to differentiate between the work of local schools at Delhi, Lucknow, Jaipur, etc. The themes of the Mughal artists mere events from the life of the court, portraits and occasional subjects drawn from the world of the Hindu epics. Among the great masterpieces of the school are the paintings of birds and beasts executed by Jahangir's painter, Mansur.

7. Later **Developments.**—During the 19th century little of note in sculpture was produced in northern India. In southern India the indigenous tradition was preserved in greater purity; copper images, sometimes of large size and little inferior in quality to those of the 17th and 18th centuries, continued to be made, and hereditary craftsmen continued to work in stone.

In the 20th century a reaction against western mannerisms took place. especially in Calcutta where a considerable (Bengal) school of painters arose, and a very large number of pictures, mostly

water colours, were produced. The pictures are delicate and often very charming, but hardly powerful; the movement is comparable in some respects to that of the Pre-Raphaelites in Europe. Among the chief artists of this school may be mentioned Gogonendronath Tagore, mainly a worker in monochrome, who flirted with Cubism; Nanda Lal Bose; Asit Kumar Haldar; Samarandranath Gupta; and many younger men and some women.

III. CEYLON

1. Sculpture. — The artistic culture of Ceylon is at all times very closely related to that of southern India, but can be more conveniently treated as a consecutive development. One of the oldest documents is a carnelian seal representing a seated king, probably of the and century B.C., from the Yatthala dagoba in the south, now in Manchester. It is difficult to say whether any or how much of the sculpture surviving at Anuradhapura dates before the beginning of the Christian era; the greater part in any case belongs to the period ranging from the 1st to the 9th century. Among the finest sculptures in Ceylon, previous to their restoration and virtual destruction by pious Buddhists, were the Buddha figures, and one traditionally known as Duttha Gamani (reigned 1st century B.C.), at the Ruanveli dagoba site; the Euddha figures show a close relation with those of Amaravati and must date from about A.D. 200. Relief sculpture may date back to the 1st century A.D. or but little later; this applies especially to the Naga reliefs and formal trees rising from lucky vases, represented on stelae at the Eastern (so-called Abhayagiriya) and Ruanveli dagobas, for these are still in flattened relief and distinctly related in style to the Sanchi and early Sarnath reliefs of the 1st century A.D. The "moonstones," or stone doorsteps of monasteries or palaces, are of various dates, and consist of half-lotus medallions with friezes of animals (horses, lions, elephants and bulls, or geese carrying floral sprays). The steps above them are flanked by solid balusters (alamba bahu, hasti-hasta) consisting of heads and trunks of elephants, or makara heads spouting vegetation. while at each side stand reliefs representing Nagas holding lucky vases and cornucopias. The rock-cut reliefs of elephants at the Isurumuniya Vihara and the elephant reliefs by the Tissawewa lake are in Pallava style and evidently of 7th-century date.

At Polonnaruwa, the rock-cut statue traditionally regarded as a representation of Parakrama Bahu I (1153–86 or 1164–97) is magnificent. Not so fine, though impressive in scale and design, are the seated and reclining Buddha figures of the Gal Vihara, where there is also a colossal standing figure of the Buddha in prayer. Some of the brick and stucco figures of the Northern temple are extremely elegant. There exist colossal Buddha figures, also of the Polonnaruwa period, at Seseruwa, Awkana and Kon Wewa.

A limited number of small bronzes, or, more accurately, copper images, of very high quality have been found in Ceylon. One of the largest is a fine seated Buddha from Badulla, of about 6th-century date, but the finest of all are a well-known seated Avalokiteshvara and figures of Vajrapani and Jambhala. of 8th- and 9th-century dates, in Boston. There is a fair collection of similar figures in the British museum. Brahmanical bronzes apparently of Chola date have been excavated at Polonnaruna.

2. Painting. — Remains of painting have been preserved at a number of sites. There are a few traces of decoration at Anuradhapura, including some figures of dwarf yakshas. More remarkable are the Apsarases of the painted rock pockets at Sigiriya, dating from the 5th century and still in excellent preservation; these are voluptuous female figures, cut off by clouds at the waist in accordance with a characteristic convention, and casting down a rain of flowers upon the mortal world below them. At Hindagala near Kandy there is a fragment of fresco regarded by some as of rather early date. but probably medieval. By far the most extensive remains, though almost destroyed by neglect since their first discovery, are those of the inner walls of the Northern temple at Polonnaruwa; these illustrate Jatakas. but can be only inadequately studied in the bad copies exhibited in the Colombo museum. The Sinhalese chronicles (Mahavamsa) contain innumerable references to painting, but nothing more survived until the 18th century, when Kirti Sri Raja Simha, one of the last Kandyan kings, restored many shrines in the Kandyan provinces. Mention must also be made of the admirable decorated ceilings of Kelaniya, Kandy and some other places; these are often masterpieces of design. *See* also INDIAN ARCHITECTURE.

BIBLIOGRAPHY.—*Indus Valley culture and other prehistoric remains:* E. J. H. Mackay, *Further Excavations at Mohenjo-Daro* (1938), *Early Indus Civilizations,* 2nd ed. **(1948)**; Sir J. Marshall (ed.), *Mohenjo-Daro and the Indus Civilization* (1931), in *Illustrated London News* (Sept. **20,** Oct. **4,** 1924; Feb. **27,** March **6, 1926;** Jan. 7, 14, 1928); H. Mode, *Indische Fruhkulturen* (1944); *S.* Piggott, *Prehzstorzc Indza* (1950); *M.* S. Vats, *Excavations at Harappa* (1940); Sir M. Wheeler, *The Indus Civilization* (1953); J. **C.** Brown, *Catalogue of Prehistoric Antiquities in the Indian Museum, Calcutta* (1917); *A.* **K.** Coomaraswamy, "Early Indian Terracottas," *Bulletin of the Museum of Fine Arts* (Boston), no. 152 (1927).

Historical period: J. Allan, *Catalogue of the Coins of the Gupta Dynasties* (1918); J. Burgess, *Ancient Monuments, Tenzples, and Sculptures of India* (1897); Archaeological Survey, *Reports,* "New Imperial Series,!' vol. i–vi (1874–83); *Buddhist Stūpas of Anzaravati and Jaggayyapeta* **(1887)**; K. de B. Codrington, *Ancient India From the Earliest Times to the Guptas* **(1926)**; A. K. Coomaraswamy, *Mediaeval Sinhalese Art* (1908), *Indian Craftsnzan* (1909), *Arts and Crafts of India and Ceylon* (1913), *Viśvakarmā* (1914) with 108 plates on sculpture, *Rajput Painting* (1916), standard work, good plates, *Dance of Siva* (1918–24), *History of Indian and Indonesian Art* (1927), "Origin of the Buddha Image," *Art Bulletin,* ix (1927); H. Cousens, *Arclzitectural Antiquities of Western India* **(1926)**; *A.* Cunningham, *Stupa of Bharhut* (1879), *Mahābodhi* (1892), *Coins of Ancient India* (1891), *Coins of the Indo-Scythian* (1888–94), *Coins of Mediaeval India* (1894); J. Fergusson, *Tree and Serpent Worship* (1873), classic, but to be read with caution, *History of Indian and Eastern Architecture,* 2nd ed. (1910), a work covering the whole ground, but iar from up to date; J. Fergusson and J. Burgess, *The Cave Temples of India* (1880); *A.* Foucher, *L'Art gre'co-bouddhique du Gandhāra* (1900–23), indispensable, but the main theory is highly controversial; *The Beginnings of Buddhist Art* (1918), excellent material, often controversial; "Lettre d'Ajanta," *Journ. Asiatique* (1921), invaluable for the frescoes; 0. C. Gangoly, *South Indian Bronzes* (1914), *Masterpieces of Rajput Painting* **(1927)**; M. Ganguly, *Orissa and Her Remains* (1912); A. Godard, V. Godard and J. Hackin, *Les antiquités bouddhiques de Barniyan* (1927), *Nouvelles recherches à Barniyan* (1933); *J.* Hackin, *Recherches archéologiques à Begram* (1939); J. Hackin *et al., Nouvelles recherches à Begranz* (1954); *V.* Golowbew, *Ajanta: les peirztures de la première grotte* **(1926)**; A. Griinwedel, *Buddhist Art itz India* (1901), *Altbuddhistische Kultstatten in Turkistan* (1912), *Alt-Kutscha* (1920); P. Gardner, *Catalogue of the Coins of the Greek and Scythian Kings of Bactria and India* **(1886)**; S. **N.** Gupta, *Catalogue of Paintings in the Central Museum* (1922); *E.* B. Havell, *Indian Sculpture and Painting* (1928), *Indian Architecture; Its Psychology, Structure and History* (1913), *Ancient and Mediaeval Architecture of India* (1915), *Handbook of Indian Art* (1920), *The Ideals of Indian Art* (1911); India Society, *Ajanta Frescoes* (1915); Jouveau-Dubreuil, *Arche'ologie du sud de l'Indie* (1914), invaluable, *Pallava Antiquities* (1916–18); *R.* C. Kak, *Handbook, . . . Sri Partap Singh Museum* (1923); S. **S.** Jacob, *Jeypore Portfolio of Architectural Details* (1890–98); S. Kramrisch, *Grundzuge der indischen Kunst* (1924), *The Vishnudharnzottaranz,* part iii, *Treatise on Indian Painting,* 2nd ed. **(1928)**; S. Lévi, *Le Nepal* (1905–08); Sir **J.** H. Marshall, *Taxila,* **3** vol. (1951), *Guide to Sanchi* (1918), articles in the *Cambridge History of India,* vol. i, *et seq.* and in *Illustrated London News* (March **24, 31,** April **7, 1928)**; **N. C.** Mehta, *Studies in Indian Painting* **(1926);** *R.* Narasimachar, *Inscriptions at Śravana Belgola,* 2nd ed. (1923); K. Okakura, *Ideals of the East,* 2nd ed. (1904); H. Parker, *Ancient Ceylon* (1909); *E.* J. Rapson, *Catalogue of the Coins of the Andhra Dynasties* (1908); T. A. G. Rao, *Elenzents of Hindu Iconography* (1914, 1917); A. Rodin, 4. K. Coomaraswamy and V. Golowbew, *Sculptures Civaites* (1921); *D.* R. Sahni, *Guide to the Buddhist Ruins of Sarnath,* 2nd ed. **(1926);** H. K. Sastri, *South Indian Gods and Goddesses* (1916); V. A. Smith, *The Jain Stupa of Mathura* (1901), *History of Fine Art in India and Ceylon* (1930), *Catalogue of the Coins in the Indian Museum, Calcutta* **(1906)**; Sir M. A. Stein, *Ancient Khotan* (1907), *Serindia* (1921); **J.** *P.* Vogel, *Indian Serpent Lore* (1926), *Catalogue of the Archaeological Museum, Mathura* (1910); D. R. Sahni and J. P. Vogel, *Catalogue of the Museum of Archaeology at Sarnath* (1914); *H.* Zimmer, *Kunstform und Yoga im indischen Kunstbild* **(1926);** *H.* C. P. Bell, *Report on the Kegalla District (Ceylon)* (1904); R. B. Whitehead, *Catalogue of Coins in the Punjab Museum,* vol. i (1914); L. A. Waddell, *Report on the Excavations at Pātaliputra* (1903); G. Yazdani, *Ajanta,* **4** vol. (1930–55), **4** portfolios **of** prints; N. Hurliman, *India* **(1928)**; M. **R.** Anand, *Hittdu View of Art* **(1933)**; *L.* Bachhoier, *Early Indian Sculpture* (1929); D. Barrett, *The Amaravati Sculptures* **(1954)**; *S.* Kramrisch, *The Art of India* (1954), *The Hindu Temple* (1946), *Indian Sculpture* (1933); B. Rowland, *The Art and Architecture of India* (1953); B. Rowland and A. K. Coomaraswamy, *The Wall-paintings of India, Central Asia, and Ceylon* **(1938)**; S. Paranavitana, *The Stupa in Ceylon* (1947), *Art and Architecture of Ceylon: Polonnaruua Period* (1954); H. **R.** Zimmer, *Myths and Symbols in Indian Art and Civilization,* ed. *by*

J. Campbell (1946), *The Art of Indian Asia* (1955).
Journals, etc.: Journal of the Royal Asiatic Society; Journal of the Royal Asiatic Society, Ceylon Branch; Journal of the Asiatic Society of Bengal; Journal Asiatique; Zeitschrift der deutschen morgenlandischen Gesellschaft; Rūpam; Bulletin of the Museum of Fine Arts (Boston); *Jahrbuch der Asiatischen Kunst; Ars Asiatica; Revue des Arts Asiatiques;* Archaeological Survey of India. *Annual Reports* (1904 *et seq*), *Memoirs;* Archaeological Survey of Ceylon; Mysore Archaeological Series; *Memoirs of the Colombo Museum;* Kern Institute, *Annual Bibliography of Indian Archaeology,* vol. 1 (1926) (A K C; B. R.)

INDIAN BARRIER STATE, the name given to the proposals made in the United States in the 18th century to establish a neutral territory in the Mississippi valley that would be open to traders but closed to white settlers from any nation. It was to be a buffer zone between antagonistic countries

Often considered in negotiations concerning sovereignty in the west this proposal was made in 1755, when France and Britain were attempting to settle their conflicting claims in the Ohio valley. Again considered in 1761–62, the buffer zone was not needed after the Louisiana territory east of the Mississippi was ceded to England

In 1782 Spain, having had the Louisiana territory west of the Mississippi ceded to it. wanted to establish such a barrier state between the Mississippi river and the mountains, south of the Ohio. But the United States signed a separate treaty aith England in 1783 and established the western boundary of the United States at the Mississippi Spain's demands concerning the Indian state were not recognized Although the treaty of 1783 set the Great Lakes as the northern boundary of the new nation, many British traders retained their influence with the Indians. and a number of northwest military posts were not surrendered A confederation of Indians opposed the new government; and in order to mediate betneen the U.S. and the Indians, the British minister suggested that a barrier state be recognized in the Great Lakes area After the treaty of 1794, the military posts were surrendered. The Indians were defeated and the barrier state proposals were no longer considered. A British proposal to establish an Indian state west of the Great Lakes was also rejected by U.S. negotiators after the War of 1812.

INDIAN DESERT or THAR DESERT. Between the ancient Aravalli mountains and the wall-like front of the recently folded ranges nest of the Indus. and from the shores of the Arabian sea to within an average distance of 80 mi. from the Himalayas, extends a lowland region more than 200.000 sq.mi in area with an annual rainfall of less than 15 in. At one extremity it touches the northern tropic; at the other it passes beyond lat 32° N. Though known to geographers as the Indian desert, it now includes parts of both the republic of India and Pakistan In Pakistan it includes most of Punjab province and (west of the Indus) Dera Ismail Khan. the southernmost district of the North-\Test Frontier Province; the Kachhi district of Kalat (Baluchistan States union); the whole of Sind province together with Khairpur state which breaks across it from the Indian frontier to the Indus; and (southeast of the Sutlej-Indus line) Bahawalpur state.

In India it includes the western hem of southeastern Punjab state, the districts of Bikaner, Jaisalmer and Jodhpur in west Rajasthan, and Cutch.

A range of 10° of latitude implies considerable climatic diversity, and the area embraced leaves room for topographical variety. Yet it remains a major natural entity, the character of which is conveyed in the term "arid lowland." The tract has a general slope from the Himalayas to the Arabian sea; *i e*, northeast to southwest Along its inner margin, in Punjab state, India, the land between the rivers (doabs) rises to about 700 ft.; but the western portions of the doabs and the land south of the Sutlej. almost all Bahawalpur, lie below the joo-ft. contour line. The 250-ft. contour line cuts the Indus river as it enters Sind. the heart of nhich is well below this; the rest. with the conspicuous exception of the Kohistan or highlands. in the southwest of the province, not much above it.

To the southeast toward the Aravallis, the lowland attains a general level of more than 1,000 ft whence it grades down northwestward; *i.e.,* traversing the prevailing slope at right angles. Except for a fringe of Jaisalmer, and the basin of the Luni river draining southeast to the Runn of Cutch, all Rajasthan stands much higher than joo ft. and betrays its physical "betweenness." Its deep mantle of aeolian deposits allies Rajasthan superficially with the alluvial expanse upon which it encroaches. But it is not completely destitute of solid rocks, and these, rising as low heights above the sandy surface, indicate a deep-seated unity with peninsular India as a coastal margin shelving from the Aravallis toward the seas, persisting to the north until late geological time.

Climate. — Climatically the tract is one of extreme temperature range, daily and seasonal. This is tempered somewhat along the coast but increasingly marked northnard. November to February is warm. with a mean daily temperature of 55°–70° F. The minimum falls in January. The designation "cold season," which is applied to this period (particularly the latter half), serves to emphasize the contrast with conditions prevailing during the rest of the year; namely, the low night temperatures with liability to frequent frost in the Pakistani province of Punjab (Khushab mean minimum in January 41.5° F.; lowest recorded 25.0° F.) and in north Sind, though elsewhere such occurrences are very rare; the limitation imposed upon agriculture by the exclusion of essentially tropical plants at this season; and, lastly, the relief which its duration affords to Europeans. Pressure is high in relation to the neighbouring seas, and only light winds blow from northwest and west. Except during the passage of shallow cyclones from across the northwest frontier, toward the southeast, bringing a little rain to the Punjab fringe (rarely elsewhere), clouds are absent. March to October is hot. From May to July the mean daily temperature exceeds 90° F., with the maximum in June. Afternoon readings of 110° to 120° F. are registered Jacobabad, 127°, June 1919; highest ever recorded in this area). The rising temperature initiates a reversal in pressure and amid the changing conditions dust storms are generated.

Winds from the west and southwest are well established by April and persist until October, blowing with increasing strength as the depression deepens over the land until they reach their final expression in the southwest monsoon proper. But the air currents entering the lowland on that side emanate from the dry land belt about the head of the Arabian sea. Hence, they are not saturated like those which, originating over a broad ocean, impinge on the Bombay coast; but only "stray" just north of the Aravallis. They confer but scant benefit to the immediate coast fringe; beyond, they desiccate. Since also the Bay of Bengal branch of the advancing monsoon, which enters the lowland from the east on a downhill journey to its barometric goal, has already served the whole Gangetic plain, its remaining moisture is soon exhausted. Thus, of the 213,110 sq.mi. actually under review 47,590 receives less than 5 in per annum; 95,560, 5 to 10 in.; 69,960, 10 to 15 in. The following illustrates briefly the salient features of distribution, and how precipitation lessens from the northern and eastern rims of the desert to the western in the Upper Sind Frontier and Kachhi districts:

Station		Var.	Oct.-Feb.	Var.	March-May	Total (in.)
Shahpur	9.6	33	2.5	44	2.2	14.3
Sirsa	11.4	37	1.6	72	1.3	14.3
Pachbhadra	11.3	33	.7	81	.8	12.8
Bikaner	9.2	67	1.0	75	1.1	11.3
Jaisalmer	5.9	53	.5	80	.4	6.8
Multan	4.9	51	1.1	58	1.1	7.1
Karachi	6.1	80	1.3	71	.3	7.7
Jacobabad	2.7	75	.9	71	.5	4.1

Var. (variability) indicates departure from average seasonal rainfall as registered in half the years during 1890–1923, expressed as a percentage. In general, March to May returns are insignificant.

Water. — It is a truism that natural boundaries are zonal, not linear; and generalizations concerning the biological effectiveness of rainfall are dangerous. Space forbids qualifications; yet it may be accepted that over the lowland precipitation is such that it precludes the transformation of the surface by permanent cultivation,

and that over those parts which lie beyond the sphere of running water a desert landscape prevails. At once, therefore, it claims a continuous area of a little more than 100.000 sq.mi. cut off from effective water circulation. This involves Bikaner, with Jaisalmer and nearly all Jodhpur; Bahawalpur practically as far as the North Western railway, which runs parallel to the Sutlej; the Runn of Cutch, and north of it as much of Thar-Parkar district (Sind), Khairpur state and Sukkar district (Sind) as lie east of the Nara river (properly canal!. The desert's alternative name "Thar" refers to the sand hills accumulated by the prevailing winds, which transport thither the saline dust picked up over the Indus delta and the Runn. Two types of sand hills are recognized. (1) Longitudinal sand hills (Sindhi bhits) are parallel ridges aligned northeast southwest; *i.e.*, parallel to the prevailing winds. The *bhits* are restricted to the west (*i.e.*, Thar and Parkar south of Umarkst, eastward to the Luni basin). They reflect greater wind force than (2) the transverse type, to which they give way. through intermediate forms. northeast of Umarkst. These lie at right angles to the wind but are less regularly aligned than (1). The marginal dunes rise to about 200 ft. above the general sandy surface and are relatively permanent. Farther inland they are lower, in constant motion. and the landscape tends toward a low plateau of deep, loose sand, reminiscent of a billowy sea.

Deserted by a "westering" parent, the feeble monsoon streams which struggle across southeast Punjab, between the Sutlej and Jamna rivers, succumb in the face of the sand before the Rajasthan border is reached. The Luni river is the only significant watercourse within the area. It receives several Aravalli streams from the southeast and is at least a support to the subsoil water within its bend; but it loses itself in sand at the head of the Runn.

Salt. — The salinity of the soil, characteristic of the whole lowland and there very marked, is sufficiently accounted for throughout Thar by the action of the wind, bringing material from the seaboard. The evaporation of subsoil brine is common over Rajasthan (particularly in the Pachbhadra neighbourhood) and also beyond, southwest of Delhi, and in the Multan and Muzaffargarh districts of Punjab (Pakistan). The Rajasthan salt lakes, representing the fixation of salt washed into basins of internal drainage, are marginal to the desert. Of these: Sambhar, on the Jodhpur-Jaipur boundary, is the largest. It lies in a closed depression in the Aravalli schists (1,184 ft.). Its maximum spread is 90 sq.mi. and during a normal monsoon it averages 4 ft. deep in the middle: but is dry the greater part of the year. The upper 12 ft. alone of saliferous silt forming its bed represents a salt reserve of about 54,000,000 tons. The lake is worked on lease by the government of India, and the salt extracted is railed to Sambhar at the eastern end of the lake, whence it is distributed.

Gypsum, also occurring on the margins of some of the lakes, may prove more important in the future. In Sind and Khairpur, where the floor of alluvial clay remains uncovered or only thinly mantled with sand, shallow though often large expanses of water known as dhands are common in the hollows (tnlis) between the sand hills. They are fed by rain water percolating through the sand and emerging as a spring (sim) above the clay. Prior to the controlling of the Nara river many *dhands* were replenished by its flood spills, but these have now mostly dried up. *Sim* water is often sweet, and gives rise to fresh pools close to where it emerges and lying a few feet above the *dhand* proper, which is either alkaline or saline, rarely fresh, its particular nature being recognizable from its fringe of vegetation. The mineral *trona,* from the alkaline *dhands,* supports the soda (chaniho) industry of Khairpur state and Nawabshah district (Sind). Saline dhands yield salt and gypsum.

Vegetation. — A varied, open, shrubby and coarse herbaceous vegetation is characteristically present, salt lovers being conspicuous. On sweet, damp bottoms. and after rain, good grass abounds. Thus, fodder exists for large numbers of cattle, sheep, goats and camels; villages are scattered everywhere.

.When rain is propitious, millets (principally bajra) are raised and husbanded to eke out a milk diet supplemented otherwise only by such imported grain as is made available by the profits of the pastoral industry and associated crafts, such as the making of blankets. felts, *lohis* (coarse shawls), ropes, bags, brushes and leather goods, render possible. Typical desert talukns of Sind have shown a population density per square mile of less than 20 (cf. Diplo, 12; Chhachhro. 18); Jaisalmer, the "core" of the desert, has an over-all density of 5 per square mile; Bikaner gives 55 (Bikaner city, 117,113); Jodhpur, 70 (Jodhpur city, 180,717), but a heavy allowance must be made for that part of the district outside the essential desert. Roughly, the Thar desert has carried about 2.500,000 people, largely marginal.

The Runn of **Cutch** (Rann of Kachh or Kutch), embracing about 8.000 sq.mi., while a part of the desert, possesses a distinctive character. It is a low-lying. salt-impregnated alluvial tract. Seemingly uniformly level, it has a general imperceptible slope seaward. while minor irregularities give shallow surface depressions. When the surface is dry, it is hard and polished; "even a horse's hoof hardly dents it in passing." During the southwest monsoon. however. it is flooded by the waters of the Luni. Puran, West Banas and other rivers assisted by rain remaining on the hard surface, but the view that at this season the sea invades it (the sea level is raised 4 to 5 ft) has been disproved and abandoned. During flood the water varies in places from a few inches to some feet; but after it subsides. evaporation proceeds until only salt remains. Lying in a belt liable to pronounced seismic disturbance, the Runn suffered severe displacement in 1819; depression increased the "rann" proper, but aeolian deposits have diminished it since. It is a range for wild asses. The impoverishment of the Runn and much of what is now Thar reflects the "westering" of the Indus and associated Punjab rivers. A map shows that the streams making for Rajasthan across the low Sutlej-Jumna watershed converge toward a large dry watercourse (the Ghaggar), which runs parallel to the Sutlej and is traceable beyond through Sind to the Runn, roughly via the east Nara and Puran. This is the Hakra, or "Lost river." fed formerly by the Sutlej (possibly at one time by other Punjab rivers), and in its lower course (as the Mihran of Sind) by the Indus. Such was the known condition in the 8th century A.D. Subsequent probably to phenomenal flooding in north Punjab, thought to have taken place in the 14th century, a rearrangement of drainage initiated the decline of the Hakra. First a "westering" Indus ceased to feed its lower reach; eventually the Sutlej completely deserted it and passed to the Indus via the Beas. By 1790 the Hakra was dead. The tapping by bunds of the waters latterly feeding the Puran from an Indus distributary assisted to complete the dereliction of the abandoned delta (the Runn).

Irrigation. — Outside Thar, the immediate valleys of the rivers sustained by the snows of the Himalayas, tree-lined and recuperated by inundations, break the arid continuity, while as a result of irrigation the desert survives only in fragments. Consequent upon the melting snows, the Indus and rivers of the Punjab begin to rise in March. and normally spill over the land in mid-June. Floods culminate in August, and the rivers fall fairly rapidly to a minimum in about February. From antiquity channels have been dug to utilize the rising naters. Such inundation canals are necessarily restricted to the lower marginal lands; *i.e*, mainly newer alluvium (Khadnr), which in Punjab lies 10 to 50 ft. below the older alluvium (*Bhangar*) comprising the doabs, and varies from 4 to 10 mi. in width. Hence. they occur mainly where the "Five rivers" converge to form the single artery continued in the line of the Indus, and attain their maximum development in Sind, where the widening *Khadar* merges into truly deltaic land. Many of these canals existed prior to British rule; they were improved and others were added.

Agriculture.—It is, however, to the expansion of great perennial systems over the broad backs of the Punjab doabs, and the development of model agricultural colonies thereon, that the elimination of the desert between the Jhelum-Chenab on the one hand and the Sutlej on the other is due. Details of what this meant must be omitted, but the following Punjab census (1921) return is notenorthy: "In 1891 the population density contour line, 100 per square mile, which enclosed the oasis of Multan was no less than 160 mi. distant from the general 100 per square mile density line. Since 1891, however, due to the development of the Lower

Jhelum, Lower Chenab and Lower Bari doab canals the line has advanced at an average rate of about 10 mi. per annum, and in 1911 Multan had been turned. from the point of view of population, from an island into a narrow-necked peninsula." Agriculturally it meant the establishment of about 1,000,000 ac. of acclimatized American upland cotton with a staple of about 1 in., and a great wheat expansion. The Sutlej valley project was undertaken to convert certain inundation canals dependent on that river into perennial, and assure the flood supply of the rest, while extending irrigation into the Bahawalpur and Bikaner fringes of Thar.

Projects.— At mid-20th century the Punjab state government was anxious to complete the big task of building a dam on the Sutlej river, near the village of Bhakra, about 50 mi. upstream from Rupar Town. Plans called for the construction of a reservoir for irrigation canals and a hydroelectric power plant. About 8 mi. downstream from the Bhakra dam site, Nangal dam was completed in 1954. Nangal dam was designed to provide storage of the irregular flows caused by variations in load requirements at the Bhakra power plant and would provide a balanced supply of water for the Sirhind canal. Water could also be diverted to the Nangal Hydel canal. As a result of this project, irrigation would be extended to Hissar. Rohtak and other adjacent areas in arid southeast Punjab. The total cost of the Bhakra-Nangal project was estimated at Rs. 156 crores. The Indian prime minister opened the Bhakra canal system on July 8, 1954. Pakistan protested that this diverted waters essential to its life.

The recession of the western mountain wall enables the Indus, after receiving the united volume of the Punjab rivers, to enter Sind as a southwest flowing river. Near Schwan it turns south in the presence of the Laki range but manifests its "westering" tendency again in its final struggle seaward. The bifurcation of the Ochito and Haidari is regarded as the head of the delta; but, of course. throughout Sind the river is really deltaic, flowing on a ridge above the land on either side, restrained in parts by embankments, but requiring more to curb its devastating moods. while the lower part of the province is riddled with its dead channels. Only in the gorge between Sukkur and Rohri, where it traverses a gap at the north extremity of low hills running for 40 mi. S. from its left bank, and in the Kotri neighbourhood is its channel. constant.

In order to afford an assured supply of water to cultivators at all times, the Sukkur barrage project, after long years of discussion, was begun in July 1923. Excavation of 7,500,000 cu.ft. of earth was necessary to extend the total length of watercourses served to 54,300 mi. The project cost almost Rs. 24 crores.

The waters of the Indus river are headed up by 66 spans, which are 60 ft. wide and have 50-ton steel gates to regulate the flow. The barrage, about 1 mi. long. regulates the distribution of the water through seven canals and canal-head regulators—spans 25 ft. wide with three electric gates. There are four canals on the left bank—Rohri, the Eastern Nara, the Khairpur Feeder East and the Khairpur Feeder West—and three on the right bank—the North Western canal, the Rice canal and the Dadu canal.

Approximately 45,763 cusecs, or 285,100 gal. per second, is the total discharge of water into the seven canals. Named the Lloyd barrage in honour of Lord Lloyd, a governor of Bombay who zealously supported the project, it was completed in Jan. 1932. After the opening of the barrage and canal system, the acreage devoted to wheat and cotton increased markedly. At mid-20th century, 7,500,000 ac. were irrigated.

In Feb. 1950 the governor general of Pakistan laid the foundation stone for another Indus river barrage to be constructed above Kotri in Lower Sind. Expected to provide water for 28 lakh ac., the project would. it was estimated, make it possible to increase crop output fourfold. The cost was estimated to be Rs. 20.5 crores.

Westward beyond the sphere of the Indus, the desert landscape is at once established, and the irrigated patches of *daman* (clayey soil) created and sustained by flood torrents searing the mountain wall only throw the naked hideousness of the limestone rampart into bolder relief.

BIBLIOGRAPHY.—W. T. Blandford, "The Great Indian Desert," *Journ. As. Soc. Bengal,* vol. xlv, pt. 2 (Calcutta, 1876); H. G. Raverty, "The Mihran of Sind and Its Tributaries," *Journ. As. Soc. Bengal,* vol. lxi, pt. 1 (1892); R. Sivewright, "Cutch and the Rann," *Geogr. Journ.,* vol. xxix (London, 1907). Among publications of the Indian Geol. Survey *see* particularly T. D. la Touche, *Mem. Geol. Surv. Ind.,* vol. xxxv, pt. 1 (Calcutta, 1911). For geology of west Rajputana *see* Holland and Christie, "The Origin of the Salt Deposits of Rajputana," *Records Geol. Surv. Ind.,* vol. xxxviii, pt. 2 (Calcutta, 1909–10); G. de P. Cotter, "The Alkaline Lakes and Soda Industry of Sind," *Memo. Geol. Surv. Ind.,* vol. xlvii, pt. 2 (Delhi, 1921); R. D. Oldham, "The Cutch Earthquake of June 16, 1819, etc.," *Mem. Geol. Surv. Ind.,* vol. xlvi, pt. 2 (Delhi, 1920). *The Triennial Rev. of Irrigation in India 1918–21* (Delhi, 1922) incorporates an outline of irrigation history under the British. (A. V. W.)

INDIAN HEMP (*Apocynum cannabinum*), a North American plant of the dogbane family (Apocynaceae), native to fields and thickets from Quebec to British Columbia and southward to Florida and Lower California. It is an erect, often much-branched perennial, 1 to 4 ft. high, with smooth, oblong, opposite leaves and small: clustered, greenish-white flowers, from each of which develops two very narrow fruit pods (follicles), about 4 in. long, containing numerous downy-tufted seeds. The tough bast fibres of the inner bark were utilized by the Indians for cordage. The variety of hemp yielding hashish is also called Indian hemp.

INDIAN INK, or INDIA INK: see INK.

INDIAN LANGUAGES. The main languages of peninsular India are largely those mentioned in the 8th schedule (articles 344[1] and 351), as modified to Sept. 1, 1951, in the constitution of India. They are: Hindi (coupled with Urdu! Hindustani, Punjabi [including those using "Gurmukhi" character] and Pahari, 149,944,311[1]); Telugu (32,999,916); Marathi (27,049,522); Tamil (26,546,764); Bengali (25,121,674[2]); Gujarati (16,310,771); Kannada (Kanarese) (14,471,764); Malayalam (13,380,109); Oriya (13,153,909); Assamese (4,988,226); Kashmiri (1,438,021[3]); and Sanskrit. Subsequently, English was publicly declared one of the languages of India. To these languages there must be added, for Pakistan. Lahnda (8,566,051[3]), or Western Punjabi, and Sindhi (4,006,147[3]). Pushtu (Pashto) and Balochi are Iranian languages. For 15 years English was to remain the official language of India, and in the meantime Hindi in Devanagari script was to be progressively established to take its place as the all-Indian language. Urdu, the official language of West Pakistan, was established in the Punjab under British rule after the conquest. 1848–49.

An Indian commission on the possibility of setting up new states on a linguistic basis for Andhra (Telugu), Karnataka (Kannada), Kerala (Malayalam) and Maharashtra (Marathi) reported in 1948, and Andhra state was later established. The report, however, concluded that "the formation of provinces on exclusively or mainly linguistic considerations is not in the larger interests of the Indian nation and should not be taken in hand." Pakistan recognizes two main languages, Urdu in the west and Bengali in the east.

The languages so far mentioned fall into two great families, Indo-European and Dravidian. The following languages belong to the Indo-Aryan group of the Indo-Iranian branch of the Indo-European linguistic family, and are sometimes described as Sanskritic since their affinities can to some extent be measured with reference to Sanskrit. the great classical source for most of present-day India, including loans in the Dravidian languages: (1) northwestern group: Lahnda and Sindhi; (2) southern group: Marathi and related dialects; (3) eastern group: Bengali, Oriya, Assamese, Bihari (including Bhojpuri, Maithili and Magahi, 37,000,000); (4) east-central group: Eastern Hindi and dialects; (5) central group: Hindi (and literary Urdu), Eastern Punjabi, Gujarati, Rajasthani (13,897,896[3]), Bhili dialects (2,110,410[3]); (6) northern or Pahari group: Eastern Pahari, Gorkhali (about 6,000,000[3]), Garhwali and Kumaoni (1,055,662), Western Pahari; (7) extra-Indian groups: Sinhalese (4,000,000[3]) and gypsy dialects of western Asia and Europe. The Dardic languages of the far northwest

[1]Except where stated, population figures are from the census of India, 1951, and exclude Pakistan.
[2]Excluding East Pakistan.
[3]1931 census.

are also Indo-European of Indian type and include Kashmiri and Shina (68,199[1]). The close relationship of Sanskrit with Greek and Latin was boldly stated by Sir William Jones in 1786. S. K. Chatterji calls this "great Aryan speech of India, our great spiritual and cultural link with the West."

Besides the four great literary Dravidian languages of south India — Tamil. Telugu, Kannada and Malayalam — there are a number of nonliterary Dravidian languages in the south such as Tulu

PROFESSOR J R FIRTH

GEOGRAPHIC DISTRIBUTION OF PRINCIPAL INDIAN LANGUAGES

(787,624), Kodagu (40,000[1]), Gondi (1,232,886) and, in far away Baluchistan, Brahui (225 000[1]).

Most of the other languages of India are allotted to two language families of lesser significance in India today. the Munda (sometimes called Austro-Asiatic or Austric) and the Sino-Tibetan. The Munda languages are thought by some to be related to the Mon-Khmer subgroup of southeast Asia. The largest population group in India speaking what some would call an aboriginal language is the group speaking Santali (2,811,578). Other related languages are Mundari (650,000[1]), Savara or Sora (256,259) and Khasi (292,923).

Manipuri (Assam) and Newari (Nepal) have been described as belonging to the Sino-Tibetan family, along with a number of other languages such as Lushai and Garo of the Bodo group.

Sanskrit, the sacred and classical language for 250,000,000 Hindus, is written in the Nagari or Devanagari script, accepted all over India. Hindi and Marathi are written in it, Gujarati, Bengali, Assamese in modified forms of it, and even the Dravidian languages of the south are written in closely related forms of it. Urdu employs the Persi-Arabic script and its classical sources are Persian and Arabic. It has been said that Urdu and High Hindi are based on one form of speech (Hindustani) split by two different classical traditions and two totally different scripts. Hindustani (if this name may still be used) "acts as the most natural inter-provincial link among speakers of the Aryan languages of the north. This is a sort of *lingua Indica*." (S. K. Chatterji, *Languages and* The *Linguistic Problem,* Oxford Pamphlets on Indian Affairs, No. 11, Oxford University Press. 1943.) *(See* also individual languages; *e.g.,* ASSAMESE; BALOCHI; BIHARI; etc.) (J. R. FH.)

[1]1931 census.

BIBLIOGRAPHY.—Sir George Grierson, *Linguistic Survey of India* (New Delhi, 1903–28); *Census of India,* 1931 and 1951 (New Delhi); Imperial Gazetteer of India, *The Indian Empire,* vol. 1 (Oxford, 1907; *Report* of the Linguistic Provinces Commission (New Delhi, 1948); S. K. Chatterji, *Languages and the Linguistic Problem,* Oxford Pamphlets on Indian Affairs, no. 11 (Bombay, Oxford, 1943); A. Meillet and M. Cohen (eds.), *Les Langues du monde,* Société de Linguistique de Paris (Paris, 1952); H. M. Lambert, *Introduction to the Devanagari Script, for Students of Sanskrit, Hindi, Marathi, Gujarati and Bengali* (Bombay, Oxford, 1953).

INDIAN LAW. The law generally in force in the Indian subcontinent was varied and modified by the succession of governments in power there. Mohammedan law, for example, came with the Moslems and remained applicable to Moslems in personal matters when the English East India company had superseded the Moguls. The influence of English law pervaded the religious and sectarian legal administrations during the British imperial rule, and British enactments and decisions in the high courts left their mark on the system of the Republic of India. The republic, however, with its Hindu majority predominant in the population, inherited the law developed after the first Aryan invasions of India, and it is with the peculiar features of this Hindu law that the present article is concerned.

The article SANSKRIT LANGUAGE AND LITERATURE mentions the written sources of Hindu law. The more ancient of these are regarded as sacred. and, since it is sacred. Hindu law is theoretically unalterable. But. in fact, it has changed by admitting wholesale into Hinduism peoples who brought their customs with them. by slow local and family changes and by adaptations to historical, political, economic and social changes. As to custom, indeed, Manu's code says "immemorial custom is transcendant law." In actual practice and apart from modifications by custom, Hindu law as administered in the courts is substantially derived from the commentaries of the great commentators. For most purposes the chief among these are the *Daya Bhaga* of Jimuta Vahana in Bengal proper only, the *Mitakshara* of Vijaneswara all over India and the *Vayavahara Mayukha* of Nilakanta in western India.

The *Daya Bhaga* in Bengal and the *Mayukha* in Bombay overrule the *Mitakshara* where they differ from it, and in the case of the *Daya Bhaga* the differences are so far-reaching in the matter of family property and in the theory of inheritance that it is rightly held that there are tuo main schools of Hindu law, the *Mitakshara* school and the *Daya Bhaga* school. The former is divided into the Benares school (upper India generally). which prefers the *Mitakshara* to all other commentaries at all points, the *Mithila* school (northern part of the states of Bihar and Orissa), the *Maharashtra* school (western India) and the *Dravida* school (southern India).

The Joint Family. — The striking feature of Hindu society and Hindu law is the joint family. It- is the form, no doubt. in which the Aryan patriarchal family *(see* INDIA: *Social Institutions)* has survived. The joint family is seen at its weakest in Bengal, the region where Brahmanical ecclesiasticism, on which the *Daya Bhaga* is based, has had its greatest effect.

Brahmanical influence on law probably increased at the post-Buddhist Hindu revival, but seems to have had little or no effect in the Punjab or among the Aryan, or Aryanized, peoples of the Himalayas. Among some of the Himalayan clans, which undoubtedly have Aryan blood in them, the joint family is more like the Roman family than it is among Hindus of the *Mitakshara* school in India generally. The joint family is so much taken for granted in the *Shastras* and the commentaries that it is scarcely described in them.

Since the question of whether a family's land could be validly alienated probably did not arise until comparatively modern times, the distinction between the right to manage. on the one hand, and ownership with the right to alienate, on the other, probably did not become an important point of law for many centuries. When it did arise, two conflicting theories emerged. One is that of the *Mitakshara,* that down to the great-grandson of a living ancestor a male Hindu acquires by birth a right of ownership as a coparcener in the ancestral family property. The other is that of the *Daya Bhaga,* that the living ancestor is the sole owner, with unfettered control and power to alienate, even for personal pur-

poses, and that on his death his descendants in the direct male line who have no ascendant living inherit the property in distinct and specified shares and may either divide it up or retain it as a jointly worked and managed property. Under the *Mitakshara* no coparcener's share is a definite thing, even if he has no ascendant living, until a partition is called for. Until that event occurs each coparcener's share can, in a manner, be said not to be ascertainable. And when a coparcener. even the common ancestor, dies, his rights pass by survivorship and not by inheritance.

Under the *Daya Bhaga*, then, when the common ancestor dies, the ownership passes in immediately ascertained shares to his heirs under *Daya Bhaga* law. But in such a case under the *Mitakshara* the ownership, that of the family. is unaltered, but in the family there is one coparcener the less. and the distribution on a partition made after his death will differ from that on one made before it. And. while the property remains joint, there is no passing of it by inheritance. The nature of the ownership of joint property is not discussed in either the *Mitakshara* or the *Daya Bhaga.*

If a family of brothers governed by the *Daya Bhaga* keep their property undivided, then, upon the death of one of them, his share goes to his heir or heirs, who. in default of agnate descendants, may be his widow, his daughters or the sons of his daughters, and in this last case his share will pass into another family, but it need not therefore be separated off by a partition. In a like case under the *Mitakshara,* if the deceased brother had any agnate male descendants they mere already coparceners in the family property. while his wife, his daughters and the sons of his daughters could not be coparceners. Upon his death there was one coparcener the less in the family, and the distribution on a partition would be somewhat altered. As long as two or more coparceners remain in a *Mitakshara* joint family, such property as it may own cannot pass out of it by inheritance.

There is a standing presumption that Hindus nearly related to one another by agnation form a joint family. When they are so far apart in blood as second cousins, that presumption is not very strong. And there is some presumption that anything in the possession of a member of a joint family belongs to the family. Honever, Hindu law now recognizes self-acquired property. though it took a long time to do so, even as the concept of *peculium* in Roman law was of slow growth. Gains of valour, science and learning made without help from family resources are the chief source of self-acquired property, apart from what is styled "obstructed inheritance."

But nhen self-acquired property passes by inheritance to agnate descendants it at once becomes ancestral, and under the *Mitakshara* the inheritors, unless they have already separated from one another, hold it as an ordinary joint family coparcenary. Under the *Daya Bhaga* the fact that each coparcener has a known and particular share of which he can dispose in his lifetime as he pleases by sale or gift or in any other way, without being answerable to anyone, greatly simplifies questions arising out of alienations. But under the *Mitakshara* the dealings by a coparcener with the share which would fall to him on a partition, and the rights of his personal creditors against that share, both while he is alive and after his death, have given rise to legal difficulties.

Noninheritors.—A joint family will usually have among it members who are not coparceners. Under the *Daya Bhaga* the wives of coparceners, the male agnate descendants of coparceners and the unmarried female descendants of coparceners or of their agnate descendants come into this category, as well as those who might in time be coparceners but that Hindu law debars them from inheriting; *e.g.*, those born deaf. dumb, blind or insane. Under the *Mitakshara* the dependent members will not include qualified sons, grandsons or great-grandsons of the senior generation of living coparceners, for these are coparceners themselves by right of birth, unless disqualified by any defects which debar from inheritance. But among the dependents there will be widows of deceased coparceners. Under the *Daya Bhaga* such a widow without sons or agnate descendants will herself be owner. at least for her life, of her deceased husband's share. Under both schools these dependents must be maintained: out of the shares of their respective branches of the family in the case of the *Daya Bhaga;* out of the general family fund in that of the *Mitakshara.* And, in theory. under the *Daya Blzaga* each actual coparcener, ahich here means the owner by inheritance, or possibly by purchase, of a share. can claim. at least approximately, that a corresponding share of the family income be allotted to him. In a *Mitakshara* joint family there is no such right. No one can claim more than that he is to be maintained. with his wife and other dependents. on a scale suited to the family's resources. Only if fraud or embezzlement or the like is alleged will current accounts be gone into. When a partition has to be made, a capital account is, of course, necessary.

Partition.— To the ancient Hindu lawgivers and commentators. partition and inheritance are different aspects of the same subject, and, in fact, in their view partition was the dominant aspect. This was because a Hindu ought to have at least one male agnate descendant. obtained in the last resort by adoption, and therefore ought to die a member of a joint family, if governed by the *Mitakshara.* Even under the *Daya Bhaga,* when two or more sons succeed their father. they do not get definitely marked out shares absolutely their own until they effect a partition. Partition is in theory simple enough under the *Daya Bhaga.* Each coparcener has a known share: all that has to be done is to lay out metes and bounds in the immovable property and to make a fair division of the movables. But when the *Mitakshara* applies, the first thing to be done is to determine the share of each coparcener. The division is made by branches. And when there is a division between a living ascendant and his descendants, the ascendant gets the same share as goes to each of his sons. Thus, a father and his four sons make a partition, and each gets one-fifth of the property. If any of the sons had predeceased the father, leaving sons or agnate grandsons, these latter between them take what would have been his share. If four brothers, whose father and other ancestors are dead, divide, each takes one-fourth.

Ancestral and Separate Property.— In case of dispute it is necessary under either school to decide what is and what is not family property. What is claimed and proved to be either self-acquired or separate property has to be excluded from the hotchpot, and there may have to be special provisions about the right to use wells, rights of way and other things which cannot be split into parts. It should be mentioned that under British administration in most provinces partitions of land assessed to land revenue came to be made by the revenue courts *(see* INDIA: *Finance*), and in those cases the joint owners often were not members of a joint family.

A father or other ascendant governed by the *Daya Bhaga* is sole owner as against his sons and other descendants; yet there are texts indicating that if he make a partition among his sons he must divide the property equally.

Honever, he undoubtedly can make a series of gifts to his sons or other descendants, and by them dispose of the estate in very unequal portions. At the back of this anomaly is the theory that a gift needs acceptance by the donee and actual transfer of possession to make it complete and cognizable in law, whereas a partition does not. If a member of a *Mitakshara* joint family obtains a partition of his share and has then no sons or other agnate descendants, the share is his sole and separate property. But it remains "ancestral," and as soon as he has a son born to him, or adopts one, that son becomes a coparcener in it with him and so with all his sons born subsequent to the partition and their sons and grandsons. Very often the question arises, "Has there been a partition or not?" The answer may affect the rights of a third party to whom a member of the family purports to have transferred property. The presumption as to jointness has already been mentioned. But whether there has been a partition or not is a question to be decided on the evidence. A fully united family is joint in house, food. worship and estate. But a family can easily be joint in house and worship and yet separated in food and estate, or it can be joint in estate and yet to some extent separated in house and in food. On effecting a partition, provision must be

made for the dependents; *e.g.,* unmarried daughters or sisters, mother uhose husband is dead. and incapables. When a dependent belongs plainly to one branch of the family. and that branch does not itself split up, the liability of course attaches to that branch; for instance, one of several brothers who separate remains responsible for his own daughters. But when brothers who have unmarried sisters or incapable brothers separate, either a special assignment must be made (for instance, to meet the expenses of a girl's marriage) or one member accepts responsibility and receives some sort of compensation. If it is a mother who has to be provided for, it is not uncommon under the *Mitakshara* for a part of the estate to be assigned to her. On her death it will be divided among her sons or their descendants.

As in a *Daya Bhaga* joint family, each coparcener has a definite share which descends by inheritance; when the estate of such a joint family is the subject of a partition. the matter to be ascertained is what portion thereof has devolved under the rules of inheritance to each present member since the death of the person who once held the whole of it. For under the *Daya Bhaga* all property goes by inheritance nhen its owner dies, whereas under the *Mitakshara* the rights of a coparcener, even if he be one of two only, go by survivorship on his death. So a Hindu governed by the *Mitakshara* risks losing all chance of inheritance to the rest of the family property when he separates by partition, for as long as two or more members remain joint even their nearest relations, once separated from them by partition, cannot inherit their joint property. since survivorship precedes inheritance,

Under the *Mitakshara,* only separate property and self-acquired property can pass by inheritance.

Impartible Estates.—Besides estates which under British provincial legislation were made subject to entail, there are some estates impartible by family custom or special tenure, mostly the residue of suppressed sovereignties or quasi-sovereignties. Junior members and branches of the family are entitled only to maintenance.

Cnder the *Mitakshara* the rule of succession may involve. first. discovering the nearest male agnates and then applying the rule of primogeniture among them, excluding more distant relations even in a senior branch.

Inheritance.—Here there is a divergence of principle between the two schools. The *Mitakshara* prefers all male agnates, however remote. to any cognate, however near, except the daughter's son. And, except under the *Maharashtra* subschool in western India, which does place some women in a more favoured position, the only women it brings in as near heirs are the widow, daughter, mother. grandmother and great-grandmother.

The basis of the scheme is preference by nearness of agnate relationship. The scheme of the *Daya Bhaga* is based upon efficacy of offerings made to the deceased; in fact, it holds that the heir gets the estate because he makes the offerings. So doubt the ancient rule, as J. D. Mayne surmises, was that the duty to make the offerings fell upon the person taking the estate. But, for the benefit of the priesthood, the later ecclesiastical theories of the Brahmans put all the stress upon the offerings and said that the estate followed them. This theory brings in some cognates in preference to more remote agnates.

There are three grades of offerings: (1) the full cake, or *pinda,* those making it being called *sapindas;* (2) the offerings of crumbs made by *sakulyas;* and (3) the offerings of water made by *samanodakas.* The cake offering is made for three generations, and the crumb offering for three more.

The leading rule is that a Hindu has to make the cake offering to his father, his father's father and his father's father's father and also to his mother's father, his mother's father's father and his mother's father's father's father. It is of importance that he does not make offerings to his father's mother's father, and so on.

A man is *sapinda* to his sons. to their sons and to their grandsons, as uell as to his three direct ancestors. And he is *sapinda* to the three generations in the direct male line from his *sapinda* ancestors, paternal and maternal. Except in the case of the daughter's son, the claims of all connected nith the deceased through a woman on the ground of being *sapinda* are rejected by the *Mitakshara* in favour of agnates however remote. But the *Daya Bhaga* admits these claims with the result. so far as the inner circle of heirs is concerned, of bringing into it sister's son, father's sister's son and grandfather's sister's son.

This inner circle includes those related to the deceased by being descended from a common great-grandfather, or nearer relation, by agnation; beyond it the differences between the two schools become much greater, in view of the *Daya Bhaga's* preference of all who offer the full cake over all who offer only crumbs and its doctrines about being mutually *sapinda* and about the effects of being *sapznda* to the same person.

Order of Inheritance.—The first heirs are sons, agnate grandsons and agnate great-grandsons. Grandsons and great-grandsons between uhom and the deceased a son or grandson survives do not take directly. but representation is allowed in the case of those between whom and the deceased the links are already dead. But for this case representation is nowhere allowed in Hindu law; *e.g.,* a brother excludes sons of deceased brothers. After the three generations of descendants come the widow, then the daughter and then the daughter's son. Daughters' sons take per capita, and a living daughter excludes all sons of deceased daughters. Next come the parents, of whom the *Mitakshara* places the mother, and the *Daya Bhaga* the father. first of the two. Then brothers, sons of brothers and agnate grandsons of brothers. Here the *Daya Bhaga* interpolates the sister's son.

Then come the grandparents and a like three generations from them. with the father's sister's son interpolated bv the *Dava Bhaga;* then the great-grandparents and the three generations from them. For the complications beyond this point. especially under the *Daya Bhaga,* thk reader should consult the works of Mayne and Sir Ernest Trevelyan cited in the bibliography below. The *Makarashtra* school brings in the sister between the two grandparents, and after each circle of heirs brings in widows of members of that circle before going on to males in the next larger circle.

Wills—There can be no doubt at all that in its beginnings Hindu law knew nothing of wills. There is no Hindu word for a will. A legacy can be regarded as a gift to take effect after death, and according to both Hindu and Mohammedan law a gift is of no effect until the donor has transferred possession to the donee. And, when dead. the donor is no longer there to do so. But undoubtedly Hindus were struggling toward a right to bequeath in the days before British rule, especially in Bengal. The doctrines of the *Daya Bhaga* had individualized property, and ecclesiasticism was bound to favour pious gifts and bequests. Slowly the supreme courts of British India recognized a Hindu's power to make a will. first in Calcutta after formally consulting the East India company's *sadr* court. It became settled law that a Hindu could dispose by will of all that he could unrestrictedly alienate in his lifetime; *i.e.,* in case of a male, of all his property under the *Daya Bhaga* and of all his separate and self-acquired property under the *Mitakshara,* and in the case of a female of certain classes of her property. The courts felt themselves compelled to deny to a testator the right to create anything approaching a perpetuity.

Debts.—Hindu law undoubtedly recognized that debts ought to be paid and had its methods of compelling payment. The religious view of debt in Hinduism is that he who dies in debt suffers torment or degradation in the next life, which can be ended only by payment of the debts, and Hindu law is a branch of Hindu religious teaching. Hence there is the principle that a son or grandson is under an especial obligation to pay the debts of his father or grandfather. As, in the ordinary way. he is the heir, this is fair and equitable. It was settled by legislation that no one, whether he take by inheritance or by survivorship, is bound to pay debts to a greater amount than the benefits he receives by the passing of the estate of the deceased. First, of course, it has to be ascertained what property the deceased left. So far as concerns the estate of a Hindu governed by the *Daya Bhaga* or the separate or self-acquired property of one governed by the *Mitakshara,* all debts which could have been recovered from him in his lifetime rank for payment. It is nhen the deceased died as a coparcener in a *Mitakshara* joint family that difficulties arise over

the "pious obligation" of sons and grandsons. A debt may have been incurred for joint family purposes. recognized as such by Hindu law. Then all the family property is liable for it. It may have been incurred for the debtor's personal purposes, and if the particular purpose of a debt was not illegal or immoral the doctrine of pious obligation will generally make liable for it all that share of the family property which on a partition would have gone to the debtor and his descendants. Or the debt may have been incurred for illegal or immoral purposes. If the creditor knew, or ought to have known, of such purposes, the family property is not liable for it at all. As the father can burden the sons by his indebtedness, if it be not the result of illegality or immorality, so too he can sell or mortgage their potential shares with his, especially to pay a debt already existing. And it was decided that the creditor can implead the sons and grandsons when suing the original debtor in the latter's lifetime. The effect of failure to implead them, or of failure to state distinctly that their shares are attached when execution of a decree is taken out. was the subject of numerous rulings of the high courts.

Alienation and Maintenance. — Originally, no doubt, a member of a *Mitakshara* joint family could not alienate his share of the property for personal purposes until he obtained a partition. According to rulings of the high courts at Madras and Bombay, not only could he do so, but his personal debts could be enforced against it, provided always that a decree is obtained and attachment of the share effected during the debtor's lifetime. On his death his rights vanish. acd. since they go by survivorship and not by inheritance, they could not be followed into the hands of the survivors unless the doctrine of "pious obligation" applies to the latter. The right of certain persons to be maintained out of family funds, or by their living agnate ancestors under the *Daya Bhaga,* has already been mentioned. But Hindu law also envisages other rights of maintenance. Quite independently of inheritance of ancestral or other property, wives, minor sons, unmarried daughters and infirm and penurious parents must be maintained by a Hindu who has means or can work. And widows and daughters of deceased members of a *Mitakshara* joint family and, under either school of law, widows of persons whose property is inherited by their sons, grandsons or great-grandsons have a definite right to maintenance. By decree of court that right can be charged upon the property, and under the *Daya Bhaga* a widow whose sons or other descendants divide up the property of their deceased father or ancestor can claim the allotment to herself for life of a share equal to that obtainea by each son; so. too. when brothers succeed to their father, and there is a widow of a predeceased brother to be maintained. In some circumstances family property can be followed into the hands of a subsequent purchaser to enforce a claim for maintenance.

A widow's right to maintenance ceases on remarriage, and any woman's ceases if she leads an immoral life.

Women's Property. — In some respects and as regards some kinds of property, the ownership by women under Hindu law differs from that by men. These differences depend on the source from which the property is derived. If a woman has inherited property from a male or has obtained it as a gift by her husband or as a share on partition, she does not own it in the same way as a man would do; she obtains only a kind of restricted ownership. She has the full enjoyment and management of it, but she cannot sell it or give it away or dispose of it by will; and at her death it goes not to her heirs but to the heirs of the person from whom she obtained it; her ownership simply comes to an end. If she obtained it by inheritance from a male it will go on her death to the heirs of that male; if as a share on partition, it will be divided among the other shares; if as a gift from her husband, it will go to the heirs of her husband.

In those parts of western India where the *Mayukha* prevails, by exception full rights of property are given to a woman who inherits from a male who belonged to the family in which she was born; *e.g.,* to a daughter inheriting from her father, or to a sister inheriting from her brother. On her death such property devolves as if she had been a man.

The estate of a woman who inherits only for her own life is one of the difficult problems of Hindu law. It is by no means the same as a "life estate" in English law. The woman represents the estate. She can absolutely dispose of it for a necessity or with the next reversioner's consent. She can surrender it to the next reversioner. And a purchaser or mortgagee dealing with a woman owner is especially put to inquire into the necessity or into the real consent of the reversioner, as the case may be. and is bound to act with the very utmost of good faith, because of the habitual seclusion of women of good social standing.

An alienation by a woman. not otherwise justified, is good for her lifetime, apart. of course, from fraud and the like, and a widow with power to adopt devests herself of the estate in favour of the adoptee. A woman owning an estate for life is absolute owner of savings that she effects out of income, and unless she deliberately adds them to the estate they go to her heirs.

There is also *stridhana,* the absolute property of women. The rules of schools and localities as to this vary. The chief sources of it are gifts from blood relations and gifts at marriage, besides the personal earnings of an unmarried woman. Generally *stridhana* is at its owner's complete disposal. The rules as to the inheritance of *stridhana* vary with the school, and even with the locality, and with the origin of the particular property. They favour women more than do the rules of inheritance to males.

Marriage. — The code of Manu enumerates eight kinds of marriage. some of which are barbaric or even savage. Four were "approved" and four "disapproved." Only two still survive — the *Brahma,* an approved form, nominally a gift of the bride by her father to the bridegroom, and, among the lower castes, the *Asura,* a disapproved form, nominally a purchase of the bride by the bridegroom. Marriages of children, which formerly were very common. were forbidden by legislation.

The essential part in a Hindu marriage is the seven steps taken together by bridegroom and bride round the sacred fire. Among the higher castes, the relationships within which marriage is forbidden are extensive. The parties should not belong to the same *gotra,* or large family, and must not be related within six generations on the father's side, or within, probably, five on the mother's. Marriage must be within the caste (*q.v.*) and sometimes, by custom. within the subcaste. Strictly speaking there is no divorce in Hindu law. But divorce is practised by many of the lower castes, and an unchaste wife forfeits all rights except that to "starving maintenance." A Hindu man may marry any number of wives and may have any number concurrently.

A Hindu woman can have only one husband. and strict Hindu law forbade the remarriage of widows, even of virgin widows. Many of the lower castes always allowed widows to remarry, some of them imposing conditions on such remarriage; and Act XV of 1856 made it lawful for any Hindu widow to remarry, although she forfeited on remarriage any property inherited by her from her first husband or from a predeceased son (unless she belonged to a caste which, before 1856, permitted remarriage accompanied by retention of such property) and all rights of maintenance as widow of her first husband. Under Act XXX of 1923 a Hindu man and a Hindu woman of different castes might marry.

Suttee. — The custom of suttee (*q.v.*) or *sati,* whereby a Hindu widow, especially in the higher castes, had herself burned alive on the funeral pyre of her husband, was prohibited and made an offense under Lord William Bentinck's administration in 1829. In consequence suttee fell into desuetude, and educated Hindus would revolt from it. But there were sporadic cases, even as late as 1954. Those who help the widow to immolate herself are guilty of culpable homicide not amounting to murder; if she is above the age of 18 years, the fact that she suffers death with her own consent then reduces the nature of the offense. If she is under 18 the offense is murder or abetment of murder, punishable even with death. The widow's own insistence on becoming *sati* became a feature of all modern cases.

Sonship. — In very ancient Hindu law the son mould seem to have been his father's property, much as he was in ancient Roman law (the common Indo-European ancestry of the Hindu and Roman peoples is reflected in their legendary traditions, some of which bear significantly on this very point of paternal authority).

In Manu eight kinds of sons are enumerated.

Most of them are "sons" because at the moment of birth the woman who bore them was owned by the "father." Some are bought or self-surrendered. Now only two kinds are recognized: legitimate sons born in marriage, and adopted sons (adoption of daughters is mostly unknown to Hindus). There are two extant forms of adoption. the *dattaka* and *kritima.* The former is used all over India. The connection between heirship and the duty of performing obsequies and ceremonials has already been noticed. To secure a Hindu's happiness hereafter, the ceremonials should be carried on by his descendants for at least three generations. A grandson or a great-grandson can, however, make up for the absence of a son or grandson or both. But it is a grave misfortune for a Hindu to have no such descendants at all; so a male Hindu who has no son, agnate grandson or agnate great-grandson may adopt a son. The adopter may be married. a bachelor or a widower.

Among the higher castes the boy must not have been invested with the sacred thread (possibly this would not apply when the child is a brother's son of the adopter or otherwise in the family', and must be the child of a woman whom the adopting father could have married had not someone else done so. So a brother's son and a wife's sister's son are obviously eligible. And the adoption must be within the caste. The child must be willingly given by his natural parents (a boy cannot be readopted); so an orphan cannot be adopted.

Because of the importance of having a Son, the widow of a deceased Hindu can sometimes adopt for him. Of course the condition of sonlessness must exist. Given this, in western India a widow can adopt unless her husband has forbidden her to while he was alive. In southern India she can adopt if in his lifetime her husband authorized it, or if after his death his near agnate relations approve of the adoption. In *Mithila* she cannot adopt at all, and elsewhere she can adopt if in his lifetime her husband authorized her to. These are the varying interpretations of the text "Nor let a woman adopt a son without the consent of her lord."

A married man who adopts does not need his wife's assent to the act, though she may become the adoptee's legal mother. Adoption removes the child entirely from his own family (except that he still cannot marry within its prohibited degrees) and makes him for all legal purposes, including inheritance from and by collaterals, the son of his adoptive father. Ceremonies are necessary, for an adoption is a religious act. Handing over by the natural parent or parents, with a sacred fire at the place, is the principal ceremony, and the absence of evidence of this would throw doubt upon the validity of an adoption, were this disputed. Among some of the lower castes, even a married man can be adopted, and the rule about the mother's being a possible wife of the adopting father does not hold.

A son adopted to a deceased Hindu by his widow becomes the former's heir at once. If there is membership of a *Mitnkshara* joint family, or if the adopting widow has succeeded to. and still possesses, her deceased husband's estate, things are simple enough. But adoptions by widows fail where their effect, if they were valid, would be to devest the estate of someone (other than the adopting widow) who holds it as heir of some deceased male, other than the person to whom it is sought to make the adoption.

This rule is not a mere piece of theory. for if a son adopted dies without male issue there may be authority to adopt one in his place, yet he may have married, in nhich case his widow. not his adoptive mother, will be his heir. An authority to adopt remains effective throughout the life of the widow to whom it is given, so long as she does not exhaust it.

Cases have been known where a widow made a valid adoption more than 50 years after her husband's death.

The conditions stated above, other than that of sonlessness, apply in the case of *dattaka* adoption only. The system of *kritima* adoption is much looser. It is followed now only in *Mithila,* where, as we have seen. a widow never can adopt to her deceased husband. In *krztima* adoption, a sonless man or woman can adopt a son to himself or herself. The adoptee must consent to the adoption and must be of full age. No ceremony is required, only mutual consent. The adopter and the adoptee succeed to each other, but neither succeeds to the other's collaterals. The adoptee is not taken out of his own family. The adoptee performs the obsequies of the adopter if the latter predeceases him. Any person within the caste, even for instance the adopter's brother or his sister's son, can be adopted, and the adoptee may be older than the adopter.

Under the interesting matriarchal system of the Nairs of Malabar, where the joint family is found in its strongest form, the only kind of adoption ever necessary is that of a daughter.

BIBLIOGRAPHY.—Sir Ernest John Trevelyan, *Hindu Law,* 2nd ed. (1917); J. D. Mayne, *Treatise on Hindu Law and Usage,* 10th ed., rev. by Srinivasa Iyengar (Madras, London, 1938); Sir Dinshah Fardunji Mulla, *Principles of Hindu Law,* 10th ed, by Sir V. Ramesam (Calcutta, 1946); J R. Gharpure, *The Collactions of Hindu Law Texts* (Bombay, 1914 *et seq.*); Venkata-Subrahmanya Aiyar, *History of the Development of Hindu Law in British India* (Madras, 1933); *H.* D. Cornish, *A Short Manual of Hindu Law* (London, 1937); Krishna Aiyar. *The Elements of Hindu Law* (Lahore, 1935); K. K. Vaidya, *Principles of Hindu Law* (Bombay, 1934); N. R. Raghavachariar, *Hindu Law, Principles and Precedents* (Madras, 1935); Venkata-Rama Aiyar, *Outlines of Hindu Law* (Madras, 1931); J. Chinna Durai and G. E Miles, *Questions and Answers on Hindu and Mahommedan Law* (London, 1935); A. C. Ghosh, *The Law of Endowments (Hindu and Mahommedan)* (Calcutta, 1938). The "Tagore Law Lectures Series," issued by the University of Calcutta, provides studies by experts on various aspects of Indian law. For further historical treatment *see* Radhavinoda Pala, *History of Hindu Law in the Vedic Age and in the post-Vedic Times Down to the Institutes of Manu* (Calcutta, 1927); H. M. Bhattacharya, *Ethical Foundations of Hindu Jurisprudence* (Calcutta, 1932) (W. MAR.; A. SAB.; X.)

INDIAN LITERATURE. An account of the history of literature in the main Indian languages is to be found in the following articles: BENGALI LANGUAGE AND LITERATURE; BIHARI LANGUAGE: *Literature;* GUJARATI AND RAJASTHANI LANGUAGES: *Literature;* HINDI AND URDU LITERATURE; MARATHI: *Literature;* PALI LANGUAGE AND LITERATURE; PRAKRIT LANGUAGES: *Prakrit Literature;* SANSKRIT LANGUAGE AND LITERATURE. The present article is concerned chiefly with general considerations of literary activity in mid-20th century India.

In India literature is polyglot, and an adequate comparison with western letters can be made only by considering Europe as a whole. In Europe, despite a variety of languages, the approach is more or less uniform and the responses predictable; and a similarity of social conditions and outlook throughout the continent makes the same problems interesting everywhere. In India, however, an analysis must be made at various levels.

Nearly 5,000,000 out of a total population of more than 350,000,000 have a knowledge of English, and new English publications are quickly available. Moreover, there is no branch of English literary activity in which Indian writers have not claimed consideration. In every field of the humanities there have been Indians who have thought in English and expressed themselves with facility. This very large output of writings is, however, Indian only in authorship and frequently in subject, but rarely in spirit and manner. The conscious effort to master a foreign language sometimes results in a self-conscious elegance, an undue emphasis on semantic chastity and a tendency to overwrite; but otherwise there is little that is distinctively Indian about the approach and outlook.

Of the writings in Indian languages, much is a continuation of ancient modes and conceptions. But, thanks to the opening of windows which was a consequence of British rule, there are many translations or adaptations of works in European languages and a great mass of literature which is simply copied from European models. A later and the most flourishing stage is represented by that vernacular literature which, while it has absorbed European influences, has yet recovered an Indian outlook and temper. Born as the cultural counterpart of Indian nationalism, it gained strength after the attainment of independence.

There are 14 major Indian languages—Assamese. Bengali, Gujarati, Hindi, Kanarese (or Kannada), Kashmiri, Malayalam, Marathi, Oriya, Punjabi, Sanskrit, Tamil, Telugu and Urdu—each with a sturdy literature of its own. Sanskrit is not spoken, but is the chief classical language of India and new philosophical, philological

and religious works in this language are not infrequent. Occasionally new poems and dramas of considerable extent and literary merit also appear. Other classical languages used in India are: (1) Prakrit, normally the language of the Jains and used in books published in Bombay state or in the Hindi or Marwari-speaking area; (2) the Buddhist Pali, rare in India; (3) Tibetan, published at Calcutta and Darjeeling; (4) the Pahlavi of the Parsees, published in Pahlavi or Gujarati script in Bombay state; (5) Arabic, appearing chiefly in Delhi, Lucknow and Hyderabad (Deccan); (6) Persian, more occasional. Many of the vernacular languages, chiefly the Dravidian group, Tamil. Telugu, Kanarese and Malayalam, also have their old or classical periods; re-editions of their classical works are very frequent, and for the most part are published within the areas of the respective vernaculars.

Translations of Sanskrit works are innumerable in nearly all the vernaculars, the Hindu epic Bhagavadgita, for instance. being reproduced many times every year; and some of the same favour extends to several of the local classics. Among modem writers Rabindranath Tagore, Mohandas K. Gandhi and Jawaharlal Nehru have a vogue in several languages; and popular novels are frequently translated. India is indeed the paradise of translators. But the main way in which the Indian languages can draw on each other is still through the common medium of English. This was given striking recognition at the inauguration of a national academy of letters in Delhi in 1954. Its very name — Sahitya Akademi — legitimizes the hybrid culture of modern India, sahitya being Sanskrit for "letters" and akademi the Indianized version of the Greek word. All its proceedings are in English. The Akademi arranges for the translation of well-known vernacular works into all Indian languages. Attempts are being made to replace the English language by Hindi. The 1950 constitution of India laid down that Hindi should be the official language of the union and should replace English after 15 years. As Hindi is used by less than half the population. the government of India encourages its study in non-Hindi speaking areas, persuading state governments to make it a compulsory subject in schools and compiling, with the help of expert committees, Hindi dictionaries of technical terms. In the mid-1950s, however, it remained to be seen whether this effort to make Hindi the national language would succeed. A major obstacle is the script: some adopt the Roman and others the Devanagari; and most of the other leading languages have their own traditional scripts.

Popular Literature. — To begin with the lowest stratum, the existence in India must be noted of an extensive, really popular, literature in verse. In all parts of India, but especially in the Punjab, the Kanarese country and the Tamil area, there is a constant output of songs and ballads, provoked by any notable occasion, such as a prize fight, a flood or calamity, a crime, a tragedy, the rise or fall of a personality, a social event, an act of administration; these have a real though often brief life upon the lips of the people, who sing them over their work or at their social gatherings. In mid-20th century this form was largely used for political propaganda, innumerable small collections of national songs appearing in all the chief languages. The best and the most long-lived of these are the stirring lyrical compositions in Tamil of Bharathi. There are also many collections of songs for special occasions; *Garbhi* songs for women, marriage songs, songs for the Holi (spring) festival and other celebrations, boat songs for aquatic sports in Orissa and Bengal, and so forth. At certain times of the year the Moslems put forth vast quantities of "verses" in honour of Mohammed or dirges for Hasan and Husain, grandsons of the prophet. Religion has a large part in this poetic activity: songs in honour of Krishna throughout India, of the mystic Chaitanya in Bengal and of Maratha saints in the west; songs for pilgrims in the Telugu and Tamil areas; songs for temple rites; collections of Jain hymns; and the many publications of Christian sects. Not all such popular literature is, however, in verse, since there are occasions when sacred stories in prose are narrated in or near the temples.

An oral tradition also attaches to much of the various classical writings of India. This is the case not only with Sanskrit works such as the epics Mahubharata and *Ramayana,* some parts of the Puranas, and some stories, such as those of the god Savitri and King Harischandra (*q.v.*), but also with the classics of the several vernaculars. Not to mention the substance of stories and legends, the texts of such poets as Kabir and Tulsi Das (*q.v.*) in the Hindi area; Vidyapati Thakur, Govind Das and many others in Bengal; Narsinh Mehta, Mira Bai and Premanand in Gujarat: Namdev and Tukaram in the Marathi country; the woman philosophical poet Lalladevi in Kashmir and the Vaishnava and Saiva saints and moralists of the Tamil country are very familiar on the lips of ordinary people in their respective areas. Besides being used in education, they are frequently re-edited. In the Punjab some parts of the Sikh *Granth* (*q.v.*) are similarly used.

Between the oral and the literary streams stands the drama. In India it is indigenous in many forms, from the heroic to the morality, the miracle play, the farce and the shadow or puppet show. These popular forms of representation. which had more or less disappeared in all parts of India except the extreme south, are now being revived and encouraged. The ordinary play, produced chiefly in Calcutta. Bombay and Madras, is similar to the European form, and presents melodrama, social sketch, burlesque. problem play, love story, and so forth. The more literary drama, still sometimes in Sanskrit, takes its subjects chiefly from old Indian poetry and legend, and is often an adaptation of well-known Sanskrit works.

The pabulum of the ordinary reader in India is furnished by the magazine, containing essays, biographies and descriptions, short stories and serials, notes and illustrations. The total output is enormous; but the standards are very low. This literature presents a big problem to the bibliographer, and the Sahitya Akademi has taken up the task of cataloguing. Schools and colleges have their organs (usually bilingual), in English and the regional language). Trades and the business world, professions (teaching, medicine. law, astrology, etc.) and grades of the official service all contribute to the mass of English and vernacular matter. The cinema, music and the stage are represented by popular periodicals. Special interests. such as the cause of women, social service. co-operation, labour, economics, business, arts and sciences, travel and boy scouting, are similarly equipped. There are, however, few political periodicals of any standing. The chief vernaculars usually have at least one literary periodical of a fairly high standard. Some of these literary journals have flourished for a long time.

Modern Indian poetry, other than translations and adaptations of old Sanskrit works and themes, is usually in the form of short lyrics issued in small volumes. This form was made fashionable by Rabindranath Tagore (*q.v.*), whose poems, originally written in Bengali, were translated into all the major Indian languages after they attained fame in English. Larger productions are for the most part collected works of single authors. or anthologies. or the outcome of literary "eisteddfods" (mushairas). In the Hindi area the old style ballad is longer, as are Tamil kavyas on classical models. The poetry is generally ethical, philosophical or religious; but the satirical and controversial and. as we have seen, the political, claim a place. The verse forms not only manifest original power, but are greatly influenced by developments in the west; T. S. Eliot, for instance, has had considerable influence on Hindi and Bengali poetry.

Fiction on European lines is making rapid headway in India, and is supplanting the old romantic tales. at least so far as prose is concerned. The novel is popular both in the form of the short story and of more substantial books; and it reflects all the varieties of subjects which have a vogue in English, historical, social, romantic and adventurous (including the detective novel). But political and economic factors have been prominent in the. novels of the best writers, such as those in Bengali of Bankim Chandra Chatterji, and in Hindi of Premchand; and this tradition continued even after 1947.

Religious Literature. — Indian religious literature, in so far as it is not lyrical, philosophical, argumentative or philological, consists mainly of manuals of ritual for daily life (dinacarya) or for particular occasions (marriage, burial, times and seasons, pilgrimages and vows), and of the stories associated with them.

Since each section, from the Vedic Sakhas downward, must have its separate rituals, the number of such publications is naturally very great.

The reproduction of old canonical texts. with or without commentaries, not for purposes of ritual but for study and edification, accounts for a great mass of republication in the Punjab: there is, for instance, a steady stream of thick volumes of selections from the Adi-granth. Important religious groups usually have one or more periodicals. which. among other things. publish and comment upon their authoritative books. Philosophy is still more popular, in the real sense. in India than in any other part of the world. but the emphasis is more on theology, mysticism and comparative religion than on epistemology and logical positivism. The writings of Sarvepalli Radhakrishnan have helped to strengthen this trend.

Philology. — Philology of a more general character is no longer in India restricted to one or two classical languages. There are societies which devote themselves to the publication of old texts in the existing vernaculars. The Bangiya Sahitya Parishat, with its Pattrika (journal) and its series of separate old Bengali texts, has a very honourable record. The Tamil Sangam of Madura (which issues the *Sentamil*) is likewise distinguished. There are other Sahitya Parishats in West Bengal. and for Telugu there is the Andhra Sahitya Parishat.

For Hindi there is the Nagaripracharini Sabha; for the Punjab the Khalsa Tract society; in Gujarat the oldest is the Gujarat Vernacular society, while there is also a Sahitya Parishat, and a Sahitya-Vardhana society; in Marathi an important series of editions of old poetry was published under the title *Kavya*-samgraha.

Literary Research. — Philological activity, also found in association with the investigation of archaeology and pre-British history (and from which we may exclude the astounding output of educational works up to the level of university textbooks), is connected chiefly with organizations of some kind. The government of India itself maintains an archaeological survey which publishes annual reports in the several states and at headquarters, and special monographs as well as two periodicals relating to archaeology and epigraphy. Several state governments have published catalogues of Sanskrit manuscripts.

After the governments may be mentioned the universities. colleges and libraries. also active in the publication of texts and research results (especially the universities of Calcutta. Madras and Benares). Important journals are issued by societies (such as the Asiatic Society of Bengal. which has also published a *Bibliotheca Indica*, a vast collection of Sanskrit, Arabic. Persian and Tibetan texts: the Bombay branch of the Royal Asiatic society; the Bihar and Orissa Research society; the Hyderabad Archaeological society; the Bhandarkar Oriental institute) and some are occasionally started independently or by religious bodies. Private organizations have also undertaken the editing of encyclopaedias in the various languages. The books issued by authors, editors or individual publishers are. however. more numerous. Much is highly meritorious. some of it equal to the best productions of Europe. The monumental Linguistic *Survey of* India, edited by Sir George Grierson for the government of India, was completed in 1928.

History and Biography. — For educational purposes and general reading many short histories of India. of England and of other countries are produced both in English and in the vernaculars. Original research and independent judgment are to be found in the monographs and studies of particular regions, dynasties and viceroys: and the output of Indian historical scholarship is increasing. The Indian History congress has undertaken the publication in 24 volumes of a standard history of India. The government of India is sponsoring a history of the freedom movement in India. The National Archives of India edits and calendars English and Persian documents dealing with British rule and publishes a journal which is one of the best of its kind. Many volumes of records and calendars in English have also been published by local governments: the gazetteers also are replete with historical information not absorbed in formal histories: and the *Journal* of *Indian* History, the proceedings of the annual Indian History congress and the organs of the Bengal Historical society, the Punjab Historical society and the Uttar Pradesh Historical society are composed of original matter.

Biography, including autobiography, is now popular in India. The best-known are the autobiographies of Mohandas K. Gandhi (originally written in Gujarati) and Jawaharlal Nehru. but there are also memoirs of many other well-known personages. Biographies of historical figures and important religious leaders are also increasing in number. D. G. Tendulkar's 8-vol. *Mahatma; Life* of *Mohandas Karamchand Gandhi* was published in 1951–52. The number of short "lives" of popular heroes, such as B. G. Tilak, G. K. Gokhale and Gandhi. is beyond counting. A very favourite form, of which there are old examples, is the serial biography. containing lives of saints, lives of famous women and hierarchical, dynastic and family biographies. Valuable work of this kind has been done in regard to the Tamil and Telugu saints and poets, and the poets of Bengal and Gujarat. The old form of biography in verse is still favoured in relation to saintly and historical characters; naturally. it has aims other than information and research. Many Indians have written accounts of their travels abroad: but India itself furnishes rich material and occasions for travellers' experiences, especially with its shrines and pilgrimages. Jawaharlal Nehru's Discovery of India is no isolated phenomenon.

See M. Winternitz, *A* History *of* Indian Literature (Calcutta, 1927 ff.) ; H. N. Das Gupta, The Indian Stage, 4 vol. (Calcutta, 1934–44).

(S. GL.)

INDIAN **MUSIC.** The music of India has a double interest. It offers the most complete example. in theory and practice, of melody untouched by harmony; hence. it provides a key to the problems of ancient Greek music, which have fascinated scholars and musicians.

Musical literature refers not seldom to the "laws of melody," but makes no attempt to formulate them. because European melody is always harmonized. and it is nearly impossible to say what part of it belongs to harmony and what to melody. From a system innocent of harmony, like the Indian, we realize that: (1) Melody swings. in the first instance, on two pivots — the vocal tonic (amsha), a sort of "ecclesiastical" dominant. at a pitch that varies nith the mode, and the tonic in our sense of the word supported by a drone (kharaj) and, secondarily, on notes related as fourth or fifth to either of these On this varying distance between the two tonics depends mainly the character of the mode (*rāg*), poignant, if the *amsha* is high, festive or placid, if low. (2) There is a general contrast of major and minor, but the third of the scale is no more decisive of this than the seventh. sixth or second: the ethos of the minor is not so much sad as elaborate and reflective, and is graduated or intensified by shades of intonation nhich we do not possess (3) **A** melody is conceived as lying within, or round, the tetrachord though the second part of it may spring to the upper octave. just as. with us, it would adjourn to a key of contrast. (4) The motion is mainly conjunct; intervals which strike us as odd (augmented second or augmented fourth) are justified as motion to or from the *amsha*. (5) The octave contains. like ours, seven notes (it is called *saptaka*, a set of seven), with possibly an eighth or ninth as an alternative. not an addition. The "quartertones" (shruti) have been entirely misconceived by European uriters. They do not provide a scale of 22 notes through which the voice threads its precarious path. but are in use as increments of intervals well-known to us, and lend them an exhilarating or pathetic colouring. (Thus, from a tonic C, the sixth. A will have 884 accents in one mode, 906 in another, B flat, similarly. 996 or 1.018.) The Indians have. in fact preserved distinctions which we have merged by our "temperaments." and non employ them for a musical purpose; just as grammar will sometimes employ different forms (nosco and *novi;* ken, can and know) for different meanings. (6) Melody centres in the mode. The amateur knons a dozen of them, the professional at least five. perhaps ten, dozen. (It is customary to say that we have only tao modes, major and minor; but for those who consider the history and the implications of the Neapolitan sixth. the German and diminished sevenths. etc., there are more than two.) The modes are differentiated

by *(a)* their amshas, (b) the flat (komal) and sharp (tivra), or the very flat and very sharp notes (*atikomal, atitivra*) and (*c*) the amount of transilience, *i.e.,* whether they are of five, six or seven notes in all. The various admixture of these elements gives each mode its flavour (raga), and this is emphasized by assigning the mode to a particular hour of the day or season of the year.

We conceive musical times as multiples, they as sums. We take $\frac{6}{8}$ as 3×2, and $\frac{9}{8}$ as 3×3; they, as $3+1+2$ and $5+2+2$ (or $4+2+3$, or in some other way). In these three instances, to go no farther, they are representing the dactyl (– ∪ ∪) of their prosody, and allowing for (a) different lengths of short syllable and (b) different proportions of long to short. They have dealt similarly with trochee (– ∪), iambic (∪ –) and anapaest (∪ ∪ –). The tribach (∪ ∪ ∪) they treat as three crotchets and a crotchet rest, thus arriving at common time, which they call "three-time." Such procedure soon becomes far too elaborate to follow out here, though, in practice, they confine themselves to only a dozen kinds of time.

But, in whatever time it may be, the essence of an Indian melody it that it employs cross rhythm. Singer and drummer converge upon a point; one sings seven bars of ten units perhaps, while the other drums ten bars of seven units; or the drummer's two hands beat different times, one $2+2+2$ and the other $3+3$; or one hand starts at the beginning and the other in the middle of the bar, in different times, and they converge half a dozen bars later. The audience appreciates such a point, and waits for it.

In the absence of harmony, grace-notes are important, to emphasize one moment as against another. The couple of dozen graces that are practised are, in principle, two—the slide (as on the violin) and the "deflect" (as produced by the tangent of a clavichord). The eminence of a performer is largely decided by his skill in these, and he uses them to accentuate the essential notes of the mode.

The chief instruments are (1) ***vim,*** with three drone strings, and four fretted strings on the finger board, plucked like, and with the tone of, the guitar; (2) sitar, a simpler form of guitar, more easily played, with less noble tone, native to Bengal; (3) *sārangi,* an elementary violin, used for the nautsch; (4) *surnai,* a hautboy of strident tone; (5) various drums, the most important being the tabla, a small pair, played one by each hand; and, in the jungle (6) the *banshri,* bamboo flute, of varying size, scale and compass. Concerted music, vocal or instrumental, is rare, and is in unison. (A. H. F. S.)

INDIAN MUTINY, THE, the great revolt of the Bengal native army in 1857 which led to the transference of the government of India from the East India Company to the Crown in 1858. This mutiny, accompanied by rebellion of the population in many parts and of some of the chieftains of India, was due to many causes, some of which remain a matter of controversy to this day. Whatever were the ultimate political and psychological reasons underlying the rebellion, the increasing of the native army to implement the holding of the newly acquired territories of Oudh, the Punjab and Sind, out of all proportion to the European garrison, together with a reduction of that small garrison during the Crimean and Persian campaigns, made a mutiny possible and sufficiently attractive to catch up into its whirlwind the discontented political elements.

During the 100 years which had elapsed since the battle of Plassey, the East India company had risen, through the crumbling of the central power of the Mogul empire, from being the mandatory of that empire for the government of certain coastal tracts, to the control of the whole of the Indian peninsula. In overcoming the various warring principalities into which the Mogul power had broken up, the instruments were largely Indian soldiers themselves, who had eagerly followed the British who were proud to lead them. A vast army modelled on the British Line[1] and clothed to resemble it had sprung up, with all the complicated machinery and traditions of a regular standing army. Elated at the success which attended the British arms, the martial races eagerly enlisted under the Union Jack, and served gallantly and faithfully, fighting more than once against the French and sailing as far as Mauritius, Egypt and Java to take part in the wars against Napoleon. But ever behind this great native army marched as a hammerhead European corps, some enlisted for the service of the company, but chiefly consisting of the British Line. The European units always bore the brunt of the hardest service. The vast native army was organized in three distinct lines, under the presidencies of Bengal, Madras and Bombay. The native army of Bengal was by far the largest, and the three armies, in addition to the line, had developed many local corps, regular and irregular, while the larger native states also maintained contingents under treaty, trained as a rule after the manner of the Bengal army and officered by British officers, which enlisted in many cases the same races as furnished the Bengal Line.

[1] Line—an *organized regular army.*

The Bengal army and indeed the whole of India were shaken by the disasters which, for the first time, overcame the company's forces in Afghanistan in 1841–42. In the wars with the Sikhs (1846–49) the fighting and the nature of the foe were far more formidable than previously experienced; the European troops had to bear a more forward part than ever in the great battles of that war, and the prestige of the Bengal army was to some extent threatened.

There had been several untoward military incidents in the 50 years preceding 1857. As early, indeed, as 1764 it had been necessary to quell mutiny by the usual oriental punishment of blowing away the offenders from the guns, when 30 sepoys (*i.e.,* soldiers, from *sipahi;* cf. the form *spahi* in the French African army) were so disposed of.

In 1806 a serious mutiny was brewing in the Madras army, partly born of the overintroduction of European-pattern clothes and accoutrements. In 1824 the 47th Bengal native infantry refused to march when it was ordered for active service in Burma and, after being somewhat severely handled by European artillery, was disbanded. In 1844 no less than seven battalions of the Bengal army broke into open mutiny over the question of allowances when garrisoning newly acquired provinces. It was to be noticed that the sterner measures of earlier days were not taken and the corps involved for the most part remained in the service.

But there were not wanting those who saw further and thought harder. Lord Ellenborough often said that a general mutiny of the native army was the only real danger with which the British empire in India was threatened. His warning was solemnly repeated by Sir Charles Napier as commander in chief, who based his warning on the many defects which had gradually crept into the military system.

General John Jacob of the Bombay army uttered still more forcible warnings during the years immediately preceding the mutiny.

Sir Henry Lawrence, than whom no greater authority existed, frequently warned all and sundry that things were not right and that what had occurred at Kabul might happen at Delhi.

There can be little doubt that the social reforms of Lord Dalhousie and his predecessors had disturbed many men's minds. The prohibition of suttee (*q.v.*) and female infanticide, the subordination of Brahmans to the ordinary criminal laws, all tended to cause bitterness and alarm. The landowning class, especially among the Mohammedans, found that British rule meant curtailment of inordinate privileges and fair .treatment for the poor, while at times British zeal for justice pressed unduly on these ancient classes.

The Greased Cartridge and the **Chappattis.**—To this accumulation of inflammatory material a spark was put in 1857 by a strange but intelligible oversight on the part of the authorities responsible for the manufacture of ammunition. The use of the Minie or Enfield rifle involved a cartridge with a heavily greased patch at the end, The use of the cartridge for muzzle-loading muskets had always demanded the biting of the end and the pouring of the powder thus released into the barrel. Then occurred an altercation at Dumdum between a high-class Bengal sepoy and a low-caste employe of the arsenal and the hurling of a gibe by the latter as to the utter defilement involved in the use of the

new cartridge. The news spread. Officers, when they heard of the trouble, took the matter up; and it was decided that whatever material had been used, clarified butter was to be the future ingredient. It was also arranged that men Should grease their own materials. But the mischief had been done, and the clever brains which had been plotting against the British found a stimulant. There is no doubt that the first cartridges did contain material that would be entirely unclean, and there is no doubt that the fears of the sepoys were genuine.

At this time, too, when half India was agape and looked for a portent, the strange phenomenon of the *chappattis* occurred. The ordinary unleavened cakes of household use seemed to be passing round. A village watchman arrived at a village, distributed a cake, saying, "To the north, the south, the east and the west," with injunctions to make four more and increase the snowball. No one knew why they came. The watchmen only knew that someone had brought them. But it was known that in the past similar appearances had taken place in time of trouble.

The first signs of the approaching upheaval were displayed at the great military station of Barrackpore, 16 mi. from Calcutta, in Jan. 1857. The rumour regarding the cartridges, which had originated at the adjacent Dumdum, had much inflamed the minds of the sepoys quartered there. The well-known sign of unrest, incendiary fires, broke out in the lines. Fortunately General Hearsey was perhaps the best known and most experienced sepoy general in India, and active withal. Trouble was for the time laid by his judicious handling, but he warned the government that he was sitting at Barrackpore on a mine ready for explosion. A month later the 19th Bengal infantry at Berhampur refused to receive their percussion caps, on the ground that to use the new cartridge meant defilement. The absence of any European troops necessitated a temporizing policy. The battalion was, however, ordered to march to Barrackpore for disbandment. Two days before its arrival, on March 29, a sepoy named Mangal Pandi[1] endeavoured to provoke an outbreak in his regiment, the 34th native infantry, shooting the adjutant who interfered and cutting down the European sergeant major of the battalion. The regimental guard failed to take action, but General Hearsey, who happened to be riding by, rode at the mutineer.

At this juncture, the gravest which had ever befallen the British in India, the commander in chief and his office, with all the military heads, were separated from the governor general and the government by many hundreds of miles. Calcutta was the headquarters of government, and though on occasion the governors general had summered at Simla during the wars with Afghanistan and the Sikhs, the offices and the ministers did not move. The commander in chief, finding that the major portion of his army was in the north, had made Simla his headquarters. The absence of the commander in chief and the adjutant general from the seat of government at this period made any concerted policy impossible.

The Outbreak at Meerut.—By May 10 the situation developed in grim earnest, and what had fizzled at Berhampur and Barrackpore broke into flame at Meerut. Meerut was the largest station south of the Punjab, commanded by Major General Hewitt and containing a considerable European garrison; viz., the carabineers, the 60th rifles and two troops of Bengal horse artillery, with the headquarters and principal depot of the Bengal artillery, commanded by Brig. Archdale Wilson. Meerut was originally instituted to watch Delhi and the Maratha frontier. The native troops were the 3rd light cavalry (a regular and nonsilladar corps) and the 11th and 20th Bengal native infantry.

The officer commanding the cavalry, who had lately returned from leave, decided that the cartridge question must be faced and ordered the sharpshooters of his regiment to receive the cartridge and practise the new loading drill. Eighty-five of the men refused, were tried by a native court-martial and sentenced to long terms of imprisonment for mutiny. At a general parade of the garrison the convicts were degraded and put in irons.

Just before dusk on the day succeeding the punishment parade, a Sunday, the native garrison broke out into open mutiny. The cavalry saddled and mounted and galloped to the jail to release their comrades. The 11th infantry shot the colonel of the 20th and fell on any of their own officers who came their way. The European and Indian barracks lay some distance apart. At Meerut the two portions of the cantonment, divided by a deep watercourse, were especially distinct. While the mutineers were murdering all Europeans that they came across, aided by all the ruffians who inhabit an Indian bazaar, the British troops, unaware of what was happening, were about to turn out for church parade which, at that season, was held in the evening, when the sound of firing broke on their ears. Fortunately the rifles were not in church and hurried to get under arms. The regimental sergeant major ordered the men to change from white cotton to their green clothing. When the British troops marched to the scene of the conflagration the mutineers were gone. A few rounds in the direction of the native lines cleared out any stragglers. The scenes of outrage did not continue. The cantonment was surrounded with woods and villages, and there were large numbers of women and children to be collected in a central place of refuge. The carabineers themselves were hardly a regiment in fact. Just out from Europe to replace a regiment sent to the Crimea, they were largely young soldiers, mounted on walers[1] as yet only half trained. No one thought that the excited rabble of soldiers without their leaders was going to march straight to face the orderly brigade at Delhi, or that anyone could think of restoring the Mogul dynasty.

Delhi.—Whether, had the situation been grasped and correctly interpreted, Delhi could have been saved, can only be a matter of opinion. It has, however, been said that matters had gone too far for any local action to prevent the rebellion and that Delhi, acting as a focus of the disease in the north, served a valuable purpose and contributed to its eventual suppression in a manner that could not have been foreseen. Early in the morning the mutinous cavalry reached Delhi, to be followed by parties of tramping redcoat sepoys. Attempts were made to prevent their entering the city and palace, but troops sent cheering from the cantonment three miles away soon fraternized with the mutineers; officers were shot down on all sides. The city and palace rabble hastened to massacre all Europeans and Christians. Those who took refuge in the palace were soon butchered. The whole of the civil lines which lay within the city wall became a shambles. Up on the ridge which lay between the cantonment and the city the brigadier with half his garrison stood to arms till dusk, the Europeans clustered at a small tower, the troops muttering and restless. Within the city walls, one of the most famous incidents in British history was taking place. Between the Kashmir gate and the fortress-palace stood the great arsenal of upper India, left by some strange folly entirely in the hands of Indian troops and within the city. Sir Charles Napier, when commander in chief, had protested, and the magazine itself had been moved to the end of the ridge in the cantonment. Within the arsenal there was an immense park of cannon, with a small "expense" magazine in which small-arms ammunition was made up. After defending the arsenal for as long as possible the resolute young artillery officers and warrant officers of the arsenal establishment, under Lieutenant Willoughby, blew up their magazine, causing great damage to their assailants. This act, however, had not the effect generally supposed, for unfortunately Sir Charles Napier's forethought in moving the main magazine had but resulted in its falling into the mutineers' hands. Without its contents (3,000 bbl. of powder) the defense of Delhi by the mutineers would have been impossible. At sunset the remnant of the Europeans left Delhi for Meerut and Umballa as best they could. The Mogul former king was proclaimed by the soldiery and was put at the head of the rebellion.

One hundred and twenty miles north of Delhi lay the great military station of Umballa, the headquarters of a large military district commanded by Maj. Gen. Henry Barnard of Crimean fame, which being in the newly occupied Punjab had many European troops. Of these, three battalions of European infantry were in the Simla hills for the summer, 60 to 80 mi. farther away. At Umballa itself were the 9th lancers and two troops of European artillery with several native units. The commander in chief, Gen. George

[1]From whose name, a common patronymic of Oudh Brahmans, the mutineers became known as "Pandies."

[1]Australian horses from New South Wales.

Anson, at once ordered all the Europeans in the Simla hills to march to the plains; the commander at Umballa was to get ready his force to march to Delhi. It was some days before the troops could be got down from the hills and supplies and transport collected.

It must be remembered that there were practically no railways in India in 1857 and that the mutiny occurred in the height of the hot season. On May 17, six days after the outbreak at Delhi, the leading portion of the commander in chief's forces left Umballa for Kurnal, about 50 mi. down the Grand Trunk road, followed by a stream of detachments. The commander in chief proceeded to Kurnal on May 23 and died there of cholera four days later.

With the rising at Delhi and the proclamation of the former king of Delhi to the throne of his fathers, the whole of the Bengal army, from Calcutta to Delhi, broke into revolt. At some stations the influence of individual officers held the regiments for a time, but with a few exceptions the whole of the Bengal army and the contingents of the central Indian states caught the contagion. Scenes of tragedy and horror were enacted all over the Bengal presidency, especially along the great waterways of the Ganges and the Jumna. But from Calcutta to Meerut, a marching distance of 1,000 mi., the European garrisons were extremely small.

At Lucknow, with one British battalion, Sir Henry Lawrence kept his troops in hand for weeks. At Cawnpore Sir Hugh Wheeler, experienced but aged, tried to maintain a bold face with a few Europeans sent him by Lawrence. At Agra one European battalion held the great fortress and became a refuge for all the neighbouring provinces. As soon as the gravity of the situation was realized by Lord Canning, the governor general, attempts were made to apply the only remedy, reinforcements of European troops. A battalion from Burma had been brought over when the trouble at Barrackpore had occurred. An expedition on the way to China was now summoned to help, and the European portion of the Persia expedition now returning to India was hurried to Calcutta.

With the upper provinces isolated and telegraphs cut, with the commander in chief dead at Kurnal, it was necessary to organize a new chief command. Gen. Sir Patrick Grant, the most famous of the Bengal sepoy officers of the day, was summoned from Madras, where he was provincial commander in chief. The pacification of the lower provinces first demanded the dispatch of such small columns as could be organized to relieve the two officers in the greatest danger—Sir Hugh Wheeler at Cawnpore and Sir Henry Lawrence at Lucknow.

To help the small stations was impossible. The restoration of order at the centre would automatically relieve them. Only in the Punjab, the most important of all the provinces, was the situation reassuring, and this for four reasons: first and foremost, the presence of a far larger number of European troops in the newly acquired provinces; second, the commanding character of the ruler, Sir John Lawrence; third, the fact that the Punjabis had recently been beaten by the British and liked their new masters; fourth, the pick of the young men of the Indian services were in civil and military employment in the north. Maj. Gen. Thomas Reed, the senior general in the Punjab, went off to Delhi to assume the provisional chiefship when Anson died, to break down immediately from his exertions. But at Peshawar, the brigadier, Sidney Cotton, was a tower of strength.

The eagerness, indeed, of Lawrence caused him to overlook the problem of moving Europeans in the Punjab summer and the want of carriage and equipment, nor did he at first realize the character of the revolt. Seeing that Delhi was the focus and should be recovered at all costs, and finding that even the combined Meerut and Umballa force could not take the city, he poured his British troops down, raising also innumerable levies to replace the Bengal troops, who were disarmed at many stations. His boldness and that of Sidney Cotton, Neville Chamberlain and John Nicholson charmed the wild Afghan and frontier tribes, who flocked to serve and share in the loot of Delhi. The amir of Kabul, contrary to expectation, held by his alliance and refrained from attacking the British. Lawrence gambled and won. But it required every man he could raise before Delhi could be taken.

By June the combined forces from Meerut, under Gen. Sir Henry Barnard, the commander of the Umballa division, and Brig. Gen. Archdale Wilson from Meerut, defeated the rebels in three engagements and found themselves once again in the cantonment of Delhi.

The final reinforcements reached the ridge from the Punjab late in August, under Brig. Gen. John Nicholson, who had hitherto passed rapidly up and down the Punjab disarming Bengali garrisons. With him came the last supplies of siege guns and ammunition. The siege batteries then opened an intense fire on a short front of wall and bastion. At dawn on Sept. 14 three columns moved against the city, two attacking the breaches and the third blowing in the Kashmir gate. The walls on the ridge side were soon in British hands, but Nicholson was mortally wounded. Days of severe fighting were necessary to clear out the city and gain the fortress-palace. This finally done, the former king was captured at Humayun's tomb outside Delhi and the sons shot to avoid a rescue. The fittest of the troops then started south to relieve Agra.

Relief of Lucknow.—The course of the mutiny had four distinct phases: (1) that of the outbreak, and the recapture of Delhi with the British garrison and Punjab troops which were chiefly stationed in the north of India; (2) the coming of reinforcements and the restoration of order along the course of the Ganges, with the relief of Lucknow; (3) the final capture of Lucknow in the spring of 1858 and the destruction of the second great centre of rebellion; and (4) the pacification of the country.

Sir Patrick Grant on his arrival had found a government in a military crisis, with no military headquarters. Not one high official of the staff of the army nor any of its machinery was available. It was necessary to improvise and reconstruct an army machinery which would handle the large forces arriving for what was now clearly seen to be the reconquest, not only of Bengal, but of most of central India, to which the conflagration had now spread. Very soon came the news that government at home had appointed Sir Colin Campbell to succeed Anson, and Grant could occupy himself only with making a machine for Campbell to use. He did, however, push forward as soon as possible a column to relieve General Wheeler at Cawnpore and Sir Henry Lawrence at Lucknow, pushing up first Col. J. G. S. Neill and his Madras fusiliers and then, as soon as he arrived, Gen. Sir Henry Havelock with more reinforcements.

The trunk road up country from Calcutta led straight across country to Benares on the Ganges, a distance of about 380 mi., of which the first 100 mi. could be travelled on the recently opened commencement of the railway. Eighty miles farther lay the Mogul fortress of Allahabad at the junction of the Ganges and Jumna, and 120 mi. beyond was the important military centre of Cawnpore, which had long watched the adjacent state of Oudh. At Cawnpore was Sir Hugh Wheeler's headquarters, with four native regiments and one European field battery. At Lucknow, 45 mi. distant, the headquarters of Sir Henry Lawrence and the administration of Oudh, was a European battalion and a large native force. Wheeler, greatly experienced in the sepoy army, realized that his troops were likely to mutiny and that it must be a race against time. He was encumbered with a large number of women and children. It was essential to find a place of refuge, and choice lay between a fortified magazine a long way from the cantonment at the other side of the native city and some disused hospital buildings, still unfortified, on the parade ground. Because it would have been difficult to move to the magazine and in order to be easily accessible to the reinforcements expected early from the south, Lawrence decided on the hospital buildings. A company of the 32nd foot from Lucknow came in to help garrison the entrenchment, into which most of the Europeans moved on May 21. On May 31 about 150 men of the 84th foot from Burma and a few Madras fusiliers arrived. Believing that the crisis was passing, Wheeler sent a company of the 84th on to Lucknow. The total force of possible combatants in the entrenchment now was about 450 men, including civilian Europeans and Eurasians, with

six guns, but there were 330 women and children. On June 4 and 5, the sepoys mutinied and marched for Delhi. But there lived, near Cawnpore, one Dandu Panth, the Nana Sahib, adopted son of the former peshwa,[1] who prevailed on the mutineers to return and attack the entrenchment, which they did on June 6.

From June 6 to June 24 the garrison held out against heavy bombardment and at last, worn out with heat and sickness, surrendered on promise of safe conduct by boat to Allahabad. Then followed the infamous massacre at the boats and the collection of women and children to be murdered later. Neill and his Madras fusiliers, pushing up from the railhead by bullock train and route march through great heat and heavy rain, first reached Benares in time to quell a mutiny there and then threw themselves into Allahabad, still garrisoned by a few artillery invalids and some Sikhs. There Neill collected supplies, pushed parties up the road and awaited Havelock, who was able to leave Allahabad on July 7, some of his troops moving by road and some by steamer. After several engagements with the mutineers Havelock heavily defeated their main force outside Cawnpore on July 16, to find that all the women and children had been hacked to death in a small house known as the Bibi-ghar the night before.

Their bodies, some still breathing, were thrown down a well, on which now stands a monument. No act in the mutiny raised so fierce a storm of anger.

At Lucknow, the headquarters of Sir Henry Lawrence and the administration of Oudh, the British still held out. Up till June 30, though there had been mutinies in Lucknow and in the neighbourhood, the garrison was not beleaguered. On June 30 Lawrence, moving out to attack the mutineers at Chinhut, immediately incurred disaster, which not only severely crippled the force of Europeans but compelled Lawrence to abandon outlying positions and concentrate in the group of houses known as the residency. The garrison, 1,720 fighting men, of whom 712 were loyal sepoys and 153 civilian volunteers, was now hotly beleaguered. Unfortunately Sir Henry Lawrence was fatally wounded by a shell on July 4, the command devolving on Brig. John Inglis. Havelock at Cawnpore was compelled to wait for reinforcements, and to collect carriage and supplies. It was not till late in September that he was able to advance to Lucknow. By Sept. 25 he had reached the residency, a reinforcement enabling the garrison to hold a less restricted area; but it had to remain for many weeks before the actual relief could come up.

In the meantime Sir Colin Campbell had arrived. By Nov. 3 he reached Cawnpore and was ready with 4,500 men to advance on Lucknow. That city had become the focus of rebellion of all who had not hurried to Delhi, and 60,000 armed men were collected round the devoted Lucknow garrison and its reinforcements.

By Nov. 12 the force reached the Alumbagh, and by Nov. 14 it advanced on Lucknow. On Nov. 16 the Sikandrabagh was stormed and Campbell joined hands with Sir James Outram and Havelock. The commander in chief had decided to withdraw the garrison and all its helpless folk at once and to leave a strong force outside the city till he was prepared to attack the whole of the Lucknow rebel concentration. The success was marred by the death of Havelock, who was buried in the Alumbagh, in mhich Outram with 4,000 men was left to face the masses of the rebels till Sir Colin was ready.

The Campaign in Oudh and Central India.—Returning to Cawnpore with the rescued people, the chief was in time to save that important place from a sudden attack by the Gwalior rebels. The second phase of the mutiny, that of the coming of the reinforcements and the reopening of the Great Trunk road, had now been accomplished. Caanpore had been avenged and Lucknow relieved, while in the far north Delhi had fallen and the Delhi troops nere marching south. It was not, however, till March 1858 that Sir Colin had enough troops for his purpose, when Jang Bahadur, the prime minister of Nepal, had also arrived with 10,000 Gurkhas. The attack on the masses entrenched at Lucknow began on March 9 and partook of the nature of a siege, lasting till March 16, when the city was in British hands and the whole rebel army routed. It was the brilliant campaign of Sir Hugh Rose in central India mhich destroyed the last mutinous forces in being and clinched the suppression of the mutiny.

Though the two great princes of central India, Sindhia and Holkar, remained true to the British, troops belonging to both of them joined the mutineers. The Gwalior contingent of Sindhia's army mutinied in the middle of June, and on July 1 Hoikar's troops revolted at Indore and the resident, Henry Durand, was forced to leave the residency. The rani of Jhansi also rose in rebellion, to become known as "the best man upon the side of the enemy." The rising in this quarter received little attention until Jan. 1858, when Sir Hugh Rose was given the command of two brigades, to act in concert with Sir Colin Campbell; he immediately began a campaign which for celerity and effectiveness was rarely equalled in India. Advancing rapidly from Bombay, Rose relieved Saugor on Feb. 3, after it had been invested by the rebels for almost seven months. On March 3 he forced the pass of Madanpur and took the whole of the enemy's defenses in rear, throwing them into panic. On March 21 he began the siege of Jhansi, the stronghold of the mutineers in central India, with a garrison of 11,000 men. During the course of the siege Tantia Topi, the most capable Indian leader of the mutiny, arrived with a fresh force of 20,000 men and threatened the British camp; but Rose, with a boldness which only success could justify, divided his force and, while still maintaining the siege of the fort, attacked Tantia Topi with only 1,500 men and completely routed him. This victory was won on April 1, and two days later Rose carried Jhansi by assault. On May 1 the battle of Kunch was fought and won in a temperature of 110° in the shade, many of the combatants on both sides being struck down by heat apoplexy. On May 22 the battle of Kalpi was won. In five months he had beaten the enemy in 13 general actions and sieges and had captured some of the strongest forts in India. News now arrived that the rebel army under Tantia Topi and the rani of Jhansi had attacked Sindhia, whose troops had gone over to the rebels and delivered Gwalior into their hands.

Rose marched against Gwalior at once, captured the Morar cantonments on June 16 and carried the whole of the Gwalior positions by assault on June 19, thus restoring his state to Sindhia within ten days of taking the field. This was the crowning stroke of the central India campaign and practically put an end to the mutiny, though the work of stamping out its embers went on for many months and was completed only with the capture and execution of Tantia Topi in April 1859.

Nature of the Mutiny.—The Indian mutiny was in no sense universal. In the first place it practically occurred only in Bengal, central India, the northwest provinces along the Ganges, Oudh and the Punjab; viz., those provinces garrisoned by the Bengal army and its offshoots. The Madras Line stood firm as did almost all that of Bombay. Seditious movements among the Marathas were kept in hand. Even in the affected districts the great mass of the people either stood neutral or helped the British troops with food and service, in many cases also sheltering British fugitives to the best of their ability. The attempt to throw off the British yoke was confined to a few disaffected former rulers and their heirs, with their numerous clansmen and hangers-on, besides the badmashes and highwaymen who saw their way to profit by the removal of the British administration under which their peculiar talents found no outlet. The Bengal native army was their tool. But the fighting races of the Punjab saw no reason for casting in their lot with the mutineers, and the great majority of the independent princes who had nothing of which to complain, like Patiala and Jhind in the Punjab, preserved a loyal or at least an interested friendship. The Sikhs kept faith with their recent conquerors, and the Gurkhas of Nepal did yeoman service for their fathers' enemies.

The chief result of the Indian mutiny was the end of the government of India by the East India company. It was felt that a system of administration which could permit such a catastrophe was no longer desirable. On Aug. 2, 1858, the queen signed the act which transferred the government of India to the crown. On Nov. 1 Lord Canning, then viceroy of India, published the

[1] The deposed and pensioned chief of the Maratha confederacy who lived in exile near Cawnpore.

proclamation in which the change was announced, and a full amnesty was offered to all the rebels who had not been leaders in the revolt or were not guilty of the murder of British subjects.

BIBLIOGRAPHY.—Sir J. W. Kaye and G. B. Malleson, *History of the Indian Mutiny of 1857–8,* ed. by G. B. Malleson (London, 1888–89); Sir O. T. Burne, *Clyde and Strathnairn* (Oxford, 1891); Sir H. Cunningham, *Earl Canning* (Oxford, 1891); G. W. Forrest, *The Indian Mutiny: Selections from the Letters, Despatches, and Other State Papers . . . in the Military Department of the Government of India, 1857–58,* 4 vol. (Calcutta, 1893–1912), *A History of the Indian Mutiny* (London and Edinburgh, 1904–12); Lord Roberts, *Forty-one Years in India,* 34th ed. (London, 1901), *Letters Written during the Indian Mutiny* (London, 1924); R. S. Rait, *The Life and Campaigns of . . . Viscount Gough* (London, 1903); Sir W. L. Warner, *The Life of the Marquis of Dalhousie* (London, 1904), *Memoirs of Field-Marshal Sir Henry Wylie Norman* (London, 1908); R. B. Smith, *Life of Lord Lawrence* (London, 1912); T. R. E. Holmes, *A History of the Indian Mutiny,* new ed. (London, 1913); F. Sedgwick, *The Indian Mutiny of 1857,* rev. ed. (London, 1920). (G. MA.)

INDIAN OCEAN, the name applied to the region bounded on the north by India, Pakistan and Iran (Persia); on the west by the Arabian peninsula and Africa; on the east by the Malay peninsula, the Sunda Islands of Indonesia, and Australia; and on the south by Antarctica. An arbitrary separation from the Atlantic is made at the longitude of Cape Agulhas (20° E.) and from the Pacific at the longitude of Tasmania (147° E.).

The ocean is more than 6,200 mi. wide between the southern points of Africa and Australia and narrows steadily toward the north, where it is separated by India and Ceylon into the Arabian sea and the Bay of Bengal. Two adjoining seas connect with the Arabian sea, the Red sea through the Strait of Bab el Mandeb and the Persian gulf through the Strait of Hormuz. Because of the concentration of maritime traffic in low latitudes, the Indian ocean is often considered to be a tropical ocean but actually it extends to latitude 70° S. and the Red sea and Persian gulf reach to 30° N.

The Indian ocean has an area of 25,300,000 sq.mi. and is the smallest of the oceans, comprising only 20.7% of the ocean-covered portion of the earth. The two adjoining seas included in these figures are relatively small, the Red sea covering 169,000 sq.mi. and the Persian gulf 92,300 sq.mi.

The Indian ocean receives few large rivers, the chief being the Zambezi, the Shatt-al-Arab (formed by the junction of the Tigris and Euphrates), the Indus, the Ganges, the Brahmaputra and the Irrawaddy. J. Murray estimated the total land area draining to the Indian ocean at 5,050,000 sq.mi. (1.3 the area of Europe), more than two-thirds that draining to the Pacific. The Pacific, however, is more than twice as large as the Indian ocean. In addition to the rivers mentioned, the southwestern and northwestern monsoons in the tropical regions on the eastern side of the Indian ocean bring heavy rains, and there is heavy rainfall also in the neighbourhood of the equatorial calms. Therefore, the salinity of the surface water in these regions is relatively low, particularly in the Bay of Bengal into which flow the great rivers from the mainland.

Relief of the Ocean Floor.—Large portions of the ocean bed remain unexplored. In the latter part of the 19th century, H.M.S. "Challenger" and the German "Gazelle" and "Valdivia" provided a general understanding of the topography which was later expanded by the expeditions of the "Sealark" and many British cable ships. The "Discovery II" made extensive cruises, beginning in 1929, in high latitudes and in the western part of the ocean. The oceanographic vessels "Willebrord Snellius" and "Dana II" worked in the open ocean, and the "Ammiraglio Magnaghi" in the Red sea. The "Mabahiss" explored the northwestern part of the ocean in 1933–34, the Swedish "Albatross" the equatorial regions in 1948 and the Danish "Galathea" selected deeper waters in crossing from southern Africa to India to Indonesia in 1951.

A longitudinal ridge, the mid-Indian ridge, extends from India to Antarctica and separates the Western Indian and Eastern Indian troughs. Although similar in general location to the Atlantic ridge, it is much wider and does not extend so near the surface. In the northwestern part of the ocean the ridge is divided with two elevations extending toward the coast of Africa and separating the Arabian, Somali and Mascarenes basins. The longitudinal ridge is continuous at depths less than 13,000 ft. Although the western part of the ocean is divided into a series of basins, the Eastern Indian trough extends from the Bay of Bengal to Antarctica with but one major break at depths of less than 13,000 ft. This transverse ridge occurs near 50° S. and lies between the mid-Indian and Macquarie ridges. The latter is continuous at depths less than 13,000 ft. over most of the distance from Tasmania to Antarctica and is one of the barriers separating the deeper waters from those of the Pacific. West of the Kerguelen ridge, which forms the southern part of the longitudinal ridge, there is deepwater connection with the Atlantic. These features influence the deepwater circulation and the distribution of properties.

The greatest depths are found in the Sunda trench, a narrow depression paralleling the Sunda Islands, where soundings of 24,460 ft. have been obtained. Depths of about 21,300 ft. exist in the central part of the Eastern Indian trough (Wharton deep, 19° S., 100° E.). The Red sea, with an average depth of about 1,600 ft. and maximum depth of 9,200 ft. is separated from the open ocean except for a narrow channel only 330 ft. deep. In contrast, the Persian gulf is a shallow sea with an average depth of only 80 ft. The mean depth and volume of the Indian ocean are 12,700 ft. and 70,000,000 cu.st.mi.

Islands.—Madagascar, the largest of the ocean's islands, rises from a plateau about 4,900 ft. deep extending out from Africa. Ceylon and Socotra are continental islands. The Laccadive, Maldive and Chagos islands rise from the central part of the Indian ridge, while those extending from the Seychelles to Mauritius rise from the westward extension of the ridge and are separated by deep water from Madagascar. The Andaman and Nicobar islands rise from a ridge extending southward from Cape Negrais. Between the ridge and the Malay peninsula lies the Andaman basin opening only to the south. Many oceanic islands, such as Mauritius, Crozet and St. Paul's, are volcanic. Those in tropical seas are often coral formations or possess coral reefs.

Bottom Deposits.—The characteristics of sea-bottom sediments are described in OCEAN and OCEANOGRAPHY: *Marine Sediments* because they are common to all oceans. The greater part of the Indian ocean north of 50° S. is covered with globigerina ooze. At depths greater than 16,000 ft. the calcium carbonate content is small and the deep basins, especially the Eastern trough, are covered with red clay. However, sediment cores up to 36 ft. long collected by the "Albatross" show a considerable quantity of globigerina ooze even at the greatest depth, and also pronounced stratification of sediments near the equator. Radiolarian ooze is found in some of the deeper basins, and diatom ooze covers a broad band in higher southern latitudes. Eighty-six per cent of the main basin (excluding adjacent seas) is covered with pelagic sediments, globigerina ooze covering 47%, red clay 22%, diatom ooze 17% and radiolarian ooze 0.4%. The remaining 14% of the bottom and the adjacent seas are covered with terrigenous sediments or shallow-water calcareous deposits (coral sands and muds). Glauconite is abundant in sediments off the African coast and calcareous sediments predominate in the Persian gulf and on many of the coasts and oceanic islands in tropical latitudes. Southeast of Ceylon an extensive flat area is apparently underlain by lava.

Compared with the Atlantic and the Pacific oceans, the high proportion of pelagic siliceous oozes is quite striking, but this is the result of the shape of the ocean and the relatively large extent of the diatom ooze band in the south.

Meteorology.—In no oceanic division does the regular half-yearly alternation of all the factors in weather conditions and particularly the winds play such an important part as in the monsoon regions from 10° S. northward of the Indian ocean. From Oct.–Nov. to March–April northeast winds prevail in the north latitude and northwest winds in the south latitude; from May–June to Sept.–Oct. south and west winds prevail. In the Arabian sea between Socotra and the Maldives these southwest monsoons are very violent and are dangerous even to modern steamship traffic. From the earliest times the voyages of the native sailing vessels between India and Africa have been regulated by these alternating winds. The southwest monsoon brings rain to the whole of India; the northeast monsoon is predominantly dry. Southward from the latitude of the Seychelles-

Chagos-Cocos islands, the southeast trade wind prevails throughout the year, and south of 30" S. the west winds which are generally particularly strong between 40" and 55° l., and of which in the 19th century the fast sailing ships bound for Australia and China took advantage.

The tropical storms, especially of Mauritius, are much dreaded; they follow a parabolic course from east to west then southward and back to the southeast, and occur in the summer season. In the Arabian sea and the Bay of Bengal these hurricanes are. fortunately, rare and occur only once or twice a year, in April–May and Oct.–Nov., that is to say, at the periods when the monsoons change. In the Hooghly delta off Calcutta the high waves which accompany the storms are dangerous and have caused the loss of thousands of lives.

Surface Currents. — Over the northern part of the Indian ocean the surface currents change with the monsoon. During the northeast monsoon the currents flow toward the southwest and west, crossing the equator, and between the easterly current maintained by the monsoon and the westerly current maintained by the southeasterly trade wind a strong countercurrent flows east in about 10° S. The southwest monsoon appears as a continuation of the southeast trade wind of the southern hemisphere which in crossing the equator turns from a southeasterly to a southwesterly direction. In the season of the southwest monsoon westerly currents prevail to somewhat north of the equator and turn then around toward the north. A strong northerly flow is found particularly off the Somali coast and the southeast coast of Arabia, where upwelling lowers the temperature near shore.

In the southern part of the Indian ocean a counterclockwise circulation prevails with westerly currents to the north of 20° S. and easterly currents maintained by the prevailing winds to the south of 40° S. These easterly currents represent part of the large antarctic circumpolar flow. The south equatorial current divides when reaching the coast of Madagascar, sending one branch north and another branch to the south. The northern branch turns around the northern end of Madagascar and flows south through the Mozambique channel and continues as the Agulhas current to Cape Good Hope. Only a small fraction of the waters of the Agulhas current continues into the Atlantic ocean, and by far the greater body of water mixes with the waters of the circumpolar current and is carried to the east with that current. In the region of mixing, the surface temperature shows a great variability with alternating streaks of cold and warm water.

Deep Water and Its Circulation.—No large amount of deep water is formed in the Indian ocean by sinking of surface water, but the deep basins are filled by water which enters the Indian ocean to the south of Africa and is therefore similar to the deep water of the South Atlantic.

The deepwater circulation appears to be very slow compared with that of the Atlantic. Along the bottom the coldest water advances to the north and at a depth of about 3.300 ft. Antarctic intermediate water of low salinity also flows north and can be traced nearly to the equator. Between these two northerly flows deep water returns to the south and rises toward the surface near the antarctic continent. To the north of the equator the movement of the deep water is probably extremely slow.

Conditions are somewhat complicated by the outflow of high salinity water from the Red sea along the bottom of the Strait of Bab el Mandeb. This Red sea water sinks! mixes with the surrounding water and spreads at depths of 3,300 ft. to 4,900 ft. To the north of the equator it can be traced as far as Ceylon, and to the south of the equator to about 25° S. off the coast of Africa. The Red sea water corresponds to the Mediterranean water in the Atlantic ocean, but since the outflow from the Red sea is relatively small it exercises a less widespread influence upon the salinity distribution at moderate depths.

Below a depth of about 6.600 ft. the temperature of the deep water decreases from about 3° C. (37° F.) to about 1.5° C. (35° F.) at the bottom and the salinity remains nearly constant at 34.8 $^{0}/_{00}$ (per mille).

Temperature. — North of the southern tropics the temperature of the surface waters is at all times higher than 20° C. (68" F.) and in the equatorial latitudes over 25° C. (77° F.); in the eastern half it is generally above 27.5° C. (81.5° F.); in the Red sea and the Persian gulf the temperature often rises to above 30° C. (86" F.). South of 40° S. the water quickly cools so that off Kerguelen (49" S.) even in summer the temperature has been found to be no more than 2° C.–3° C. (36° F.–37° F.). The isotherms run mainly from west to east, and their course is not diverted by currents to so great a degree as in the Atlantic.

Salinity. — The saltiest surface water is found in the Arabian sea and along a belt extending from southwest Australia to south Africa, the highest salinity in this belt occurring at the Australian end. In both regions the salinity exceeds $36^{0}/_{00}$ (per mille). In the monsoon region west of Sumatra and throughout the Bay of Bengal. because of rainfall and the inflow of rivers, the salinity is diminished to $34^{0}/_{00}$ and at the mouth of the Hooghly channel, below $30^{0}/_{00}$. In the northern portions of the Red sea and the Persian gulf, on the other hand! the salinity is sometimes as high as $40^{0}/_{00}$. South of New Amsterdam and St. Paul the salinity, as also the temperature, quickly diminishes, and south of Kerguelen as far as the antarctic shelf there is a uniform antarctic water of salinity $33.7^{0}/_{00}$.

Ice. — In the extreme southern part of the Indian ocean, pack ice and icebergs from the Antarctic are encountered in all seasons. In October the northern limit of the pack ice lies in about latitude 58° S. and in March it closely follows the coast of the antarctic continent in about latitude 65° S. The average northern limit of icebergs lies in about 45° S.

BIBLIOGRAPHY. — J. Murray, *Reports on the Results of H.M.S. "Challenger"* (1880–95); Deutsches Marineamt, *Forschungsreise S.M.S. "Gazelle"* (1880–90); C. Chun, *Ergebnisse der "Valdivia" Tiejsee-Expedition* (1902); E. von Drygalski, *Deutsche Siidpolar-Expedition auf "Gauss"* (1905); J. H. Gardiner, "The Percy Sladen Trust Expedition H.M.S. 'Sealark,'" *Trans. Linn. Soc. Lond.*; Meteorological Office, London, *Wind and Current Charts for the Indian Ocean* (1896); Kon Nederl. Meteorological Institute, *Oceanograph-en meteorol. Waarnemingen in d. Ind. Ocean* (1915–26); Meteorological Department, Government of India, *Weather Charts of the Bay of Bengal* (1886), *Weather Charts of the Arabian Sea* (1888); Deutsche Seewarte, *Segelhandbuch fur den Zndischen Ozean mit Atlas* (1891–92), *Monatskarten fur den Indischen Ozean* (1908); Discovery Office, London, *Discovery Reports* (1929 *et seq.*); University of Adelaide. *British Australian New Zealand Antarctic Expedition, 1921–1931* (1937 *et seq.*); Carlsberg Foundation, Copenhagen, *Dana Reports* (1932 *et seq.*); British Museum, *John Murray Expedition, 1933–34* (1935 *et seq.*); Lotte Moller, *Die Zirkulation des Indischen Ozeans,* Berlin University Institute of Oceanography, Publication, New Series A, Geographical-Natural Science Series, issue 21 (1929); Gerhard Schott, *Geographie des Indischen und Stillen Ozeans* (1935); *Reports of the Swedish Deep-Sea Expedition, 1947–48* (1953 *et seq.*); *Galathea Report* (1956 *et seq.*); G. Dietrich and K. Kalle, *Allgemeine Meereskunde* (1957); *Andhra University Memoirs in Oceanography,* vol. 1 (1954); Russia (1923 U.S.S.R.) Voenno-morskoe ministerstvo, *Morskoi Atlas,* ed. by I. S. Isakov, vol. 1 (1950), vol. 2 (1953); H. U. Sverdrup, M. W. Johnson and R. H. Fleming, *The Oceans* (1942); Hans Pettersson, *The Ocean Floor* (1954).

(H. U. S.; R. H. Fg.; C. A. Bs.)

INDIANOLA, a city of Iowa. U.S., 17 mi. S. by E. of Des Moines; the seat of Warren county. Farm machinery is manufactured and corn. oats and wheat are grown in the vicinity. It is the seat of Simpson college (Methodist), founded in 1860 and chartered as a college in 1867. Indianola was laid out in 1849. incorporated in 1864 and chartered as a city in 1884. For comparative population figures see table in IOWA: *Population.*

INDIAN PAINTBRUSH or PAINTED CUP (*Castilleja*) is a large genus of plants which are partial parasites on the roots of other green plants; they are most abundant in the central and western states of the U.S. The leaves are alternate. and those immediately beneath the flower cluster are brightly tipped with red or yellow. The corolla and calyx of the flower are flattened! the former being two lipped. Indian paintbrush is a member of the Scrophulariaceae or figwort family.

See PAINTBRUSH; SCROPHULARIACEAE.

INDIAN PHILOSOPHY is a singularly manifold philosophic development. It is impossible to touch in this article on all the special points of interest or doctrinal variations. For these the student must consult special works (see *Bibliography*).

It is not possible to determine exactly the dates of the Indian systems of philosophy, but for the broad divisions the dates may

be taken as follows: for the Vedic period, c. 1500–600 B.C.; for the Epic period, 600 B.C. to A.D. 200; and for the period of the Six Systems, A.D. 200.

This article is divided into the following sections:

I. Vedic Period
A. The Rig-Veda
1. Monotheism
2. Monism
3. Cosmology
4. Future Life
B. The Upanishads
1. Metaphysics
2. Subjective Analysis. Atman
3. The Doctrine of Maya
4. Ethics
II. Epic Period
1. Materialism
2. Jainism
3. Early Buddhism
III. Six Systems
A. Nyaya
1. Inference
2. Induction
3. Causation
4. Comparison
5. Metaphysics
B. The Vaiseshika
1. Categories
2. Atomic Theory
C. Sankhya
1. Theory of Evolution
2. Plurality of Souls
D. Yoga
E. Purva Mimamsa
F. Vedanta
1. Shankara's Non-Dualism (Advaita)
2. Doctrine of Maya
3. Ramanuja's Theism
4. Madhva's Dualism

I. VEDIC PERIOD

The Vedic literature comprises (1) the four Vedas, which consist of hymns, prayers and spells addressed to the gods; (2) the Brahmanas (*q.v.*) or ritual treatises; (3) the Aranyakas, or the forest treatises, the concluding portions of the Brahmanas; and (4) the Upanishads, which form the basis of much of the later Indian philosophy. The religion of nature of the hymns, the religion of law of the Brahmanas and the religion of spirit of the Upanishads correspond in a very close way to the three great divisions in the Hegelian conception of the growth of religion.

A. The Rig-Veda

The Rig-Veda represents the thought of successive generations of thinkers, and so contains different strata of thought. In it may be seen the development of religious ideas from the animistic to the absolutistic stages. "Where is the sun by night?" "Where go the stars by day?" "Why does the sun not fall down?" "Of the two, night and day, which is the earlier, which the later?" "Whence comes the wind, and whither goes it?" These are some of the questions which harassed the mind of the early Aryan. His first efforts to answer them resulted in naturalistic polytheism. There is a deity which makes the strong wind to blow, the lightning to flash and the thunder to roll. While some of the chief Vedic deities like Indra and Varuna, are completely emancipated from connection with the phenomena of nature which originally suggested them, others, such as Surya (Sun) and Agni (Fire), are conceived on the lines of the actual phenomena whose names they bear. In some later hymns appear abstract deities which show no traces of connection with natural phenomena, as Prajapati ("lord of creatures"), or personifications of pure abstractions, as Faith and Wrath. The conception of Varuna, the lord of physical and moral order, reaches a high level and is majestic enough both in its cosmical and ethical aspects. Varuna is the lord of rta: rta refers to the physical order in the universe, the order of the sacrifice and the moral law of the world. On account of rta, the sun pursues his daily, and the moon her nightly, journey across the sky, and the silent procession of the seasons moves regularly in light and shadow, in cloud and sunshine across the earth. The doctrine of karma (discussed under Ethics below) is a reformulation of this principle of rta.

When mythical conceptions from beyond the limits of the Aryan world belonging to a different order of thought entered into the Vedic pantheon skeptical tendencies developed. There were men who were harassed by doubts: "Who is Indra? whoever saw him?" "To what god shall we offer our oblation?" (x, 121). Some men were devoid of faith. An undercurrent of satire may be noticed in some of the hymns (ix, 112; x, 119; vii, 103).

1. Monotheism. — The crowding of gods and goddesses proved a weariness to the intellect. Attempts were made to identify one god with another or to throw all the gods together. The close connection of the elements in nature helped the growth of syncretism. An orderly system of nature signified by the conception of rta has no room for miraculous interferences in which alone superstition and confused thought find the signs of polytheism. Besides, religious consciousness is naturally inclined to believe that the supreme is one. What is called henotheism, or the worshiping of each divinity in turn as if it were the greatest and even the only god, is the expression of the logic of religion. When the same functions of establishing the earth and sustaining the air and the sky are assigned to the different deities we tend to drop the peculiarities and make a god of the common functions. This becomes easy when the several gods are not clear-cut individuals but cloudy and confused concepts. The supreme is identified with Prajapati (x, 85. 43, 184. 4, 189. 4), sometimes with Hiranyagarbha (x, 121), sometimes with Brihaspati (x, 72).

2. Monism. — Those dissatisfied with monotheism argue that there is one impersonal reality of which Agni, Indra, Varuna are the names or forms. "The real is one, the learned call it by various names." This one is the soul of the world, the reason immanent in the universe (x, 129. 2). "Priests and poets with words make into many the hidden reality which is but one" (x, 114). Our minds seem to be satisfied with inadequate images of this reality, "the idols which we here adore."

3. Cosmology. — At the pluralistic stage the deities are looked upon as the authors of the universe who create it by a process of manufacture or organic development or through the power of the sacrifice (x, 123. 1). When we rise to the monotheistic level the one god creates the world with the help of pre-existent matter (x, 121). Sometimes the dualism of the creator and the pre-existent matter is overcome and God is said to create the world out of his own nature. In the Purusha-sukta (x, 90) the world is produced by the gods from the sacrifice of a primeval *purusha* (person). This person is all that has been, is, and shall be. But the most advanced theory of creation is suggested in the Nasadiya hymn (x, 129). It starts with the assertion that in the beginning there was neither being nor nonbeing, neither air nor sky, neither death nor immortality, neither night nor day. There was nothing else save the one which breathed breathless, of its own power. This is the poet's way of describing the primal unconditional ground of all being, which is beyond our categories. The third verse states that through the power of tapas (austerity), the first antithesis of being and nonbeing, the active energy and the passive matter is produced. Through desire (kama), which is the germ of mind (manasoretah), the rest of the development takes place. Desire, which is the sign of self-consciousness, is the bond binding the existent and the nonexistent. We cannot say why the original being develops into an active creator and the passive chaos. The hymn concludes with an expression of doubt. Creation is a mystery. *Ko* veda? ("who knows?")

4. Future Life. — A healthy joy in life dominates the Rig-Veda. The worshiper asks not for immortality or heaven but a long life for a full 100 years. There is belief in future life, a heaven for the good and a hell for the wicked. Reward follows righteousness and punishment misconduct.

B. The Upanishads

The Upanishads form the concluding portions of the Veda and are therefore called Vedanta or the end of the Veda. Their aim is not so much to reach philosophical truth as to bring peace and freedom to the anxious human spirit. They represent free and

bold attempts to find out the truth without any thought of a system. Notwithstanding the variety of authorship and the period of time covered by them, a unity of purpose and a vivid sense of spiritual reality may be discerned in them. They are distinguished from the Vedic hymns and the Brahmanas by their increased emphasis on monistic suggestions and subjective analysis as well as their indifference to Vedic authority and ceremonial piety.

1. Metaphysics. — The Taittiriya Upanishad (iii) gives an account of the gradual evolution of ideas regarding the ultimate basis of things. The seeker tries to find out the one comprehensive principle from which "all things are born, by which they are sustained and into which they return at death." His first answer—that matter (annam) is the basic principle—is discarded in view of its inadequacy to vital phenomena. The second answer of life (prana) is found unsatisfactory when sentient entities are considered. The third suggestion of mind (*manas*) is incapable of accounting for logical phenomena. The fourth formula of logical intelligence (*vijnana*) cannot be regarded as the highest reality, since there are aspects of being which cannot be reduced to intellectual terms. Thought as ordinarily understood deals with objects viewed as beyond or other than the process of thinking. Reality can be reached in the state of highest immediacy which transcends thought and its distinctions, which is *ananda* or bliss. Ananda is Brahman.

2. Subjective Analysis. Atman. — The Chandogya Upanishad (viii, 3. 12) institutes an enquiry into the nature of the self. The body which is born, grows up, decays and dies cannot be the true self which persists throughout the changes of birth and death. The dreaming self, subject as it is to the accidents of experience, must not be confused with the true self. The self is not the unity of the evergrowing and changing mental experiences. The self in dreamless sleep cannot satisfy our need, since it is empty of all content and is a bare abstraction. The true self is said to be the universal consciousness existing both in itself and for itself. The Mandukya Upanishad observes that the three states of the soul — waking, dreaming and sleeping — are included in a fourth (turiya) which is intuitional consciousness, where there is no knowledge of objects, internal or external. It is the unchanged and persistent identity which continues in the midst of all change. It is the Atman.

Brahman and Atman are one. The inmost being of universal nature is the same as our innermost self. Tat *tvam* asi: "that art thou." The nature of this ultimate reality cannot be defined. It can be grasped, however, through intuition. This intuition is not objective like perceptual experience or communicable to others like inferential knowledge. A formal exposition of it cannot be given. To any suggested definition of reality we can only say, "not this," "not this" (Brihad-aranyaka, iv, 2. 4). Contradictory accounts are given to show that negative descriptions do not mean negation of all being but only the poverty of intellect.

We cannot, however, remain long at this high level. We insist on framing intellectual pictures of the absolute. When the Atman is identified with the self-conscious individual, Brahman is described as a personal being (Isvara). When the Atman is identified with the mental and the vital self, Brahman becomes the cosmic soul (Hiranyagarbha). When the Atman is taken for the body, Brahman is taken for the cosmos (Virat). Brahman is the sole and the whole explanation of the world, its material and efficient cause. The metaphors of the spinning of the web by the spider, the bearing of the child by the mother, the production of notes from musical instruments point to the oneness of Brahman and the world. There is, however, no logical deduction of the world of multiplicity from the ultimate cause. At the theistic level the world is regarded as the self-limitation of the Supreme. The power of self-expression possessed by the personal Isvara (God) is sometimes called Maya.

3. The Doctrine of Maya. — There is hardly any suggestion in the Upanishads that the entire universe of change is a baseless fabric of fancy. The dominant note of pantheism goes against this view. The assertion 'of the sole reality of Brahman denies duality and traces all change to Brahman but does not suggest that change is illusion. The frequent emphasis on the oneness of the world and Brahman need not be repudiated as a mere concession to common-sense ideas. The texts which declare that the variegated universe is due to the development of name and form from out of the one Brahman warn us against getting lost in the world of multiplicity. The passing semblance of life is in no wise its immortal truth. The theory of the world-illusion is inconsistent with the conception of degrees of reality, or, to be more accurate, unreality which is found in the Aitareya Aranyaka (ii, 3. 2 et seq.). When Yajnavalkya contends that duality is necessary for empirical consciousness and suggests that the world of duality is not real by the use of the particle '*iva*' (Brihad-aranyaka, ii, 4. 14; iv, 3. 31), he refers to the non-ultimate character of the world of duality.

4. Ethics.—*Moksha* is release from the bondage to the sensuous and the individual. The morality of the Upanishads is, in a sense, individualistic as it emphasizes self-realization. The term "individualistic," however, ceases to have any exclusive meaning. To realize oneself is to identify oneself with a good that is not private to any one. Insistence on the knowledge of God (jnana) is tempered by the recognition of the need for moral life.

When the moral striving ends in religious realization the individual is said to be freed from all moral laws. This does not mean that the free can do what they choose with perfect impunity. Laws and regulations are necessary for those who do not naturally conform to the dictates of morality. For those who have risen above the selfish ego and who have died to sin, morality is the very condition of their being.

Those who have not reached the highest perfection will have other chances for striving. Sansara offers a succession of spiritual opportunities. The hypothesis of rebirth is formulated in this period (Chandogya Upanishad, v, 3. 10; Brihad-aranyaka, vi, 3.), though there are still compromises with the Vedic views. Good and evil actions experience a twofold retribution, once in the other world and again by a renewed life on earth.

Moral striving is governed by the law of karma (*q.v.*). Our life carries within it a record that time cannot blur or death erase. The soul that sinneth, it shall decline. Though we cannot efface the results of our acts on the outer universe, its effects on us can be wiped away by strenuous exertion. Karma emphasizes individual responsibility. It is more favourable to self-culture and meditation than to prayer and petition.

In every sphere the Upanishads indulged in inconsistent compromises with the Vedic views. The chaos of the Brahmanical religion reached its climax in the post-Upanishad or pre-Buddhist, period when truth hardened into tradition and morality stiffened into routine. The need for reconstruction was clear.

II. EPIC PERIOD

The systems of materialism, Jainism and Buddhism, belong to the Epic period. which is the age of reconstruction.

1. Materialism. — Materialism is called Lokayata (directed to the world), as it holds that only this world (loka) is real. According to it, perception is the only source of knowledge. Inference which assumes universal relations, testimony and analogy are all defective. Matter is the only reality, of which the elements are earth, water, fire and air. Consciousness is a function of matter. There are different opinions about the nature of the soul. It is identified with the gross body or the senses or breath or thought. There is no future life. As the soul is an attribute of the body, it comes into being when the body is formed by the combination of the elements even as the power of intoxication arises from the mixture of certain ingredients. When the body is destroyed the soul disappears. The world is born of itself. God is a myth which we accept — thanks to our ignorance and incapacity. Pleasure and pain are the central facts of life. Virtue and vice are conventions.

2. **Jainism.**—Vardhamana (c. 599–527 B.C.), the founder of Jainism, is a slightly older contemporary of Buddha. He is said to have systematized the faith held by a succession of 23 other sages, of whom the chief was Parsvanatha (c. 776 B.C.). (For the historical development see JAINS.)

Jainism assumes that truth is relative to our standpoints. The

Jains are fond of quoting the old story of the six blind men who each laid hands on a different part of the elephant and tried to describe the whole animal. The man who caught the ear thought that the creature resembled a winnowing fan; the holder of the leg imagined that he was clinging to a big round pillar, and so on. It was he who saw the whole that perceived that each had only a portion of the truth. The doctrine of *nayas* (particular ways of looking at things) brings out this relativity of thought. The most important application of this doctrine is the theory of *Syadvada* or *Saptabhangi*. Every proposition gives us only a perhaps, a may be, or a *syat*. We cannot affirm or deny anything absolutely of any object, owing to the endless complexity of things. Being is not of a persistent unalterable nature. Every statement of a thing is necessarily onesided and incomplete. If we take it as true and complete we make a mistake. There are seven different ways of speaking of a thing or its attributes according to the point of view. All things, *i.e.*, substances *(dravya)*, are divided into lifeless *(ajiva)* and living *(jiva)*. The former are again divided into (1) space *(akasa);* (2) and *(3)* two subtle substances called *dharma* and *adharma;* and (4) matter *(pudgala)*. Space, *dharma* and *adharma* are the necessary conditions for the subsistence of all other things, viz., souls and matter. Space affords them room to exist; *dharma* makes it possible for them to move or be moved, and *adharnza* to rest. Time is recognized by some as a quasi-substance beside those mentioned. Matter is eternal though it may assume forms as earth, air and so on. It exists in the two forms of atoms *(anu)* and aggregates *(skandha)*. The changes of the physical universe are traced to atomic aggregation and disintegration. The atoms are not constant in their nature but are subject to change or development *(parinama)*, which consists in their assuming new qualities. There are not different kinds of atoms answering to the different elements of earth, water, fire and air. Homogeneous atoms produce different elements by varying combinations. While things which we perceive are made of gross matter, there is matter beyond the reach of our senses in subtle form which is transformed into the different degrees of *karma*. This kind of matter fills all space. The soul by its commerce with the outer world becomes literally penetrated with the particles of this subtle matter. *Karma* works in such a way that every change leaves a mark which is retained and built up into the organism to serve as the foundation for future action.

The characteristic essence of the soul is consciousness *(cetana)*, which is never destroyed, however much it may be obscured by external causes. The souls are said to possess size, which varies with the nature of the bodies with which they happen to be connected. Subtle matter coming into contact with the soul causes its embodiment. Being then transformed into eight kinds of *karma* and forming, as it were, a subtle body, it clings to the soul in all its migrations. The individual soul *(jiva)* is a composite of consciousness and matter or body. Jainism believes that there are souls even in inorganic objects, though they lie dormant in them.

Jainism does not believe in God, though the souls can reach a divine status. The souls and the world are self-existent and eternal. The chief means to the end of *nirvana* is the performance of austerities. By it we destroy the old *karma* and prevent the formation of the new. Right faith, right knowledge and right conduct are recommended. The peculiarity of the Jaina ethics is its insistence on avoidance of taking life of any kind.

3. Early Buddhism. — This also falls within the Epic period. *See* BUDDHA AND BUDDHISM.

For the *Bhagavad-Gita* (part of the epic Mahabharata) *see* BHAGAVAD-GITA and INDIA: *Hinduism and Its Offshoots*.

III. SIX SYSTEMS

The revolt of Buddhism and Jainism helped to bring about a critical point of view and led to the great movement of philosophy which produced the six systems of thought, where criticism and analysis take the place of poetry and religion. The different systems are not antagonistic but are complementary. They are regarded as an evolutionary chain, a single series, rather than as destructive of one another. Each of them is a metaphysics and a religion, an explanation of the world and a method of salvation.

A. NYAYA

Logic as epistemology may be called a critical reflection on metaphysics. The *Vaiseshika*, which deals with the analysis of nature. is earlier than the *Nyaya*, which discusses the problem of knowledge; yet we start with the latter, as it gives the main logical principles assumed by the *Vaiseshika* as well.

Assuming that the account of the world which our minds afford us is, in the main, a trustworthy one, the *Nyaya* analyzes the different ways in which our knowledge is acquired. They are said to be intuition *(pratyaksha)*, inference *(anumana)*, comparison *(upamana)*, and verbal testimony *(sabda)*. Though *pratyaksha* originally meant sense-perception, it soon came to cover all immediate apprehension whether through the aid of the senses or otherwise. It is knowledge whose instrumental cause is not knowledge *(jnanakaraṇakaṁ jnanam)*. In inference, comparison, etc., we require a knowledge of premises or of similarity, but such knowledge is not an antecedent condition of intuition. The word is used for the result or the apprehension of the truth as well as the process or the operation which leads to the result.

Sense-perception follows on the modification of the self produced by the contact of the senses with their objects. Two kinds of perception are distinguished, determinate *(savikalpaka)* and indeterminate *(nirvikalpaka)*, which correspond roughly to knowledge about and acquaintance with an object.

1. Inference. — Inference operates "neither with regard to things unknown nor with regard to those known definitely for certain; it functions only with regard to things that are doubtful." It derives a conclusion from the ascertained fact of the subject possessing a property which is constantly accompanied by another. We ascertain that the hill is on fire from the fact that the hill has smoke and smoke is universally accompanied by fire. Inferential reasoning is stated in the form of a syllogism of which the five members are (1) proposition *(pratijna)*: the hill is on fire; (2) reason *(hetu)*: because it smokes; *(3)* example *(udaharana)*: whatever shows smoke shows fire, *e.g.*, a kitchen; *(4)* application *(upanaya):* so is this hill; and (5) conclusion *(nigamana)*: therefore, the hill is on fire. The first member states the thesis to be established. It is only a suggestion. It ccntains a subject or what is observed, which is generally an individual or a class, and a predicate which is to be proved. The subject is the minor term *(paksha, dharnzin)* and the predicate the major *(sadhya, dharma)*. The second member of the syllogism states the presence in the minor of the middle term called ground *(hetu)*. The third takes us to the basis of inference, the major premise. Though Gautama Buddha and Vatsyayana may not have regarded the example as the illustration of a general rule, later Nyaya looks upon it as the statement of an invariable concomitance between the mark and the character inferred *(vyaptipratipadikaṁ vakyam)*. The conclusion restates the proposition as grounded. Nagarjuna is given the credit for dispensing with the last two members of the syllogism as superfluous.

2. Induction. — Universal propositions are reached through enumeration, intuition and indirect proof. Uninterrupted agreement *(niyata sahacarya)* reinforced by absence of exceptions *(avina-bhāvarūpasambandha)* leads to unconditional concomitance~. Nature does not always supply us with positive and negative instances of the necessary type. In such cases indirect proof *(tarka)* may be used. By pointing out the absurdities in which we are landed if we deny a suggested hypothesis, we indirectly prove its validity. Even when we observe all possible cases and strengthen our conclusion by indirect proof we cannot reach absolute certainty. Experience of sensible particulars, however thorough and exhaustive, cannot give rise to universal relations. Gangesa recognizes the nonsensuous *(alaukika)* activity involved in the apprehension of universals *(samanyalakshana)*.

3. Causation. — A cause is that which invariably precedes the effect. It is not merely accessory to but is necessary for the production of the effect. Two things cannot be causally related unless there is the positive-negative *(anvayavyatireki)* relation between them, such that the presence of the cause means the presence of the effect and vice versa. Three different kinds of causes are distinguished, material *(upadana)*, nonmaterial or formal

(*asamavayi*) and efficient (ninzitta). The appearance of plurality of causes is traced to defective analysis. When the effect is understood in its uniqueness (karyavisesha) it will be seen to have only one cause.

4. Comparison. — By means of comparison (upanzana), we gain the knowledge of a thing from its similarity to another thing previously well known. Hearing that gavaya (wild ox) is like a cow, me infer that the animal which we find to be like the cow is the gavaya. This argument involves knowledge of the object to be known and perception of similarity. Comparison relates to the problem of identification. The problem of sabda or verbal knowledge is mainly of theological interest. Certain questions of logical value are incidentally discussed. Regarding the import of words, the Nyaya holds that a word denotes an individual (vyakti), or a form (akrti) or a genus (jati) or all these. It depends on our interest at the moment. The validity of knowledge is not self-established but is proved by something else (*paratah* pramana). If every cognition were self-evident there would be no possibility of doubt. We discover the truth by the test of action.

5. Metaphysics. — The individual self is a real substantive being possessing the qualities of knowledge, feeling and desire and aversion. It is different from the body, the senses and the understanding. It is all-pervading though it does not cognize many things simultaneously on account of the atomic nature of *manas* or the inner sense. It is unique in each individual, and we have an infinite number of souls. The soul is an unconscious principle capable of being qualified by consciousness.

B. The Vaiseshika

The system takes its name from visesha or particularity. It is in the particulars of the world. pre-eminently in the particular imperceptible souls and atoms, that true individuality is found.

1. Categories. — The Vaiseshika adopts a sixfold classification of *padarthas* (objects which can be thought and named) into substance (dravya), quality (guna), movement (karma), generality (samanya), particularity (visesha) and inherence (*samavaya*), to which later thinkers add a seventh, nonexistence (abhava). That something is, is the first principle; but nothing can be without possessing certain qualities. Some of the qualities reside in a plurality of objects, while others are confined to individuals. The former are general qualities (sanzanya), while the latter are distinguished into permanent (guna) and transitory (karma). Inherence is a special kind of relation distinct from occasional or separable conjunction. When the scheme became logical in scope, nonexistence was included. Later Nyaya develops this idea with great subtlety. The first three categories possess a real objective existence, while the other three are products of intellectual discrimination.

2. Atomic Theory. — The atomic theory is developed in connection with the substances of earth, water, light and air. The things that we experience are made up of parts. They are therefore noneternal. Noneternal has no meaning apart from eternal. The component particles are eternal. The atom marks the limit of division. If it were endlessly divisible, then material things would be products of an equally endless number of constituent parts, and differences in the dimensions of things could not be accounted for. Though the atoms have no extension, their heterogeneous nature is the cause of the extension and visibility of the combinations of atoms. Though Kanada is not clear about where the visibility of the combinations begins, his later followers suggest that an aggregate of three atoms (tryanuka), others of three double atoms, produces extension, and it is visible in the shape of the dust mote (trasarenu) dancing in the sunlight. Ans ering to the four kinds of material objects — earth, water, light and air, we have four kinds of atoms producing the four senses of touch, taste, sight and smell. This is why each special sense reveals a single quality, however excited. Though the qualities of earthly things, as colour, taste, smell and tangibility, vanish on the destruction of the thing itself, they are always found in their respective atoms, though in earth and atoms of earth new qualities are produced by heat (pakaja). Water, light and air do not suffer a similar change. There can never come a time when there will be an utter annihilation of things. The atoms will abide for ever.

C. Sankhya

The *Sankhya* is a reaction against the idealistic monism of the Upanishads. It believes in a real matter and an infinite plurality of individual souls which are not emanations of a single world soul.

The Sankhya adopts the view that the cause and the effect are the undeveloped and the developed states of one and the same substance. Development is the coming to light of what is latent or hidden even as destruction is disappearance into the original cause. There is no such thing as utter annihilation. Applying this principle, the ultimate basis of the empirical universe is said to be *prakrti* (nature). The world is the transformation of prakrti (nature), which cannot be equated with any one of the stages of its evolution.

Prakrti (nature) is a string of three strands or *gunas*, sattva or potential consciousness, rajas or activity and *tamas* or restraint. They are called *gunas* (qualities), as they are factors in the substance of prakrti (nature). They represent different stages in the evolution of any particular phenomenon. Sattva signifies the essence or the form which is to be realized, *tamas* the obstacles to its realization, and rajas the force by which the obstacles are overcome. The *gunas* are always changing, but when they are held together in a state of equilibrium (*samyavastha*) there is no action. The tendencies to manifestation and activity are held in check by that of nonmanifestation and nonactivity. When the tension is relieved development results. Prakrti (nature) evolves under the influence of purusha (subject) into the apparatus of thought as well as the objects of thought.

1. Theory of Evolution. — The first product of the evolution of prakrti (nature) is *mahat*, "the great" or buddhi (intelligence). Self-sense (ahankara), or the principle of individuation, arises next. From this, in its sattva aspect, arise the *manas* (internal organ), the five organs of perception and the five of action; from the same in the *tamas* aspect the five fine elements (tanmatras) arise. The rajas element helps both. From the five fine elements, by a preponderance of tanzas, the five gross elements are produced. The account is probably suggested by the subject's experience and transferred to a cosmic plane. In the state of dreamless sleep the self is present, though it does not apprehend the world. So, in the case of world dissolution, the selves are not distinguished and prakrti (nature) is unperceived. When one wakes from sleep there is, first, the rise of consciousness. followed immediately by the sense of selfhood and the restlessness of desire. The senses begin to function until the world is perceived. This order is followed in the Sankhya theory of evolution.

2. Plurality of Souls.—*Purusha* is the intelligent self, for whose experience prakrti (nature) evolves. It is a mere witness, a solitary indifferent spectator. It is pure consciousness while prakrti (nature) is unconscious. It is inactive, unalterably constant, and devoid of the *gunas* while prakrti is active, alterably constant and consists of them. Prakrti and its products depend for their manifestation on the light of *purusha* (self), which does not depend on anything else for illuminating objects. The Sankhya believes in a plurality of selves. If the self were one all should become free when one attained freedom, which is not the case. Freedom is not coalescence with the absolute spirit but isolation from prakrti.

The empirical individual is not the pure self but the self distinguished by the conjunction of the senses, etc., and limited by the body. While the pure self remains beyond the intellect the reflection of the self in it appears as the ego. Activity belongs to the intellect, and on account of its union with purusha (self) the indifferent self appears as an actor. Though not an agent, the self appears as an agent through confusion with the agency of nature, even as the latter through proximity to the self appears to be conscious. Every ego possesses within the gross material body, which suffers dissolution. a subtle body formed of the psychical apparatus including the senses. This subtle body is the basis of rebirth as well as the principle of identity in the various existences.

The evolution of nature is adapted to the ends of the self. The spiritual centres are, however, incapable of exerting any direct influence on nature, though they are said to excite it to activity. The union of self and nature is compared to a lame man of good

vision mounted on the shoulders of a blind man of sure foot.

The real self has relations with a real world on account of a fancied relation between the two. When the self recognizes its distinction from the ever evolving and dissolving world of nature the latter ceases to operate towards it. The efficient cause of the development of nature is not the mere presence of the selves but their nondiscrimination. Freedom is the result of discrimination. No cause is assigned for the original entanglement of the free spirits in the bonds of ignorance.

D. Yoga

The Yoga differs from the Sankhya in its insistence on mental discipline and acceptance of theism, though its connection with belief in God is somewhat loose. God does not create, reward or punish. Union with God is not the goal of Yoga endeavour. God is only a particular soul not essentially different from other souls co-eternal with him. He stands in an eternal connection with the most refined constituent of matter and is endowed with supreme power, wisdom and goodness.

Our bondage is due to nondiscrimination. The true light of the spirit will shine if the obscuring mental activities are suppressed. The method of Yoga consists in the suppression of all mental activities, conscious as well as unconscious. The eightfold path is a means of it. The first two, *yama* (abstention) and niyama (observance), refer to the ethical preparation. The next two, asana (posture), *pranayama* (regulation of breath), insist on the discipline of the body so as to make it flexible. We can control involuntary muscles as well by the breathing exercises. The next step of pratyahara or the withdrawal of the senses from their natural outward functioning answers to what modern psychology calls introversion. While these five are only accessories, dhyana (fixed attention), dharana (contemplation), and samadhi (concentration) are integral elements of Yoga. Through concentration we get into direct touch with the reality of the things and obtain intuitional knowledge. The process of concentration is to be continued until the mind is dissolved and self-illumination results. Samadhi is the perfect life of spirit.

E. Purva Mimamsa

The Purva Mimamsa has for its special object the ascertainment of duty (dharma). It is not a philosophical system, though it refers to philosophical topics incidentally. It believes in the reality of the world and the individual souls. As it deals with ritual specially, it points out how every act produces its effect sometime or other through the principle of apurva or the link between the act and the result. While the earlier writings do not admit the existence of God, the later ones do.

A chief writer of this school, Kumarila, argues for the theory of self-evidence (svatah *pramana*). Truth is its own guarantee. Cognitions are by themselves valid and their validity can be set aside only by the contrary nature of their objects or by the recognition of discrepancies in their causes. When we are in doubt about the true nature of a thing perceived at a distance or in faint light, we can resolve the doubt by a second cognition obtained under improved conditions. Even in the most difficult cases we can obtain an absolutely true cognition after a series of three or four. Correspondence and coherence theories do not produce validity but only test it.

F. Vedanta

The Vedanta Sutra attempts to set forth the teachings of the Upanishads in a consistent way. Its short aphorisms are unintelligible by themselves. Many different systems ranging from pure nondualism to explicit dualism attempt to interpret the Sutra. The chief of them are those of Shankara, Kamanuja and Madhva.

1. Shankara's Non-Dualism **(Advaita).**—Shankara in his system asks whether there is anything in experience which may be regarded as foundational and discusses the claims of the different factors of experience to that title. Our senses may deceive us and our memory may be an illusion. The waking tracts may not be different from dream worlds, where also we visit places, handle shadows and battle with ghosts. Though all objects of experience may be open to doubt, there is something which is beyond all doubt. Everyone is conscious of the existence of one's own self and no one thinks "I am not." The self cannot be doubted or denied for "it is the essential nature of him who denies it." Though we cannot know it by thought, it does not entirely escape us. It is the object of the notion of self (*asmat-pratyayavishaya*) and is known to exist on account of its immediate presentation (*aparokshatvat*). This self is distinct from the body, the senses and the understanding. It is the principle of consciousness which is unaffected when the body is reduced to ashes and the mind perishes. It is one, universal and infinite.

Logical knowledge based on the distinction of subject and object is not final. The real excludes all relations, but logical knowledge is relational in character. The real simply is, but we attempt to characterize it in knowledge and no predicate is found adequate to it. In judgment, we equate the real with the unreal, the subject with the object. We attribute to the Atman activity, agency and enjoyment: All our knowledge is strictly speaking nonknowledge (*avidya*). The ascertainment of the ultimate reality by the exclusion of all that is imposed (adhyasta) on it is wisdom (vidya). Avidya is another name for our finitude. When its roots are cut our bondage is broken. Shankara admits the reality of intuitional consciousness where the distinctions of subject and object are superseded.

Shankara adopts the distinction between truth (paravidya) and empirical truth (aparavidya). The latter is not illusory or deceptive but only imperfect or relative. The empirical world is not self-existent or real. Yet there must be a reality on which it rests. Even if we regard the whole universe as merely imaginary there must be something which is the basis of all imagination. That reality is Brahman. As it is opposed to all empirical existence, it is given to us as the negative of everything that is positively known. We cannot even call it one (ekam). It is to be called nondual (advaitam). It is the wholly "other" but not nonbeing. When we are not content with such negative accounts we describe it as the personal God (Isvara). God is the absolute cast through the molds of logic.

2. Doctrine of Maya.—Every object in the world tends to pass away from itself to something else. The categories of time, space and cause which bind experience are self-contradictory. Our knowledge of the world is inconsistent. When intuitional experience arises the pluralistic universe is sublated. The term maya (appearance) registers the imperfection and relativity of the world. It does not mean that the world is a mere illusion. Shankara's refutation of Buddhistic subjectivism is decisive on this question. While he traces the world to avidya (ignorance) he takes care to point out that this ignorance is cosmic in character. The phenomenal self and the phenomenal world are mutually implicated facts. The mind with its categories on the one side and the world which it construes through them on the other hang together.

We cannot conceive the relation between the world and the absolute. The question of relation has meaning only if we have two "distincts," but the world is not distinct from Brahman. The finite is the infinite hidden from our view through certain barriers. When we intuitively recognize the absolute the relative disappears; when we discuss about the relative there is no absolute to which it has to be attached. The problem arises on account of a confusion of standpoints. If Brahman is to be viewed as the cause of the world it is only in the sense that the world cannot be explained apart from Brahman, though the latter is in no way touched by the world of appearance. Brahman is the basis of the apparent existence of the world (vivartopadana).

The individual soul is different from the Atman. Its divine nature is concealed by the external adjuncts (upadhis) of the sense organs and vital airs which form the subtle body. These, together with karma, accompany the soul in its migrations. Moksha or salvation is the lifting of the veil of ignorance which conceals from the soul the truth that it is and always has been one with Brahman. The road to realization lies not through something done or accomplished but through knowledge or the sweeping aside of the delusive veil of ignorance. Shankara is clear that this insight cannot be attained without the discipline of moral life. Insight is not

so much an answer to a riddle as a victory in a battle.

3. Ramanuja's Theism.—Ramanuja endeavours to show that the God of religious faith is not the unconditioned abstraction of Shankara but a personal being whose reality need not be doubted simply because our knowledge of him is imperfect. The sense of personal communion with God involves a real fellowship with an other. The supreme Brahman has internal differences (*svagatabheda).* Souls and matter are comprehended within the unity of the supreme as attributes to the substance or parts to a whole or body to the soul which animates it. Though attributes of God, souls and matter are in themselves substances possessing qualities with their own distinct modes, energies and activities. Souls, matter and God are different on account of their natural differences *(svarzrpabheda)* but one on account of their identity *(aikyam)* of the modes and substance. Identity means only inseparable existence *(aprthaksiddhi).*

For Ramanuja, causation is only an alteration of state. The creation of the universe from Brahman is not a production of something new but only a change of condition. It is a modification of that which is subtle into that which is gross. In the causal condition Brahman has for his body or mode the conscious (*cit*) and unconscious *(acit)* entities in their subtle form, while in the effect condition they are in a gross form.

Ramanuja does not accept the explanation of the world and of the individual souls as mere productions of ignorance enveloping the nature of Brahman. If the multiplicity is due to human ignorance, then there should be no such world for God. But Scripture tells us of God's creation, etc., which means that God reckons with the world of multiplicity. We cannot regard the world as unreal, like the mirage, for while the activity prompted by the latter is unsuccessful, that based on the knowledge of the objects is successful. The reality of the world established by perception cannot be sublated by Scripture as the spheres of perception and Scripture are different. Simply because objects do not persist we cannot conclude that they are unreal.

While for Shankara, freedom consists in the removal of a barrier and the entering into the secure realization of a permanent and inalienable truth, for Ramanuja, it is communion with God to be reached by devotion and faith. The individual is not effaced when the goal is reached but maintains his self-identity and enjoys the fruit of his faith in unending felicity.

4. Madhva's **Dualism.**—Madhva stands out for unqualified dualism and insists on the five great distinctions of God and soul, God and matter, soul and matter, one soul and another and one part of matter and another. Reality is of two kinds, independent *(svatantra)* and dependent *(paratantra).* God is the only independent reality; matter and souls are dependent. God controls souls and matter though he does not create or destroy. He is the efficient but not the material cause of the universe. Though absolutely dependent on Brahman, the individual souls are essentially active agents and have responsibilities to bear. While God is all-pervading, the souls are said to be of atomic size. They yet pervade the body because of the quality of intelligence. No two souls are alike in character.

BIBLIOGRAPHY.—A. B. Keith, *The Religion and Philosophy of the Veda and Upaniṣads* (1925), careful and critical but overcautious; R. D. Ranade, *A Constructive Survey of Upaniṣadic Philosophy* (1926), gives important extracts in Sanskrit; B. M. Barua, *Pre-Buddhistic Indian Philosophy* (1921); *P.* Deussen, *Philosophy of the Upaniṣads* (1906), follows Sankara; J. L. Jaini, *Outlines of Jainism* (1916); M. Stevenson, *The Heart of Jainism* (1915); *A.* B. Keith, *Indian Logic and Atomism* (1921); *M.* Faddegon, *The Vaiśesika System* (1918); *J.* C. Chatterji, *Hindu Realism* (1912); F. H. Woods, *The Yoga Systenz of Pataiijali* (1914); *V.* S. Ghate, *Veddnta* (1926); *P.* Deussen, *The Systenz of the Veddnta* (1912); Max Müller, *Six Systems of Indian Philosophy* (1899); S. N. Das Gupta, *History of Indian Philosophy,* 4 vol. (1922–55); S. Radhakrishnan, *Indian Philosophy,* 2 vol. (1923–27), expository and critical; E. W. Hopkins, *The Ethics of India* (1924). Translations: R. E. Hume, *The Thirteen Principal Upanisads* (1921), a good translation, author's introduction unsympathetic; S. Radhakrishnan, *The Principal Upaniṣads* (1952); H. Jacobi, *Jaina Sūtras,* 2 vol. (1884, 1895); A. Chakravarti, *Kundakundācārya's Pañcāstikāyasāra* (1920); S. C. Ghoshal, *Nemicandra's Dravyasaṁgraha* (1917); *T.* Jaini, *Umāsvāt's Tattvārthādhigama Sūtra* (1920); Gaṅgānāth Jhā, *Nyciya Sūtra* (1919); Nanda Lal Sinha, *Sāṁkhya Philosophy* (1915), with *Vātsyāyana's Bhāṣya and Udyotakara's Vārttika,* gives translations of important Sankhya texts; G. Thibaut, *The Vedānta Sūtra With Śaṁkara's Commentary,* 2 vol. (1890, 1896), *The Veddnta Sūtra With Rāmānuja's Commentary* (1904); S. Radhakrishnan and C. A. Moore (eds.), *Source Book in Indian Philosophy* (1957). (S. RA.)

INDIAN PIPE *(Monotropa uniflora)*, a saprophytic herb of the wintergreen family (Pyrolaceae), called also corpse plant, American ice plant and ghost flower, found in moist, rich woods almost throughout temperate and warm North America and also in the Himalaya mountains and Japan. It is a smooth waxy-white plant, of unusual appearance, which grows on decaying vegetable matter and is somewhat parasitic on roots. The erect, usually clustered stems, four to ten inches high, bear small scales representing leaves and terminate in a single nodding flower, about one inch long, blossoming from June to Aug., followed by a many-seeded capsule which becomes erect in ripening. Occasionally the flower, or more rarely the whole plant, has a pinkish or reddish tinge. All parts of the plant turn blackish in drying. There are two other species of the genus, both north temperate, one of which, M. *hypopytis,* the yellow bird's-nest or pinesap, with flowers in a drooping cluster, widely distributed in Europe, Asia and North America, occurs in the British Isles.

INDIANS: *see* INDIAN, LATIN-AMERICAN; INDIAN, NORTH AMERICAN.

INDIANS, NORTHWEST COAST. The Indians of the coast of southern Alaska, British Columbia. Washington, Oregon and northern California formed an areal grouping of tribes with a common cultural foundation. The principal tribes and stocks comprised are the Tlingit, Haida, Tsimshian, Kwakiutl, Nutka, Bella Coola and other Coast Salish, Chimakun, Makah, Chinook, Yakonan, Kus, Takelma, Yurok, Wiyot, Karok and the Hupa and other Athabascan groups. Linguistically there was considerable diversity among these groups; otherwise their similarities exceeded their differences. Generic cultural features extending over the entire area were: dependence primarily on fish, especially salmon; coastal maritime navigation; development of woodworking, including the carver's art; wealth accumulation, with an elaborate system of economic exchange and property law; the organization of society on the basis of hereditary rank dependent on economic status; religious cults heavily influenced by proprietary rights. Particular traits exemplifying these trends were: deep-sea fishing; whale hunting; large dugout canoes with plank lashings for higher freeboard; mat sails; clothing largely of mats, with basketry hats; twined basketry with overlay decoration; villages of large, all-frame houses facing the beach or river; totem poles and wooden grave monuments; boxes for cooking, storage. etc.; clubs, spoons and most utensils, also rattles, masks, etc., elaborately carved or painted in a peculiar totemic-symbolic art style; dentalium shells, plates of native copper, boxes, etc., serving as standardized mediums of exchange, often with high fictitious credit values; potlatches or competitive socioreligious festivals with wealth distribution for prestige; loans with high rate of interest; division of society into rich nobles with titles, crests and privileges, commoners and slaves; marriage by purchase; secret religious societies with elaborate ranks and masks. The greatest concentration and elaboration of this distinctive combination of traits occurred among the Haida, Tsimshian and Kmakiutl. In several respects, however, the classic manifestations of the complex among these tribes were late and short lived. Thus, woodworking and potlatching were greatly stimulated through access to iron tools and external sources of wealth subsequent to 1800, but both practices were on the decline well before the end of the 19th century.

BIBLIOGRAPHY.—P. E. Goddard, *Indians of the Northwest Coast* (1924); monographs by F. Boas, G. M. Dawson, M. Eells, G. T. Emmonds, G. Gibbs, P. E. Goddard, E. Gunther, C. Hill-Tout, G. Hunt, A. Krause, A. L. Kroeber, A. B. Lewis, T. F. McIlwraith, C. F. Newcombe, A. P. Niblack, E. Sapir, G. M. Sproat, J. G. Swan, J. R. Swanton. G. Vancouver and M. Barbeau. (A. L. K.; H. G. BT.)

INDIAN SUMMER, a spell of warm, clear weather often persisting for a week or more, characteristic of middle and late autumn in central and eastern United States. It occurs in a large, stagnating, anticyclonic area; the first day or so may be cold, but under the clear skies with light winds the daytime hours of each

succeeding day become warmer and warmer, while frost, dew, hoar or valley fog may occur during each chilly night. The haziness of the air, the musty odour and glorious mordant colouring of the leaves, the smell of smoke from rampant fires in the dry woods and the relaxing physiological effect of the warmth following the previous cold snap all contribute to the distinctive and romantic stereotype of Indian summer that has been cherished by generations of Americans. In some years Indian summer spells may be brief or lacking; in others they are prolonged or recurrent. The weather-map situation for Indian summer is not so definite, or clear-cut a type as the weather itself: it may be described in general as caused by conversion of a moving, cool, shallow, polar air mass into a deep, warm and stagnant anticyclone. The strong temperature inversions that develop at low levels in the free air in such an anticyclone (*q.v.*) have the effect of concentrating the smoke and dust in the air near the ground and causing a large range of temperature between day and night. (R. G. SE.)

INDIAN TOBACCO: see LOBELIA.

INDIAN TURNIP: see JACK-IN-THE-PULPIT.

INDIA RUBBER: see RUBBER.

INDICATOR, CHEMICAL. An indicator is a substance that is capable of indicating the completion of a reaction. Methyl yellow, for example, imparts a yellow colour to an alkaline solution. If acid is slowly added, the solution remains yellow until all the alkali has been neutralized, whereupon the colour suddenly changes to red. Methyl yellow is therefore classified as an acid-base indicator.

Like most indicators, methyl yellow is visible even if its concentration is as low as a few parts per million parts of solution. Gsed at such low concentrations, indicators do not interfere with or have any influence on the reactions for which they are recommended. The common application of indicators is the detection of end points of titrations (see CHEMISTRY: Analytical *chemistry*).

The colour of an indicator alters when the acidity or the oxidizing strength of the solution, or the concentration of a certain chemical species reaches a critical value or, more precisely, a critical range of values. Indicators are therefore classified as acid-base, oxidation-reduction, or specific-substance indicators, every indicator in each class having a characteristic transition range. Methyl yellow is yellow if the hydrogen ion (acid) concentration of the solution is less than 0.0001 mole per litre and is red if the concentration exceeds 0.001. Ferrous 1,10-phenanthroline, an oxidation-reduction indicator, changes from red to pale blue when the oxidation potential of the solution is increased from 1.04 to 1.08 v.; and diphenylcarbazone, an indicator for mercuric ion, changes from yellow to violet when the mercuric ion concentration is increased from 0.000001 to 0.00001 mole per litre. Each of these indicators thus has a relatively narrow transition range, and each is capable of giving a sensitive, sharp indication of the completion of a reaction (the end point). In devising a new titration the chemist first calculates or empirically determines the changes in the properties of the solution that occur as the end point of the reaction is approached and passed. He then selects an appropriate indicator from tables of indicator transition ranges. Thousands of indicators have been studied, some of which have been individually synthesized to provide them with specified characteristics.

Commonly, indicators are complex organic compounds, similar in structure and optical properties to dyes. The chemical behaviour of indicators is, however, usually simple. The acid-base properties of methyl yellow (p-dimethylaminoazobenzene), for example, are entirely analogous to those of ammonia. Both compounds are weak bales which, when acid is added, combine reversibly with hydrogen ions. Moreover, the same simple mathematical equations describe the acid-base behaviour of both compounds; namely, the ratio of the concentration of the acidic form to the concentration of the basic form is proportional to the hydrogen ion concentration (see HYDROGEN IONS). The principal difference is that the basic form, NH_3, and the acidic form, NH_4^+, of ammonia are both colourless, whereas the corresponding forms of methyl yellow are yellow and red. The addition of a hydrogen ion to the methyl yellow molecule causes a redistribution of electrons and a consequent alteration in light absorption properties. This redistribution is in part made possible by the complexity of the indicator's molecular structure (see DYES).

Although the visible change of the indicator is usually a colour change, it may instead be the formation or disappearance of a turbidity. If, for example, a soluble silver salt is added to a solution of cyanide that contains a trace of iodide, the solution remains clear until all the cyanide has reacted to form the soluble silver cyanide complex ion, $Ag(CN)_2^-$. Upon the addition of more silver a turbidity of silver iodide forms. Iodide is therefore an indicator for excess silver ion in this reaction.

A peculiar kind of indicator is the adsorption indicator, the best-known representative of which is the dye, fluorescein. Fluorescein is used to detect the completion of the reaction of silver ion with chloride ion the colour change occurring in the following manner. After a quantity of silver sufficient to precipitate all the chloride has been added, additional silver ion is partially adsorbed on the surface of the particles of silver chloride. Fluorescein also is adsorbed and, in combining with the adsorbed silver ion, changes from yellow-green to red.

Until about 1935 acid-base indicators were used extensively for the colourimetric determination of the pH of aqueous solutions. (The pH is a measure of acidity and alkalinity. The pH scale runs from approximately zero—very acidic solution—to approximately 14—very alkaline solution.) The procedure was (1) to select by trial and error an indicator with a suitable transition range; and (2) to compare the colour of the sample solution with the colours of standard solutions of known pH, all solutions containing the same amount of the same indicator. After the development of the glass electrode, which permits a precise and convenient electrochemical measurement of pH, the use of indicators for this purpose was abandoned, except as it survives in the employment of the so-called wide-range or universal indicator. The wide-range indicator is actually a mixture of indicators, the transition ranges of which slightly overlap one another and in combination extend from the very acid range to the very alkaline range. The indicators of the mixture are so chosen that the colour of the mixture indicates uniquely the pH; a colour chart gives the pH corresponding to a given colour. Thus, a mixture of methyl yellow (pH range 3 to 4), methyl red (4 to 6), bromthymol blue (6 to 8), thymol blue (8 to 9.5), and phenolphthalein (8.2 to 10) is coloured cherry red at pH 1, rose at pH 2, red-orange at pH 3, orange-red at pH 4, orange at pH 5, yellow at pH 6, yellowish-green at pH 7, green at pH 8, bluish green at pH 9, and blue at pH 10.

"Indicator paper" is dry, absorbent paper impregnated with one or more indicators. An estimation of pH can be made by putting a drop of test solution on wide range indicator paper and observing the colour. This technique avoids contamination of the solution. (T. S. L.)

INDICATORIDAE: see HONEY GUIDE.

INDICTION, a period or cycle of 15 years. The word means "impost" and was first applied to publicly imposed taxes in Egypt, a system which Diocletian, following Hadrian's proposal of a 15-year period of revision of tax censuses, extended to the whole Roman empire in A.D. 297. But the first indiction is usually given as beginning with A.D. 312, being associated with Constantine's victories of that year.

Dating by the year of indiction became regular during the middle ages, particularly in ecclesiastical affairs.

INDICTMENT. England.— An indictment is a formal accusation in writing presented to the court in any criminal prosecution other than an offense to be tried summarily before magistrates, with certain exceptions that do not often occur in contemporary practice, such as impeachments before the house of lords and the trial of certain misdemeanours in the queen's bench division. Its purpose is to state the offense or offenses with which the person accused is charged, the statute, if any, which creates the offense, and such particulars as are necessary to enable the accused to know what charge he has to answer.

To give an example, the statement of offense will charge the accused with robbery with violence, contrary to section 42 of the

Larceny act, 1861; the particulars of offense will specify, naming the accused, that on a certain day of a certain month in a certain year, in a named county, he robbed a particular individual of a watch. and that at the time of or immediately before or immediately after such robbery he did use personal violence to the said individual.

Historically, there have been two lines of development that have affected indictments. The first is that they were previously drawn up in the form of a "bill" of indictment and sent before the grand jury; the grand jury then heard in private the witnesses in support of the charge, and, if satisfied that a prima-facie case had been made out, found the bill to be a true bill and returned it to the court as such, or otherwise reported to the court that they found "no true bill." This procedure was fundamentally altered by the Administration of Justice (Miscellaneous Provisions) act, 1933, s. 1 of which abolished grand juries, while s. 2 prescribed the procedure for the indictment of offenders. No bill of indictment charging any person with an indictable offense (that is, any offense other than such minor offenses as can only form the subject of summary proceedings before magistrates) can be preferred unless either (1) the person charged has been committed for trial or (2) the bill is preferred by the direction or with the consent of a judge of the high court or pursuant to an order made under s. g of the Perjury act, 1911; where a person has been committed for trial, however, the bill of indictment may include any counts founded on facts or evidence disclosed in any examination or deposition taken before a justice, being counts that may lawfully be joined in the same indictment; and a charge of a previous conviction of an offense or of being a habitual criminal or a habitual drunkard may, notwithstanding that it was not so included or in a judge's direction or consent, be included in an indictment.

The second line of development is a relaxation of the technical rules that previously obtained in the preparation of indictments, and used frequently to be a cause of undeserved acquittals. This process has been connected with the elimination of much of the old harshness of the penalties incurred on conviction! together with the greatly increased opportunities that the modern procedure in criminal trials gives to the accused of conducting his defense with the help of counsel at all stages. Since 1825 numerous enactments have been passed for getting rid of technicalities in connection with indictments, and from 1851 the courts had power to disregard technical objections to the form of indictment and to amend in matters not essential should the indictment and the evidence be at variance. The technicalities of criminal pleading were finally dealt with by the Indictments act, 1915, which made rules as to indictments and set up a rule committee under the lord chief justice having power to vary or annul the rules in the statute and to make further rules. Although the individual counts in the indictment must still relate to separate offenses and be free of duplicity or ambiguity, charges for more than one felony or more than one misdemeanour, and charges for both felonies and misdemeanours, may be joined in the same indictment. Power is given before or at any stage of trial to amend the indictment. if it can be done without injustice; to order the separate trial of separate offenses if the accused would otherwise be prejudiced or embarrassed; or to postpone a trial for amendment or separate hearing.

Scotland. — In Scotland the terms indictment or criminal letters are used to express the acte d'accusation. The indictment is filed by the lord advocate or one of his deputies; it is only by order of the court of justiciary that a prosecution can be instituted without the general assent of the lord advocate. As in England. the form of indictment has been much simplified. (W. T. Ws.)

United States. — As a general rule, an indictment must state the crime charged with sufficient certainty to fulfil three iunctions: to enable the defendant to prepare his defense; to enable the court to pronounce judgment, upon conviction, according to the rights of the case; and to prevent a second prosecution for the same offense.

Further requirements of form and rules relating to the indictment vary considerably among various jurisdictions. In many cases the indictment contains a number of counts, each charging a different version of the same offense or, subject to certain limitations, separate offenses. The modern tendency has been to shorten and simplify the form of the indictment. In addition, there frequently has been recognition of a defendant's right to obtain from the prosecution a "bill of particulars." This contains such additional details of the facts and circumstances of the offense as the trial judge determines are required for the proper defense of the accused. Under some statutes the granting of bills of particulars is mandatory upon application by the defense.

Since the indictment is a finding by the grand jury upon oath, and depends for its validity upon this fact, among others, it could not, until recent times, be amended by the court without the concurrence of the grand jury that presented it. Under modern practice, however, certain formal mistakes, such as the name or description of any place, person or thing, may be corrected by amendment at the trial on such terms as the court may deem necessary. Such amendment may not be ordered, however, to correct errors that affect the substance of the accusation.

The fifth amendment of the U.S. constitution declares that "No person shall be held to answer for a capital or other infamous crime unless on a presentment or indictment of a grand jury. . . ." This provision applies only to prosecutions in the federal courts, but in many of the state constitutions there are similar provisions applying to the state courts. Under these provisions it has sometimes been held that an indictment is absolutely essential before the court has jurisdiction to try the offender, and the accused cannot even waive the benefit of the provision by consenting to be tried without an indictment. This view was rejected, however, in the Federal Rules of Criminal Procedure, adopted in 1946 and applicable to federal prosecutions. The rules provide that a defendant "may be prosecuted by information if . . . after he has been advised of the nature of the charge and his rights, (he) waives in open court prosecution by indictment."

It has long been held that the U.S. constitution does not require the use of indictments in state criminal proceedings. Where the state constitution contains no such requirement there is nothing to prevent the legislature from providing for prosecution of all crimes. even capital offenses, by some other mode of accusation. For example, the accusation might be by information, which is a written accusation of crime preferred by the prosecution without the intervention of the grand jury. A large number of the states, by either constitutional provision or statute, authorize the prosecution of serious offenses by information, with various qualifications. In some of these states indictments are never or rarely ever employed. (F. A. A.)

INDIES, LAWS OF **THE,** in general, the whole body of law promulgated by the crown of Spain for the government of the Spanish kingdoms outside Europe; and more particularly, a series of collections of decrees. compiled and published by royal authority, culminating in the Recopilacidn de Leyes de *los* Reynos de *las Indias* of 1680. From the beginnings of American settlement, the law of Castile was regarded as the basic law of the Indies also. American conditions, however, presented many problems which had no exact parallel in Spain. An entire administrative and judicial hierarchy, civil and ecclesiastical, had to be created; and a vast native population europeanized and converted to Christian belief. Land had to be distributed and labour organized to work the land. From an early date, therefore, the crown found it necessary to legislate separately for the Indies and to adopt the principle — implicitly at first, but explicitly in the Recopilacidn — that new legislation promulgated for the Iberian kingdoms had no force in the Indies, unless given such force by explicit decree. Thus, while the subjects of the crown in the Indies continued to live, in general, according to the system of private law prevailing in Castile, they acquired a separate body of public law of their own, designed to carry over into America the spirit and intent of Spanish law, but also to adapt it to the vastly different conditions of American life.

Of the many thousands of legislative enactments issued by the crown, with the advice of the Council of the Indies in the 16th century, a small number took the form of codes of rules dealing

with particular aspects of colonial life throughout the empire. The earliest of these codes, the "Laws of Burgos" of 1512, was primarily an attempt to order the relations between Spaniards and Indians and to limit the demands made upon the conquered people. It was, in part at least, a response — a quite inadequate response — to complaints made by Dominican missionaries. The "New Laws" of 1542, which also owed much to missionary agitation. dealt with the same subject in much more radical fashion, in particular by attempting to abolish the system of *encomiendas*, whereby leading Spanish settlers were empowered to levy tribute and services from specified Indian villages in return for military service. the provision of churches and the payment of parish clergy. The "New Laws" provoked armed rebellion by the *encomenderos* in Peru and the threat of it in New Spain, and some of the clauses concerning *encomiendas* had to be repealed; though restrictions upon *encomenderos* were reintroduced, in a different form. in 1549. In 1552 a code of commercial regulations was published for the Casa de Contratación ("House of Trade") in Seville; in 1563 the constitution, procedure and powers of the colonial courts of appeal *(audiencias)* were defined; and in 1573 appeared the justly celebrated "Ordinances Concerning Discoveries," prohibiting unauthorized operations against independent native peoples and laying down rules for establishing good relations with the inhabitants of newly discovered lands. The vast majority of decrees (*cédulas*), however, were not arranged in code form but dealt empirically with matters of concrete detail, in response to specific complaints or reports. The bureaucratic paternalism of the Habsburg kings produced an extraordinary legislative profusion. Before the middle of the 16th century, the need for a general legal code was already apparent.

Attempts at codification made in the 16th century included the *Cedulario* of Vasco de Puga, published in 1563, which applied only to the viceroyalty of New Spain and contained many errors and omissions; the work oi Juan de Ovando of 1570–71, never published; and the iour iolio volumes of Diego de Encinas (1596), a roughly classified collection of decrees in chronological order, again with many mistakes — a valuable historical source but oi little use to working lawyers. None of these met the need for an authoritative code. The collection which eventually appeared as the *Recopilación* was begun by Antonio de León Pinelo in 1624, under the supervision first oi Rodrigo de Aguiar y Acuña, later of Juan Solorzano Pereira, both councillors of the Indies and both, particularly Solorzano, jurists of proiound learning and great experience. The work, extracted irom more than 400,000 *cédulas*, u-as completed in 1635 and approved by Solórzano the following year. It was not immediately published, largely because of lack oi funds; and was iurther edited and abbreviated by Fernando Jiménez Paniagua before its eventual approval in 1680 and publication in 1681. The *Recopilación de Leyes de los Reynos de las Indias* or *de Leyes de Indias* in its final iorm contains about 6,400 laws, in nine hooks of very unequal length, subdivided into *titulos* or chapters. Briefly stated, the contents of the books are: (1) ecclesiastical government; (2) the Council of the Indies and colonial *audiencias;* (3) political and military administration, viceroys and captains-general; (4) discoveries, colonization. municipalities; (5) provincial government and lower courts; (6) Indians; (7) penal law; (8) public finance: and (9) trade and navigation. Subsequent legislation, especially the far-reaching administrative and economic reforms introduced in the later part of the 18th century, rendered much of the *Recopilacidn* obsolete; but proposals made under Charles III for bringing it up to date came to nothing. It remained in force until the Spanish-American wars of independence and, in Cuba, in Puerto Rico and in the Philippines, until the end of the 19th century. It was reprinted three times in the 18th century and twice in the 19th, the last two editions containing a supplement of later legislation; but the main body of the work was never revised.

The *Recopilacidn* is a notable monument of colonial legislation. It contains, no doubt, many inconsistencies; its phrasing is not always precise; and the marginal references to original *cédulas* are often inexact. It has nonr of the organic character of a modern (or of a Roman) code. Side by side with decrees enunciating vital principles of law, it gives rulings on trivial local matters: the installation of a clock in the courtroom at Seville; the gratuities of court ushers; and so on. Much space is devoted to details of ceremonial and precedence; much, again, to restrictive commercial regulations that were not only a defiance both of geography and of common sense but also in many cases uneniorccable. The general tendency of the whole code was to retain all interpretation and decision in peninsular Spanish hands, thus cutting the creole upper classes off from the normal political functions of aristocracy and so rendering them irresponsible and, ultimately, disloyal. These deiects are more apparent. however, to the hindsight of the 20th century than they were irom the normal standpoint of the 17th or 18th. The *Recopilación* remains the most comprehensive code of law eyer devised for a colonial empire and in many ways the most humane. It is permeated by lofty moral and religious principles. This characteristic is most apparent in the sections concerning Indians, which date, ior the most part, irom the 16th century. They reflect the public influence of such men as Francisco de Vitoria, one oi the greatest theologians of his age and a iounder of modern international law; Bartolomé de Las Casas, indefatigable missionary and polemist and a passionate advocate of Indian rights; and Garcia de Loaisa, the emperor Charles V's confessor, general of the Dominican Order and president of the Council of the Indies. Their arguments reinforced the royal determination to prevent the growth of a new colonial feudalism. The *Recopilacidn*, accordingly, declared that the Indians were free men, the direct subjects of the crown, entitled to the protection of the law in their persons, lands and possessions; that they were rational beings, to be converted to the Christian iaith by persuasion, not by force; that tribute and services might be demanded from them only by public authority; and that their laws and customs, where not repugnant to Christian morality or to the laws of Castile, mere to be respected. The laws of the Indies mere often evaded or disregarded. Yet the records of the *audiencias* and of the *juzgado general de Indios* indicate that the laws, where they concerned Indians, mere by no means a dead letter. At the very least, they were an unequivocal declaration oi policy, which anticipated many ideas associated with the doctrine of colonial trusteeship in the 20th century. (J. H. Py.)

INDIGESTION (Dyspepsia) is a subjective variable sensation of discomfort associated with food intake by the person experiencing the discomfort. It may be of nervous origin, the result of poor food habits, a reflex to pain or due to disease in the gastrointestinal tract. The sensation may be a bad taste in the mouth; a burning or tight feeling in the chest; belching or frequent vomiting; heaviness, gnawing, burning or fullness in the upper abdomen; a bloating or cramping sensation in any part of the abdomen or irregular bowel habits. Nervous indigestion usually dates from youth and is associated with added stresses and strains of life as well as the intake of irritating foods. It responds well to mild sedation, antispasmodics and a bland diet. Indigestion caused by poor food habits usually can be corrected by eating in leisurely fashion, chewing the food well with the mouth closed and observing a bland diet. Indigestion may arise in reflex to pain in any part of the body, fatigue, anger or fear. This may be eliminated by elimination of the inciting cause. Similar sensations may be caused by spasms or tumours in the esophagus, inadequate valve action between the esophagus and stomach, ulcers or tumours of the stomach or duodenum, tumours or inflammation of the intestine. Therefore, such symptoms require thorough medical study in order to eliminate any such serious causes. (JE. A. S.)

INDIGO, an important and valuable dyestuff. was obtained up until the last decade of the 19th century entirely from plants, mainly those of the genus *Indigofera*, of which the **I.** *sumatrana* and *I. arrecta* were the most important. The material was known to the ancients of Egypt, Greece and Rome, and according to Julius Caesar also to the Britons who obtained it from the woad plant, *Isatis tinctoria.*

In all the plants from which it was derived, indigo occurred in the form of a colourless glucoside, indican, $C_{14}H_{17}NO_6.H_2O$ which was readily soluble in water. By a process closely akin to fermentation, the glucoside was split into glucose and indoxyl, C_8H_7NO, the latter also colourless. By mild oxidation, even by air, two molecules of indoxyl were converted by the loss of four hydrogen atoms into indigo $C_{16}H_{10}O_2N_2$, a dark blue powder. (*See* Dyes.)

The cultivation of indigo plants and the extraction of the dyestuff was an important industry in India up to the beginning of the 20th century. In 1897, for example, no less than 1,750,000 ac. of land in this country were under cultivation for this purpose, and something like 17,000,000 lbs. of indigo were exported. The introduction of comparatively cheap synthetic indigo at about this time by the Germans therefore produced an economic upheaval in India.

In 1883, the German chemist, A. von Baeyer, announced the true chemical structure of indigo, and at once a race began between the leading German dyestuff companies to develop a commercial method for its manufacture. But it was not until approximately 1j years later that a process was developed that was economically sound. Although discovered elsewhere, it was developed in the plant of Meister, Lucius and Bruening at Hoechst and consisted in the fusion of phenylglycine sodium salt, $C_6H_5.NH.CH_2COONa$,

in a mixture of caustic soda and sodium amide to indoxyl, the use of soda amide being the key to the success of the development.

Since the World War II period synthetic indigo has been made by this method in every country in the world possessing a first-rate dyestuff industry.

The cultivation of indigo-bearing plants in India has practically ceased. (J. H. Ss.)

INDIGO BUNTING (INDIGO BIRD) (Passerina cyanea), a North American bird of the finch family (Fringillidae), breeding chiefly in the northeastern United States and adjacent Canada. south to Georgia, west to Colorado and Texas. The adult male is of a deep blue nearly all over, changing to brownish in the autumn. The female is brown above and ochreous-white beneath. See BUNTING.

INDIUM, a lustrous, silvery, metallic element softer than lead and both malleable and ductile, was discovered in 1863 by Ferdinand Reich and Theodor Richter by means of the spectrograph, and because of the prominent indigo-blue spectral lines they gave the name indium to the element. It is in group IIIb of the periodic table between gallium and thallium, which it resembles in many chemical properties.

For more than 50 years after its discovery little use was made of the substance, which has since found valuable applications in the manufacture of transistors, in finishing engine bearings, as an ingredient in fusible alloys and solders and in other specialized uses, including the measurement of the thermal neutron flux of nuclear reactors (see Uses, below).

Occurrence and Recovery. — Indium is scattered widely throughout the world and is found in small amounts in many minerals, particularly those of zinc and lead. Numerous methods have been suggested or used for the extraction of indium from concentrates or residues. In one method, the zinc concentrates containing indium are roasted and leached with a solution maintained somewhat acid with sulfuric acid. The solution is treated with zinc and the indium is precipitated, together with copper, silver, etc. The precipitate is treated with sulfuric acid, and the silver is removed from the resulting solution by hydrogen sulfide. Indium is then recovered from solution by electrolysis. Aluminum can also be used, in place of zinc, for precipitating indium from acid solution.

Another process is based on the fact that indium can be precipitated selectively as a phosphate from a slightly acid solution. The method includes the precipitation of indium from the leach solution as indium phosphate, the conversion of indium phosphate to indium hydroxide by treating with strong caustic solution, filtering and heating to form the oxide, followed by the reduction of the oxide to metal. The resulting metallic indium can be further refined electrolytically if desired.

To recover indium from a zinc-lead metal, the molten bath is treated with a suitable chlorine-supplying agent or gaseous chlorine to remove selectively the zinc and indium as chlorides, using a low-melting cover slag and temperatures sufficiently low to avoid loss of indium by volatilization. The resulting chloride slag is then leached with dilute sulfuric acid and the indium is precipitated with zinc dust after removing lead sulfate by filtration. The zinc-indium sponge is then melted and the zinc is removed by means of chlorine.

TABLE.—*Physical Properties of Indium*

Atomicnumber	49
Atomicweight	114.82
Boiling point	2,046° C. (3,722° F.)
Crystal structure	Face-centred tetragonal
Density at 20° C. (68° F.), g./c.c.	7.31
Electrical resistivity, microhm-cm.	
(solid) 20° C.	2046° C.
(at melting point) 156° C. (313° F.)	29
Electrochemical equivalent for In^{+++}, mg./coulomb	0.39641
Electrode reduction potential for $In^{+++}(H_2=0.0$ volt)	0.34
Latent heat of fusion, cal./g.	6.8
Latent heat of vaporization, cal /g.	468
Linear coefficient of thermal expansion, per 1° C.	33×10^{-6}
Mechanical properties:	
Tensile strength, p.s.i.	380
Elongation, % in 1 in.	22
Brinell hardness	0.9
Modulus of elasticity, p.s.i.	1,570,000
Melting point	156.17 ± .05° C. (313.1 ± .1° F.)
Nuclear data:	
Stable isotopes	In^{113}; In^{115}
Thermal neutron cross section, 2,200 m./sec.	
Absorption (barns)	190 ± 10
Scattering (barns)	2.2 ± 0.5
Specific heat cal./g./° C.	
(solid) 20° C.	0.057
Thermal conductivity at 20° C., cal./sq.cm./cm./° C./sec.	0.057
Valence	Usually 3, but also 2 & 1

Characteristics. — Indium metal is unaffected by air at ordinary temperatures, but at a red heat it burns with a blue flame to form the oxide, In_2O_3. The metal dissolves in mineral acids but is unaffected by potassium hydroxide or boiling water. When heated in the presence of the halogens, direct combination takes place; when heated with sulfur, the two elements combine with incandescence.

Uses. — Indium is used as a coating for aircraft sleeve bearings since it improves corrosion resistance and enables the surface to retain a more adherent oil film. For fire protection indium is an ingredient of low-melting alloys used in sprinkler heads, fire door links, fusible plugs, etc. Indium has the unique property, when molten, of wetting glass and other surfaces, which makes it valuable for producing hermetic seals between glass, metals, quartz, ceramics, marble, etc. It is also used extensively in the manufacture of P-N junctions in semiconductor devices and for soldering various parts of germanium transistors and rectiiiers (see also TRANSISTOR: Fabrication Techniques: P-N Junctions).

In the nuclear field indium is used to measure the thermal neutron flux of a reactor and to monitor neutrons for the protection of personnel and equipment. This ability of indium to measure neutrons depends on the activation of the indium by neutron capture. The main stable isotope (11j), which is approximately 96% of natural indium, has a large capture cross section for thermal neutrons and the resulting isotope, In^{116}, is a radioactive beta ray and high-energy gamma ray emitter with a half life of 54 min. This activity, which is readily measured by conventional ionization instruments, gives a measure of the neutrons available for capture by indium. The characteristic of giving off intense gamma rays is the reason why serious consideration is being given to indium as a source of these rays for the preservation of food.

Organic indium compounds (particularly indium laurate) are used as additives to gasolines to give higher fuel efficiencies and to inhibit the deposition of carbon by the fuel during combustion. Another use of indium is as an anode in miniature alkaline batteries which are characterized by their long shelf life and freedom from gas evolution.

See M. *T*. Ludwick, *Indium* (1950); *A.* **A.** Smith, Jr., *Encyclopedia of Chemical Technology (1951).* (**A. A.** SH.)

INDIVIDUALISM is a term somewhat similar in meaning to liberalism (*q.v.*). Both concepts place high value on the freedom of the individual. While liberalism, changing in connotation with the times, has come to include concepts of freedom that are compatible with either governmental control or conjoint activity, individualism stresses the self-directed, self-contained and comparatively unrestrained individual or ego. In present day usage, the term sometimes lacks liberalism's suggestion of approval and may even imply disapprobation. Alexis de Tocqueville (*q.v.*), who coined the word, described it in terms of a kind of moderate selfishness, disposing men to be concerned only with their own small circle of family and friends. **A** hermit is an individualist but not necessarily a liberal.

Conceptual Bases. — As a philosophy, individualism involves a value system, a theory of human nature, a general attitude or temper and belief in certain political, economic, social and religious arrangements. The value system may be described in terms of three propositions: all values are man-centred, that is they are experienced (but not necessarily created) by human beings; the individual is an end in himself and is of supreme value, society being only a means to individual ends (held by some to be divinely ordained); and all individuals are in some sense morally equal. this equality being best expressed by the proposition that no one should ever be treated solely as a means to the well-being of another person.

The individualistic theory of human nature holds that the

interests of the normal adult are best served by allowing him maximum freedom and responsibility for choosing his objectives and the means for obtaining them: and acting accordingly. This belief follows from the conviction that each person is the best judge of his own interests and. granted educational opportunities. can discover how to advance them. It is also based upon the assumption that the act of making these choices contributes to the development of the individual and to the welfare of society.— the latter because individualism is thought to provide the most effective incentive to productive endeavour and because it is also believed to lead to variety of individual development. which itself is judged valuable. These beliefs about human nature have tended. historically. to be based upon a mechanistic and atomistic theory of psychology.— that is. the idea that behaviour is a matter of mechanical responses to sensations, directed toward maximizing pleasure and minimizing pain. Society, from this point of view, is seen as only a collection of individuals; each of which is a self-contained and ideally almost self-sufficient entity.

As a general attitude, then. individualism embraces a high valuation on self-reliance, on privacy and on respect for other individuals. Negatively, it embodies opposition to tradition, to authority and to all manner of controls over the individual, especially when they are exercised by the state. It also looks with favour upon variety rather than uniformity. and change rather than fixity; it anticipates and values progress and. as a means to this end, subscribes to the right of the individual to be different from, to compete with and to get ahead of (or fall behind) others.

The institutional embodiment of individualism follows from these principles. Liberal democracy is the favoured form of government and *laissez faire* (*q.v.*) the approved policy. The role of the state is to maximize individual freedom and opportunity. Only the most extreme individualists believe in anarchy *(see* ANARCHISM), but all believe that government should keep its interference with men's lives (including their voluntary arrangements for social life) at a minimum and that it should confine itself largely to maintaining law and order, preventing individuals from interfering with others and enforcing agreements (contracts) voluntarily arrived at. The state tends to be viewed as a necessary evil and the slogan "That government that governs least governs best" is applauded. Moreover, each individual should have equal opportunity, through the ballot, to determine the form and activity of the state and, through freedom of expression and association. to influence the beliefs and behaviour of others.

Individualism also implies a property system according to which each person (or family) enjoys the maximum of opportunity to acquire property and to manage and dispose of it as he sees fit. Freedom of association extends to the right to join (or to refuse to join) any religious organization. For some. individualism implies the belief that individuals do not stand in need of priest or church to mediate between them and God and that church organization should not be authoritarian.

History.— Both a clearer understanding of its meaning, and a better perspective for judging its value and prospects, can be obtained by examining individualism (or tendencies toward the development of an individualistic approach) in terms of its history. Primitive societies seem frequently to be characterized by a group solidarity that leaves relatively little room for individual autonomy. Within the period of a few centuries ancient Greece, in Periclean Athens, saw the development from this kind of tribal society to a degree of democracy. equality and individual assertiveness that was a far cry from the degree of subordination of the individual to the authority of a graduated social structure found in Sparta. Athenian democracy was short-lived, but it was individualism rather than the Platonic notion of the state as analogous to an organism that came to prevail in Hellenistic Greece. Epicurus. following the atomism of Democritus. developed a more thoroughgoing individualism than the world had yet known. For him the individual was the unit, the basis of society, and the sensation was the foundation of individual psychology. Not only were society and the state secondary, but the individual was encouraged as iar as possible to find his freedom and realization in withdrawal from politics and development of self-sufficiency. Justice, founded upon agreement or convention, was based upon the need of the individual for protection.

Although Epicureanism was widely adopted in the post-Xristotelian and Roman worlds. it was another and less individualistic school of thought, stoicism. that became dominant. Stoicism did develop a doctrine of moral equality. Its cosmopolitanism, however. and its insistence on an absolute standard of justice independent of the individual (and on the state as a natural institution having as its purpose the enforcement or approximation of this natural justice or natural law) constituted significant modifications of the stark individualism of the Epicureans.

Christianity, drawing upon ideas already developing in Judaism, introduced into the prevailing philosophy the emphasis on the supreme worth of the individual that had been lacking among the Greeks. Jesus' teaching also implied for many Christians the direct relation between man and God. This outlook provided a radically individualistic basis for religion that was not fully realized until the Reformation. For centuries. however. this individualistic element in Christianity was tempered by the concurrent belief that the individual most fully realizes himself by losing himself, by committing himself wholly to God and by emphasizing the importance of the life hereafter beyond that of earthly existence.

If individualism was highly qualified in the days of the Roman empire. the middle ages saw a far greater retreat into barbarian tribalism while the opening centuries of the modern period found a growing state centralism emerging from the weakness of feudal political society. Perhaps it was the very consolidation once more of political authority, freeing men from the insecurities of feudal society, that provided the condition for a rebirth of the spirit of individualism. Whatever the causes. and they were certainly complex, the Renaissance was characterized by a new spirit of inquiry, of discovery and of individual self-confidence and assertiveness. An exchange economy in which money replaced payments in kind. and in which free contract gave a new flexibility to arrangements hitherto fixed by immemorial custom, was representative of this development in the economic sphere. Similar movements toward freedom of the individual appeared throughout western culture. Science and the arts flourished. Soon the major over-all institutions found themselves under attack. The authority of the Roman Catholic Church was challenged by Luther, Calvin and their followers, and the new doctrine of the "priesthood of all believers" soon gained sway over large parts of Christendom. Partly as a result of religious strife, partly because in other ways the authoritarian secular states whose power had made possible the transition from feudalism to emerging capitalism were themselves unable or unwilling to adjust to the needs and demands of the rising commercial class. and partly because of the democratic demands inherent in the new individualism, some western European authoritarian political regimes were overthrown. Gradually the doctrine that government must be based upon popular consent implicitly or explicitly expressed in some form of a contract came to prevail.

Full-fledged individualism. as it is usually conceived to be, seems to have emerged first in England, perhaps because the English Catholicism was weaker and its ties to Rome more attenuated, and because England's insular position and consequent greater security following the Tudor era permitted a more relaxed society and a state in which it was easier for the individual to assert his demands successfully. Thomas Hobbes (*q.v.*), in the middle of the 17th century. building upon Epicurean ideas, presented a radically individualistic philosophy which was still politically authoritarian. His contemporary, John Lilburne (*q.v.*), less systematically but more effectively developed from a radically different viewpoint, that of economic "leveling." the democratic implications of the new philosophy, with emphasis on assertion of the universally accepted doctrine of natural rights (*q.v.*), including the natural right of political equality. The latter ideas were systematized and further developed later in the century by the Whig philosopher John Locke (*q.v.*), and gained support in British North America and France in the 18th century. The French Revolution, however. was characterized more by national sentiment than by

individualism.

It was again in England, through the ideas of Adam Smith and Jeremy Bentham and their followers in economic and political theory, respectively, that the 19th century saw individualism advance to new heights. Smith's doctrine of *laissez faire*, based upon a profound belief (borrowed from French Physiocrats) in the natural harmony of individual wills and Bentham's hedonistic utilitarianism, with the basic rule of "each to count for one and none for more than one," set the stage for these developments. On the economic side, Smith's "obvious and simple system of natural liberty," pictured exchange of goods and services in free and competitive markets as the ideal system of co-operation for mutual advantage. Such an organization should maximize efficiency as well as freedom, secure for each participant the largest yield from his resources to be had without injury to others and achieve a just distribution, meaning a sharing of the social product in proportion to individual contributions.

Restrictions on Economic Individualism. — While economic individualism, and political individualism in the form of democracy, advanced together for a while, eventually they proved incompatible as newly enfranchised voters increasingly came to demand, in the course of the 19th century, governmental intervention in the economic process. In point of fact the reasons for the growing demand for intervention were inherent in the attempt to adhere rigorously to an economic theory based almost solely on individualistic assumptions. In economics as in all other phases of life these assumptions are inadequate. Man is a social animal. His nature, his wants and his capacities are to a great extent the product of society and its institutions. His most effective behaviour is often through groups and organizations running the gamut from the family, through all manner of voluntary social and economically motivated associations to the state and international organizations. These units in varying ways interfere with the individualistic ideals of perfectly free association and of atomistic competition. Problems of monopoly and of technological, seasonal and cyclical unemployment, frequently associated in the public mind with individualistic economic theory, caused widespread dissatisfaction. Moreover, pure individualism, involving the institution of inheritance, tends to increase the tendency toward inequality inherent in the fact of unequal abilities. In this and other ways the individualistic society of the 19th century became more and more unsatisfactory to increasing numbers of people. Karl Marx demanded a radical departure from individualistic principles. Although his call for revolution and socialism did not succeed in the 19th century, gradually the collectivist principle gained headway, sometimes relying upon state ownership and management of business enterprises, but more frequently consisting of all sorts of state regulations limiting the freedom of the individual (and the corporation) in the management of property, for the welfare of society as a whole. The individualist state would intervene, if at all. only where it was clear that private activities. through the market or otherwise, were seriously damaging the public.

In the 20th century, even in nonsocialistic states, the presumption against state control became far weaker. If in any respect the nonpolitical institutions of society were apparently not working well, there was a strong demand that the state should intervene; and in the subsequently developed "welfare state," for instance, it was the government rather than the individual that took primary responsibility for insuring the great mass of the working population against the major hazards of life.

Organic View of Society. — Increased recognition of the need for a greatly enlarged role for the state went hand-in-hand with a modification all over the western world, of the individualistic theory of the nature of man and his relationship to the state. Contract theory tended to yield to theories that saw the state and the relationship between individual and state in less mechanical and more organic terms, while perceiving the individual himself less atomistically and more as an entity who was regarded as being as much effect as cause of society. Early examples of this emphasis were to be found in the works of Rousseau and Hegel. Even the mildly Hegelian British liberal T. H. Green, emphasized the organic relationship between individual and society. Among 20th century American democratic theorists, John Dewey exemplified a similar trend (*e.g.*, in his *Individualism, Old and* **New,** 1930).

In the extreme form of romantic (Nazi and Italian) totalitarianism all residue of individualism disappeared, the state or race became the final end of all, and the very notion of the individual as the basis of the western value system tended to fade away, along with its attendant belief in the moral equality of all men. Human reason is denigrated, and blind will or a mystical "spirit" of the group (political or racial) takes its place.

While the excesses of the 20th century totalitarianism had by mid-century produced a reaction against it in the free countries of the western world, particularly with respect to the supreme worth of the individual, there was also notable an attempt to capture certain values felt by some to have been embodied in totalitarian movements and to respond to forces that brought it about. More than this there were evidences of group-oriented thinking and values that seemed to be the unpremeditated product of innumerable conditions of modern life: large populations thrown together in tremendous metropolises, enabled by modern technology to share in each others' feelings and experiences to a greater degree than ever before; and a growing recognition of the fact that most human ends entailed group activity and group living. Psychologists discovered that men's minds seemed to perceive wholes before the parts of which they were composed. Similarly in many other fields the organic tended to displace the mechanistic approach and the whole tended to assume an importance that seemed to many men to be greater than that of the sum of its parts. In educational theory emphasis on "electives" had in some places given way to "core curricula," while much was heard of "adjustment to society" as a goal and less of the development of individuality; in criminology the idea that society was to blame for the criminal, or at least that he was not the master of his own soul, was bringing about sharp modifications in the theory of punishment; in economics "macro-economics," starting with measurement and analysis of the inputs and outputs of the economy as a whole, was supplementing if not displacing "micro-economic" analysis, which began with the individual firm; in political science the group had largely displaced the individual as the basic unit for analysis. Even physical science, with the development of the science of cybernetics, seemed to be moving from the mechanistic and atomistic approach to something more akin to the study of organisms.

The notions of the individual as the centre of value and of the moral equality of all individuals seemed to retain their fundamental position. In most other respects individualism and its corollaries appeared to be giving way to more social and organic modes of thought and endeavour although here and there, as in the field of education, there were indications of retreat from the most extreme applications of group theory. The possibilities for still further development seemed to be (1) an extension of these trends into totalitarianism; (2) a return to greater emphasis on the private; or (3) some degree of stabilization, philosophically and institutionally, at a point where the claims of the individual and the group, the private and the social, were in better balance than they had been in western civilization at least since the Renaissance. *See* also COLLECTIVISM; CORPORATE STATE; FASCISM.

BIBLIOGRAPHY.—J. S. Mill, *On Liberty* (1859); Herbert Spencer, *Man Versus the State* (1940); Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, trans. by Talcott Parsons (1930); R. H. Tawney, *Religion and the Rise of Capitalism* (1926); Élie Halévy, *The Growth of Philosophic Radicalism*, trans. by Mary Morris (1928); A. V. Dicey, *Lectures on the Relation Between Law and Public Opinion in England During the Nineteenth Century*, 2nd ed. (1914); W. S. McKechnie, *The State and the Individual: an Introduction to Political Science with Special Reference to Socialistic and Individualistic Theories* (1896); Warner Fite, *Individualism* (1911); J. M. Keynes, *The End of Laissez-Faire* (1926); R. H. Tawney, *Equality* (1931), esp. ch. 4; R. S. Devane, *The Failure of Individualism: a Documented Essay* (1948); J. Dewey, *Individualism, Old and New* (1930); Horace M. Kallen, *Indivżdualism: an American Way of Life* (1933); T. V. Smith, *The Promise of American Politics*, 2nd ed. (1936); Friedrich A. von Hayek, *Individualism and Economic Order* (1948); Ludwig von Mises, *Socialism: an Economic and Sociological Analysis*, trans. by J. Kahane (1951), *Human Action: a Treatise on Economics* (1949); Robert H. Murray, *The Individual and the State: Their Relationship Historically Considered With Some of its Bearings on the Future of* ***Civilisation***

(1946); H. C. Hoover, *American Individualism* (1922), *The Challenge to Liberty* (1934); Guido de Rugpiero, *The History of European Liberalism* (1927); David Kiesman *et al., The Lonely Crowd* (1950); David Riesman, *Individualism Reconsidered* (1955); Harold J. Laski, *The Rise of European Liberalism* (1936); J. Salwyn Schapiro, *Liberalism and the Challenge of Fascism* (1949); Eric Fromm. *Escape from Freedom* (1941). (J. R. Pk.)

INDIVIDUALITY, BIOLOGICAL. Two different meanings are associated with "biological individuality." First, it is used synonymously with "entity" or "unit." This connotation is derived from higher animals and plants which are encountered as individuals; that is. as clearly defined entities set apart from each other. They are characterized by a complex structure, but the diversity of their tissues and organs is integrated in a unit. When we speak of an individual robin or beetle, fir tree or tomato plant. we have in mind the unity in form. structure and function which enables the robin, fir tree. etc., to behave and react as a whole, in its environment. The individual. in this sense, constitutes the basic biological unit, as a self-sustaining and self-reproducing entity. Higher categories. such as species. or plant and animal communities: are composed of large numbers of such units.

In modern biology, "biological individuality" frequently has another quite different meaning. It refers to the "uniqueness" of the individual, or "individual specificity." In examining a population of robins. or of fir trees, the student is impressed. first. with the similarity of all individuals in all essential structural and behavioural features. It is this similarity on which the species concept is based. However. closer inspection brings to light another. equally significant. biological phenomenon, namely. the remarkable variability among individuals within the general framework of the species characteristics. In fact, no two individuals are completely alike, if the details of structure and function are considered. In the final analysis. the uniqueness of the individual is due to its unique hereditary constitution.

Entity. — Returning to the first-mentioned definition of biological individuality as an "integrated entity," it can be seen that this connotation is not so simple and unequivocal as it may seem. It loses its sharp focus when lower organisms. in both the animal and plant kingdoms, are considered. There exist forms of life to which the definition "integrated entity" is not applicable, and there arc others which show transitions from unindividuated to individuated organization. The difficulty that may arise in applying the term "individual" to plants, even the more highly organized, is seen when these are multiplied by mere division. When cuttings are rooted they may for practical purposes be considered distinct individuals, but theoretically they are separated portions of one. Again. a grafted apple tree is a composite unit built up of portions of two, sometimes more, individuals, termed stock and scion. mutually influencing one another. Furthermore. in the vegetable kingdom the change with lapse of time is well exemplified by the fact that in a tree new tissues are continually added at the periphery of the older, which gradually die; thus, though it is said that the age of a certain tree is to be measured in centuries, no living portion may, in fact, have survived for more than a few decades.

The unicellular organisms (many bacteria. algae and slime molds, and the protozoa) represent clear individuality on the cellular level. Other bacteria and algae and higher fungi exist in the form of cell colonies — that is. strings (filaments) or sheets of cells — which may grow and branch indefinitely and fragment fortuitously. The mycelium of fungi is an irregular, dense feltwork of such filaments. with no definite shape or boundary. and no inner organization, hence lacking the characteristics of individuality. However. the mycelium forms mushrooms (fruiting bodies), which represent the beginning of individuation.

The transition from unicellular to multicellular individuality is well represented by the small spherical green alga. *Volvox,* which any observer would designate as an individual. Actually, it is a colony of hundreds of flagellate cells embedded in a gelatinous mass. which swims and behaves as a unit. The constituent cells resemble their free-living, single-cell relatives; but there are signs of beginning organization, or division of labour, in that some cells specialize in reproduction and others are particularly active in locomotion. The slime molds (see Mycetozoa) offer another striking example of a shift from cellular to supracellular individuality. These organisms spend the major part of their life cycle as single-celled. freely moving. amoebalike cells. Under appropriate conditions. hundreds of such individuals aggregate in a tightly packed cluster. which transforms itself into an erect fruiting body of definite shape and structure. The individual amoeboid cells, like those of *Volvox,* give up their independence and become building stones in a higher unit, whereby they undergo a certain degree of specialization. The term "individual" can be applied legitimately to both levels, the cellular and the supracellular.

The evolutionary trend from cellular to multicellular organization is observed in all higher organisms: it is undoubtedly related to the greater efficiency that can be achieved through division of labour among cell groups. *Volvox* and slime molds represent early steps in this direction. At the other extreme are the highest animals and plants. in which the specialization of the individual cells has been carried to the point where they are completely interdependent and subservient to the whole. and no longer capable of a free, independent existence. Yet cellular individuality is not completely obliterated even in the highest forms. The individual cell remains the basic unit for all metabolic processes, such as energy transformation, respiration and growth. Furthermore. some cell types, such as white blood cells. are single cells, capable of amoeboid movements. Finally. living tissue cells (*e.g.,* nerve tissue or connective tissue) can be removed experimentally from an organism and grown in an artificial nutritive medium. In these so-called tissue cultures the cells not only survive for long periods, but they may regain some characteristics of free-living cells, such as the capacity for active movements. Therefore, there is some justification in viewing the higher organism as a highly integrated cell colony. In a sense, higher organisms, plants and animals, are organized in a peculiar way: they represent both levels of individuation. cellular and supracellular, in one.

In some animal groups (coelenterates, tunicates and others) a new type of individuality has been achieved on a still higher level, in the form of animal colonies: that is, groups of interconnected multicellular organisms. Successive steps in colony formation in the coelenterates may be observed. The well-known fresh-water polyp *Hydra* and its relatives. the sea anemones, are solitary beings. In the colonial corals, the polyps are linked together by a system of channels which enables them to share in a common food supply, but otherwise they retain their relative independence. In related forms, division of labour results in high specialization and modification of form of the individuals (polymorphism)! which, in extreme cases, appear merely as special organs attached to a common stem. For instance, the colourful marine siphonophores (Portuguese man-of-xvar and others) have all but lost the appearance of a colony; individuation on a supraorganismic level comes into existence.

In the two parallel series — that is, the evolution from unicellular to multicellular organisms and from there to animal colonies of the siphonophore type — may be recognized a general rule: wherever the subordinate units are strongly individualized and only loosely connected with each other, the individuality of the higher unit is indistinct; and. conversely, the more the individuality of the lower units is obscured, the more definite and distinct is the individuality of the higher unit.

Animal societies have been viewed by some biologists as supra-individuals or supraorganisms. particularly with reference to the elaborate caste systems in termite. ant and honey bee societies, where, again, division of labour has resulted in a high degree of specialization and consequent interdependence of the different types. These societies may be compared with animal colonies in which the physical linkage is replaced by communication systems, such as the elaborate language of honey bees.

The phenomenon of reproduction (*q.v.*) presents special difficulties to the individuality concept. The continuity of life is maintained by the faculty of all organisms to detach parts of their own living substance, thus giving rise to a new generation. This is done in a variety of ways: by the formation of gametes

(egg and sperm) or of seeds or spores. or by budding, as in yeast or polyps. or fission, or by still other devices. Difficulties arise when we try to determine exactly when and how the individuality of the offspring begins. Actually, one generation emerges from the other by a gradual process of individuation, and there are transitional stages during which no sharp line can be drawn between parent and offspring.

Phenomena of regeneration and regulation are closely akin to reproduction and present a similar dilemma. It is well known that a new plant can be grown from a cut-off shoot, or even from a fragment of a leaf, as in *Begonia*. Likewise, fragments of flatworms (Planaria), earthworms or starfish can regenerate a new individual (see REGENERATION). The same capacity for regulation is manifest in the early developmental stages even of higher animals and man. If eggs or very early embryos of a sea urchin, salamander or frog are cut experimentally in half, each part will regulate to form a whole individual (see EMBRYOLOGY, EXPERIMENTAL). In the armadillo, fragmentation of the egg has become the established procedure; each litter of four to eight individuals derives from a single egg. Identical tnins in man and in other forms arise in the same fashion from one egg. The difficulty of applying the individuality concept becomes insurmountable in the case of double monsters which derive from incompletely separated egg parts. There is a continuous series, from the Siamese-twin type, in which the individuality of the conjoined partners is undisputed, to those types in a-hich only the heads or the posterior body parts are dualicated.

Surveying the variety of design in the organization of living matter. it must be recognized that not all organisms are individualized. that individuality has become manifest at different levels of organization and in different degrees of distinctness, and that it is necessary to be cognizant of transitional states No rigid definition of individuality can do justice to the diversity of the biological phenomena.

Individual Specificity. — As mentioned above, "biological individuality" has a second meaning referring to the "uniqueness" of the individual with respect to the sum total of its structural, physiological, biochemical and behavioural traits. This is the result of the unique genetic constitution with which each organism is endowed, reflecting the enormous variety of recombinations and mutations of hereditary factors (genes) which occur in a cross-breeding population and are maintained by natural selection (see GENETICS OF POPULATIONS). As a result of the reshuffling of genes at fertilization and in the preceding processes of egg and sperm formation, each individual starts out with a unique constellation of hereditary factors which determine not only the structural and physiological adult characters but also the responses to its environment.

Everyday experience shows that no two human individuals are alike, but even in organisms in which the individual differences are not so obvious they can be demonstrated by appropriate methods. The most sensitive indicator of biological individual specificity is the well-known intolerance of an individual for transplants of skin (*see* PLASTIC SCRGERY) or other tissues from another individual (except from an identical twin nhich shares its genetic make-up). This incompatibility, akin to immunological reactions, is based on biochemical agents, the "individuality differentials" (Loeb). Such differentials have been detected in all vertebrates, down to fishes with the aid of the transplantation method. Of equal interest and significance are individual differences in blood groups; that is, immunological (antigenic) differences in red blood corpuscles (erythrocytes), which can be detected by their agglutination or lysis nhen combined with blood serum from other individuals. In man and several higher animals (monkey, cattle. sheep, chicken, dove) detailed studies have revealed numerous blood groups (the best knonn in man are the ABO groups, the MN group and the Rh factors) and subgroups (*see* also HEREDITY: Human *Heredity*). The possible recombinations of the blood group substances discovered so far go into the millions, and it can be assumed that each individual has its own peculiar blood type. Fortunately, many blood types are compatible with each other in transfusions, and only differences between major groups cause detrimental transfusion reactions. On the other hand, blood tests have been found to have practical applications in legal matters, and they may eventually supply a reliable index of individuality in animals, comparable to that of fingerprints in man; and assume great importance in animal breeding. It is'of interest to note that many blood group factors in animals can be referred to particular genes, whereby the genetic basis of individuality is firmly established.

The clinician is well aware of individual differences in the response to many drugs, to anesthetics and to antibiotics. The wide range of variability in the drug reaction of human individuals is illustrated in a study of the minimum concentration of mercuric chloride that is required to produce skin irritation. The sensitivity varied over a hundredfold in a small sample of individuals. Remarkably great differences among individuals have also been found with respect to the chemical composition of blood and saliva, to enzyme and endocrine patterns, vitamin needs, amino acid excretion, taste sensitivity and many other physiological and biochemical characteristics. A striking example was found in connection with the study of taste sensitivity to phenyl thiocarbamide (PTC). This substance has a bitter taste for some individuals but is tasteless for others, and this trait is due to a single hereditary factor. It was found that PTC can be tasted by "tasters" only when it is dissolved in the individual's own saliva, but not when it is dissolved in that of another person. The anatomist is familiar with corresponding individual variations in structural details. such as the shape of skeletal elements, the patterns of nerves and blood vessels, and the weight of organs. The uniqueness of fingerprints is so far the best criterion for identification of human individuals, and handwriting, when expertly analyzed, would be equally valid. The argument that in some of the instances cited above the differences may be due not to inborn diversity but exclusively to environmental factors can be met by studies of identical twins. They derive from a single egg and have therefore identical genetic constitution. In all traits that can be studied, identical twins show greater similarity. than fraternal twins or other siblings, thus demonstrating the significant part that heredity plays as the foundation of biological individuality. In man, the uniqueness of his biological heritage combines with the uniqueness of his stream of life experience to create "personality" (see PERSONALITY).

BIBLIOGRAPHY. — J. S. Huxley, *The Individual in the Animal Kingdom* (1912); *L.* Loeb, *The Biological Basis of Individuality* (1944); *P.* B. Medawar, *The Cniqueness of the Individual* (1957); *R.* Williams, *Biochemical Individuality* (1956); *C.* Stern, *Principles of Human Genetics* (1949). (V. H.)

INDO-ARYAN LANGUAGES are the satem languages of the Indo-European family that are still spoken in the northern and central parts of India and in Pakistan (see INDO-EUROPEANS) and include the Sinhalese language of Ceylon.

Classification. — Inscriptions of the Mitanni country (northeast Syria) of the 14th century B.C. contain proper names of Indo-Iranian type. Otherwise, the oldest specimens of Indo-Aryan speech very closely resemble the oldest Iranian. The development of the two old forms of speech went on independently and followed some\\-hat different lines. This is most marked in the treatment of a nexus of two consonants. . While modern Iranian often retains the nexus with little or no alteration, modern Indo-Aryan prefers to simplify it.

The earliest extant literary record of Indo-Aryan languages is the collection of hymns known as the Rig-Veda. It may be taken as representing. on the whole, the particular vernacular dialect spoken in the east of the Punjab and in the upper portion of the Gangetic Doab. Later it extended between the Punjab and the modern Allahabad from the Himalayas to the Vindhya hills in the south, over the area known to Sanskrit geographers as the *Madhyadēśa* or Midland, also called *Āryāvarta* or the "home of the Aryans." There it received constant literary culture, and a refined form of its archaic dialect became fixed by the labours of grammarians during the 4th century, B.C., receiving the name of *Saṁskṛta* (Sanskrit) or "polished," "refined" in contradistinction to the folk-speech of the same tract and to the many Indo-Aryan dialects of other parts of India. all of which were grouped together under the title of *Prākṛta* (Prakrit) (*q.v.*) or "natural," "unrefined."

Sanskrit (*q.v.*) became the language of religion and polite literature, and thus the Midland, the native land of its mother dialect, became accepted as the true pure home of the Indo-Aryan speech.

Dialectal Variations. — In the time of Asoka (c. 269–232 B.C.), there were at least three dialects, an eastern, a western and another in the extreme northwest. The grammarian Patañjali (150 B.C.) mentions the existence of several dialects.

Round the Midland, on three sides — west, south and east — in Vedic times, Indo-Aryan dialects were spoken which all appear more closely related to each other than was any of them to the language of the Midlands. Thus, at an early period of the linguistic history of India there were two sets of Indo-Aryan dialects — one the language of the Midland and the other that of the dialects which form an Outer Band, according to the scheme suggested by Sir G. A. Grierson.

As time went on, the people of the Midland conquered the eastern Punjab, Rajputana with Gujarat (where they reached the sea) and Oudh. Hence in all these territories are found mixed forms of speech. The basis of each is that of the Outer Band, but the body is that of the Midland. From the Midland to the external borders of this tract, the influence of the Midland language grows weaker and weaker, and traces of the original Outer language become more and more prominent. In the same way the languages of the Outer Band were forced farther and farther afield over the Maratha country, into Orissa, into Bengal and, last of all, into Assam.

At the present day, a Midland Indo-Aryan language (western Hindi) occupies the Gangetic Doab and the country immediately to its north and south. Round it, on three sides, is a band of mixed languages, Panjabi (of the central Punjab), Gujarati, Rajasthani (of Rajputana and its neighbourhood), and eastern Hindi (of Oudh and the country to its south). Beyond these again, are the Outer Languages (Kashmiri, with its Dardic basis), Lahnda (of the western Punjab), Sindhi (here the band is broken by Gujarati), Marathi, Oriya (of Orissa), Bihari, Bengali and Assamese. The Pahari languages in the Himalaya, north of the Midland belong to the Intermediate Band, being recent importations from Rajputana, while Kohistani includes mixed dialects of the Sivat and Indus Kohistans. Thus, the Midland language is enclosed within a ring fence of intermediate forms of speech.

BIBLIOGRAPHY.—J. Beames, *Comparative Grammar of the Modern Aryan Languages of India* (1872–79); A. F. R. Hoernle, *A Grammar of the Eastern Hindi Compared With the Other Gaudian Languages* (1880); *R. G.* Bhandarkar, "Phonology of the Prakrits of Northern India," J. Roy. *Asiatic Soc.* (Bombay Branch), vol. xvii, 2, 99–182. For linguistic conditions of Vedic times, *see* introd. to J. Wackernagel's *Altindische Grammatik* (1896). G. A. Grierson, "On the Phonology of the Modern Indo-Aryan Vernaculars," Z. *dtsch Morgenland. Ges.,* vol. xlix, 1, 393, i (1895–96); "On the Radical and Participial Tenses of the Modern Indo-Aryan Vernaculars," J. *Asiatic Soc. Bengal,* vol. lxiv, pt. i, 352 (1895); "On Certain Suffixes in the Modern Indo-Aryan Vernaculars," *Z. vergl. Sprachfor.,* p. 473 (1903); *Linguistic Survey of India,* vol. i (1927). A list of works on the history of philological discovery: W. Schmidt, *Sprachfamilien und Sprachenkreise der Erde,* pp. 39–40 (1927). Jules Bloch, *L'Indo-Aryan (du Veda aux temps moderne)* (1934); S. *K.* Chatterji, *Indo-Aryan and Hindi* (1942); T. Burrow, *The Sanskrit Language* (1955). *See* also J. Vendryes and E. Benveniste in A. Meillet and M. Cohen, *Les langues du Monde,* 2nd ed., pp 18, 70 with map xi A (1952). (ET. B.)

INDOCHINA, English equivalent of the French INDOCHINE, the name given collectively to the group of southeast Asian territories constituted by the French protectorates of Tongking, Annam, Cambodia and Laos and by the French colony of Cochin-China, bounded north by the Chinese provinces of Yunnan and Kwangsi, east and south by the South China sea and west by Siam (Thailand) and by the easternmost region of Burma. By the middle of the 20th century this unit was dissolved into three parts, Vietnam. Cambodia and Laos, the old names Tongking, Annam and Cochin-China surviving only as geographical expressions to denote northern, central and southern Vietnam respectively. (See also CAMBODIA; LAOS; VIETNAM.)

The population of the eastern area is predominantly Vietnamese, or, as it was formerly called, Annamite (the Annam of modern times being but the central zone of the earlier empire of Annam); that of Cambodia, Khmer; that of Laos, Thai. There are also, however, considerable groups representing aboriginal peoples, some of them speaking Malayo-Polynesian languages, such as the Cham (*q.v.*) of southern Annam and the Moi (*q.v.*) and Kha, whom the dominant peoples class as "savages." Finally there are peoples of northern or Chinese origin, Muong, Man, Meo and others in Tongking and Laos.

By the middle of the 20th century the racial distribution of these peoples was estimated roughly as follows: Vietnamese, 21,000,000; Cambodian, 3,000,000; Laotian, 600,000; Cham, 100,000; Muong, 200,000; Thai other than Laotian, 800,000; Man and Meo, 300,000; Moi and Kha, 1,000,000. Nonassimilated Chinese of immigrants of modem times numbered 600,000; Europeans, 40,000, of whom 36,000 were French.

The religions of Indochina are little less diverse than the peoples. The Annamite form of Buddhism is of Chinese origin and in practice resolves itself largely into ancestor-worship. Cambodian and Laotian Buddhism is very different, being of a form adopted from the Indian. The Moi and the Kha are pagan. Christian missionaries have been active in Indochina since the first quarter of the 17th century, so that there are now several Catholic bishoprics. Finally there are the eclectic sects, Cao-Daists, Hoa-Hao and Bin-Xuyen, often of a paramilitary and highly nationalistic character.

HISTORY

French political influence in Indochina dates from Nov. 27, 1787, when, through the efforts of the great missionary P. J. G. Pigneau de Béhaine (1741–99), bishop of Adran *in partibus infidelium,* a treaty was signed at Versailles between Louis XVI of France and the chua (king) of Cochin-China, Nguyen phua Anh.

As a result of this treaty, despite obstruction by the French king's Irish governor of Pondicherry, a number of French officers, notably V. C. Olivier de Puimanel, Philippe Vannier, J. M. Dayot and J. B. Chaigneau, helped the chua to recover his throne, disputed by the Tay Son rebels, in 1801 and to become, under the name of Gia Long (1802–20), the founder of the new imperial dynasty of the Nguyen. Tourane and the island of Poulo-Condore (Pulo-Condor) were ceded to France. A great ruler who did much for his country, undertaking considerable public works, a land-survey and the promulgation of a new legal code, Gia Long never forgot his obligation to the French and particularly to Pigneau, whose tomb he built in Saigon and whose epitaph he himself composed.

The Establishment of the **Colony.**—Gia Long's successors, however, began a persecution of Christian natives and missionaries in the course of which, between 1833 and 1873, 8 European bishops and 15 missionaries were put to death. In the reign of Tu Duc (died 1883), the persecution was intensified, and, as the victims included both Frenchmen and Spaniards, a Franco-Spanish expedition, under Vice-Admiral Charles Rigault de Genouilly, was eventually sent to intervene. Rigault took Saigon in 1859; but the Annamite siege of the latter place, which began in the following year, was not raised till L. V. J. Charner arrived with reinforcements for the French in 1861. By the treaty of June 5, 1862, the three eastern provinces of Cochin-China were ceded to France.

From 1863 to 1879 the newly acquired territory was governed by the "administration of the admirals" (it should perhaps be pointed out that until 1889, when they were transferred to the ministry of trade, the French colonies were under the same minister as was the navy). The first of these admirals, L. A. Bonard, was succeeded by P. P. M. de la Grandière (1863–68), during whose tenure of office three important events took place: a French protectorate was established over Cambodia (Aug. 11, 1863), secured by E. M. L. Doudart de Lagrée's occupation of the capital (1864); M. J. F. (Francis) Garnier explored the valley of the Mekong (1866–68); and the three western provinces of Cochin-China, which had been left to Annam in 1862, were annexed to the French colony (June 1867).

Tongking and the New Protectorates. — It was during the governorship of M. J. Dupré that French intervention in Tongking began, as a consequence of differences between the Annamite

authorities there and the French merchant Jean Dupuis. Sent on a mission of enquiry Garnier took Hanoi in Nov. 1873 and had subdued several other places in the Red river delta before he was killed in battle a month later, by the Black Flag brigands whom the Tongkingese had called in from Yunnan.

Dupré then concluded an agreement (1874) with Tu Duc of Annam whereby the French were to renounce Garnier's abortive conquests in return for Tu Duc's undertaking to "conform his policy to that of France" and to grant them certain trading rights in Tongking, necessary for their commerce with Yunnan. This agreement is sometimes considered as tantamount to the establishment of a protectorate, though the term itself was not used in it. Its validity, however, was called in question when in 1880 Tu Duc decided to reaffirm Annam's status of vassalage to China, which had been disregarded for many years; and the continued depredations of the Black Flag brigands in the Tongking area led to the dispatch of a new expedition under the commandant Henri Riviere, who took Hanoi in April 1882 but was killed in battle in May 1883, after which Gen. A. E. Bouet took his place in command of the expedition. Subsequent French successes in Tongking and the arrival off Hué of a squadron under Vice-Admiral A. A. P. Courbet induced the Annamite government to accept a French protectorate over Annam and Tongking (Aug. 25, 1883). Warfare continued, however, with the Black Flags, who began to receive imperial Chinese support after the French advance on Sontay.

The convention of Tientsin (May 11, 1884), signed by the French representative François Fournier, stipulated that Chinese troops would withdraw from Tongking and was followed by another treaty signed at Hué (June 6, 1884) confirming the French protectorate over Annam and Tongking. At the same time a treaty was signed confirming the French protectorate over Cambodia (June 17). But misunderstandings as to the terms of the Fournier convention prolonged the war in Tongking, as the French forces tried to occupy Langson before the Chinese were ready to withdraw: France declined the mediation of the powers; Courbet destroyed the Chinese fleet on the Min and bombarded the Foochow arsenal (Aug. 1884); then the defeat of Gen. François Négrier at Langson led to the fall of Jules Ferry's ministry in Paris (March 1885). The mediation of the British ambassador, Sir Robert Hart, led to the signing of preliminaries of peace at Peking in April 1885; this was followed by the conclusion of the treaty of Tientsin on June 9, 1885, whereby China again recognized the French position in Annam and Tongking. (The Sino-Tongkingese frontier was defined in conventions of June 1887 and June 1895.) There was rebellion in Cambodia during the first six months of 1885.

Peace with China, however, did not bring peace within the protectorates. Operations against the bandits of Tongking had to be undertaken for a further decade. In Annam the mandarins who controlled the regency for Tu Duc's short-lived successors were alarmed at France's use of the protectorate: they organized an attack on Gen. P. M. H. Roussel de Courcy when he entered Hué in July 1885; and the French had to install a new emperor, DongKhanh, in the following September. Paul Bert (*q.v.*) the first resident general for Annam and Tongking, died in Nov. 1886, seven months after his arrival.

The Union from 1887 to 1900.—The unification of Cambodia, Annam, Tongking and Cochin-China under a governor general was first undertaken by decrees of Oct. and Nov. 1887; but neither the first governor general, Jean Antoine Constans, nor his immediate successors exercised any very considerable powers over the residents general of the three protectorates. It was the decree of April 21, 1891, that gave the governor general effective authority. J. M. A. de Lanessan (*q.v.*), the first to be appointed with these new powers, was in office when Auguste Pavie saved Laos from being divided between Siam and Annam and secured the Laotian acceptance of a French protectorate over the kingdom of Luang-Prabang (Sept.-Oct. 1893). Lanessan's policy, however, which tended to restore something of the power of the mandarins (at whose disposal he put a native police force, the *Linh co*), to check the recurrence of expeditions and minor military operations and to restrict the authority of the residents superior. was objectionable to certain influential groups, who obtained his abrupt recall in Dec. 1894. For a few years after this the governor general's powers under the decree of 1891 were somewhat modified; but the decree recovered its full force shortly after the appointment of Paul Doumer (*q.v.*) as governor general. The decree of July 31, 1898, established the financial unity of French Indochina by setting up a general budget (the separate budgets for the several countries, which had survived Indochina's passing under the control of the newly created French ministry of the colonies in March 1894, were allowed to subsist); and that of Sept. 9, 1898, put the public works of Indochina "under the direct authority of the governor general as regards works entered to the general budget account." Doumer's administration (1897–1902) saw also the creation of a network of railways and, in April 1898, the leasing of the Chinese mainland territory of Kouang-Tchéou-Wan, which was placed under the governor general's authority in 1900.

The Siamese Treaties, 1904 and 1907.—By the treaty of Feb. 13, 1904 (replacing an unratified one of Oct. 7, 1902), France restored to Siam the district of Chantabun (taken in 1893 while the Laotian protectorate was being established) in return for the cession of Melupré (northern Cambodia), of Bassac (southern Laos) of Dansai (the southernmost part of the old Laotian kingdom of Luang-Prabang) and of the maritime frontier district of Krat. Dansai and Krat, however, were returned to Siam by the treaty of March 23, 1907, when the latter country ceded Battambang. Siem Réap and Sisophon, the three western provinces of Cambodia, to the French protectorate.

The 20th Century to 1940.—The history of French Indochina from 1907 to the outbreak of World War II is primarily that of its organs of government. A decree of Oct. 20, 1911 (a few months after A. P. Sarraut's first being appointed governor general), redefined the governor general's powers, making them wider as regards local budgets. In 1914 the Conseil de Gouvernement de l'Indochine was established to replace the Conseil Supérieur de l'Indochine (which had been reorganized by the decree of Aug. 8, 1898). The Grand Conseil des Affaires Économiques et Financieres de l'Indochine was constituted on Nov. 4, 1928, to deal with budgetary questions.

The governor general was the head of the administration, controlled the armed forces and represented the French republic in Indochina; he also approved the budgets of the separate countries of the union. The separate countries, however, maintained their own governments, with internal autonomy. By 1939, the structure was as follows: Cochin-China, a colony under a governor, had its colonial council (established in 1880) and sent a deputy to the parliament in Paris. Cambodia, a kingdom, and Annam, an empire, both under protectorates, had each a council of ministers, over which a French resident superior presided, as well as an assembly elected by the natives and a council for economic and financial affairs elected by the French; native affairs in each were administered by the prince; and each sent one delegate to the Conseil Supérieur des Colonies in Paris. Tongking, a protectorate, was similarly organized, except that the French resident-superior was responsible for native as well as for French administration (the Annamite emperor having agreed to withdraw his viceroy in 1897); it also sent a delegate to Paris.

Laos comprised both the kingdom of Luang-Prabang (a protectorate) and a colony; the French resident-superior being responsible for both French and native administration except where the king had jurisdiction; the country also had a consultative assembly. Ports under a regime of concession to France were Tourane in Annam and Haiphong in Tongking; there was also a concession in Hanoi.

The administration of justice throughout Indochina was based in principle on French law; but in the protectorates there were native tribunals with jurisdiction in civil cases in which no European was involved, while in Cochin-China the Annamite law could be administered in the French courts, as there were no native tribunals there. The court of appeal had four chambers (two in Saigon, two in Hanoi); its French judges had native advisers for cases affecting native law.

Before World War II, Indochina had a flourishing commercial economy: in 1939 the value of exports was 3,494,729,000 francs, that of imports 2,382,262,000. The principal exports were as follows: rice, grown mainly in Cochin-China (1,692,000 tons exported in 1939; Indochina rose to be the world's third largest exporter of this commodity); rubber, grown mainly on estates planted by the French in Cochin-China and in Cambodia (nearly 69,000 tons exported in 1939); corn (average annual production more than 500,000 tons); coal, iron, manganese and zinc from Tongking and tin from the Cammon province of Laos; fish, caught mainly off the coasts of Cambodia Cochin-China; pepper from Cambodia (between 3,000 and 4,000 tons exported annually); livestock and hides, mainly from Laos, Annam and Cambodia; and cement. Other crops included tea, coffee and various spices. The teak forests of Laos were particularly valuable. Imports consisted principally of manufactured goods and petroleum products.

World War II.—Gen. Georges Catroux was appointed governor general in Aug. 1939. Within a month World War II had broken out; and after the fall of the French republic in June 1940 Catroux was replaced by Adm. Jean Decoux, a nominee of the Vichy government. From Sept. 1940 the Japanese secured the use of bases in Tongking for their operations against China; and by the middle of 1941 they had obtained a virtual monopoly of Indochina's rice and rubber exports and a hold over the transport system. The Siamese had meanwhile attacked Laos and Cambodia and, through Japanese mediation, won the cession of the Laotian provinces lying west of the Mekong and a large portion of western Cambodia (March 1941). In July 1941 the Japanese occupied southern Indochina, from which they attacked Siam and Malaya in December. (See WORLD WAR II.)

The Rise of the Vietminh.—On March 9, 1945, the Japanese overthrew the French administration, interning or killing French officials. Proclaiming a policy of "Asia for the Asiatics," they then set up nationalist governments of their own creatures. On Aug. 19, however, after the bombing of Hiroshima, the Japanese withdrew. At Hanoi the Vietminh seized power. This was a nationalist party that had been formed on Chinese territory during the war, under the leadership of a veteran Communist, Ho Chi-minh. Soon the Vietminh had set up administrative committees throughout Vietnam (Tongking, Annam and Cochin-China, the predominantly Annamite or Vietnamese areas), in the place of the mandarins. Then they declared their country independent.

Meanwhile the Allies, at Potsdam, had decided that northern Vietnam should be occupied by the Chinese and southern by the British. The British were soon superseded by the French, who opened negotiations with Ho Chi-minh. French troops under Gen. Jacques Leclerc landed at Haiphong on March 6, 1946, and then occupied Hanoi. France recognized the republic of Vietnam as a "free state forming part of the Indochinese Federation and of the French Union." Ho Chi-minh then went to Fontainebleau for negotiations with a view to defining this formula; but agreement was reached only on points of secondary importance.

The Indochinese War, 1946–54.—On Nov. 23, 1946, the French at Haiphong took measures to halt the smuggling of arms; shots were exchanged, followed by artillery fire. In the night of Dec. 19 the Vietminh made a sudden attack on the French forces, failed to overcome them and had to take to the jungle.

This marked the beginning of a long war. The French occupied the Tongking delta, several points on the coast of Annam, the Moi and Thai countries and, in particular, Cochin-China, where Saigon became a vast city of refuge as well as the seat of government. The Vietminh controlled the hinterland of the Tongking delta, most of Annam and certain areas of Cochin-China and had moreover the support not only of secret sympathizers but also of guerrilla forces in all the French-occupied parts of Vietnam. The French could not leave the towns except in convoys; and even in Saigon attempts at assassination were frequent.

The French government tried to reach a compromise by addressing itself to the former emperor of Annam, Bao Dai. The agreements of March 8, 1949, established the independence of Vietnam within the French union. The former colony of Cochin-China, momentarily classed as an overseas territory of France, was transferred to Bao Dai's Vietnam. A Vietnamese army was gradually created, to fight beside the French forces. Yet Bao Dai's regime failed to attract the large local adherence that had been expected.

Conditions in the two other countries of French Indochina were settled more peacefully (for their postwar constitutions. see below). The authority of the king of Luang-Prabang, Sisavang Vong, was extended to cover the rest of Laos, so as to form a single kingdom of Laos, which was recognized as an iridependent state associated with the French union by the treaty of July 19, 1949. The king of Cambodia, Norodom Sihanouk, agreed to a similar treaty, signed on Nov. 8. The Issarak dissidents, however, armed first by Siam and then by the Vietminh, continued to infest some parts of Cambodia.

The year 1950 marked a turning-point in the war in Vietnam. The French had to evacuate the Langson area, on the Chinese frontier, which enabled Communist China to furnish generous supplies of arms to the Vietminh. In 1951 the French managed to clear the delta of enemy forces and to recover the initiative. thanks to the efforts of their high commissioner and commander in chief, Gen. Jean de Lattre de Tassigny. The latter's death, however, was a blow that jeopardized his successes.

In the following years the French conducted some successful diversionary operations in the Thai country of southwestern Tongking and on the coast of Annam. But in April 1953, after occupying the Thai country, the Vietminh invaded Laos, set up an independent government (Pathet Laos) in the northeast of the country and temporarily advanced almost into the suburbs of Luang-Prabang. In Jan.-Feb. 1954 they made another invasion along the same route without achieving anything further; but they succeeded in occupying central Laos (west of Annam).

Provided with heavy artillery. the Vietminh laid siege to Dien Bien Phu, a post in the Thai country that had been occupied by French parachute troops in Nov. 1953. After a heroic resistance by the defenders, Vietminh forces entered the central stronghold of Dien Bien Phu on May 7, 1954, where they took 10,000 prisoners. The French in the delta then withdrew into the Hanoi and Haiphong zones.

The Convention of Geneva.—Meanwhile an international conference had met at Geneva to reach an agreement on affairs in Asia. The French prime minister, Pierre Mendès-France, was active in negotiations both with the Chinese and with the Vietminh. The convention of July 20, 1954, for the cessation of hostilities, stipulated that the Ben-Hai river, near the 17th parallel of latitude north of Hué, should be the line of demarcation between the two zones into which either party would withdraw its armies: the French troops were to evacuate Tongking, the Vietminh those parts of southern Annam, Cochin-China and Laos which they had been holding. Supervised elections were to take place before June 20, 1956, to decide the terms on which northern and southern Vietnam should be reunited. These dispositions may be taken to mark the end of the French Indochina first unified in 1887. There were now four successor states, again wholly separate: North Vietnam, South Vietnam, Cambodia and Laos.

North Vietnam, styled the Democratic People's Republic of Vietnam, was the Vietminh state, organized on totalitarian Communist lines. The Communist party (Lao Dong) held the key industries and exercised an effective and entire control by means of a hierarchy of communal, district and provincial committees, the members of which were elected from its approved lists of candidates. The disciplinary efficiency of the party was enhanced by its wartime experience.

South Vietnam, on the other hand, could present no such consolidated front. Bao Dai, as chief of state, enjoyed but a remote authority. One prime minister followed another all too quickly, and power was divided between the powerful religious sects (Cao-Daists, Hoa-Hao and Bin-Xuyen) and the generals of the new army.

Cambodia, through a constituent assembly, had received a constitution in 1947. The prime minister was to be designated by the king and to be responsible, with his cabinet. to a national assembly elected by universal suffrage. A second chamber, the council

of the realm, was to comprise representatives of the king, of the assembly, of the provincial authorities and of the professions. After disturbances in Jan. 1953 the king dissolved the assembly and assumed power himself.

Laos, which also received a constitution in 1947, had likewise a national assembly elected by direct suffrage. The king could refer decisions back to the assembly for a second deliberation, he could act as president oi the council, and dissolve the assembly. Buddhism was recognized as the state religion. The seat of ministerial government and of the assembly mas at Vientiane; the royal palace was at Luang-Prabang. The non-Laotian tribes, especially the Meo, were practically beyond the government's control.

South Vietnam, Cambodia and Laos, as independent states, were voluntary ("associated") members of the French union, represented in Paris in the assembly of the Union and in the high council. French troops were stationed provisionally in all three of these states, the independence of which was guaranteed in 1954 by the signatory powers of the Manila agreement (Southeast Asia Treaty organization). France was represented by a high commissioner in the three "associated" states and in northern Vietnam.

BIBLIOGRAPHY.—P. Boudet and R. Bourgeois, *Bibliographie de l'Indochine française*, 3 vol. (Hanoi, 1929–33); J. Condominas, section on Indochina in *Ethnologie de l'Union Française* (Paris, 1953); G. Maspéro, *Un empire colonial français: l'Indochine*, 2 vol. (Paris, 1929–30); P. Le Boulanger, *Histoire du Laos français* (Paris, 1931); C. Robequain, *L'Indochine française* (Paris, 1949); Philippe Devillers, *Histoire du Vietnam de 1940 à 1952* (Paris, 1952); P. Mus, *Vietnam: sociologie d'une guerre* (Paris, 1952). (Hu. DE.)

INDO-EUROPEANS. The term Indo-European appears to have been invented by the well-known physician and physicist Thomas Young. In an article in the 10th volume of the *Quarterly Review* (Oct. 1813) he uses the word without any remark as to its being a new coinage. The word was devised especially to indicate a family of languages, but from the beginning it has been found very difficult to keep apart the use of the word as indicating languages and the application of the term not only to the speakers of the languages at any given period but also to the supposed original speakers of these languages. The effect of this confusion has often been serious. It is obvious that a language may be spoken by persons who have no blood relationship with the general body of speakers of the language, and that this body itself may not be all of one and the same origin. Thus the negro in Liberia or in the Southern States of America who speaks English as his mother tongue may have no drop of English blood in his veins, and even 200 years ago Daniel Defoe was certain that there was no such person as the "true-born Englishman."

Ever since it was possible to identify a separate family of languages as Indo-European, continual efforts have been made to ascertain who were the original speakers of the language from which the surviving members of the family, or those which are recorded in literature or other monuments, have sprung, where was their home, what were their surroundings and their manner of life. The first of the elaborate statements of these problems was that published by Adolphe Pictet in 1859. The more important attempts of the same kind which have appeared since are enumerated in the bibliography at the end of this article. It is hardly necessary to say that the majority of such attempts deal mainly or altogether with the evidence derived from language. This is necessarily so, because, when the question arose, the linguistic scholars were the first who were ready to carry on the investigation; but the problem can be attacked in various other ways; and it is only by an attack converging from all quarters that a certain result will ever be attained.

Fauna.—From language it is clear what were the animals, what were the plants and what were the seasons in the country whence this language was derived. The animals still familiar amongst us were well known; the sheep, the cow, the horse, the dog and the pig. The names of the goat vary much more from language to language; but it does not necessarily follow from this that the goat was not known until a later time. Animals for which there are no early terms in the Indo-European languages are the lion, the tiger, the elephant, the camel and the ass. It may therefore be safely concluded that these animals did not exist in the original habitat. The lion, at one time, certainly roamed over a much larger area than it does now. According to Herodotus lions were found as far to the west as Macedonia and the prevalence of the representation of the lion in monuments of Asia Minor and Persia is proof to some extent, that the animal was well known. It still survives in Cutch but has lost its mane and is on the way to extinction in Asia. As there is no word for the elephant and no representation of it in the more western part of Asia or in Europe it is clear that this animal also was unknown. The same is true of the tiger and the camel and the ass. In Asia the common beast of burden was the ass. The horse, though known in Mesopotamia from the time of Hammurabi before 2000 B.C., owes its introduction to the Kassite invasion of 1926 B.C., and was called the mountain ass. Palaeolithic man was able to represent in his drawings two species or varieties of horse. The name of the cow has the same origin in almost all the languages and the same is true of the sheep, the pig, the dog and the mouse; but in their wild state the same environment is not suitable to all. The horse is an animal of the prairie; it lives in the open plain and the foal is able from the day of its birth to accompany the mare. The cow, on the other hand, in the wild state lives in countries with open spaces well provided with woods or clumps of trees. When the cow travels afield to find food, the calf is unable to accompany her and has to be hidden in some brake or thicket, as it can walk but feebly and its eyesight is still imperfect. Unless it were so hidden it would fall a prey to animals like wolves or eagles, both of which seem to have been known to the first Indo-Europeans. The grass which suits horses or cows is unsuitable for sheep which prefer the short crisp grass of upland pasture. If, therefore, all these animals were well known to the early Indo-Europeans they must have lived in an area where the landscape was diversified. The country seems to have no connection with the sea; the more widely spread meanings of the word for the sea are either moor or marsh. That open water was known is shown by the fact that there were words for water birds, the swan, the goose and probably the duck, but all of these could find a resting place in very small sheets of water. From what has been said, it will be clear that the Indo-Europeans must originally have lived in the temperate zone. The bear was known, but which species we cannot tell. It is well known that the name "bruin" meant the brown bear, being cognate with the Lithuanian word *béras*, for the Lithuanian word is used as an adjective meaning brown. Other animals known were the beaver and the hare, the word for the beaver being generally a reduplicated form from the same stem as the word for the bear and the hare, meaning originally the grey beast. Its origin was the same as that of the Latin adjective *canus* from an older *cas-nos*.

Flora.—The trees and other plants are not so easy to identify because it is found that when men migrate to a new area, they carry with them the names of plants and, to some extent, also of animals and apply them to plants or animals in the new area which bear some resemblance to the plants or animals they have left behind. Thus in England the oriental plane, so well known in Asia Minor and Persia as the Chinar, grows only with difficulty north of the Trent and in northern Scotland not at all. But the name plane is preserved, notwithstanding, and applied to the sycamore which resembles the plane in being an umbrageous tree and having a leaf somewhat similar. In the same way, the English in America have given the name of robin to a much larger bird, because it has a red breast. The trees most widely spread in the temperate zone are the willow and the birch. The birch extends from the British Isles to the farthest Himalayas. Some variety of willow is the first tree to grow near streams in a country like Siberia which has not long been freed from surface ice. On the other hand, some of the commoner trees, like the beech, do not penetrate far into the southern peninsulas of Europe. The consequence is that in Greece the word corresponding to *beech* in English and to *fagus* in Latin, means oak or sometimes possibly chestnut. In the same way in Latin the word cognate with the English birch is used for the ash, *fraxinus*. The pine in some of its numerous forms was also certainly known.

Cereals and Seasons.—More important, perhaps, for the history of the race, is the existence of cereals. Within historical times, only two new cereals have been introduced into Europe, rice and maize, though a plant of another kind, buckwheat, was

brought in by the Tatars and has received its name because its fruit was ground, and treated as a cereal. Many attempts have been made to connect the Greek oryza with the Sanskrit *vrihi,* which in modern Persian appears as *birinj*. But traffic down the Red Sea was mostly with southern India and the simpler explanation is to connect the Greek word with the Tamil, *arishi*. The early names for grain are very ambiguous. The word corn connotes in England wheat, in Scotland oats, in Sweden barley, in Germany rye and in America maize. The most widely spread name for a cereal is that which appears in Sanskrit as yava, in Greek as *zka* or *zeiá,* the latter a derivative of the former, in Lithuanian *jawaĩ*. It may have meant originally barley, but is also used for spelt, a simple and ancient form of wheat, which, as being such, was long used in religious ritual.

The names for the seasons of the year help us somewhat. There **are** words widely spread for winter and for snow. The stem *hima* is found in the name of the Himalayas ("the abode of Snow") and in the Greek khezma with its adjective duskhimos, the Latin *hiems* and many others. We do not use a word from its root for winter ourselves; but notwithstanding we have a word borrowed from the Norse and much used by Cumberlanc shepherds, *gimmer,* a winterling or sheep one year old. There is less agreement about the other seasons but there is a fairly widely spread word for spring. In many countries summer is simply the hot season. For harvest the languages do not agree very well; the Latin *auctumnus* is simply the "season of increase," which we have introduced into English as autumn. The word harvest is probably the season of fruit gathering, not of corn harvest, the two being still distinguished in German as *herbst,* the fruit harvest, and ernte, the reaping time. Snow was certainly known because the stem is found in so many languages, but with lofty mountains in the neighbourhood that might well be, even in a hot climate; from the names of the animals and plants, however, as we have seen, the climate was temperate and if it was a continental climate as, from the absence of words for sea, it apparently was, the climate might be severe, even if it were tolerably far south. The areas that will satisfy the conditions require a land with a temperate climate, remote from the sea and shut off from other areas, for otherwise it seems impossible that languages with so complicated a grammatical system as the Indo-European could have developed, bearing so close a resemblance to one another and on the whole so strongly differentiated from other languages. The only area which will satisfy the conditions postulated by the languages is the great area in Europe which includes practically the former empire of Austria-Hungary. In this area are found rich corn land, great prairies for the production of horses, pasture for cattle in the plains and for sheep on the mountain slopes, while the mountains themselves contain a large supply of minerals which were later utilised by man. But when the migrations from this centre began, the use of metals had not advanced very far, the only word for metal common to many languages being that which appears in Sanskrit as ayas, in Latin as aes and in English as ore. The word at the time of the migration meant either copper or bronze which sometimes, as in Greek, are not distinguished, the first bronze probably being a natural alloy. From what has been said it is clear that much could be done on this subject by the geographers.

Migration. — Even when we have found a people using a certain vocabulary, it is necessary to discover, if they migrated from their original habitat, in what manner it was possible or probable that they did migrate. It is, for example, a common belief that migration from Europe to Asia or the reverse, was carried on largely by the steppes of Southern Russia, the shores of the Caspian and Turkistan. In ancient times, however, progress in this direction would not have been so easy as it is to-day. In the Caspian area very large and important changes in the earth's surface have taken place. The eastern end of the Caucasus, for example, has sunk till it is now far below the level of the Caspian. The northern Caspian is steadily being filled up by siit from the Volga. In earlier times, it extended much further north than it does at present, while eastwards its extent was very much greater, including within its area not only the present Sea of Aral and what is now the intervening desert, but also passing still further to the east to a distance which is not yet clearly determined. Scholars often talk lightly also of great hordes passing the Caucasus. This also would be very difficult to achieve. According to early Greek notions the Caucasus was a barrier without openings through it and in fact at the present day there is but one, the Pass of Dariel. Historical migrations, in fact, have taken place much more readily across Asia Minor than across the Steppes. The main movement from Asia into Europe which went north of the Caucasus was in early times that of the Scythians and in mediaeval times that of the Hungarians. That the migration of the Indo-Europeans was through Asia Minor is proved by the discovery in 1906–07 of a large mass of records dating from the 1 jth and 14th centuries B.C., at Boghaz Keui, an important site east of the river Halys. Here were discovered the archives of the ancient Hittite empire, recorded in eight languages of which two have a certain Indo-European element in them. The most important is called Kanisian by Dr. Emil Forrer, who has been very successful in their decipherment. The grammar of this language, its noun and verb forms, are clearly Indo-European; but only a small part of its vocabulary is so, the main part coming from an unknown tongue. The first records of this language which were discovered came not from this find at Boghaz Keui, but from two letters discovered many years before, in the archives of Ikhnaton (*q.v.*), the heretic king of Egypt at Tell-el-Amarna. The mixture of two languages might be compared to what has happened in English where the pronouns, the numerals and the few remaining inflections of noun and verb are Teutonic but the bulk of the vocabulary is of Latin, or of Greek origin. The forms of this language, particularly in the names of certain deities, and of the numerals were so like those of Sanskrit that the first investigators were of opinion that either the records proceeded from Indians advancing westwards, or that the original home of the Indo-Europeans must once more be carried back to central Asia, where it had been located by some of the early authorities. A difficulty was found in the fact that the existing remains of the ancient languages of Persia — Zend and old Persian — as represented in the dialects of the Avesta and the kindred tongue of Darius' inscriptions at Behistun were so much less archeic in sounds than either the forms of these records or of Sanskrit. The explanation, however, is simple. When the speakers of Sanskrit passed over the mountains into a new country, they found themselves faced by powerful tribes more numerous than themselves and speedily realized that if they were not to be absorbed, they must stand aloof from mixture with the native tribes. Hence the beginning of the system of caste in India, for the Sanskrit word for "caste" means colour. The changes found in the language left behind in Persia must have taken place after the migration of the emigrants to India. This is not at all unusual. In the 16th century important changes took place in Spanish, but these changes were not shared by those who had already established Spanish in America. The English settlers of New England carried with them the forms noos for news and Toosday for Tuesday, because the y sound before *u* had not developed when these settlers left England.

If the original home of the Indo-Europeans is really located in Austria-Hungary, we should expect a considerable number of the Indo-Europeans to have been pile-dwellers. For this country had at one time much more water in it than it has now, when the Platten See, a shallow marshy lake, is all that remains of what was at one time a vast expanse of slowly drying morass. That there were amongst them many pile-dwellers, we can be certain, because they carried into Switzerland and into Italy for the western migrations, the same form of habitation, and gradually extended it further to the West.

Anthropology. — What manner of men were these emigrants? In Germany many scholars contend that they were tall men with fair hair and blue eyes and they attribute to the Indo-Europeans all the characteristics of the ideal German. For this, however, there is no solid foundation. It is said by these scholars that when Homer talks of xanthos *Menelaos,* this should be translated "yellow haired Menelaos." This translation, however, is not accurate. To a Greek xanthos did not mean blond, but brown,

as is clearly shown from the use of the verb, which signifies "to change the colour of meat in roasting," so that the colour would not have been lighter than auburn. In fact, when the Greeks came in contact with German children they did not know how to describe the colour of their hair and said they had hair like old men and described them as *polioi*, "with grey hair."

The anthropologists at one time maintained that the Indo-Europeans had long heads as distinct from other people with short heads. The mixture, however, of long and short heads is not a new thing. As Sir Arthur Keith points out (*Antiquity* of *Man*, vol. i. p. 110 [1925]), the antiquary, Dr. R. R. Schmidt, found at Ofnet, fifty miles south-west of Nuremberg, a large number of skulls of the Azilian epoch (a period linking up palaeolithic with neolithic times), some of which were long and others short. There is no reason to suppose that the Indo-Europeans had only one type of skull. No records lead us to suppose that we can trace the Indo-Europeans back more than ten thousand years. In earlier Europe there were peoples of different types, some of a physical frame now confined to the natives of South Africa, others with features akin to those of native Australians, and others again of types which no longer exist. The Basque language in the Pyrenees is a last relic of languages which preceded the Indo-European in the west of Europe; and the characteristics of colouring, hair and eyes of natives of western Britain and western Ireland, which Huxley called Iberian, are probably the relics of this population which has been almost absorbed. In Persia, on the other hand, a short, very dark people (negrito), which survives only in the extreme south-west of Asia, apparently preceded the Indo-European stock. The value of the relation of length to breadth of head, to which the elder Retzius first referred, has been much exaggerated, for the total content must be of more importance than the relation of length to breadth. As has been emphasized in recent years by Mr. Griffith Taylor, the height of the brain-pan is worthy of consideration.

Pottery.—Still more recently the subject has been attacked from another point of view. In 1902 Professor Kossinna of Berlin undertook to show that pottery would be a more certain index to the history of peoples than any of the other methods proposed. But in the quarter of a century which has since elapsed, Professor Kossinna has withdrawn almost all the statements which he then made and his proposed new treatment of the Indo-Europeans has stuck fast after one part was published. That, however, evidence will be forthcoming from this side is certain. But a good deal more has still to be done in identifying the makers of particular types of pottery before this clue can be regarded as of more value than any of the others. At present the best chance of progress lies in the possibility of dating positively, and linking up with the linguistic evidence, the results which can be derived from the "Bell-beaker Civilization" and the Megalithic graves which extend very nearly over the same area which was covered by the early migrations of the Indo-Europeans The probability is that the Indo-Europeans and their civilization arose from the mixture of two earlier types, a Mediterranean and a Northern type. But Schuchhardt in the second edition of his *Alteuropa* (1926) goes further and boldly assigns (p. 282) the Indo-Europeans to a mixture of the Germans coming from the north and the Celts from the Danube area, a stock in Thuringen possibly first "indogermanizing" north Germany by settlement and south Germany by conquest. To this he has added (*Sitzungsberichte der preussischen Akademie*, Feb. 16, 1928) that it was the conquest by the Thuringians of South Germany and Switzerland that created the Celtic stock; the Thuringians afterwards wandered to the Danube and were thus the original stock of the Indo-European people.

Language Classification.—Leaving these archaeological points to be definitely decided by future investigation, we may classify the Indo-European languages according to their connections. The Indo-European languages fall into two groups distinguished from one another by their treatment of certain guttural sounds. In one group, lying mainly in Europe, these sounds remain as k, g, kh and gh, whereas in the other group they change into some form of sibilant *ç, z* and the aspirated sounds either drop the aspiration and are treated as *k* or g, or appear as *h*. The causes for this distinction are not certainly known and the distinction did not mark a deep difference between the languages at an earlier period, because the Greek, which is a *k* language, resembles in its syntax Sanskrit, which is a *ç* language, more than any other. The two series are generally named from the word for 100, in Latin *centum (kentum)*, in Zend *satem*. The languages which preserve the guttural are *centum* languages, those which change it into a sibilant are *satem* languages. Thus the Greek *kuōn* "dog," Latin *canis*, appears in Sanskrit as *çvā (n)* and in Lithuanian as *szuo*. The chief *centum* languages are (1) Greek, in three distinct groups of dialects, Aeolic, Ionic and Doric, with more archaic forms in Arcadian and Cyprian. (2) Latin and the other Italic languages of Italy, Oscan in Campania and the South, Cmbrian on the East of the Apennines. (3) The Celtic languages, which fall into two groups according to their treatment of an original combination of a guttural with a w sound like the English *qu*. One group changes *qu* into *p* (ancient Gaulish, Welsh, Cornish, Breton), the other represents *qu* by *c* (Irish and its descendants. Scotch Gaelic and Manx of the Isle of Man). Thus, corresponding to Latin *quis* is Irish *cia* and Welsh ***pwy***. (4) The Teutonic or Germanic languages which fall into three groups: (a) Gothic, (b) Norse (Danish, Norwegian, Icelandic, Swedish), (c) West Germanic, including English, Frisian, Dutch and Flemish, Low and High German. The most distinctive feature of this group is the "sound shifting" which the stop consonants and *s* have undergone, and which are catalogued under the action of "Grimm's Law" and "Verner's Law," in the treatment of Teutonic languages. (5) Very remote from these four sections which are all in Europe, is Tocharish, presumably the language of migrants from somewhere much farther to the west, though the records of this now extinct language are found in Chinese Turkestan. (6) The Indo-European section of the Hittite languages (*see* above).

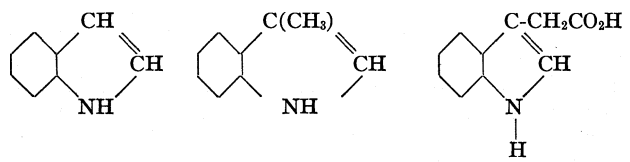
The *satem* languages are (1) in northern India Sanskrit and its descendants, and in Persia and its adjacent countries the ancient dialects called Iranian, viz., Zend (of the Avesta), Old Persian, Sogdian and North Iranian; Sanskrit and Iranian together form the Aryan branch properly so-called, though in England the word has often been applied wrongly to mean Indo-European. (2) Armenian, (3) Slavonic in its numerous dialects and Baltic (Lithuanian, Lettish, and Old Prussian, which is now extinct), (4) Albanian, more probably the descendant of the Ancient Thracian than of the Ancient Illyrian which occupied in part the same area. The relation of Illyrian to the Ancient Venetic, once spoken north of the Po and to the Ancient Messapian spoken in the heel of Italy, is not yet definitely ascertained. The other important language of Italy, Etruscan, did not belong to this family, but seems to have been related to Ancient Lydian and other languages of the Levant now extinct. (*See* also HITTITES; and separate articles on various languages.)

BIBLIOGRAPHY.—(i.) *Indo-European Antiquities:* O. Schrader, *Sprachvergleichung und Urgeschichte* (3rd ed., 1907); *Reallexikon der indogermanischen Altertumskunde* (2 vols., 2nd ed., 1917–26); H. Hirt, *Die Indogermanen* (2 vols., 1905, 1907); S. Feist, *Kultur, Ausbreitung und Herkunft der Indogermanen* (1913), *Indogermanen und Germanen* (3rd ed., 1924), and *Germanen und Kelten in der antiken Ueberlieferung* (1927); A. Carnoy, *Les Indo-Européens* (1921); V. Gordon Childe, *The Dawn of European Civilization* (1925), and *The Aryans* (1926); Carl Schuchhardt, *Alteuropa* (2nd ed., 1926); Sir G. A. Grierson, *Linguistic Survey of India*, vol. i. part i. (1927). The best book of reference for prehistoric antiquities is Max Ebert, *Reallexikon der Vorgeschichte* (1924 etc., S–Z still unpublished).

(ii.) *Indo-European Languages:* K. Brugmann, *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen* (2nd ed., 1897–1916), of which a small additional part has been published since the author's death in 1919; a shorter work by the same author is *Kurze vergleichende Grammatik* (in 3 parts, 1902–04), dealing only with the more important languages; H. Hirt, *Indogermanische Grammatik* (the first four vols., only, are published, 1921–28); A. Meillet, *Introduction à l'étude comparative des langues Indo-Européenes* (1903, now in the 5th ed.), and *Les dialectes indo-européens* (1908). The comparative grammar of Latin and Greek is often treated separately, as by A. Meillet et J. Vendryes, *Traité de grammaire comparée des langues classiques* (1924); P. Giles, *A Manual of Comparative Philology for Classical Students* (3rd *ed.* in preparation). A complete bibliography of recent publications appears annually in the *Indogermanisches Jahrbuch* begun by *A.* Thumb and W. Streitberg in 1913.

(P. GI.)

INDOLE (BENZOPYRROLE), first prepared by A. Baeyer in 1866 and regarded by him as the parent substance of indigo. It crystallizes in colourless lustrous leaflets, melts at 52° C.. boils at 253°–254° C., is readily volatile in steam and easily soluble in water, alcohol, ether or benzene. Its odour is generally faecal, but after careful purification and in sufficient dilution indole possesses a not unpleasant odour of flowers. Accordingly it finds a limited application in perfumery. Indole occurs in the coal-tar fraction (*see* COAL TAR), boiling at 220°–260° C.; after removal of phenols and strong bases the oil is treated with sodium or sodamide to form sodium indole, which is separated mechanically and decomposed by water. It is synthesized by treatment of o-amino-w-chlorostyrene, $H_2N.C_6H_4CH=CHCl$, with sodium ethoxide, or by reduction of o-nitrocinnamic acid, $O_2N.C_6H_4.CH=CH.CO_2H$. These reactions indicate its constitution (I).



(I) (II) (III)

Scatole (3-methylindole; II) occurs in human faeces, of which it is the chief volatile constituent; it melts at 95° C. and boils at 265°–266° C. 3-Indole acetic acid, III, or heteroauxin, is one of the natural plant-growth hormones.

INDONESIA, a country of southeast Asia extending for more than 3,000 mi. across the equator between Asia and Australia. The Republic of Indonesia comprises all the islands, or parts of them, which until Dec. 27, 1949, constituted the Netherlands Indies, the only exception being Netherlands New Guinea. It includes Sumatra, Java, Bali, Borneo or Kalimantan (in part), Sulawesi (Celebes), Halmahera, Lombok, Sumbawa, Flores, Timor (in part), the Moluccas and hundreds of smaller islands of the largest archipelago in the world. (For geography see MALAY ARCHIPELAGO and separate articles on different islands.)

HISTORY

Not much is known of the prehistory of the area. Remains of Pithecanthropus or "Java man" were found in east Java. It is believed that the aboriginal inhabitants were a dark-skinned race of which the Kubu people of south Sumatra may be descendants. It seems likely, however, that the islands were populated by various waves of migrations probably from southwestern China and taking place over a long period of time and not all following the same route.

The historical record begins with a period roughly coinciding with the beginning of the Christian era, when states developed in the larger islands under strong Hindu and Buddhist influences from India. The two most important states of this period were Srivijaya (centred around Palembang in south Sumatra) from about the 7th to the 13th century, and Majapahit (with its capital in east Java) founded at the end of the 13th century. At the height of its power Majapahit claimed sovereignty not only over the Indonesian islands but also over large areas of the Malay peninsula; but outside Java it is doubtful whether its control in fact extended beyond the more important trading ports and coastal areas. Both Srivijaya and Majapahit maintained commercial and diplomatic links with other Asian states, including China. The cultural heritage of this so-called Hindu period is still preserved in the life and arts of the island of Bali (whose people remain Hindu) and in the music and dances of Palembang, Djokjakarta (Jokyakarta) and Solo; it is visible in such world-renowned temples and monuments as the Prambanan group and the Borobudur of central Java.

Islam was brought to Indonesia by Arab and Indian Moslem traders, who converted the rulers of the seaports to their faith. It reached north Sumatra at the end of the 13th century and north Java in the second half of the 15th and the early 16th century. Thence it spread along the trade routes and, more slowly, into the interior of the larger islands. By about 1j20 the Moslem ports of north Java had become independent, their attacks on the decaying state of Majapahit assisting its downfall and the eventual rise of the Moslem state of Mataram, which brought most of east and central Java under its control in the early 17th century. Balambangan in southeast Java, however, was not converted to Islam until the second half of the 18th century, and large areas of Sumatra, Borneo and the islands east of Java were still pagan until converted by Christian missionaries in the 19th century. Large numbers of Indonesian peoples retain animistic and Hindu beliefs mingled with the newly acquired observances of Islam.

The **Colonial** Period.—When the Portuguese reached the "Spice Islands" of eastern Indonesia in the latter half of the 16th century, Islam was well established on Sumatra and Java, and there was considerable discord among the princes who had succeeded to the broken-up parts of the former Majapahit empire. After the Portuguese came the British and the Dutch, likewise for the sake of the spice trade, over which quarrels broke out among the three European powers. The final outcome eliminated the British and Portuguese from any significant role in the future of the archipelago.

The Dutch East India company (*q.v.*), formed in 1602, set out to monopolize the export and import. at first of the products of the Spice Islands, but soon of the considerable trade both domestic and foreign which was already well established and centred on Java. The company obtained trading privileges from the local princes; when it became evident that political interference was necessary to enable the company to protect its monopoly, one prince was played off against another, so that the company came to exercise ever greater political as well as economic control. Political administration was achieved through increasing the power of local rulers amenable to Dutch influence, who were required to control economic activities in their domains in accordance with the company's interests.

For Indonesia this system had two consequences: not only did it result in considerable material extortion, it also upset the social organization of the areas where it was enforced. Politically it favoured an autocratic system of government; economically it almost annihilated the class of Indonesian merchants and traders through the company's promotion of the Chinese as middlemen. For the Dutch East India company this system produced great profits, but it also led to corruption which contributed to its collapse in 1789. In 1800 the entire area controlled by the company was placed under the direct authority of the Netherlands government which. however, made no sharp break with past practices of forced labour, deliveries in kind and monopolies in certain crops.

During the brief British occupation of Java and its dependencies (1811–16), which resulted from the Netherlands coming under the control of Napoleon Bonaparte, Sir Stamford Raffles, the lieutenant governor, attempted to introduce a more liberal system embodying private trade and cultivation and the abolition of compulsory services to government. But with the end of the Napoleonic wars in Europe Indonesian territories returned to the Netherlands. The opportunities for private enterprise which had begun under Raffles continued to some degree under the Dutch until 1830 when there was a return to government monopoly. The culture system was introduced, compelling cultivation of stipulated crops in stipulated quantities. Implementation of this system required also a return to strict political control. The social pattern of the company's regime was consolidated. The people were unable to acquire trading experience, their initiative was hampered and a growing proportion of agricultural land was devoted to export crops at the expense of rice and other crops for local consumption. The culture system began to be curtailed in the 1860s, after which the government's grip on export crops was progressively diminished, and the Land law of 1870 opened great opportunities for the investment of private capital. But the compulsory cultivation of coffee, the last remnant of the culture system, was not abolished until 1917.

Mitigation of the worst features of colonial policy, which began to appear in the 20th century under the so-called ethical system, proved in the event to have been too little and too late. Demands for improved conditions gave birth to demands for political self-

determination. From the first attempts at political interference the Indonesian people had never submitted placidly. The endeavours of the company to play offone prince against another had led to armed clashes of a sporadic and scattered nature. The company frequently had to use force to secure its objectives, for instance against Sultan Agung Hanjokrokusumo (Djakarta, 1629) and against Hasanmudin (south Celebes, 1653–69). The company's territories transferred to the Netherlands government did not encompass the whole of Indonesia, nor did the transfer bring greater peace. From 1825 to 1830 there was the considerable uprising led by Prince Diponegoro of central Java. Pattimura revolted in the Moluccas in 1817, Imam Bondjol in west Sumatra in 1833; there was warfare in Bali in 1846, in Banka (Bangka) in 1811 and in Lombok in 1894 as a result of attempts to extend or consolidate Dutch rule. It was only as late as 1907 that Atjeh, the northernmost part of Sumatra, was brought under Dutch control.

The Nationalist Movement. — By the end of the 19th century the backnardness of the common people began to cause concern among Indonesian intellectuals. Raden Adjeng Kartini (1879–1904) began her campaign for the emancipation of Indonesian women. A few years later Wahidin Sudirohusodo began the education of cadres as a means of raising the cultural standards of the people; as a result of his efforts,the Budi Utomo educational organization was established in 1908. In 1911 Indonesian merchants founded the Serikat Dagang Islam with the idea of protecting the last remaining field of trade, the batik industry, from the domination of non-Indonesian businessmen. However, purely nonpolitical effortssoon proved to be ineffective. The existing organizations became openly political and political parties were formed,including a Social Democratic party.

Political demands in Indonesia increased and were coupled with criticisms in the Ketherlands. In response. the volksraad was created in May 1918 as an advisory council to the Netherlands Indies government of mainly appointed representatives. In Nov. 1918 Count J.P. van Limburg Stirum, the governor general. promised both u-ider powers for the volksraad and democratic government for Indonesia. As this promise was never fulfilledthe activities and demands of the nationalist movement increased, and the government began to retaliate by imprisoning and exiling prominent leaders, becoming especially harsher after the general strike of 1926–27 called by the Indonesian Communist party. The governors general were given powers to take action under criminal law without trial; some persons were hanged, thousands were imprisoned or exiled. But the nationalist movement continued to grow. Indonesian students abroad formed associations through which echoes of the struggle in Indonesia reached the knowledge of western public opinion opposed to colonialism.

The Japanese Occupation. — When the Japanese attacked Indonesia in 1942 the Netherlands army and such Allied forces as were there were quickly overpowered. Though there were Indonesian elements in the Netherlands Indian army the people in general had never been associated in the defense of the country, and they did not feel themselves associated with the Dutch in the war against Japan. The common people were at first prepared to listen to Japanese propaganda of "Asia for Asians," believing then that the Japanese had liberated them from colonialism. But the seizure of crops, the press-ganging into forced labour, the suppression of freedom of information and the cruelty of the Japanese showed otherwise. In Blitar and some other places mutinies broke out among the Japanese-organized home defense guard.

Nevertheless the Japanese had been compelled to give Indonesians military training and appoint them to technical and administrative posts never open to them before: the Indonesian language was used officially as the national language. Some Indonesian leaders of the prewar nationalist movement, such as Sukarno (1901–) and Mohammed Hatta (1902–), accepted posts in the Japanese administration to safeguard as best they could the interests of their people; but they also kept in touch with other leaders, such as Sutan Sjahrir and Amir Sjarifuddin, who worked underground. Early in 1945 the Japanese allowed the formation of a body to prepare for Indonesia's independence. This body met from May to July 1945 and began to draft the future constitution.

Independence. — The independence of Indonesia was proclaimed on Aug. 1, 1945, two days after the collapse of Japan. The five years of revolution which followed were marked by two characteristics: major armed clashes with Allied or Dutch forces were followed by major agreements; the battle of Surabaja (Surabaya; Kov. 10, 1945), fought against occupation troops of the British southern Asia command, was followed by the Cheribon (Tjirebon) or Linggadjati agreement (initialled Nov. 15, 1946 and signed on March 25, 1947). The first large-scale military attack by the Dutch army (launched on July 21, 1947) was followed by the "Renville" agreement (Jan. 17, 1948). The second attack by the Dutch army (launched on Dec. 18, 1948) was followed by the Round Table conference agreements (signed at The Hague on Nov. 2, 1949). The periods between these events were filled with recurrent clashes and negotiations, as well as, for the republic, with some months of civil war when a Communist-led rebellion broke out in Madiun (Sept. 18, 1948). While the Indonesian people were determined to win complete independence, the Dutch were unwilling to grant it. The means used by the Indonesians were largely limited to guerrilla warfare and to appeals to world opinion. The Dutch attempted to deprive Indonesia of the world's sympathy by describing the republic as "made in Japan," while in Indonesia they endeavoured to isolate the republic both economically and politically. At the time of the 1946 agreement the republic controlled a part of Java with Jokyakarta as capital. An economic blockade was instituted by the Dutch after the attack of 1947. In parts of Indonesia which were under their administration, the Dutch sponsored the formation of separate states, such as that of East Indonesia (founded Dec. 24, 1946), East Sumatra (Dec. 29, 1947) and West Java (Feb. 26, 1948); by the end of 1948 there were altogether 15 such "states" or "special territories," each of which sent one delegate to a Dutch-sponsored federal consultative assembly. But international intervention could not be prevented. The first negotiations had been arranged with British assistance; the following two major negotiations were arranged with the help of the UN Security council. In consequence of the agreement of Nov. 2. 1949, the Netherlands transferred complete and unconditional sovereignty to Indonesia on Dec. 27, 1949.

Difficulties with the Dutch were not, houever, over. Not all Dutch elements accepted without reservation the recognition of Indonesia's sovereignty and independence. Capt. R. P. P. Westerling gathered around him troops from the Netherlands Indies army, which had not yet been disbanded, and attacked the city of Bandung (Jan. 23, 1950). Similar disturbances occurred in several parts of Indonesia for months to come, the most important being the South Moluccas rebellion (April 25, 1950). Indonesia claimed that the rebels, including some Dutchmen. dispersed to the hills and joined certain bands of irregulars, that they received support from Dutch-owned estates and enterprises and formed a subversive movement against the republic.

Another source of friction between the Netherlands and Indonesia was the latter's claim that Netherlands New Guinea (or West Irian) should be transferred to the new republic. The Dutch. however, refused to discuss this. their argument being that neither ethnographically nor geographically was New Guinea a part of the Malay archipelago.

The political consequences of the Nov. 2, 1949, agreements also proved short-lived. First the federal form of the state, described as the Republic of the United States of Indonesia, to which sovereignty had been transferred, and which had 16 member states, was accepted by the Indonesian government only as a lesser evil. In the first few months after transfer of sovereignty, all but two of the member states dissolved themselves and joined the original republic as a means toward achieving a unitary state for the whole of Indonesia. Negotiations with the two other remaining states led to the formation of a unitary state on Aug. 17, 1950, and the name of the country became again the Republic of Indonesia. Second, the union with the Netherlands never came to life and was formally dissolved on Aug. 10. 1954. Finally, certain clauses of the agreements reached at the Round Table conference, especially

those guaranteeing a favoured position to Dutch interests, proved disadvantageous to Indonesia. When negotiations of Jan.–Feb. 1956 broke down, on April 9, 1956, Indonesia unilaterally abrogated the whole of the Round Table conference agreements.

POPULATION

The population of Indonesia is composed of a large number of different peoples of varying degrees of civilization. Hunting tribes such as the Punaus in central Borneo live in the near vicinity of agricultural tribes, whose agriculture is sometimes of a very primitive nature. The highest level of civilization is found in Java, Bali and some parts of Sumatra. The islands between Celebes and New Guinea are inhabited by a population of mixed races.

The main population groups of Sumatra are the Achinese, at the northern point, the Gajo and Alas people, south of Achin; the Bataks, around Lake Toba, divided into Toba, Timur, Karo and Pak Pak Bataks in the interior; the Menangkabaus on the plateau of central Sumatra; and the Malays. Among them live the remnants of the Kubu tribe, who are descendants of the oldest-known inhabitants of the archipelago. All these peoples are Moslem except the Bataks, most of whom are Christian.

There are three main population groups in Java: the Sundanese in the west, the Javanese in the centre and east and the Madurese who migrated from the island of Madura into the eastern coastlands of Java. There are also some small groups of older stock, the Badujese in west Java and the Tengerese in east Java. The people of Java. Moslem in great majority, form about 70% of the total population of Indonesia.

The main part of Borneo's population is formed by the Dayaks. Malays have settled along the coast and the rivers; mixed with Javanese, they form the population of Banjermasin on the south coast. From the 18th century onward the Chinese began to settle in western Borneo where gold was mined. They came as miners and continued as farmers, handworkers and traders but are strongly mixed with Malays and Dayaks. On the east coast of Borneo there was immigration from Celebes, by the seafaring Buginese. The Dayaks are mainly pagans, the Chinese maintain their own culture, and the other groups are Moslem.

The southwestern part of Celebes is inhabited by Macassars and Buginese, the interior by the Toradjas and the northeastern part by the Minahassans. Among the Minahassans the Christian religion predominates, to which some tribes of the Toradjas also have been converted. The Balinese and the inhabitants of the western part of the adjacent island of Lombok have clung to the pre-Islamic Indonesian type of Hindu culture. On the other islands east of Celebes and Java the population is partly Christian (Amboina, part of Flores, the Kei Islands, etc.), partly Moslem (Ternate, Tidore, etc.).

The only population census was taken in 1930, revealing a total of 60,412,962 inhabitants, excluding Netherlands New Guinea; the estimated population in 1940 was 70,476,000 and in 1956 was 84,432,141.

Political and social unrest caused a great influx into the cities. Jakarta (Djakarta), the capital, had 533,000 inhabitants in 1930 and an estimated 1,927,788 in 1956. Jogjakarta had 280,067 inhabitants in 1956. During the same period the population of Surabaya increased from 342,000 to 980,905; of Bandung from 166,800 to 870,346; of Semarang from 217,000 to 389,970; of Surakarta or Solo from 165,000 to 380,843; of Medan (east Sumatra) from 76,000 to 307,115.

By 1955 the total number of Moslems in Indonesia, generally belonging to the Shafi'i sect, was estimated at 62,160,000 (approximately 80%), Christians at 3,400,000 (4.3%), Balinese Hinduists at 1,710,000 (2.2%), while about 2,330,000 (3%) were Buddhists, almost three-quarters of them Chinese or descendants of Chinese. Other religions were Taoism and Confucianism. Animist influences were still prevalent in certain isolated areas.

The population of Indonesia is composed of about 17 language groups. Prewar statistics of the ethnic groups were based mainly on linguistic characteristics. On this basis were established the following estimates for 1955: Javanese (inhabitants of central and eastern Java) 41,250,000; Sundanese (western Java) 13,260,000; Madurese (the island of Madura and eastern Java) 6,580,000; Jakartans 3,960,000; Menangkabaus (central Sumatra) 3,050,000; Buginese (southern Celebes) 2,350,000; Bataks (northern central Sumatra) 1,820,000; Balinese 1,720,000; Malays proper (eastern Sumatra) 1,110,000; Toradjas (central Celebes) 900,000.

The two main nonindigenous groups are the Chinese and Europeans. The Chinese were estimated in 1955 at 1,600,000, most of whom lived in Java, Sumatra and western Borneo. The majority had been born in Indonesia and was of mixed blood. The Europeans counted about 350,000 in 1940. By 1955 their number had been reduced by emigration to the Netherlands to about 60,000.

In all there are approximately 25 major languages and about 250 dialects spoken. Bahasa Indonesia, an adaptation of Malay, is the official language and language of instruction in elementary schools, at least from the third form.

The total area of Indonesia, excluding Netherlands New Guinea, is 575,893 sq.mi.

GOVERNMENT AND ADMINISTRATION

The form of government in Indonesia varied in accordance with its three successive constitutions: that of 1945 (proclaimed on Aug. 17, 1945); that of Nov. 2, 1949, drafted during the Round Table conference for the Republic of the United States of Indonesia; and that of Aug. 17, 1950, controlling the unitary Republic of Indonesia. All three constitutions were provisional until a democratically elected constituent assembly should draft a permanent one. These constitutions varied not only in providing for different forms of state, but also in powers and rights of institutions common to all three forms. In the preamble to all three constitutions were incorporated the *Pantja Sila*, the five principles upon which the state was based: belief in God, nationalism, humanism, sovereignty of the people and social justice.

The 1950 constitution provides for five instruments of state: the presidency, the cabinet, the house of representatives, the supreme court and the General Audit council. Among these the administrative, legislative and judicial functions of government are divided. The president is the supreme commander of the armed forces; as head of state his office stands outside the mutations of party politics and is outside the jurisdiction of the courts; he appoints the prime minister, upon whose advice he appoints the ministers; he has the power to dissolve parliament. The vice-president fulfils the functions of the president when the latter is unable to do so. President Sukarno and Vice-President Hatta had extraconstitutional roles in the affairs of the country by virtue of their past positions as leaders of the nationalist movement. The cabinet is responsible to parliament; the ministers, both collectively and individually, are obliged to report important matters to the president; the cabinet has the power of initiating legislation. In addition to the prime minister there are two deputy premiers, a titular minister for each of the 18 ministries and a minister without portfolio in charge of general affairs. The house of representatives, which also has the power of initiating legislation, but through the cabinet, is elected every four years. There is one representative for each 300,000 persons, with special provision for representation of the minorities. All citizens above the age of 18 years may vote at elections and may stand as candidates; the vote is direct and secret and the distribution of seats determined by proportional representation. Judges of the supreme court and members of the General Audit council are appointed for life.

Indonesia is divided into ten provinces: North Sumatra, Central Sumatra, South Sumatra, West Java, Central Java, East Java and Madura, Kalimantan, Nusa Tenggara (Lesser Sunds), Sulawesi (Celebes) and Maluku (Moluccas). West Irian or Netherlands New Guinea is described as the 11th province. Each province has an appointed governor and an elected regional council of representatives. There is a movement toward local autonomy: the "special territory" of Jogjakarta and several small areas have become autonomous.

The first general elections were held on Sept. 29, 1955, for the house of representatives and on Dec. 15, 1955, for the constituent assembly. In Table I the results are compared with the provisional

house of representatives whose members were government or party nominees. *(See* Table I.)

TABLE 1.—*Elections to the House of Representatives, 1955*

Parties	Votes	Seats*
Indonesian National (P.N.I.)	8,434,653	65 (42)
Masjumi (Moslem)	7,903,886	59 (41)
Religious Teachers' (Nahdlatul Ulama)	6,955,141	54 (8)
United Moslem (P.S.I.I.)	1,091,160	10 (4)
Christian Protestant (Parkindo)	1,003,325	9 (4)
Catholic	770,740	5 (9)
Socialist (P.S.I.)	753,191	3 (15)
Communist (P.K.I.)	6,176,914	49 (17)
Other 160 parties or groups	...	6 (93)
Total	37,410,249†	260(233)

*Members of the old house in parenthesis. †Out of an electorate numbering 43,104,464.

Education. — The estimates of illiteracy in Indonesia vary. In 1930 it amounted to 96.8% of the population; according to a 1955 estimate this had been reduced to about 40%. In the Setherlands Indies school attendance was not compulsory. The Republic of Indonesia intended to introduce compulsory attendance by 1961, but much depended on the availability of teachers, buildings and equipment. In the school year 1939–40 there were 48.206 teachers employed at the elementary schools, 542 at the secondary schools and 125 at the University of Batavia. By 1953 Indonesia had about 86.000 teachers instead of the 224,400 that were needed; many of the teachers employed since 1945 did not possess the necessary training.

The government maintained t o universities: the Gadja Mada university at Jogjakarta (about 2,500 students in 1951) and the University of Indonesia with a teaching staff of 548 and 6,754 students in 1952–53. *(See* Table II.)

TABLE II. —*Education*

Level	1939–40		1953–54	
	Schools	Pupils	Schools	Pupils
Elementary	18,091	2,348,798	27,400	4,977,304
Secondary (junior	114	21,879	1,053	236,000
Secondary (senior	17	2,232	61	22,000
Vocational and technical	86	12,525	978	168,000
Higher	5	1,635	17	14,907

Public Health. — The republican government faced from the outset a great shortage of hospitals (less than 1 bed per 1,000 inhabitants in 1950), shortage of equipment and medicines and shortage of medical personnel (about 1 doctor per 60,000 inhabitants in 1950). In addition, it was necessary to persuade the population of the desirability of public health and of the efficacy of scientific medicine. Side by side with normal educational programs, the shortage of personnel was being alleviated by training of paramedical personnel for narrowly limited purposes, A complete system of public health was being instituted as means became available, following a scheme known as "the Bandung plan," while a series of mass campaigns had been organized with the assistance of the UN World Health organization to reduce and eradicate the worst diseases endemic among the people. Because of the psychological advantages for the introduction of a thorough public health system which could be anticipated as a result of dramatic cures, yaws was chosen in 1950 as the subject of the first mass campaign, Later a beginning was made with the much more difficult campaigns against malaria, tuberculosis and venereal diseases.

ECONOMIC CONDITIONS

The 1950 constitution provided that the economy be built up by common effort on the basis of the family principle; that branches of production important for the state and affecting the daily necessities of the masses be controlled by the state; and that the land and waters with their natural resources be controlled by the state to obtain the greatest possible prosperity for the people. These principles sum up the intention to convert the colonial economy, which stressed the export of raw materials and had left the economy heavily dependent upon the world market, into a national economy which, stressing the basic necessities of the people, would secure more even development and better balance in the economic life of the country. More even development implied opening up of the virgin or underdeveloped areas. notably of Sumatra and Borneo, using the manpower from overcrowded Java, where the population rises to more than 1.000 per square mile. The migration scheme had already resettled 104.649 persons in 1951–5j. More balance in the economy implied greater production of consumers' goods, notably foodstuffs and textiles, which mould require the creation of new industries in order to lessen Indonesia's dependence upon world markets.

Agriculture and Forestry. — Agricultural production and livestock by 1951 reached more or less prewar levels, but the population was then larger by 8,000,000 than it had been in 1938. Rice imports, which in 1950–52 amounted to an annual average of 600,000 tons. were reduced to 99,000 tons in 1954. While still Indonesia's fourth largest earner of foreign exchange (after rubber, petroleum and tin), copra output was being increasingly absorbed by the domestic market. Production in 1954 was 728,000 tons, slightly higher than the pre-1938 annual average, but export during the period fell from 554,000 tons to 296,000 tons. (See Tables III, IV and V.)

TABLE III.—*Agricultural Production*
(In thousands of metric tons)

Product	1948–52	1953	1954	1955
Rice, paddy	9,075	10,970	11,793	11,117
Maize	1,536	1,815	2,721	1,883
Cassava	6,818	8,568	9,569	9,380
Sweet potatoes	1,750	2,176	2,112	1,866
Peanuts	283	365	448	...
Soybeans	270	306	400	410
Rubber, natural	635	706	751	746

Source: Food and Agriculture Organization, *Monthly Bulletin of Agricultural Economics and Statistics* (Rome, 1956).

TABLE IV.—*Agricultural Estate Products*
(In metric tons)

Product	1949	1950	1951	1952	1953	1954
Tea	27,269	35,384	46,513	37,277	36,778	46,900
Coffee	10,877	11,111	12,055	13,248	21,847	14,196
Palm oil	118,777	126,491	121,147	146,351	160,569	168,636
Palm kernels	29,373	30,775	29,965	38,647	42,377	43,319
Cinchona bark	6,513	5,708	9,080	3,803	1,115	1,770

Source: *Statistical Abstracts* (Djakarta, 1956).

TABLE *V.*—*Livestock*
(In thousands of head)

Livestock	1947–51	1952	1953	1954
Cattle	4,111	4,569	4,624	5,025
Sheep	2,000	2,230	2,381	2,887
Pigs	1,160	1,100		...
Horses	j60	549	593	631
Buffaloes	2,746*	2,851	2,867	2,011

*1947–50.
Source: Food and Agriculture Organization, *Monthly Bulletin of Agricultural Economics and Statistics* (Rome, 1956).

Between 1950 and 1953 timber production rose from 1,114,000 cu.m. to 1,553,000 cu.m.; that of charcoal in the same period from 36,200 tons to 61,100 tons.

Industry. — By 1951 mineral production recovered more or less its prewar level, and by 1955 the extraction of crude petroleum was 46% higher than in 1938. *(See* Table *VI.)* Between 1949 and 1953 the output of oil refineries also increased; production of motor spirit (gasoline) rose from 1,898,000 tons to 2,215,000

TABLE VI.—*Mineral Production*
[In thousands of metric tons)

Product	1938	1947	1951	1952	1953	1954	1955
Crude petroleum	7,398	1,113	7,445	8,523	10,225	10,776	11,796
Coal	1,457	223	868	969	897	894	815
Salt	91	...	481	323	268	130	46
Bauxite	245	90†	642	344‡	150	166	264
Tin concentrates*	30.2	16.2	31.5	35.6	34.3	36.4	33.8

*Metal content. †Exports. ‡Beginning 1952, dried equivalent of crude ore.

tons, of aviation spirit from 123,500 tons to 384,500 tons, of kerosene from 792,000 tons to 1,256,000 tons and of heavy oils from 3,482,000 tons to 5,700,000 tons.

While the supply of electric power was only about 10 kw.hr. per

capita in 1954, there had been an increase in generating capacity of electricity from 162.609 kw. in 1949 to 227,309 kw. in 1954. Production of electricity was 362,000,000 kw.hr. in 1948 and 812,000,000 kw.hr. in 1954. About 68% of electricity produced was for lighting and other domestic uses.

In 1954 there were 6 j weaving mills in operation (47 in 1951), and their output of cotton piece goods amounted to 46,144,000 m. (22,829,000 m. in 1951).

Foreign Trade. — Indonesia's difficulties with its trade balance began with a drastic decline in export earnings in 1952 from the 1951 level. The terms of trade fell from 104 (1950=100) in 1951 to 76 in 1953. *(See* Table VII.)

TABLE VII.—*Foreign Trade*

Item	1937	1948	1950	1951	1952	1953	1954	1955
				(In millions of rupiah)				
Imports	515	1,230	5,019	9,954	10,806	10,723	8,993	
Exports	995	1,945	6,076	9,816	10,652	9,579	9,759	10,620
				(In millions of U.S. dollars)				
Imports	283	464	440	873	948	765	629	604
Exports	548	394	800	1,292	934	840	856	932

Source: International Monetary Fund, *International Financial Statistics* (Washington, 1956).

Transport and Communications. — In 1954 the railway system in operation comprised about 6,700 km. of track of various gauges (75% in Java). The situation with regard to rolling stock, which suffered great losses during World War II and after, improved only slowly and by 1954 was still below the 1938 level. *(See* Table VIII.) In 1954 the Indonesian railways transported 125,744,000 passengers and 6.375,000 tons of freight.

TABLE VIII.—*Railway Rolling Stock*

Item	1938	1948	1950	1952	1954
Locomotives		584	809	1,004	1,063
Passenger cars		2,021	2,621	2,741	3,019
Freight cars	27,036	16,690	20,910	23,560	24,041

The highway network totalled 70,300 km., of which about 30,000 km. were in Java; about one-third of the Java network was asphalted. Between 1938 and 1954 the number of motor vehicles in use rose from 70,000 to 178,300 (60% in Java).

About 90% of interinsular sea communications was conducted by a Dutch-owned shipping company which in 1954 carried 701,148 passengers and 3,312,000 tons of goods.

The Garuda Indonesian Airways (G.I.A.) flew 47,514 hours in 1954, covering 12,392,766 km. and carrying 180,100,000 passenger-km., 5,679,000 ton-km. of cargo and 1,545,000 ton-km. of mail. Most of the routes are internal, but routes to Manila, Bangkok and Singapore are also operated by G.I.A.

Finance. — By 1956 the economy of the country was still at a transitional stage. A steady rate of growth had not been achieved and the economy was not stabilized. Both the balance of payments and the national budget were in deficit. *(See* Table IX.)

TABLE IX.—*Budget Estimates*
(In millions of rupiah)

Item	1950	1952	1953	1954
Revenue	6,414	11,334	9,707	8,451
Expenditure	7,798	17,563	12,672	13,973
Deficit	1,384	6,229	2,965	

Currency circulation, which at the end of 1948 amounted to 1,520,000,000 rupiah, was 8,820,000,000 rupiah in Dec. 1955. The new monetary unit, the rupiah, was originally at par with the Dutch florin. From March 1950 and July 1952 the official exchange rate was 3.81 rupiah per U.S. dollar. This was nominal, however, with most exchange transactions being concluded at effective rates of 11.43 rupiah per U.S. dollar. From Aug. 1952 exchange transactions were conducted at four different rates; from Sept. 1955 there were five import rates from 11.48 to 57.38 rupiah per U.S. dollar, while most exports were at the 11.36 rupiah basis. From Dec. 1951 to Dec. 1955 the gold assets of the Bank of Java shrank from $280,000,000 to $81,000,000. The foreign exchange holdings stood at $231,000,000 in Dec. 1951, fell to $67,000,000 in Dec. 1954, but by the end of 1955 recovered at $226,000,000.

The cost of living index based on 12 basic foodstuffs (July 1938=100) stood at 1,463 in March 1950 and at 3,334 in Dec. 1954.

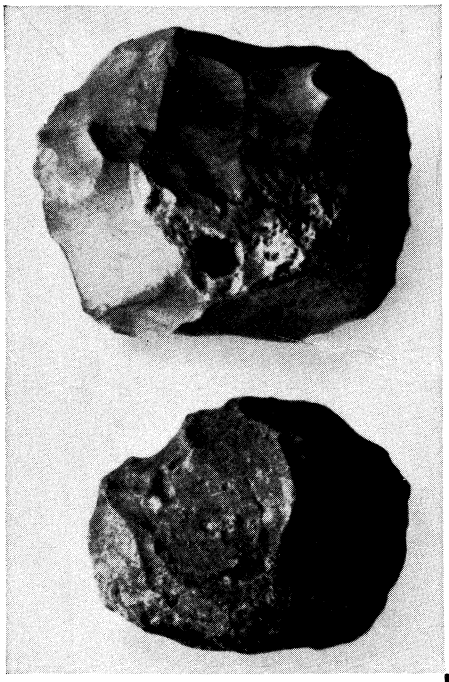
BIBLIOGRAPHY. — J. Sion, "L'Insulinde," vol. ix, pt. 2, pp. 478–504 of L. Gallois and P. Vidal de la Blache, *Géographie universelle* (1929); *B.* Schrieke, *The Effect of Western Influence on Native Civilization in the Malay Archipelago* (1929); *W.* J. Cator, *The Economic Position of the Chinese in Netherlands Indies* (1936); G. H. Bousquet, *A French View of the Netherlands Indies* (1941); J. S. Furnivall, *Netherlands Indies: A Study of Plural Economy* (1939); *J.* H. Boeke, *The Structure of Netherlands Indian Economy* (1942) and *The Evolution of the Netherlands Indies Economy* (1946); J. O. M. Broek, *Economic Developnzent of the Netherlands Indies* (1942); *H.* M. Vlekke, *Nusantara: A History of the East Indian Archipelago* (1943); Soetan Sjahrir, *Out of Exile* (New York, Toronto, 1949); H. J. van Mook, *The Stakes of Democracy in Southeast Asia* (1950); *P.* S. Gerbrandy, *Indonesia* (1950); N. A. Douwes Dekker, *Tanah Air Kita: A Book on the Country and People of Indonesia* (1951); *G.* McTurnan Kahin, *Nationalism and Revolution in Indonesia* (1952); Dorothy Woodman, *The Republic of Indonesza* (1956); United Nations, *Economic Survey of Asia and the Far East 1955* (1956). (K. So.; X.)

INDONESIAN ARCHAEOLOGY. This article deals first with the prehistoric background to the cultures of Indonesia and their relations with other cultures of the far east and southern Asia. The subsequent cultural development of certain areas is then treated, together with that of parts of mainland southeast Asia which have Indonesian affinities. The primary concern is with material culture. Reference should also be made to ARCHAEOLOGY: *China, Southeast Asia and Japan;* ASIA: *Anthropology; Ethnology.*

PREHISTORIC CULTURES

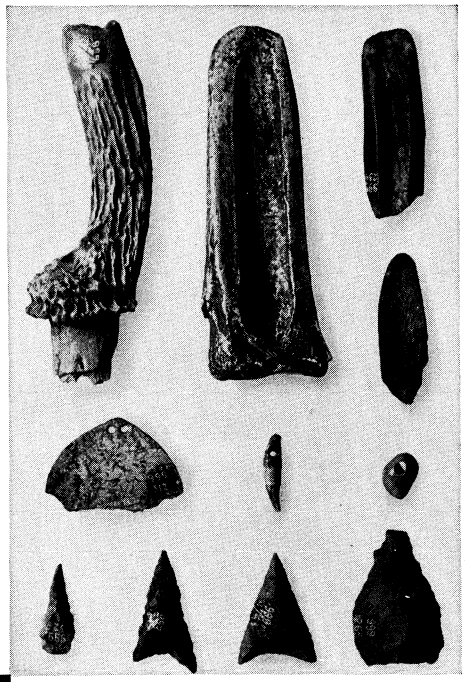
Paleolithic Cultures. — Although human remains are known from the Lower Pleistocene of Java *(Homo modjokertensis),* stone tools have not been found in contexts earlier than the later Middle Pleistocene. Even this date is to some extent conjectural since almost all the material comes from surface finds, but careful analysis of all the available evidence suggests that the bulk of the Patjitanian material (named after Patjitan in southern central Java) can be assigned to the later phases of the Middle or the earliest phases of the Upper Pleistocene. The association of this culture with *Pithecanthropus* species rests upon the assumption that, in the absence of other skeletal material, Java man was responsible for the artifacts. *(See* also MAN, EVOLUTION OF: *Pithecanthropus.)* These consist of pebble and chopping tools, flaked upon one side only, together with a certain number (about 6%) of hand axes which have been compared with those of the Madrasian culture of south India. Actually, the technique of manufacture is clearly related to that of the chopping tools and to be distinguished from the Madrasian. Related cultures are the Soan of northwest India, the Anyathian of Burma, the Tampanian of Malaya and that associated with *Sinanthropus pekinensis* at Chouk'ou'tien, China. Some evidence exists for the occurrence of a similar culture in Thailand, but in Indochina definite traces are lacking. The general homogeneity of this culture and its known distribution lends colour to the view that it is to be associated with the *Pithecanthropus-Sinanthropus* group of early man.

The Upper Pleistocene levels of the Solo river valley at Ngandong, central Java, have yielded a considerable number of skulls of *Homo soloensis.* The relation of this species to *Pithecanthropus erectus* is a matter of debate. In the same region numbers of artifacts were also found, though their diversity — they include picks made from the antlers of *Axis lydekkeri* (a Pleistocene deer), pointed bone tools and flakes, points, borers and scrapers of stone — and the imprecise nature of the reports make it difficult to decide whether these tools represent one or more cultures. Also from the Solo river is a bone harpoon with a double set of barbs. It is probable that the implements from Sangiran, which include small flakes, points and scrapers. as well as chalcedony cores, belong to the same horizon as H. *soloensis* (*i.e.,* to the Notopoero beds rather than to the Trinil horizon, as G. H. R. von Koenigswald proposed).

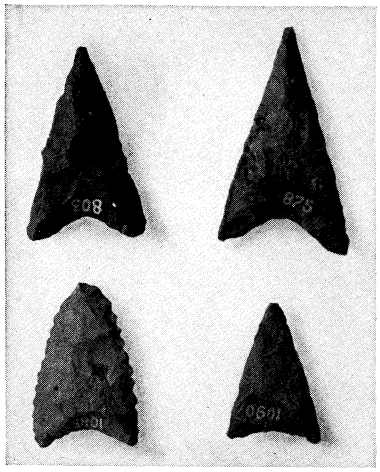


Patjitan stone choppers from south central Java. Paleolithic

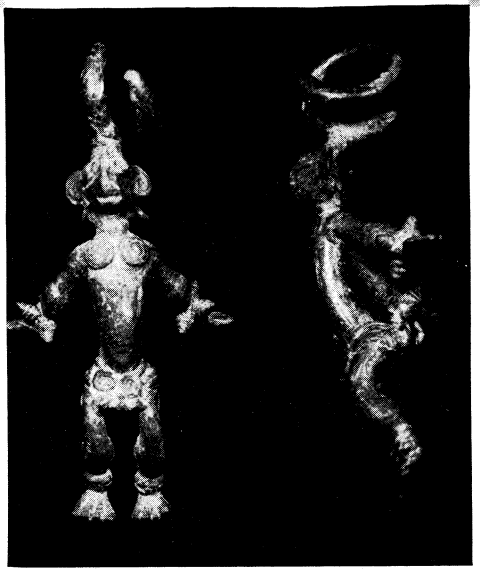
Negative hand stencil on a red background in Burung cave, south Celebes. Mesolithic



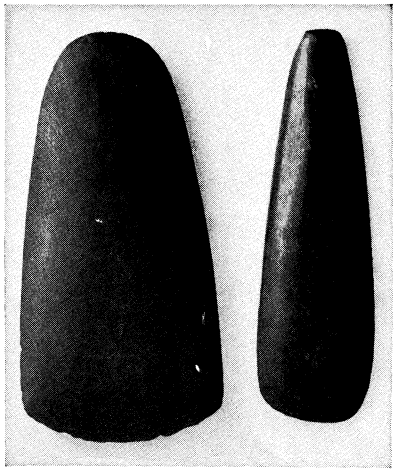
Mesolithic bone tools and Neolithic intrusive stone arrowheads from Sampang cave, Java



Winged stone arrowheads from Punung, central Java. Neolithic

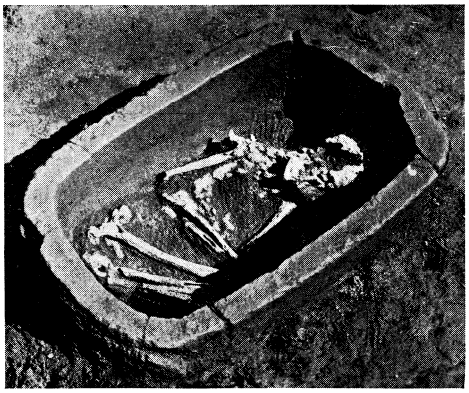


Front and side view of a bronze figurine from Bangkinang, south Sumatra. Early metal age

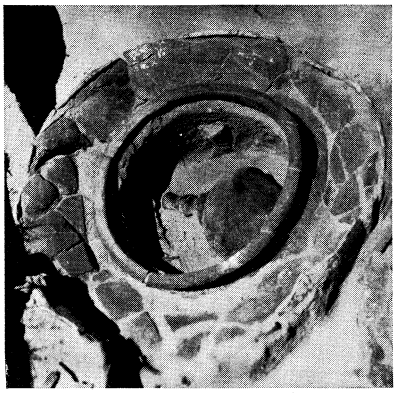


Round axes. Left, from New Guinea; right, from Celebes. Neolithic

Kettledrum from Java. Early metal age



Flexed burial in a small sarcophagus from Petang, Bali. Early metal age



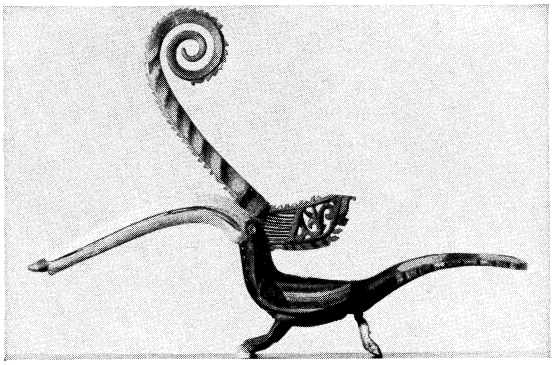
Funeral gift in urn at Melolo cemetery, east Sumba. Early metal age

ARTIFACTS AND BURIALS OF PREHISTORIC INDONESIAN CULTURES

BY COURTESY OF KONINKLIJK INSTITUUT VOOR TAAL-, LAND- EN VOLKENKUNDE

INDONESIAN ART

Balinese sculpture representing Vishnu; polychrome, height 31⅝ in.



Wooden effigy representing a hornbill, the common patron of head-hunting expeditions. Dayak, central Borneo; height 11¾ in., length 36½ in.

"Topeng" mask of central Java; polychrome wood, height 7 in.

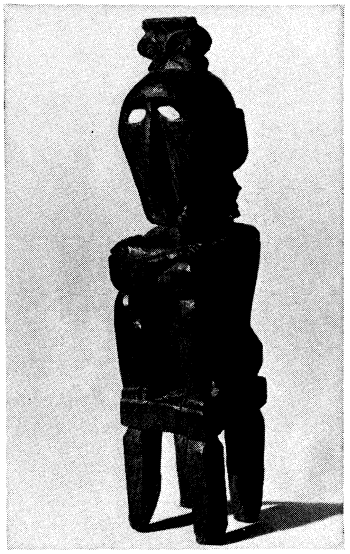
Coloured pottery jug from the Kai archipelago, southern Moluccas; height 11 in.

Bodhisattva Ksitigarbha (detail), stone carving from the Hindu period in central Java (9th century); height 15¼ in.

Red and gilt wood sacrificial box. Bali, height 13 in.

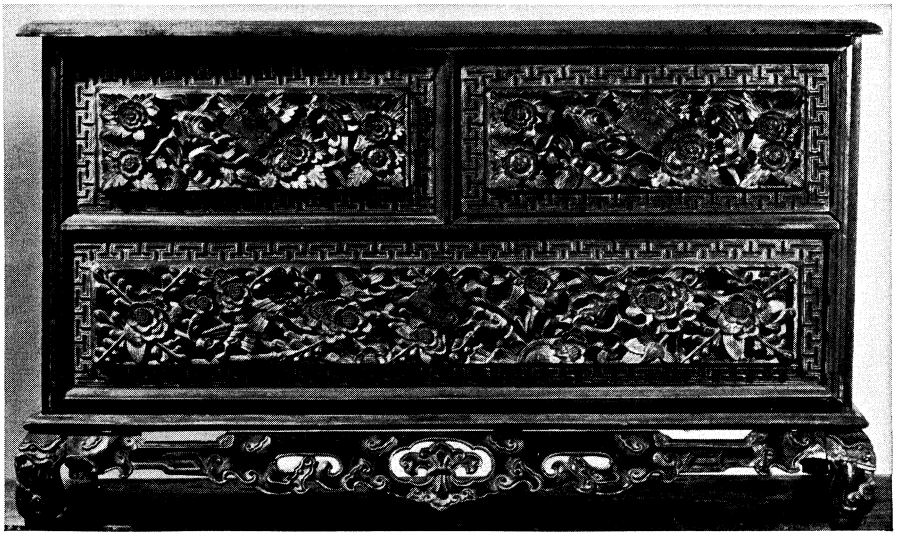
Wayang puppet representing the hero Arjuna; polychrome leather. Java, height 15 in.

Devil-mask, polychrome wood. East Java, height 14 in.



Ancestor image carved in hard wood. Tanimbar islands, southern Moluccas, height 15 in.

Mask made by the Timor-Batak people of Sumatra. Polychrome wood with black horse mane, height 15¼ in.



Polychrome wooden coffer with flowery ornaments. East Java, height 21 in., length 35⅝ in.

STONE, WOOD AND LEATHERWORK OF INDONESIA

BY COURTESY OF [ALL EXCEPT CENTRE RIGHT) ROYAL TROPICAL MUSEUM, C. T. BERTLING, AMSTERDAM, (CENTRE RIGHT) C. T. BERTLING: PHOTOGRAPHS, (ALL! R. L. MELLEMA

Later Stone Age Cultures. — In addition to the above cultures, various sites in Indonesia have yielded implements which, while morphologically paleoliths, are unquestionably of Holocene date. They have been classed as Mesolithic since they occur between the Paleolithic and the fully developed Neolithic, but the name must not be taken to imply either true transitional forms between these two readily distinguishable cultures or the typical European Mesolithic facies. However, while the forms are not transitional, they do, nevertheless, show a slow transformation as a result of Neolithic influences, presumably from the mainland. These cultures can be divided into four groups.

Hand Axes. — These are closely related to the Hoabinh-Bacson types of Indochina and the Malay peninsula. While most of the mainland forms are known from Indonesia, it is not possible to demonstrate their sequential development in the islands because of the unsatisfactory nature of the sites and the inadequacy of the archaeological reports. In north and northeast Sumatra typical hand axes occur, both as surface finds and in shell mounds; these are waterworn pebbles, generally worked upon one side only, and usually of oval shape, though leaf forms also occur. The *hache* courte, a transversely cut hand ax with a straight butt, a typical Hoabinh form, is also known, together with roughly chipped pebble tools, pounders, grinding stones and ruddle. The Hoabinh hache courte is also known from west Java and from an east Javanese rock shelter. The later, "proto-Neolithic," hand ax, with ground edge, which represents the final Hoabinh-Bacson stage, is also found in Java and Sumatra, and it seems probable that this represents a later cultural influence rather than a local evolution. It has been reported that all the stages are also found in the Philippines, Borneo and Celebes.

Flake Cultures. — Knives, points and scrapers are known from two caves in east Java which have also yielded bone tools. Another find of the same type is from Roti, off Timor. Both these groups are comparable with the so-called "proto-Toalian" of Celebes where they are widespread, sometimes in association with shell mounds. The subsequent Toalian culture includes, in addition to proto-Toalian types, Neolithic forms, notably arrowheads. some of which have serrated edges. In Timor the finds include tanged spearheads in jasper and chalcedony, as well as pottery. The relation between these objects and the rest of the material is not clear. It is likely that the whole represents a typical complex of survivals in a relict area.

Microliths. — Three sites in central Sumatra (two caves and a surface find near Lake Kerintji) have yielded cultures with scrapers, knives and points in obsidian; similar finds are known from Bandung, west Java. The latter sites, and that in the vicinity of Kerintji, have produced a number of microlithic forms, those from Bandung including typical geometric forms apparently comparable with western microlithic cultures. R. von Heine-Geldern has claimed, against the majority of the Dutch prehistorians, that these cultures are pre-Neolithic, but it is doubtful whether, on the present evidence, any firm conclusions as to date can be properly made. The same observation is applicable to their relation to the Capsian and Tardenoisian of Eurafrica, while an analysis of their Indian affinities has yet to be made.

Cave cultures *of* East Java. — The situation obtaining in Guwa Lawa, near Sampang, east Java, is illustrative of the complexity of Indonesian prehistory. There the lowest stratum has winged Neolithic arrowheads, while the succeeding level contains bone, deer-horn and shell implements, which in their turn are succeeded by a layer with fully developed neoliths. The middle stratum contains awls, spatulas and adzes of bone, horn tools and shell scrapers; there are no stone tools. In isolation it would almost certainly be described as Mesolithic, but the context must require a Neolithic analysis. Typically, a neighbouring site, Bodjonegoro, like those of Tuban, yields the range of the three strata of Guwa Lawa, but all in a single level.

Neolithic Cultures. — In the absence of adequate excavations and research, it is possible to analyze the Neolithic in typological terms only. So far, it seems that there are four main types.

Grooved Axes. — These are found in association with developed Mesolithic chipped hand axes and mat-marked pottery. While traces of these tools have been widely found in Indonesia, it is not yet possible to assess their distribution and importance.

Round-Ax Culture. — This culture is characterized by the occurrence of axes of oval or lenticular cross section and pointed or rounded butts. Their distribution includes the Philippines, Moluccas, Timor and the eastern islands, Celebes and Borneo, with outlying elements in Malaya, where they are rare, and a restricted region of northeast Sumatra. This seems to point to a route through Formosa and the Philippines, the outliers being an offshoot from Borneo.

Quadrangular Adzes. — Throughout Indonesia, with the exception of a few of the smaller islands and the northern half of Sumatra, are found adzes of a rectangular (more rarely trapezoid or square) cross section. These are also known from China, Laos, Thailand and the Malay peninsula. The finest specimens, in terms of workmanship, are those from Java and southern Sumatra, where the existence of numerous examples in such semiprecious stones as agate, jasper and chalcedony suggests that this type had become an object of esteem rather than a purely functional tool or weapon. If these are taken to be the end product, as the evidence suggests, it is clear that they have reached Java from elsewhere, while their uidespread distribution might indicate that they accompanied a major ethnic movement. The very large number of these adzes in Java suggests a considerable population, while the thousands of unfinished specimens in restricted localities indicate a high degree of industrialization in factory sites of considerable size.

Shouldered and Stepped Adzes. — These types, known at present only from northeast Borneo and Celebes, appear to be related to the preceding, though with Bacson elements. These latter are exemplified by crude tanged axes. The later phase shows developed shouldered neoliths and stepped adzes in which the butt is thinned as the result of the removal of the back of the upper side to make a stop ridge at right angles to the longitudinal axis.

Bronze Age. — Various elements appear to have contributed to the Bronze Age of Indonesia — socketed celts, which can be traced throughout Eurasia, ceremonial "halberds" (west Java), decorated axes with cast handles as well as blades (Roti) and the characteristic drums of the Dong-son culture. At present there is no satisfactory evidence to distinguish these various components chronologically, and only the Dong-son element seems native to southeast Asia, though the "halberds" and Roti axes may be evolved forms of this last. Some of the typical drums were imported, but the discovery of part of a stone mold in Bali provides evidence for local manufacture. There does not seem to have been a full Iron Age in Indonesia, probably because more sophisticated cultures reached the area before it could deveiop, but the practice of burial in stone cists, sarcophagi or urns seems to belong to the later Bronze-Iron period, at a time when stronger Indian and Chinese influences were beginning to appear. In eastern Java, at least, this tradition persists until the European middle ages. Beads testify to the presence of Greco-Roman trade goods, as well as to Chinese influences. The latter are more definitely attested by the vigorous Pasemah culture of south Sumatra. The dynamic stone reliefs of men and animals, riders, fighters with beasts, warriors with typical Bronze Age weapons and drums, are stylistically close to certain early Han sepulchral monuments, and Han pottery is found in the larger Indonesian islands. Some remarkable wall paintings have survived in Pasemah on the cist walls.

Prehistory: General Survey. — During the Pleistocene period Indonesia shows clear relations with other countries of eastern Asia. Both the implements and the skeletal material have affines in a wide area from India to China. There is some evidence for a development in Indonesia of a cultural pattern with a distinctive ethnic component from its beginnings with Pithecanthropus species. The Holocene saw the commencement of new cultural influences from the mainland, especially Hoabinh-Bacson elements arriving probably at various times. The relationship between this culture and the "proto-Toalian," Toalian and microlithic cultures is obscure, but it is probable that, whatever their origins, evolved "Paleolithic," flake, bone microlithic and proto-Neolithic cultures existed and persisted side by side in the islands, many surviving in relict areas until well into historical times. Racially, too, there

appears to have been a mixture of Papuan-Melanesians, Indonesians. Australoids and possibly survivors from an evolved element of basic pithecanthropoid stock. As is the case throughout Indonesian history, both the Malay peninsula and the Formosa-Philippine routes seem to have provided a way of access to Indonesia.

During the Neolithic period these same routes contributed new elements to Indonesia. The round-ax culture came via Formosa, while the quadrangular-ax culture followed the peninsula, almost certainly with peoples who spoke Indonesian languages and who brought with them many of the surviving cultural traits of Indonesia — outrigger boats, wet rice cultivation, cattle and pig rearing, bark cloth manufacture and the megalithic burial tradition. Heine-Geldern wished to date this period to 2 joo–I 500 B.C. These peoples were ancestral, both ethnically and culturally, to present-day Indonesia. Later, in the last few centuries B.C., the Bronze Age cultures of the mainland began to influence Indonesia, their bearers being in part later successors to the quadrangular-ax people, perhaps the Yueh of the Chinese texts. There is little evidence to substantiate Neine-Geldern's hypothesis of Thraco-Cimmerian influences.

Nor does the matter rest there, for while Indonesia, or at least the greater part of it, came under Indochinese influences, the cultures discussed above spread into Australasia and Oceania where many of them survive long after their disappearance in the Indonesian islands. Round axes persist in New Guinea and Melanesia; the quadrangular axes accompanied the Polynesians; Hoabinh-Bacson hand axes and "proto-Toalian" flakes reached Australia; stepped and shouldered adzes from the Philippines and Celebes are paralleled by those of eastern Polynesia and New Zealand.

The Bronze Age cultures of Indonesia penetrated northern New Guinea and survive in the decorative arts of Oceania as far as the Solomons.

CULTURES IN HISTORIC TIMES

Indonesia and the Mainland: Later Developments. — While the Pleistocene cultures of eastern Asia show a marked homogeneity, which persisted in part through the later Stone Age period and in some aspects of the Bronze Age, a divergence set in during this later period which grew as time went on. The northern areas of Indochina came under strong Chinese influence, while Indian cultures overlaid the rest of southeast Asia, modified by the cultural patterns which had already been established there in the last few centuries B.C. Some aspects of this development are noted below; *see* also CAMBODIA: *Archaeology;* EMBROIDERY; INDIAN ARCHITECTURE; INDIAN ART; JAVA: *Archaeology;* and TEXTILES.

Borneo, Celebes, Sumatra. — While the main evidence for the interaction of Indian and Indonesian culture is to be found in Java, the relatively less-explored areas of the other islands have also yielded data for the cultural historian. Thus there are early, in terms of countries outside India, Buddhist images from Sampaga (Celebes) and Seguntang (south Sumatra) and one of rather later date from east Borneo, where there are also inscriptions from the beginning of the 5th century A.D. in Sanskrit. The earliest Buddha images belong to the so-called Amaravati school, but may in fact be from Ceylon. Numbers of Brahmanical and Buddhist images are also known from eastern Borneo which seem to be related to central Javanese art of the 7th to 10th centuries. At later periods the Chinese appear to have exploited the resources of Borneo, more especially the iron ores, and have left vast quantities of pottery as evidence of their visits. (Collecting of Chinese art objects, particularly ceramics, is still characteristic of many of the peoples of Borneo.) It has been argued by a number of scholars that many of the patterns still surviving in this island are relics of the Dongson culture of mainland Indochina. In Sumatra, after the Stone Age cultures of which mention has already been made and of which some traits at least survive in the peripheral islands, notably Nias, a markedly Indianized culture developed which is connected with the kingdom of Srivijaya. Remains in the vicinity of Palembang probably belong to this epoch. These include a more than life-sized statue of Avalokiteshvara in stone, and three very fine bronzes, a Buddha, a Maitreya and another Avalokiteshvara of central Javanese type. There are also four inscriptions in Old Malay, with a considerable Sanskrit admixture, which are the earliest record of the Malay language. Three of these are dated, in the Saka era, A D 683, 684 and 686. Other finds are from the vicinity of Djambi (7th-10th century) and a fine bronze group dates from AD. 1024 and records the artist's name, an unusual event. Buildings include the Muaratukas group (?12th century), Padanglawas (?13th century), apparently a Tantric centre, and Tandjungmedang. The use of brick rather than stone is a distinctive feature of Sumatran as opposed to Javanese building.

Burma. — The Paleolithic cultures of Burma belong to the general eastern Asian complex. There is no evidence of Dong-son influence in the archaeology, but one or two references in T'ang Chinese texts suggest that at least some of the musical instruments of the 8th century survived from this culture. The earliest relics of historical Burma which we possess are the finds from Hmawza, near Prome, and Halingyi, Shwebo, which are assigned to the Pyu, a Tibeto-Burman people who occupied parts of central and upper Burma during the 5th-8th centuries. The material includes terracotta plaques, some Indian and some native, statuary and reliefs which show considerable skill in carving. and some notable metalwork. To the south of the Pyu were probably outlying groups of the Mons of the lower Menam valley and possibly settlements of Indian traders from the east coast ports. So far little is known of their archaeology, but the few pieces found show even greater affinities with their Indian originals than is the case with the Pyu remains. A survival from the earlier period of Burmese protohistory is probably to be seen in the habit of burials in stone urns, some of which bear inscriptions in the Pyu language.

At a later epoch, the Pagan period, there developed a great efflorescence of building, almost entirely religious in character. Here the sources are diverse, though mainly Indian. Much has survived in a fair state of preservation and demonstrates the skill of the masons, carvers and mural painters. Both buildings and statuary show much dependence upon India, mostly the eastern areas, while the murals derive from Bengal and Nepal, though there are also parallels with the Jain works of the Gujarati school. The most notable buildings are the Ananda, Myazedi, Thatbinnyu and Mingalazedi pagodas. In addition to carving and painting, Burmese decorative techniques included the use of glazed sandstone, in green, and glazed terra-cotta bricks. Some of these bore Jataka (*q.v.*) stories. The relief sculpture is often very fine, notably the 81 panels, telling part of the Buddha's life story, in the Ananda and the splendid Brahmanical reliefs of the Nan-paya. Little of the sculpture other than figures of deities has survived, but statues of Shin Arahan and King Kyanzittha suggest that the image maker was capable of high-quality creative work.

It seems likely, however, that it was in wood that the Burmese artist achieved his real masterpieces. Little survives from the earlier periods, but the monasteries of Mandalay and Amarapura testify to the skill of the wood carvers working in a truly Burmese tradition. Other arts of Burma include silverware, glass mosaics and the famous Burmese lacquer wares. These were, and still are, used for the adornment of buildings and for the construction of smaller objects of everyday use. The craft, Chinese in origin, probably came to Burma through the Shan states. The earliest specimens date from the Pagan period.

It is notable that there does not seem to have been a culture as strong as that of the Indonesian which could markedly adapt and modify foreign influences in Burma. Thus the Burmans themselves, relatively late arrivals in southeast Asia, seem at best to have utilized Indian and to some extent Chinese originals and to have found little else which can be claimed as a native tradition. Thus one does not find, as in Java, a recrudescence of indigenous culture as Indian direct influences wane, unless the later emphasis upon woodwork may be claimed as such.

Champa. — Linguistically the Chams appear to be related to the speakers of Indonesian languages and, if this is correct, they must represent the last main group of these people to establish a major cultural group on the mainland of southeast Asia. The archaeology of Champa is not adequate to give an account of the earlier phases of Cham culture, but a certain amount of information can

be gained from Chinese sources (cf. R. A. Stein; see bibliography). At the beginning of the Christian era they seem to have occupied a position in the vicinity of the Tongking delta and to have been forced south by pressure from the Annamites moving southward. Indian influence seems to have been a powerful factor in the formation of the classic Cham culture, and it is not surprising that the earliest evidence from Champa is the Dong-duong Buddha which belongs to the same school as those of Sempaga and elsewhere in southeast Asia. The first monuments belong to the 7th century A.D. (*e.g.*, temple E.1, Mi-son) and the last phase is represented by the temples of Po Klaung Garai and Po Rome. which can be dated to the 14th-15th centuries. This means that the Cham period is probably rather longer than that of the better-known Khmer of Cambodia, and it probably never achieved the greatness of the Khmer civilization at its apogee. The greatest period of Cham material achievement was during the 7th-9th centuries when the capital was in the neighbourhood of Trakieu, a period to which belong the main groups of Mi-son and Dong-duong. A series of Annamite attacks toward the end of the 10th century led to the transfer of the capital farther south to Quinhon where further building took place, as witness the remains of Hung Tanh and others, but the decline can already be detected. The final collapse of the Chams came in the 15th century, by which time the decline had reached its nadir.

There can be little doubt that the earliest phases of Cambodian monumental architecture owe something to the Chams, but whereas the Khmer builders proceeded to develop the single tower (prasat) into the familiar temple complex, the Chams persisted with the kalan (tower) as their principal architectural feature, nor did they often try, so far as it is possible to judge, to group their single towers into symmetrical patterns. A feature of Cham architecture which distinguishes it from that of the Khmers is their continuing use of bricks as the preferred building material. Nor do they appear to use wood so readily as their western neighbours. The complex, pyramidal base which forms so marked a feature of Khmer architecture would seem to be unknown in Champa. The earlier buildings are noteworthy for the use of sculpture as an integral part of the structure—*e.g.*, apsarases upon the corners of buildings and an ambitious treatment of the foot of the building—and the Cham decline is, in part, marked by the substitution of terra-cotta moldings for these features, as though there was a shortage of skilled craftsmen in the later stages of the kingdom.

Whatever was subject to Indian influences in Champa does not seem to have been recognizably Indonesian; Cham art at its best is sui generis. For although there is little that does not belong to India in its origin, the treatment is distinctive and, in the period of Cham greatness, of considerable aesthetic merit. The handling of movement, in the case of some of the dancing figures, or of repose in the case of ascetics, is skillful and impressive, but with the general decline of Cham culture stereotypes are substituted for creative work.

Malaya. — The Tampanian culture of the Paleolithic in Malaya belongs to the general eastern Asian group to which reference has already been made. During the later stages of prehistory, Malaya exhibits the same main features of cultural development as the rest of southeast Asia, and serves, above all, as one of the principal routes into Indonesia. This characteristic, as a transit zone, persists into historic times. While there is evidence in Chinese texts of settlements, presumably from India, in the peninsula from the beginning of the Christian era, archaeological evidence is scanty until the 7th-8th century. Certain pieces in Gupta style, and a few others which are reminiscent of Kanheri, together with a few inscriptions which are difficult to date epigraphically, form the greater part of the evidence. In the 8th century a style develops which may be called Indo-Malaysian, and which seems to be connected with the rise of the kingdom of Srivijaya with its capital in Sumatra, probably at Palembang. The origins of this style, which is concerned with Mahayana Buddhist imagery, are a matter for debate, but it is likely that they are basically eastern Indian. A splendid Avalokiteshvara from Jaya, now in the Bangkok museum, and the plan of Wat Keo at Jaya both suggest Javanese influences. Other finds are reminiscent of the earliest stages of Cambodian (almost certainly pre-Khmer) statuary, and in the north of the peninsula, Khmer and Mon influences are to be seen. It seems likely that during most of the pre-European period Malaya's importance was "strategic" rather than cultural, in the sense that it was an area of marked and distinctive cultural development.

Thailand. — The prehistory of Thailand has never been satisfactorily studied but after a Paleolithic stage, at present almost unknown, it is possible to detect three phases of the later Stone Age, consisting of crudely chipped tools, tools chipped into regular shapes and ground tools. There is little or no evidence to enable these phases to be differentiated chronologically, and it must be admitted that they give the impression of representing three cultural groups rather than three periods in time. The problem which confronts the prehistorian in southeast Asia is always one of trying to decide when morphological distinctions represent differences of time, when differences of culture. Nor is anything known of the Bronze Age of Thailand, so that its archaeological history begins in fact with the development of historical cultures, though these are unconnected uith the country's eponymous people who are late-comers into southeast Asia. The first period, known as Dvaravati, is generally considered to be due to the Mons, who occupied the Menam delta in about the 5th century A.D. The relation between this people and the Khmer, with whom they are usually associated, is by no means clear, but it is certain that they occupied at one time a very considerable area of southern mainland southeast Asia. Little or no archaeological evidence is available for the earliest Mon period or for that of their immediate predecessors, though air photographs reveal sites which may perhaps belong to the kingdom of Funan or its vassals. (See CAMBODIA.) The earliest remains are those of P'ong Tuk, where, in addition to structural foundations, a Greco-Roman lamp was found which appears to belong to the and century A.D. There was also a fine bronze Buddha which some scholars hold to be another of the Arnaravati school, of which a specimen is known from Korat, but in fact is almost certainly Gupta. The finds from Prapathom and Lopburi are certainly of the Dvaravati school, and include both Buddhist and Hindu images, which parallel those of the pre-Khmer period of Cambodia and are related stylistically to the Gupta art of India. This style, with some local development, persists until the 11th century when Khmer influences begin to take the place of Indo-Mon. The Dvaravati style has no obvious connection with that of contemporary Indonesia. The material is usually limestone, in contrast with the Khmer preference for sandstone which comes into use in Thailand with the setting up of a Khmer kingdom at Lopburi. The art of this period is unmistakably Khmer, but in the north the Thai were beginning to establish small principalities whence, in the 13th century, they expanded southward to establish sway over the central areas of modern Thailand. The Sukhothai school of sculpture is the beginning of true Siamese art and shows an interesting blend of various elements. Technical skill from the Khmer was applied to certain Dvaravati traditions, which still survived, though in attenuated forms, among the Mons of the south. To these were added fresh inspirations from Ceylon, so that by a process of what seems to have been deliberate selection the Thai evolved a characteristic art style well suited to their native abilities and taste. The rapid expansion of the northern kingdom led to a rapid dissemination of this new formula throughout the Menam valley, its development being shown by the two schools of U Thong, difficult to date and probably less homogeneous than the convenient label might suggest, and of Ayutthaya; the former is perhaps 14th century, the latter about 100 years later. Contemporary with the Ayutthaya school is that of Lan-na in the north, formerly known as early and late Chiengsen, which shows an independent development, based on the style of the Mon (Dvaravati) kingdom of Lamphun and strongly influenced by Sukhothai. Ayutthaya fell into decline. apparently largely as a result of overproduction, but at its height it was a centre of amazing virtuosity and enterprise. with considerable technical skill, as witness the colossal bronze Buddha figures, among the largest in the world. After the sacking of Ayutthaya (*q.v.*) by the Burmese in 1767, the culmination of long Burmo-Siamese wars, the capital and the art centre shifted to Bangkok, but the great days of Thai sculpture were over,

though the minor arts, lacquer, inlay, mural painting, weaving and embroidery, continued to flourish. Painting in particular, descended from a long Indian tradition which goes back to Ajanta and Sigiriya and owes something to Pagan, shows a most lively charm and a timelessness without anachronism so that tradition and modernity are happily combined and the royal palace of the Buddha's father is that of a Siamese king with sentries carrying rifles on guard. The Thai ceramic tradition owes almost everything to China and much of the ware was made there for export, but kilns were established in central Thailand at Sukhothai and Sawankalok where native skills developed a distinctive and charming tradition which persisted to the 19th century.

BIBLIOGRAPHY.—*Prehistory: Bulletin of the Raffles Museum,* series *B,* vol. i (1936–37); *Hommage du service archéologique des Indes Néerlandaises au premier congrès des pre'historiens d'Extrême-Orient à Hanoi* (1932); *Proceedings of the Third Congress of Prehistorians of the Far East* (1940); "Koninklijk Bataviaasch Genootschap van Kunsten en Wetenschappen," *Catalogus der Praehistorische Verzameling* (1941); R. von Heine-Geldern, "Urheimat und friiheste Wanderungen der Austronesier," *Anthuopos,* vol. xxvii, with bibliography (1932), "Prehistoric Research in the Netherlands Indies" in *Science and Scientists in the Netherlands Indies,* ed. by P. Honig and F. Verdoorn, with bibliography (1945), "Vorgeschichte Grundlagen der Kolonial-indischen Kunst," *Wiener Beitr. zur Kunst und Kulturgeschichte Asiens* (1934); A. T. van der Hoop, "De Praehistorie," *Geschiedenis van Nederlandsch-Indie,* ed. by *F.* W. Stapel, vol. i, with bibliography (1938), *Megalithic Remains in South Sumatra* (1932); W. Kaudern, *Megalithic Finds in Cent?-a1 Celebes* **(1938)**; A. **H.** Christie, *Early Man in Eastern Asia* (1956); *H.* De Terra and H. L. Movius, "Research on Early Man in Burma . . . Pleistocene Geology and Early Man in Java," *Trans. Am. Phil. Soc.* (1943); H. L. Movius, "The Lower Palaeolithic Cultures of Southern and Eastern Asia," *Trans. Am. Phil. Soc.* (1949).

General: A. *K.* Coomaraswamy, *History of Indian and Indonesian Art* (1927); *B.* Rowland, *The Art and Architecture of India,* pp. 209–70 and bibliography (1953); H. R. Zimmer, *The Art of Indian Asia* (1955).

Burma: C. Duroiselle, articles in *Archaeological Survey of India, Annual Reports* (1904 *et seq.*); *T.* S. Ko, "Archaeological Notes on Pagan," *ibid.* (1917), "Mandalay," *ibid.* (1924); N. R. Ray, *Brahmanical Gods in Burma* (1932); A. Grünwedel, *Buddhistische Studien* **(1897)**; E. Huber, "Les Bas-reliefs du temple d'Ananda à Pagan," *Bulletin de l'Ecole Française d'Extréme-Orient,* vol. xi (1911); A. H. Christie, "Burmese Arts and Crafts: an Historical Survey," *Burma* (1956), *Burmese Music* (1956).

Champa: E. Lunet de Lajonquière, *Atlas arche'ologique de l'Indo-Chine* (1901); *H.* Parmentier, "Les Monuments du cirque de Mi-son," *Bull. E.F.E.O.* (1904), *Inventaire descriptif des monuments, čams de l'Annam* (1909–18), "Les Sculptures chames du Musée de Tourane," *Ars Asiatica,* vol. iv (1923); J. Leuba, *Les Chants et leur art, etc.* (1923).

Sumatra and Malaysia: G. Ferrand, "L'Empire sumatranais de Srīvijaya," *Journal Asiatique* **(1922)**; *H.* Quaritch Wales, "A Newly Explored Route of Ancient Indian Cultural Expansion," *Indian Art and Letters,* vol. xi (1935); E. M. Loeb and R. von Heine-Geldern, *Sumatra* (1935); F. M. Schnitger, *The Archaeology of Hindoo Sumatra* (1937); *R.* A. Stein, "Le Lin-yi," *Han-Hiue,* ii, 1–3 (1947).

Siam: L. Fournereau, *Le Siam ancien,* 2 vol. **(1895,** 1908); A. Salmony. *Sculpture in Siam* (1925); **J.** Y. Claeys, *L'Archéologie du Siam* (1931); C. S. Doehring (ed.), *Art and Industry in Siam,* 2 vol. (1925); C. **R.** Le May, *A Concise History of Buddhist Art in Siam* (1938); *A.* B. Griswold, "The Buddhas of Sukhodaya," *Archives of the Chinese Art Society of America* (1953); P. Dupont, "Art de Dvaravati et art Khmer," *Revue des Arts Asiatiques,* vol. ix, and various articles in *Bull. E.F.E.O.;* H. R. von Heekercn, "Prehistoric Discoveries in Siam," *Proc. Prehist. Soc.,* vol. xiv **(1948).**

(A. **H.** CE.)

INDONESIAN ART. The peoples of the Indonesian archipelago exhibit a rich diversity of old Malay cultural forms. The more original forms have been most purely preserved in the remoter islands and in the mountainous interior of Sumatra, Borneo and Celebes, but there are marked traditional differences in style. In south Sumatra) Java and Bali, however, artistic forms since the 7th century have been influenced by the cultures of south Asia through political interference and the penetration of Hindu doctrines. The "grand style" of Indian architecture and sculpture overgrew the indigenous folk art and, according to modern archaeologists, Indonesian architects and artists must have received their training in India. On the other hand, this advanced culture from the mainland had been developed from mythological conceptions that were also common in Indonesia, and basic symbols such as the tree of life or the ship of death are repeatedly found.

For the Indonesian the artistic criterion is less aesthetic decoration than the potential magic of the ideal shape, but the symmetrical decoration of textures and the definite shape of specific objects strive for beauty while determining the magical value.

Ancestral figures hewn from stone are to be found on the island of Nias, in the Batak districts, in west and central Java, in north Celebes (Minahasa) and in the Timor archipelago, but examples of wood sculpture are more numerous wherever the Islamic religion (which forbids the portrayal of human beings) is not professed by the people. Characteristic is the rendering of the human figure in a squatting position (the usual position of rest among Indonesians). The inhabitants of Nias are not only admirable architects but excel at making impressive wooden ancestor images in an individual style and sometimes of considerable size. The wood sculpture of the Batak (northwest Sumatra) is impressive in its rendering of the human figure in the upper figures of the sorcerer's staff, symbolizing a tree reaching from the underworld into the upperworld. Finally, in the most easterly islands (Leti, Tanimbar and Kai) there are idols, usually of small dimensions but carefully carved out of extremely hard wood, which are carried as fetishes on lengthy sea voyages.

The oldest people on Celebes, the Toradjas, have a high reputation for weaving, in which they employ a complicated dyeing technique. Into their magnificent ceremonial ikat cloths the women weave human figures representing their ancestors, normally in red. black and white. The same technique is found among the inhabitants of the islands of Timor. Sumba and Sanu. Such cloths (in which the dead are often wrapped) are supposed to have a magical and favourable influence on descendants.

In Indonesia noven material is the symbol of woman and has its complement in the masculine symbol, the dagger or creese (kris). In the exchange of presents preparatory to an exogamous marriage, *e.g.,* among the Batak, the creese and the cloth represent the bridegroom's and the bride's clans respectively and the exchdnge is designed to preserve the cosmic balance. It has indeed been argued that the original function of the creese could have been that of a totemistic clan emblem. Such conceptions, directed at the continuation of the existing order and wealth, must have stimulated Indonesian art and, in particular, have caused the high standard of the goldsmith's art.

Masks, too, have a dynamic function. They hide the wearer's personality in order to express some supernatural idea or power, and in this way impending disasters are given a demonic shape that can be exorcized by the sorcerer. Masks used by Toba- and Timor-Batak tribes at their funeral feasts are dark and threatening; the Dayak masks on the other hand, of white overlaid with black and red spirals, recall lurid skeletons, and dancers wearing them represent evil spirits threatening the harvest after the planting of the rice. On Bali the archaic and the civilized forms exist together. Great care is taken in making the masks expressive artistic objects: in the Batak highlands the priest performed this task in the secl'usion of the forest and the masks, to which sacrifices were made, were carefully preserved. Sometimes, *e* g., among the Dayaks of central Borneo, the head-hunters' wooden shields served as magical masks in which a stylized monster's head was a central figure in the traditional decoration. The motif is similar to that on certain ancient bronze shields from southern China and is found again in the Balinese play dealing with the magical contest between the Barong (tutelary spirit of the Balinese village) and the Rangda (personification of evil).

The Javanese shadow play. which is at least 1,000 years old (and was also originally designed to ward off evil), is an art form by itself. Both the technique of employing dolls cut from leather and its meaning can be traced to an old Javanese theme: the initiation preparatory to the marriage of the mythical forebears of the Javanese people. The audience witnesses the ordeals endured by their old national hero, Pandji, before he attained to full maturity of body and spirit, and this explains why this classic drama has to be acted whenever Javanese villages are threatened by disaster or smitten by hardship. This shadow play has retained its original magical function.

It is difficult to differentiate clearly between expressionistic magic and purely decorative art. Cosmic symbols for heaven and earth are used as decorative motifs in wood, silver or bronze and woven into cloths. Pottery, cloths, bamboo containers, basketwork

and beaded headbands are often decorated with geometrical figures that can be derived from more sacred emblems. Painting alone was almost entirely used for the decorating of ships and dwellings, but on Bali the influence of Hindu myth had led at an early stage to the development of a magical tantric art of painting on canvas, showing high skill and taste in its conservative style. The amazing development and flourishing of art and handicraft on Bali was certainly helped by its geographic location and by the particular history of the people, but most of all by the innate sensibility to the great symbols and the delicate intelligence of the Balinese people.

BIBLIOGRAPHY.—A. N J. Thomassen à Thuessink van der Hoop, *Indonesian Ornamental Design* (1949); M. Covarrubias, *Island of Bali* (1942); *R.* L. Mellema, *Wayang Puppets* (1953); J. H. Jager Gerlings, *Sprekende weefsels* (1952). (C. T. BG.)

INDONESIAN LANGUAGE: *see* MALAYO-POLYNESIAN LANGUAGES.

INDONESIAN TIMOR (TIMOR RARAT): *see* TIMOR.

INDORE, a city and district of Madhya Pradesh, India; the district was formerly one of the five into which the princely state of Holkar or Indore (Central India agency) was divided. The city of Indore (pop., 1951, 310,859) is 1,738 ft. above sea level on the Saraswati river, near its junction with the Khan. It was the capital of the former princely state and is now the summer capital of Madhya Bharat. One of the most important trading centres in central India, it has flourishing cotton mills. Daly college, a fine marble building. is for the education of young noblemen; the Christian college, Holkar college and Mahatma Gandhi Memorial medical college are all affiliated to Agra university.

The DISTRICT OF INDORE had a population in 1951 of 596.622. The former princely state had an area of 9,934 sq.mi. and a population (1941) of 1,513,966. The difference in population between the territories now and formerly bearing the name Indore is accounted for by the detachment and separate absorption of the former princely state's four other districts—Nimar (pop., 1951, 758.694). Mehidpur. Nemawar and Garoth (Rampura-Bhanpura).

The territory of HOLKAR or INDORE STATE, like that of most other princely states in central India, was not homogeneous. The largest tract of territory ran south from the Vindhya hills (in which Indore city is situated) across the Narbada river to the Satpura range. This. with the large, isolated Nemawar tract to the east and three smaller areas to the west, constituted the southern division of the state (Indore, Nimar and Nemawar districts). North of the Vindhyas the detached Mehidpur and Garoth tracts and three smaller areas formed the northern division (Mehidpur and Rampura-Bhanpura districts).

The state had its origin in an assignment of lands made early in the 18th century to Malhar Rao Holkar, a peasant's son who worked his way up to a cavalry command in the army of the Maratha peshwa. Of the Dhangar or shepherd caste, he was born in 1694 at the village of Hol near Poona, and from this circumstance the family derives its surname of Holkar. Before his death in 1766 Malhar Rao had added to his assignment large territorial possessions acquired by his armed power during the confusion of the period. By the end of that century the rulership had passed to another leader of the same clan, Tukoji Holkar, whose son, Jaswant Rao, took an important part in the contest for predominance in the Maratha confederation. At first he defeated a British force that had marched against him under Col. William Monson; but when he made an inroad into British territory he was completely defeated by Lord Lake in 1804 and compelled to sign a treaty which deprived him of a large portion of his possessions. In 1818, by the treaty of Mandasor, the state transferred to the British government its suzerainty over a number of minor tributary states and acknowledged the British protectorate. For many years afterward the administration of the Holkar princes was troubled by internal quarrels, misrule and dynastic contentions, necessitating the frequent interposition of British authority; and in 1857 the army, breaking anay from the chief's control, besieged the British residency. In 1899 a British resident was appointed and changes were made in the system of administration. On June 15, 1948, Indore was merged into the United States of Gwalior, Indore and Malwa (Madhya Bharat).

INDORSEMENT or ENDORSEMENT, anything written or printed on the back of a document. In its technical sense, it is the writing upon a bill of exchange. check, or other negotiable instrument by one who has a right to the instrument and who thereby transmits the right and incurs certain liabilities. In the U.S., the usual method for indorsing a check is for the first indorser to sign the check exactly as it is made out if he wishes to convert the instrument to cash. This signature may be preceded by the words "for deposit only" if the indorser wishes to have the value of the check credited to his bank balance or by the words "pay to the order of (name)" if he wishes to transmit the check to another party. By indorsing a check a person makes himself liable to payment of it if it is not honoured, but usually retains the right to try to collect compensation from any previous indorsers. *See* also BILL OF EXCHANGE.

INDO-SCYTHIANS, a name commonly given to various tribes from central Asia, who invaded northern India and founded kingdoms there. They comprise the Sakas, the Yue-Chi or Kushans, and the Ephthalites or Hunas.

INDRA, in Vedic Hindu mythology god of the clear sky and greatest and best of deities; he is lauded in about 300 hymns (or quite a fourth of the Rig-Veda). Unquestionably of Zoroastrian origin, the Boghaz Keui inscription (*c.* 1400 in Asia Minor) mentions Indra with Varuna and Asvins, but in the Avesta he appears as a demon. In the Vedas however his paternity is ascribed to Dyaus, the Sky, and he is almost the national god of the invading Aryans. Represented as having four arms and hands, in two he holds a spear and in a third a thunderbolt, his body is depicted as Sahasrakhsha, "with 1,000 eyes." In the epic age Indra survives as one of the eight great Devas, but is gradually subordinated to Brahma, Siva and Vishnu, and in modern Hinduism he is merely vicegerent of Smarga the heaven of the gods.

INDRE, a *de'partement* of France, formed in 1790 from parts of the old provinces of Berry, Orléanais, Marche and Touraine. Pop. (1954) 247,436. Area 2,667 sq.mi. It is bounded north by the *de'partement* of Loir-et-Cher, east by Cher, south by Creuse and Haute-Vienne, southwest by Vienne and northwest by Indre-et-Loire. The *département* slopes northwestward from the Plateau Central and is drained by the Indre river. In the north is the Champagne, a land of corn and of sheep with fine wool; in the west is the Brenne, once marshy, now drained and afforested; the wooded Boischot is in the south, east and centre. The average annual temperature is nearly three degrees higher than that of Paris, but the winter on the higher Boischot is somewhat severe. The average rainfall is 23½ in. Wheat and oats are largely grown, as are beetroots and artichokes. Wool spinning and weaving and iron working are the chief industries; felt hats and parchment are made.

The *de'partement* is divided into the *arrondissements* of Châteauroux, the capital, le Blanc, Issoudun and la Chbtre, with 23 cantons and 248 communes. It is in the archbishopric of Bourges, where is the court of appeal; it is in the region of the 9th army corps (Tours), and of the *académie* (educational division) of Poitiers. At Neuvy-St. Sépulchre there is an 11th-century circular church with a 12th-century nave; at Mézières-en-Brenne a 14th-century church; at Levroux a 13th-century church and the remains of a feudal fortress; and a magnificent Renaissance chbteau at Valençay. St. Genou has an 11th-century church and a 12th-century tower. There are several dolmens in the *de'partement.*

INDRE-ET-LOIRE, a *de'partement* of France, consisting of nearly the whole of the old province of Touraine and of small portions of Orléanais, Anjou and Poitou. Pop. (1954) 364,706. Area 2.378 sq.mi. It is bounded north by the *de'partements* of Sarthe and Loir-et-Cher, east by Loir-et-Cher and Indre, south and southwest by Vienne and west by Maine-et-Loire. The department is floored by the southern outcrop of Eocene of the Paris basin, with barren shell-marl at Ste. Maure between the Indre and the Vienne; the Loire and its affluents, the Cher, Indre and Vienne, cut valleys with fertile slopes through these Eocene deposits. North of the Loire is the barren Gâtine; between Cher and Indre the vine-clad slopes of Champeigne; between the Loire and Vienne

the vine- and fruit-growing Véron sloping down to the Val d'Anjou; and in the south the Brenne (see INDRE). The climate is mild with average annual temperature 1.8° F. above that of Paris, and about 24 in. of rainfall. Cereals, potatoes, hemp, beetroot and the vine are grown, and many sheep reared. There are quarries of building and mill stones. The industries include iron and lead working. potteries, silk spinning and weaving. important tanneries and the making of famous wines.

Indre-et-Loire is divided into the arrondissements of Tours, Loches and Chinon. possessing 24 cantons and 281 communes. The chief town is Tours, which is the seat of an archbishopric; the court of appeal is at Orléans, and the dtipartement is in the region of the 9th army corps (Tours) and of the *académie* (educational division) of Poitiers. Chinon, Loches, Amboise, Chenonceaux, Langeais and Azay-le-Rideau are also important. Montbazon has the ruins of a square donjon of the 11th and 12th centuries. Preuilly has the most beautiful Romanesque church in Touraine. The Sainte Chapelle (16th-century) at Champigny is a survival of a château of the dukes of Bourbon-Montpensier. The church of Montrésor (1532) has the mausoleum of the family of Montrésor. The town of Richelieu, founded in 1631 by the famous cardinal, preserves its *enceinte* and many 17th-century buildings. Megalithic monuments are numerous.

INDRI, the largest of the existing lemurs, belonging to the family Indriidae (see PRIMATES: Lemuroidea) which includes also the avahi and sifakas. The tail is rudimentary, only two inches long, while the head and body length is about two feet. It is slender, long limbed and has large feet. The pointed face is naked, the rounded ears furry. Indris are usually blackish, with white markings on the head, throat and buttocks, but individuals may be almost white. These lemurs live in the forests of eastern Madagascar. They are diurnal in habit, feeding on shoots, berries and flowers as well as animal matter. (J. E. HL.)

INDUCTION, in logic, usually means reasoning in support of a general proposition by consideration of particular cases which fall under it. Aristotle calls induction "a passage from individuals to universals." John Stuart Mill defines it as "the operation of discovering and proving general propositions" or as "that operation of the mind, by which we infer that what we know to be true in a particular case or cases, will be true in all cases which resemble the former in certain assignable respects."

Induction is called summative (or complete) if it proceeds through an enumeration of all the cases which fall under its conclusion. Aristotle gives an example, which can be rendered as follows: Man, the horse and the mule are long lived; but man, the horse and the mule are all the bileless animals; therefore all the bileless animals are long lived. Summative induction is a conclusive argument.

Induction is called ampliative (or incomplete) if its conclusion goes beyond its premisses in the sense that the former is not a logical consequence of the latter. Ampliative induction is thus an inconclusive argument. It proceeds "from the known to the unknown" (Aristotle, Topics; Mill).

Induction is often contrasted with deduction. Induction and deduction are sometimes (*e.g.*, by W. Whewell and by W. S. Jevons) described as "inverse operations" of the mind; induction leading from less general to more general propositions, deduction leading to conclusions of a generality either equal to or less than that of its premisses. This contrast is not an altogether happy one: summative induction can properly be regarded as a type of deductive argument. The appropriate contrast is between arguments which are logically inconclusive—of which ampliative induction is one—and arguments which are conclusive.

Some logicians, following Mill, wish to restrict the term "induction" to ampliative reasoning. In the rest of this article we shall consider induction in this restricted sense only.

Ampliative reasoning need not aim at the establishing of general propositions. It may also conclude from some particular cases to other particular cases This type of inference is sometimes called eduction (W. E. Johnson).

Induction and Laws of Nature.—The conclusion of an inductive argument can often be stated in the form "everything which is a is β." If x is something of which a and β can be significantly predicated, the general proposition can be used for predicting that if x is a then x is also β. If x, on examination, turns out to be both a and β, we say that x constitutes a confirming instance of the generalization. If x is a but not β, we say that x constitutes a 'disconfirming instance.

A general proposition of the form "every a is β" is called a law of nature if it satisfies some additional requirements. The following three may be regarded as minimum requirements:

1. The scope of the generalization must not be numerically restricted; *i.e.*, the things of which α and β can be significantly predicated must not be restricted by definition to a finite number of objects. This means that a law of nature, reached by ampliative induction, cannot be subsequently established by summative induction.

2. The scope of the generalization must not be spatiotemporally restricted; *i.e.*, the things of which a and β can be significantly predicated must not be restricted by definition to a certain place or to a certain period of time. The laws of nature are valid always and everywhere.

3. The generalization must be a basis for asserting so-called unfulfilled or contrary-to-fact conditionals; *i.e.*, if a certain x, on examination, turns out not to be a, we shall be willing to assert that if it had been a it would also have been β.

Besides universal generalizations of the type "every α is β" there are statistical generalizations of the type "a certain proportion (percentage) of things which are a are β." Statistical generalizations are often established by induction from samples of a "parent" population. Induction of this kind is a species of statistical inference, which will be excluded from consideration here.

ELIMINATION THEORY

An Important Asymmetry.—A single disconfirming instance of a law of nature is a falsifying instance. If we find an x which is a but not β, then it cannot be the case that everything which is a is β. But a confirming instance of a law of nature is never a verifying instance. Since the scope of the generalization is numerically unrestricted, any number of x's which are both a and @ will be compatible with the existence of an x which is a but not β.

Laws of nature are thus asymmetrical with regard to verification and falsification. To have appreciated the importance of this asymmetry to a theory of induction and scientific method is the immortal merit of Francis Bacon (1561–1626).

Of induction which proceeds by enumeration of confirming instances Bacon says that it is "exposed to danger from one contradictory instance" and therefore "utterly vicious and incompetent." But "greater is the power of the negative instance": relying upon it we can reject false inductive conclusions and, by this negative approach, so Bacon thought, ultimately single out the true ones. Scientific induction is a selective process of elimination among a number of alternative possibilities as to a nomic relationship (law of nature). Inductive logic is elimination theory, not confirmation theory.

Elimination theory is today chiefly known in the form given to it by Mill in his System of Logic (1843). Mill distinguished four variants of induction by elimination. He called them the methods of "agreement," of "difference," of "residues" and of "concomitant variations." He regarded them as methods for ascertaining causal connections. More recent contributions to elimination theory are due to J. M. Keynes (1921), to W. E. Johnson (1922) and to C. D. Broad (1930). Broad placed the study on a new basis, abandoning the traditional causal schemas in favour of the terminology of a logic of conditions (necessary, sufficient, necessary-and-sufficient, contributory, counteracting, etc.).

The Canons of Elimination.—Suppose we are searching for a necessary condition of a. To this end we may compare different cases which agree in exhibiting the feature a. It is clear that a feature, say γ, which is missing in some of these cases, cannot be necessary for the presence of a. It is also clear that a feature, say β, which is present in all examined cases, may be a necessary condition of a. If, "varying the circumstances," we find that the

examined instances of α have only one common feature β, we can conclude that, if α has any (simple) necessary condition at all, then β is such a condition. If we are left with more than one common characteristic, we shall have to reckon with the possibility that a has several or a plurality of necessary conditions. If again the instances are found to have no common feature (beside a), we must not conclude that α lacks a necessary condition, since this condition may be complex, which here means that it is a disjunction of two or more features, say β and y, so that the presence of either β or γ is necessary for the presence of a.

The canon of elimination employed in the search of necessary conditions corresponds roughly to Mill's "method of agreement."

Suppose next that we are searching for a sufficient condition of α. To this end we compare an instance in which a is present (a positive instance) with instances in which a is absent (negative instances). Obviously any feature, say y, which is present in the absence of α cannot be a sufficient condition of a. On the other hand any feature, say β, which is absent in the absence of a, may possibly be a sufficient condition of α. If there is only one feature β which belongs to the positive instance under consideration but does not belong to any negative instance, then we can conclude that, if α has any (simple) sufficient condition at all (in the positive instance), then β is such a condition. As long as there remain more than one feature in which the positive instance differs from all the examined negative instances, we have to admit the possibility that α has a plurality of sufficient conditions. If again there is no (simple) feature in which the positive instance differs from all negative instances, we must not conclude that α lacks a sufficient condition, since this condition may be complex, which here means that it is a conjunction of two or more features, say β and γ, so that the presence of both β and γ (but not of either of them alone) is sufficient to produce a.

The eliminative procedure thus outlined corresponds roughly to Mill's method of difference. This method has a characteristic use in scientific experimentation, when the "transition" from positive to negative instances is achieved through a removal of one feature from an instance, all the other features being left intact. If this removal is accompanied by the disappearance of one other feature from the instance, we may suspect that the removed feature is a sufficient condition of the disappearing feature.

Sufficient and necessary conditions are interdefinable. The presence of a is necessary for the presence of β if and only if the absence of a is sufficient for the absence of β. If oxygen is necessary for life, then removal of oxygen from an organism's environment is sufficient to extinguish life. This interrelatedness makes it possible, in the search of determining conditions of a given phenomenon, to switch over from one method of elimination to another and is thus responsible for a wealth of possible variations and combinations in the use of inductive canons.

Induction by Elimination as Demonstrative Induction. —Mill says: "Every induction may be thrown into the form of a syllogism, by supplying a major premiss." Inductive inference, when exhibited in syllogistic form, is sometimes called demonstrative induction.

Mill thought that the major premiss, needed for making reasoning from elimination demonstrative, was a law of universal causation stating that: "Every event, or the beginning of every phenomenon, must have some cause; some antecedent, on the existence of which it is invariably and unconditionally consequent."

The necessity of assuming some kind of deterministic principle is clear from the description of the methods of elimination given above. Unless we assume that a has a necessary condition, we can conclude nothing from the fact that a number of examined instances of a agree in only one other common feature β.

On the other hand. a law of universal causation as formulated by Mill or a deterministic principle stating that every phenomenon possesses a nomic condition of a certain kind, is much too weak to serve its purpose as a supplementary premiss of all induction by elimination. This was never clearly appreciated by Mill. It becomes plain when we pay due attention to the possible plurality and complexity of conditions (as Mill and most subsequent authors on induction failed to do).

The number of attributes (characters, features) among which the nomic conditions of a given phenomenon are to be sought may be infinite, or some of them may have escaped our notice or otherwise been ignored. In order to cope with difficulties arising from these possibilities, a second major premiss is needed in addition to a deterministic principle. It may be called a selection postulate. Its function is to limit the range of alternative possibilities in eliminative induction.

Mill ignored the function of a selection postulate and acknowledged only the need of a deterministic principle. Bacon, on the other hand, took determinism for granted but was aware of the necessity of limiting the range of possibilities. He postulated that all variety in nature could be reduced to combinations of a finite number of independent elements or "generic" properties. Thus the number of possibilities with which the scientist has to count in his search of law connections is necessarily finite (and relatively small). This postulate of limited independent variety was reintroduced into inductive logic thanks to Keynes (1921).

The postulate, however, is too weak for its purpose as supplementary premiss; and so, too, are any general principles which, like Mill's law of universal causation or Keynes's principle of limited variety, profess to remain the same for all inductions. Each inductive inference requires supplementary premisses (a deterministic principle and a selection postulate) of its own in order to acquire the force of a demonstration. The first writer on induction clearly to have appreciated this "in opposition to the prevalent view" was Johnson (1922).

CONFIRMATION THEORY

Inverse Probability and the Law of **Succession.**—Ampliative induction from confirming instances admittedly does not yield certainty. But may it not establish its conclusion with a degree of probability? The advent of a mathematical theory of chances in the late 17th and the 18th century opened fresh prospects for a confirmation theory of induction.

The calculus of probability was already regarded by its early champions as being an ars conjectandi or technique for estimating the value of empirical evidence for conjectures about the unknown. One of its classical problems can be formulated as follows: If, of n examined instances of a, m instances possess the character β, what is the probability that a random instance of a is β? An answer to this and to kindred questions was provided by the doctrine of so-called inverse or inductive probability. Its foundation was laid by Thomas Bayes (1763), and it was greatly developed by Pierre Simon de Laplace (1749–1827) and his school. (*See* PROBABILITY.)

A famous formula of inverse probability is Laplace's "law of succession." It professes to answer the question: If n instances of a all agree in being β, what is the probability that the next instance of a is β? The answer given is: $\frac{n+1}{n+2}$. If n is a large number, this value is very near 1; *i.e.*, if we observed a great number of a's and found that they without exception are β, then it is "practically certain" that the next a which comes within our experience will be β too.

The formula of Laplace was long considered a most powerful means of justifying inductive inference of the type called eduction (see above). In view of the debatable and sweeping assumptions on which its derivation from the fundamental principles of probability rests, the faith accorded to the law of succession by many 19th-century writers on induction (*e.g.*, Augustus De Morgan and Jevons) was amazingly uncritical.

A critical attitude toward the doctrine of inverse probability was developed, parallel with the revival of the so-called frequency theory of probability. from the middle of the 19th century onward. The law of succession was acutely criticized by C. S. Peirce and others.

The Principal Theorem.— Although inverse probability is also traditionally called "inductive" and a branch of it was known under the name of "probability of causes," the doctrine is not

directly concerned with degrees of probability in universal generalizations (laws of nature). The foundations of a confirmation theory dealing with laws of nature were laid by Broad (1918) and Keynes (1921). These authors proved what may be called the principal theorem on confirmation. It runs:

The probability of a generalization is increased by a confirming instance, provided that the probability of the generalization prior to confirmation is greater than o and that the probability of the confirming instance, relative to the previous coniirmations, is smaller than 1.

The content of the theorem ought not to be uncritically interpreted as meaning that induction by the multiplication of instances, sometimes also called pure induction, possesses a value independently of induction by elimination. Keynes was of the opinion that the condition, according to which the confirming instance ought not to be maximally probable, can be satisfied only if this instance, at the same time as it confirms the generalization. also disconfirms (and thus "eliminates") some alternative generalization. In opposition to this view, Jean Nicod (1923) tried to show that the conditions for increase in a law's probability through confirmation can be satisfied independently of elimination.

The arguments of both authors are unconvincing. It is hardly possible to settle the controversy over the value of pure induction without giving an interpretation (definition, model) of the notion of probability in the principal theorem. Actually an interpretation can be found, on which the theorem merely reflects, in numerical terms, the working of an underlying mechanism of induction by elimination. This may be said to support Bacon's opinion on the relative value of confirmation and elimination to the systematical pursuit of inductive knowledge.

Some Other Problems of Confirmation Theory.—After Keynes and Nicod, few contributions to confirmation theory were made until the study was revived in the 1940s. To the subsequent period belong the contributions of J. Hosiasson, C. Hempel, Rudolf Carnap and others.

The concept of a confirming instance has turned out to present serious problems. Let the generalization be that every α is β. It is clear that an x which is not α cannot disconfirm the generalization. But can it be said to confirm it? Similarly, no x which is β disconfirms the generalization. But shall we say that it confirms it, irrespective of whether it is α or not? These and some related puzzles are sometimes referred to under the name of the paradoxes of confirmation.

Another problem of confirmation theory is, whether the probability attributed to laws on the basis of confirming evidence is capable of numerical evaluation or whether it is a comparative concept. Most authors seem to agree on the second alternative, but the reasons given for their views vary greatly.

A further problem is, whether the "meaning" of probability as an attribute of laws of nature is the same as the meaning of probability in some other typical uses. To indicate a distinction, some authors prefer to speak cf degree of confirmation (credibility, acceptability, reasonableness), rather than of degree of probability, in connection with laws.

THE PLACE OF INDUCTION IN SCIENCE

Induction and Hypothesis.—The framing of hypotheses and theories in science mould be arbitrary and useless. could they not be put to a test by deducing from them predictions to be confronted with the testimony of future experience. Likewise. the application of science for technical purposes essentially depends upon the predictive force of scientific laws. The very aim of science is often said to be that of making successful predictions possible: *savoir pour prkvoir pour pouvoir,* as Auguste Comte put it.

Science cannot be used for making predictions unless its results transcend the data of experience so as to contain an element of conjecture (anticipation) about the future course of events. This transcending of experience is an act of ampliative induction. In virtue of this fact, science which is predictive can rightly be called inductive science.

It would, however, be a mistake to believe that the hypotheses (theories. laws) used for prediction were reached through "mere" inductive inference. This is true only of those cases in which it is readily clear which features of a given situation can possibly lend themselves to generalization. It is not true, for example, of those cases in which, experience having provided us with a set of values of co-ordinates of points in a diagram, the "problem" is to discover the mathematical law (curve) connecting the points. The first step to the solution of the problem here is to suggest a hypothesis about the curve and to see whether values which are deduced from this hypothesis "fit" the points of observation. If they do, we may by induction extend the hypothesis to points to be observed in the future. This second step often follows as a matter of course and presents no "problem." Authors who put strong emphasis on the invention of scientific hypotheses sometimes neglect this generalizing step in their accounts of scientific method.

Thus hypothesis in science has a double function: it introduces a new concept or idea to account for observed data; and it makes a conjecture about the unobserved. To fulfill the first function is to make an invention or discovery; and discoveries are "happy guesses" or "leaps which are out of the reach of method" (Whewell). To fulfill the second function is to reason inductively. Thus the uses of induction and hypothesis in science are not to be contrasted: induction is a step in the use of hypothesis. (*See* also HYPOTHESIS.)

The Justification of **Induction.**—Ampliative induction, as has been said. is an inconclusive argument. Its conclusion does not follow "logically" from its premisses. In what sense. if any, can the use of induction and a belief in the truth of inductive conclusions be ··justified"?

David Hume was the first to appreciate the full significance of the epistemological problems which originate from the inconclusive character of inductive reasoning. The problem of justifying induction has therefore also been called the "problem of Hume." Kume's attitude to the problem is his famous "skepticism": induction, in a sense, has no rational justification. Kant's efforts in the theory of knowledge mere largely directed toward rebutting Humean skepticism. According to Kant, there exist "synthetical judgments a priori," which are amplifying in the sense of going "beyond the evidence of our memory and senses" (Hume) and at the same time known to be true prior to experience.

This attempt to solve Hume's problem encounters two principal difficulties. One concerns the notion of a synthetic a priori. This notion has been severely criticized, particularly by philosophers of a positivist turn of mind. The second difficulty is connected with the application of the synthetic a priori principles to actual cases of inductive inference. It is notorious that no such principle can, without sweeping additional assumptions, raise a single inductive conclusion to the rank of certainty.

Early in the 20th century the French mathematician Henri Poincaré (La *Science* et *l'hypothèse*, 1902, and other publications) pointed out the important role played by conventions, as he called them, in science. A well-confirmed inductive conclusion is often raised to the rank of a principle which we refuse to let become falsified in the event of (seemingly) adverse experience. For example, experiments have taught us that pieces of phosphorus, under "normal" conditions, melt at 44° C. From this we inductively conclude that all pieces of phosphorus melt at this same temperature. If later a piece of phosphorus is found not to melt at the temperature in question, we "explain" this failure by declaring either that the experimental conditions were not "normal" or that the substance was not "really" phosphorus. The inductively found melting point has been made a defining characteristic of the substance. The inductive conclusion has gained certainty and thus become "justified."

Poincaré himself did not use these ideas for offering a wholesale solution to Hume's problem. But others have made the attempt. "Conventionalism" was for some time a fashion among writers on induction. Its most serious shortcoming as a contribution to the problem of induction is that it does nothing to justify our reliance on predictions in science.

An approach to the justification problem which has found

favour among many authors (R. B. Braithwaite, W. Kneale, H. Reichenbach, J. O. Wisdom) is one suggested for the first time by Peirce in 1877. Induction is a policy which we adopt for predicting the course of events. We cannot know that this policy will be successful, but we can justify its use as being rational on the ground that it is, in a certain sense, the best way of making conjectures about the unknown. The superiority of inductive policies is in the fact that induction is self-correcting. To follow an inductive policy means to let past experience determine one's belief about the future and to let new experience correct false beliefs. If we follow this policy consistently, we cannot, so it is thought, fail to reach true inductive conclusions in the end. "The validity of an inductive argument consists, then, in the fact that it pursues a method which, if duly persisted in, must in the very nature of things, lead to a result indefinitely approximating to the truth in the long run" (Peirce).

The idea of an indefinite approximation to the truth is open to criticism. It is doubtful whether the Peircean approach can prove more than that to follow inductive policies is part of what we mean by "rationality" in action and beliefs. It is worth suggesting that no justification of induction can be based on the ground of its being rational, but that reasoning is sometimes called "rational" on the ground that it employs an inductive policy.

BIBLIOGRAPHY.—*Classical works:* Francis Bacon, *Novum organum* (1620); J. Stuart Mill, *System of Logic* (1843), still one of the best introductions to the subject; K. Whewell, *Novum organon renovatum* (1858); W. S. Jevons, *The Principles of Science* (1874); C. S. Peirce, *Illustrations of the Logic of Science* (1877–78).

Modern works: J. M. Keynes, *A Treatise on Probability* (1921); J. Nicod, *Le Problème logique de l'induction* (1923); W. E. Johnson, *Logic,* vol. ii–iii (1922–24); A. Lalande, *Les thdories de l'induction et de l'expérimentation* (1929), a good introduction of broad scope; G. H. von Wright, *The Logical Problem of Induction* (1941); W. Kneale, *Probability and Induction* (1949); and G. H. von Wright, *A Treatise on Induction and Probability* (1951). (G. H. v. W.)

INDUCTION COIL, an electrical device for producing an intermittent source of high voltage. An induction coil consists of a central cylindrical core of soft iron on which are wound two insulated coils: an inner or primary coil having relatively few turns of copper wire, and a surrounding secondary coil having a large number of turns of thinner copper wire. An interrupter is used for making and breaking the current in the primary coil automatically. This current magnetizes the iron core and produces a large magnetic field throughout the induction coil.

The principle of operation of the induction coil was given in 1831 by Michael Faraday (*q.v.*), who showed that if the magnetic field through a coil is changed an electromotive force is induced whose value depends on the time rate of change of magnetic field through the coil. This induced electromotive force. is by Lenz's law, always in such a direction as to oppose the change in the magnetic field.

When a current in the primary coil is started, induced electromotive forces are created in both the primary and secondary coils. The opposing electromotive force in the primary coil causes the current to rise gradually to its maximum value. Thus, when the current starts, the time rate of change of the magnetic field and the induced voltage in the secondary coil are relatively small. On the other hand, when the primary current is interrupted, the magnetic field is reduced rapidly and a relatively large voltage is produced in the secondary coil. This voltage, which may reach several tens of thousands of volts, lasts only for the very short time during which the magnetic field is changing. Thus an induction coil produces a large voltage lasting for a short time and a small reverse voltage lasting a much longer time. The frequency of these changes is determined by the frequency of the interrupter.

After Faraday's discovery many improvements were made on the induction coil. In 1853 the French physicist Armand Fizeau placed a capacitor across the interrupter, thus breaking the primary current much more rapidly. Methods for winding the secondary coil were greatly improved by H. D. Ruhmkorfi in Paris, by A. Apps in London and by Klingelfuss in Basel, who was able to obtain sparks in air about 59 in. long. There are various kinds of interrupters. For the small induction coils a mechanical one is attached to the coil, while the larger coils use a separate device such as a mercury jet interrupter or the electrolytic interrupter invented by A. R. B. Wehnelt in 1899.

About the beginning of this century. induction coils were used to provide the high voltage for electrical discharges in gases at low pressure. and as such were instrumental in the discovery of cathode rays and roentgen or X-rays. Another form of induction coil is the Tesla coil. which generates high voltages at high frequencies. The larger induction coils for use with X-ray tubes have been displaced by the transformer-rectifier source of voltage. while the smaller ones are still used to provide the ignition spark in gasoline engines. (R. J. SN.)

INDULGENCE, a term defined by the Roman Catholic Church as "the remission before God of the temporal punishment still due to sin after the guilt has been forgiven." The doctrine is based on the same church's teaching that the remission of guilt does not necessarily imply the remission of temporal punishment and that the debt of punishment may be paid vicariously. In the case of an indulgence. the debt of punishment is paid from the superabundant treasury of Christ's merits and the satisfactory works of the saints. The payment may be made in full (plenary) or in part (partial); the indulgence may be gained by the living, or applied by way of suffrage to the souls in purgatory. The authority of the church to grant such an indulgence is derived from the power granted the apostles to bind and to loose (Matt. xvi. 18; xviii. 18) and more specifically to forgive and to retain sins (John xx, 23).

The history of indulgences is intimately bound up with the penitential discipline of the early church (see CONFESSION). The sacrament of penance was frequently referred to as a secbnd and more laborious baptism in which the penitent endeavoured to free himself not only of the guilt of sin but of the temporal punishment as well. To this end fixed penances (canonical) were assigned which were calculated to compensate the debt of punishment contracted by sin. The penitent was not, however, left to his own resources. Conscious of his solidarity with the church, the mystical body of Christ, he was encouraged to enlist the aid of the whole Christian community in making fitting reparation for his personal transgressions (cf. Caesar of Arles, *hom.* I, de *Poenitentia*). This principle of vicarious satisfaction finds striking application in the action of St. Cyprian during the Decian persecution (A.D. 250–252). At the request of the martyrs, and it would appear out of regard for their sufferings, St. Cyprian considerably curtailed and even waived the canonical penance in favour of the lapsed nho had received from the martyrs certificates of peace (St. Cyprian. epist. xvi, xxi, xxii). The essential elements of an indulgence may be recognized in this action of St. Cyprian; the practice did not, however, outlive the period of persecutions which occasioned it.

In succeeding centuries, particularly under the influence of the Celtic discipline, the procedure ti-as rather to commute the protracted canonical penance by substituting periods of fasting (usually of 40 days, a quarantine). special private prayers, almsgiving and payments of money nhich were used for religious purposes. This last substitute, a form of redemption, was efficacious in redeeming only a part of the canonical penance and the debt of temporal punishment implied. The first to grant a plenary indulgence nas Pope Urban II on the occasion of the first Crusade (1095). The pertinent section of the indulgence decree reads: "Whosoever out of pure devotion and not for the sake of gaining honour or money, shall go to Jerusalem to liberate the Church of God, may count that journey in lieu of all penance" (Council of Clermont. Mansi. Concilia, xx, 816).

After the 12th century references to indulgences became more frequent. Innocent II granted a 40-day indulgence for visiting and contributing to the adornment of the great church at Cluny (1132), and soon every church of any importance had its own indulgence to further the work of construction. The evident lack of proportion betneen the small sums of money contributed and the debt oi punishment remitted posed a problem for the great speculative theologians of the age. Their solution fixed the doctrine which was regarded as implicit in contemporary practice. Money contribu-

tions and other pious works were not to be considered as substitutes for the canonical penance but rather as conditions for gaining the indulgence. The debt of punishment was paid from the church's treasury.

While the doctrine of indulgences was sound enough, the practice of demanding an offering as a necessary condition for certain indulgences inevitably prepared the way for serious abuses. The magnificent cathedrals of Europe, its older universities, hospitals, bridges and other social and cultural projects are evidence enough that much of the money collected on the occasion of an indulgence was actually directed to legitimate purposes; not a little, however, found its way into the pockets of greedy ecclesiastics and professional collectors (quaestores). And it is at least possible that preachers in their zeal for the church (edifice) of God went beyond the limits of the doctrine, misleading the more credulous into believing that the indulgence was a substitute for true sorrow and confession.

It would appear also that the expression *"ab omni culpa* et *poena"*—from all guilt and punishment—contributed to this misconception. Whatever the original significance of this misleading phrase, it is noteworthy that during the rebuilding of the Kaiserdom in Speyer (1451) "fifty and often a hundred priests with their stoles sat hearing confessions," and this despite the fact that "on the church doors in Speyer there was written in big letters in Latin and in German: In this place is full pardon of all sins for punishment and guilt." (Eikhardt Artzt, the Chronicler, in Badissches Archiv fur Vaterlandskunde, II, 232 ff.)

It was not until the great reform council of Trent (1562) that an end was put to abuses connected with the practice of indulgences. The name and office of quaestor was abolished and with the office the privileges attached. Five years later, Pius V revoked all indulgences for which money payments or alms were prescribed and ordered the bishops to destroy all briefs in which such indulgences were granted. The church did not, however, retreat from its doctrinal position that the debt of punishment could be paid from the church's treasury; insisting on this point, it kept before the minds of the faithful the consoling doctrine of the communion of saints and of that solidarity of all its members in Christ's mystical body, which is basic to the doctrine of indulgences.

BIBLIOGRAPHY.—Amort, *De Origine Indulgentiarum* (1735); H. C. Lea, *History of Auricular Confession and Indulgences* (1896); N. Paulus, *Geschichte des Ablasses im Mittelalter* (1923), and *Indulgences as a Social Factor in the Middle Ages, tr.* (1921); M. Lepicier, *Indulgences, their Origin, Nature and Development,* 3 ed. tr. (1928). More accessible are the articles 'Indulgences in Hastings' *Ency. of Religion and Ethics* and in the *Catholic Encyclopaedia;* A Gougnard, *Tractatus de Indulgentiis,* 1933; R. M. Huber, *Portiuncula Indulgence from Honorius III to Pius XI,* 1938; Beringer, *Les Indulgences,* 1925.
(P. F. P.)

INDUNA, a Zulu-Bantu word for an officer or head of a regiment among the Kafir (Zulu-Xosa) tribes of South Africa. It is formed from the inflexional prefix in and ***duna,*** a lord or master.

INDUS (Sanskrit *Sindhu,* Greek Sinthos, Latin *Sindus*), one of the mightiest rivers of the Indian subcontinent. It rises in Tibet in the glaciers on the northern slopes of Kailas Parbat, 17,000 ft. above sea level. Its sources are within 100 mi. of these of the Brahmaputra and the Sutlej. In its upper course the river flows northwestward in the trough between the Kailas range (N.E.) and the Ladakh range (S.W.) for about 200 mi. Near Thangra it pierces the Ladakh range and continues its northwesterly course between the Ladakh range in the northeast and the Zaskar (Zanskar) range in the southwest for about 300 mi. It is joined by the Zaskar river from the southwest about 12 mi. west of Leh, the capital of Ladakh (eastern Kashmir) and the chief town on the great trade route to central Asia via the Karakoram pass. It recrosses the Ladakh range to the north near Kiris where it receives the Shyok. The combined stream is soon joined by the Shigar near Skardu, the chief town of Baltistan, and flows another 100 mi. to the northwest under the shadow of a vast snow-covered range of the Great Himalayas to the south. It flows past the Haramosh peak in a magnificent 10,000-ft. gorge, then suddenly turns southwest. It is now joined by the Gilgit river from the northwest, having dropped to 4,000 ft., and strikes across the Great Himalayas, flowing below the famous Nanga Parbat (26,660 ft.). Past Chilas it continues southwest through the Kohistan (highlands) of the northwest frontier regions of Pakistan. It debouches on to the Terbela plain near Ghazi in Hazara district (North-West Frontier Region) and ultimately comes out of the Himalayan region through a narrow gorge near Attock (2,079 ft.), where it is joined by the Kabul.

Below Attock the river flows along the western margin of the Potwar plateau and finally cuts across the Salt range in a narrow gorge to emerge into the Punjab plain near Kalabagh. From Kalabagh to the sea it flows in the west of an extremely flat plain formed by it and its tributaries. Just above Mithankot in south Punjab it receives the Panjnad ("five waters"), carrying the combined Jhelum, Chenab, Ravi, Beas and Sutlej rivers. It is joined by several smaller streams from the western mountains including the Kurram, Tochi and Gomal. All through the Punjab the Indus is broken by islands and sandbanks and in winter is divided into numerous channels.

Near Kashmor it enters Sind. From Bukkur to the Arabian sea it is familiarly known as Darya (Big river). In Sind its gradient is very gentle and it carries down enough detritus to raise its own bed above the general level of the surrounding plains. As a protection against floods, therefore, the river is confined with bunds (embankments). At Hyderabad, about 115 mi. from the sea, begins the delta, through which the river discharges along about 125 mi. of coast-line. It is almost perfectly level, but the soil is generally infertile. The marshy parts contain good pasturage and rice grows luxuriantly where cultivation is possible.

The river is about 1,800 mi. long; its total drainage area is estimated at 372,000 sq.mi. The catchment basin in the Himalayan region covers about 103,800 sq.mi., which is larger than that of any other river in the subcontinent.

Because of the general absence of firm banks in the plains bridges are difficult to construct. There are railway bridges at Attock, Kushalgarh, and Mari Indus (near Kalabagh), and spanning the river between Sukkur and Rohri and between Kotri and Hyderabad.

The volume of water in the river remains small during the cold season. The river begins to rise in March, attaining its maximum in July or August after which it begins to subside. The average monthly discharge for the decade ended 1950 at Kalabagh above the barrage was 27,244 cu.ft. per second in January when it is lowest and 409,670 cu.ft. per second in July when it is highest. For the same period the average monthly discharge above the barrage at Sukkur was 31,071 cu.ft. per second in January when it is lowest and 409,670 cu.ft. per second in August when it is highest. Unusual floods, caused by landslides, breaches or other exceptional causes are not infrequent. Because of the large volume of water it carries during summer and the flatness of the country, the river shows a great tendency to shift its course in the plains. Formerly it used to flow down in the middle of the Thal. A long lake still exists in the south of the Thal that once formed the bed of the river. In prehistoric times a branch found its way to the Runn of Cutch and the gradual shift of the river westward led to the disappearance of many old towns on its banks. One of the most important changes took place as a result of an earthquake in A.D. 962. when the stream broke through the limestone ridge between Sukkur and Rohri. Formerly it flowed through another gap. 4 mi. to the southeast of Rohri.

Almost the entire plains course of the river from Kalabagh to the sea lies in the zone of deficient rainfall, the mean annual being generally under ten inches. The cultivation. therefore, depends mostly on irrigation. The prosperity of Sind has been particularly dependent upon the water supply from the river through the perennial and inundation canals. which irrigate 7,500,000 ac. Inundation canals take off from it in southwestern Punjab and Sind. The Jinnah barrage near Kalabagh feeds the canals of the Thal project. planned to irrigate 2,000,000 ac. in the Sind-Sagar doab. The canals from the Sukkur barrage irrigate about 5,000,000 ac. The Ghulam Mohammed or Lower Sind barrage, officially opened at Kotri on March 15, 1955, was to irrigate about 2,800,000

ac. The proposed Gudu barrage in upper Sind and the Taunsa barrage in Punjab would irrigate 2,320,000 ac. and 1,400,000 ac. respectively. (K. S. AD.)

INDUSTRIA (mod. *Monteù da* Po). an ancient town of Liguria, 20 mi. N.E. of Augusta Taurinorum. Its original name was Bodincomagus, from the Ligurian name of the Padus (mod. Po), Bodincus. *i.e.,* bottomless, and this appears on inscriptions of the early empire. It stood on the right bank of the river, which has shifted more than 1 mi. to the north. It was a flourishing town, as excavations (which have brought to light streets, the forum, theatre, baths, etc.) have shown, but was deserted in the 4th century A.D.

INDUSTRIAL ACCIDENTS or work injuries include in the United States all injuries and occupational diseases suffered by workers which arise out of and in the course of gainful work, except (1) work injuries to domestic servants and (2) injuries occurring in connection with farm household chores. Because these two types of injuries arise out of circumstances which are peculiar to the home, they are considered as home injuries. Except for these two special activities, gainful work includes the full range of work activities, in manufacturing. construction, mining, public utilities, transportation, agriculture, trade and service.

Work injuries are classified, by degree of seriousness, into five general groups: (1) fatalities; (2) permanent total disabilities—loss of both eyes. both hands, etc.; (3) permanent partial disabilities—loss of one eye, one hand, etc.; (4) temporary total disabilities—no permanent impairment but loss of one or more full day's time following the day of injury; (5) medical treatment and first-aid cases.

The first four groups of injuries are referred to as disabling. In the United States injuries of these kinds totalled about 2,000,000 in 1953, of which about 15,000 were fatal, and about 85,000 resulted in some permanent disability, ranging from partial loss of use of a finger to blindness and complete crippling. No data were available on the number of medical-treatment and first-aid cases which occurred annually, but in some instances frequencies of these cases. in relation to disabling cases, were reported as high as several hundred to one.

Table I shows the total number of disabling work injuries and the number of fatalities in the United States in 1953, summarized separately for eight major industry groups.

Although fairly accurate estimates of total work deaths in the U.S. date back only to 1928, approximations have been made for as far back as 1913. For that year, indications are that work deaths totalled between 18.000 and 22.000. In relation to an estimate of employment for that year. the death rate would be between 48 and 59 deaths per 100,000 workers.

While the number of work deaths decreased by 1953 only to 15,000, this was accomplished while employment was increasing sharply; thus the death rate dropped about 50%, to 26 per 100,000 workers.

Both employment and deaths increased between 1933 and 1937, but the increase in deaths was greater, proportionally, with a resulting increase in the death rates. After 1937 the trend in the U.S. was steadily; although irregularly, down, despite an increase in the number of workers (excluding domestic servants) from about 44,000,000 in 1937 to about 58,000,000 in 1953.

TABLE I.—Work Injuries in the United States in 1953

Industry	Deaths		All injuries*	
	Number	Rate per 100,000 workers	Number	Rate per 100,000 workers
All industries	15,000	26	2,000,000†	3,450
Trade	1,400		360,000	3.120
Manufacturing	2,400	14	480,000	2.810
Service	2,300	16	380,000	2,610
Public utilities	300	22	10,000	1,400
Transportation	1,400	44	190,000	6,030
Agriculture	3,800	59	320,000	5,000
Construction	2,500	81	220,000	7,100
Mining, quarrying, oil and gas wells	900	107	60	7,140

*Includes those causing death, permanent total disability, permanent partial disability and temporary disability—the last being limited to injuries resulting in a full day's disability beyond the day or shift on which the injury occurred. †Possibility of error in the industry estimates makes it advisable to round the all-industry total to 2,000,000.

Work Accidents Compared With All Accidents.—Work accidents are one of four major classifications into which accidents are grouped. The other classifications are motor vehicle, home and public nonmotor vehicle. Accidents in all classifications resulted in about 9,600,000 disabling injuries in 1953, of which about 95,000 were fatal and about 350,000 resulted in some permanent disability (see Table II).

TABLE 11.—Distribution of Deaths and Injuries in Major Classifications, 1953

Class of accident	Deaths	Injuries
Total	95,000*	9,600,000*
Work	15,000	2,000,000
Motor vehidle	38,300	1,350,000
Home	29,000	4,350,000
Public nonmotor vehicle	16,000	2,000,000

*The motor vehicle totals include some cases which are also included in the work and home totals. This duplication amounted to about 3,300 deaths and 100,000 injuries.

In addition to accidents which workers have on the job, they are also the victims, of course, in many of the motor vehicle, home and public accidents. Fatalities of workers in these off-job accidents normally total more than twice the number that occur on the job, while injuries total nearly one-third more.

Time Lost From Work Accidents.—Time lost from work accidents falls into three categories. (1) time lost by injured workers in the year in which the accidents happen; (2) time lost by injured workers in later years; and (3) time lost by workers who were not injured (these losses occur in the year in which the accidents happen) (see below).

Time lost in 1953 totalled about 250,000,000 man-days (the sum of categories 1 and 3). About 45,000,000 of these days were lost by the injured workers (1), and about 205,000,000 days were lost by other workers (3).

Time lost by injured workers in the year in which the accident occurred (category 1) is a minimum figure and includes primarily just the actual full days lost during the year from disabling injuries. It does not include time lost on the day of the injury or time required for further medical treatment or check-up following the injured person's return to work, nor does it include the countless number of losses of less than a full day's time. Fatalities are included in the year of occurrence at an average loss of 150 days per case, and permanent impairments are included at actual days lost plus a small allowance for lost efficiency resulting from the impairment.

It was estimated that time lost in future years from accidents which happened in 1953 would total about 140,000,000 more days (category 2). Most of the future loss results from the fatalities, but a considerable amount also results from a reduction in the capacity of workers who have suffered permanent impairments. A worker with only one arm, for example, might produce less during the remaining years of his working life than a worker with two arms.

Time lost by workers other than those injured (category 3) arises when these persons stop to help the injured or to discuss the accidents. Slowdowns resulting from temporary reductions in efficiency by persons witnessing serious accidents. suspensions of work cdused by damaged equipment and the time required to replace damaged products. machinery and structures also are included in this total. Such losses are not always plainly identifiable. but they result in losses of production time as real as the losses of injured workers.

Accident Costs.—Detailed and precise figures on the cost of work accidents in the U S. were not available in the mid-1950s, but conservative estimates placed the cost to the entire nation at about $3 000.000 000 in 1953. This total was about equally divided between visible costs and indirect costs.

Visible costs included wage losses of about $900 000,000, medical expense of $250,000,000, and insurance overhead costs of $3 50,000,000. Wage losses are borne partly by the injured workers and partly by industry. The other costs are borne by industry, either directly or through payment of insurance premiums. The

indirect costs included the money value of damaged equipment and materials, production delays and time losses of workers other than those injured. The total costs to U.S. industry averaged about $45 in 1953 for every worker employed. This figure obviously would be higher in companies or industries with high injury rates, or in which little has been done about safety.

Measures of Work Accidents.—Preceding paragraphs commenting on the frequency with which work accidents occur and the losses in both time and money resulting from them indicate their impact on business activity. In a particular company, the accident experience may have an important effect on its profits or losses--even on its success or failure. The prevention of accidents, therefore, deserves the same serious consideration that is given to other phases of business activity.

In accident prevention as in other phases of business, accurate records are essential for effective planning and intelligent appraisal of progress. One purpose of such records is to measure the accident problem and indicate whether or not progress is being made in meeting that problem. This purpose can be accomplished by getting answers to such questions as these: (1) Is the volume of accidents greater or less than in other establishments or activities having similar hazards? (2) How serious are the accidents and how do they compare in this respect with accidents experienced in other establishments or activities? (3) Is the accident experience in terms of volume of cases and seriousness of cases improving or getting worse?

Obviously the answers to each of these questions involves a comparison. It is important, therefore, that the basic records be constructed so that they may be used for comparison purposes. Primarily this means that the records must be prepared in accordance with a standard procedure, and one which provides for adjusting differences in the plants or operating units which they represent. For example, if the records for one operating unit include all injuries treated or reported in the first-aid room, while the records of another unit include only injuries which are serious enough to cause lost time, obviously a meaningful comparison between the totals cannot be made. Similarly, if one operating unit has 10 employees while another has 100, it would be illogical to compare the accident totals without making some allowance for differences in the size of the two units.

A procedure for keeping accident records which accomplishes the objectives stated above, developed under a program of the American Standards association, was published as standard Z16.1, "The American Standard Method of Recording and Measuring Work Injury Experience."

Injury Frequency Rate.—Since concern centres principally on accidents which cause injury, this standard defines the injuries which should be counted for comparison purposes, and specifies a method of indicating the relative seriousness of different injuries and how the recorded experience should be expressed for comparison purposes. Specifically, the standard provides two injury rates for making the necessary comparisons: (1) the injury frequency rate and (2) the injury severity rate.

The injury frequency rate measures the volume of disabling injuries in terms of 1,000,000 man-hours of work, and is computed in accordance with the following formula:

$$\text{Frequency rate} = \frac{\text{total disabling injuries} \times 1{,}000{,}000}{\text{total man-hours worked}}$$

The frequency rate indicates the relative degree of safety achieved during the period covered by the rate and permits direct comparisons between injury volume in different establishments or activities regardless of differences in size or number of man-hours worked in these establishments or activities.

Injuries included in the standard frequency rate are those which arise out of and in the course of employment and which cause loss of a full day's time on any one or more days after the date of the accident, or which result in some permanent impairment or death. These injuries are referred to as disabling injuries. Minor injuries are not included in the rate computations because of the impossibility of obtaining standardization of such cases. Injury totals include the number of disabling injuries and not the number of accidents. For example, if five employees suffered disabling injuries in an explosion, five injuries would be included in the total number of injuries.

As itemized previously, disabling injuries are of four types: death, permanent total disability, permanent partial disability and temporary total disability. Specifically, a death is any injury which terminates fatally regardless of the time interval between the accident and the death. Permanent total disability is any injury which permanently and totally incapacitates an employee from following any gainful occupation; or in the same accident results in the loss of or complete loss of use of both eyes; or one eye and one hand, leg, or foot; both hands; or any two of the following, not on the same limb: hand, arm, foot or leg.

Permanent partial disability is any injury which results in the complete loss of any member or part of a member of the body, or any permanent impairment of function of the body or part thereof to any degree less than permanent total disability. Temporary total disability is any injury which does not result in permanent impairment or death, but which renders the injured worker unable to perform a regularly established job during his entire normal period of employment on the day after the accident, or on a later day, regardless of whether the next day is a holiday, or whether the injured worker is not employed for other reasons.

Injury Severity Rate.—The injury severity rate measures the loss resulting from disabling injuries in terms of 1,000,000 man-hours of work, and is computed by the following formula:

$$\text{Severity rate} = \frac{\text{total days charged} \times 1{,}000{,}000}{\text{total man-hours worked}}$$

Loss is the sum of actual calendar days lost for temporary total injuries, and scheduled charges for permanent impairments and deaths as set forth in the Z16.1 standard procedure. For example, the scheduled charge for a fatality is 6,000 days, while for permanent impairments the charges range from 4,500 days for loss of an arm to 75 days for loss of a part of a finger. If an injury causes permanent loss of use of a body member instead of amputation, a percentage of the scheduled charge is used which corresponds to the percentage loss of use. For injuries of these kinds, the scheduled charges are used in place of actual days lost, or even if no days are lost at all.

In the U.S. major industry groups report to the National Safety council and to the U.S. bureau of labour statistics. The National Safety council rates are based principally on the experience of council members, while the bureau of labour statistics rates cover many more reporters and probably are more representative of injury experience in general.

On the average, employees work about 2,000 hours a year; 1,000,000 man-hours, then, represents a year's work for about 500 employees, and in general terms a rate of 20.0 may be interpreted as 20 disabling injuries per year for each 500 employees, or about 1 disabling injury for each 25 employees. A severity rate of 2,000 may be interpreted as four days charged per year for each employee.

Accident Analysis.—Accidents should be analyzed to determine their basic, underlying causes, so that direct, positive action can be taken to prevent recurrence. An accident usually is the last occurrence in a series of events. Complete success in accident prevention will be accomplished only when earlier events in the series are identified and corrected. Accident analysis is a procedure for identifying these earlier events.

To use a simple example, workers frequently suffer eye injuries because they fail to wear safety goggles, and often this is given as the cause of the accident. The corrective measure usually consists of instructions to the workers to wear goggles. However, if there are basic reasons why workers do not wear their goggles, and if these reasons are not determined and eliminated, eye injuries will probably occur again and again. Perhaps the goggles are of the wrong type, or they do not fit properly, or the workers have not been convinced of the importance of wearing goggles.

The method of accident analysis is a standard procedure set forth in standard Z16.2 of the American Standards association, and titled "American Recommended Practice for Compiling Industrial Accident Causes." This procedure, which is primarily concerned with accidents which cause injury, provides for selecting, cross-

classifying, and summarizing the fundamental factors in accidents. Each essential point of information about an accident is referred to as an accident factor. These may be grouped into six major classifications: (1) agency of the injury—the tool. material, machine or substance most closely associated with the injury; (2) agency part—the particular part of the selected agency most closely associated with the injury; (3) unsafe mechanical or physical condition—the condition of the selected agency or conditions in the environment of the agency which could have been guarded or corrected; (4) type of accident—the manner in which the employee was injured; (5) unsafe act contributing to the accident—the violation of a commonly accepted safe procedure which resulted in the accident; and (6) the unsafe personal factor—the mental or bodily characteristic which permitted or occasioned the unsafe act.

Often supplementary items of information closely related to the basic factors, such as sex, occupation and type of work performed at the time of injury, are included in an analysis so that all facts are available for taking the proper preventive steps.

Experience has proved that the most effective way to reduce accidents is to concentrate on one phase of the problem at a time. Analyses, therefore, can approach the problem in many ways, any one of which should prove effective. The accident reports may be grouped by occupation of the injured person in order to determine what types of accidents are most prevalent among different occupations, the actions which contribute to the accidents, and the manner in which the accidents occur. Such information is particularly helpful in planning employee training and in developing educational materials and programs.

Injury frequency rates computed by departments may reveal that injuries occur at sharply higher rates in some departments than in others. If such is the case, an analysis could be made of the accidents in the high-rate departments to find out the sources of the accidents and their causes. This method will permit concentration of effort in the locations in which accidents occur most frequently.

If injury frequency rates reveal that a high rate of occurrence is general throughout the plant, the accident reports might be grouped by agency of the injury to find out the principal sources of the injuries; or by accident type to find out how the persons were injured; or by unsafe act, or unsafe condition. Any one of the accident factors may be used as a starting point.

Table III presents an example of one part of a typical analysis of ladder accidents showing the unsafe acts and unsafe conditions which were found to have contributed to the accidents. The complete analysis might also include information on such factors as occupation of the injured, place of the accident, etc.

Analyses of the circumstances of accidents according to the recommended standard procedure make it possible, for example, to: (1) identify and locate the principal sources of accidents by determining from actual experience the materials, machines and tools most frequently involved in accidents, and the jobs most likely to produce injuries; (2) disclose the nature and size of the accident problem in departments and among occupations; (3) indicate the need for engineering revision by identifying the principal unsafe conditions of various types of equipment and materials; (4) disclose inefficiencies in operating processes and procedures where poor layout, for example, contributes to accidents, or where outdated methods or procedures which overtax the physical capacities of the workers can be avoided, as by using mechanical handling methods; (5) uncover the unsafe practices which need special attention in the training of employees; (6) discover improper placement of personnel in instances in which inabilities or physical handicaps contribute to accidents; (7) enable supervisors to use the time available for safety work to the greatest advantage by providing them with information about the principal hazards and unsafe practices in their departments; (8) permit an objective evaluation of the progress of the safety program by noting in continuing analyses the effect of different safety measures, educational techniques and other methods adopted to prevent injuries.

TABLE 111.—Analysis *of Ladder Accidents*

Unsafe conditions and acts	No. of cases
Unsafe conditions	
Slippery rungs	6
Broken rungs	3
Weak, worn or cracked rails	1
Lack of hooks for fastening ladder at top	1
Worn ladder shoes	1
Unsafe acts	
Ascending or descending improperly	
Carrying too heavy loads	11
Improper or Insecure grip	9
Running up or down ladders	6
Jumping from lower steps to ground	5
Oily or wet shoes	3
With back to ladder	1
	35
Failure to secure ladder at top	29
Placing ladder unsafely	
On boxes or other equipment	
At too great an angle	
Near moving equipment	2
On inclined or irregular surface	2
On planking over opening	1
	22
Failure to secure ladder at bottom	12
Working in unsafe position	
Overreaching	6
Improper stance while using leverage tools	2
Straddling space between ladder and nearby object	2
	10
Using ladders known to be defective	8

Sources of Injury Statistics.—Injury rates by industries are published in the United States by the National Safety council, the U.S. bureau of labour statistics and the department of labour or compensation commissions in some states. Data concerning the cause of injury, giving such information as type of accident, type of injury, agency of injury, and in some cases unsafe acts and unsafe conditions, were published in the mid-1950s by at least the following states: California, Illinois, Iowa, Maryland, Minnesota, New York, Ohio, Pennsylvania, Rhode Island, West Virginia and Wisconsin.

Special studies giving the detailed circumstances of accidents in selected industries, or in the use of particular equipment, are published by the National Safety council, the U.S. bureau of labour statistics, and numerous trade associations and insurance companies. Because of the rapidly expanding interest in safety in recent years, it would be difficult to keep up-to-date a list of all agencies compiling data. For this reason, companies should check with their insurance carriers. trade associations and state labour departments to learn what records are available at the local level. Care must be used in making comparisons between the U.S. and other countries because of differences in such factors as industry classification, injury definition and hours worked per week.

Organized Safety Efforts.—Preceding sections have dealt primarily with the size and character of the work accident problem, how the problem may be measured and studied in any industrial unit, and the change in experience over a period of years. In conclusion, it is pertinent to review briefly the nature of efforts that are made to control and reduce work accidents.

Throughout human history work accidents have taken their toll in death, disabilities and handicaps and in wastage of manpower and materials. These undesirable, and often disastrous, results of accidents were certainly always apparent. However, the idea that a planned and sustained effort could and should be made to keep people from having accidents while at work is a relatively recent development, beginning in the United States around the turn of the 20th century. Important factors in this development were (1) the concentration of large numbers of employees in factories and other places of work where, on account of the increased exposure, the number of accidents and the seriousness of accident losses became more apparent; (2) the pioneering safety efforts of certain industries, which proved the feasibility and effectiveness of organized and sustained safety programs; (3) the passage of workmen's compensation legislation, which, by placing a sizable share of the cost of accidents directly on the employer, made clear the monetary benefits of accident control.

It has been recognized for many years that the avoidance of accidents at work depends fundamentally on two factors: (1) a safe environment, including buildings, equipment and materials; and (2) performance of the job by the worker in a safe manner.

Though stated fundamentally in these two categories—safe conditions and safe work practices—the ramifications of the modern safety program are many and varied. On the environmental side

are involved such things as properly constructed work places, use of nonhazardous materials, adequacy of lighting and ventilation, the guarding of moving machinery, proper provision for fire protection and many others.

In the second category — safe work practices — it is recognized that these can be achieved by the employee only if he knows how to work safely, why it is important for him to do so, and if he is reminded of these facts at frequent intervals. Safety-minded companies place no less emphasis on such a safety program for employees than on the maintenance of safe working conditions.

For many years a stumbling block in the path of work safety was a deep-seated idea that doing a job safely was likely to result in lower production — avoidance of accidents could be accomplished only by doing the' job less efficiently. Experience has proved, however, that the opposite is true. There is a right way to do every job, and that way is both the efficient way and the safe way. Thousands of business concerns, by organizing their plants for efficiency and safety, have prevented enormous economic losses as well as untold human suffering.

Although safety interest on the part of employers is widespread and growing every year, much remains to be done to secure universal acceptance of the importance of work safety. On the whole, the largest companies proved most successful in safety programs, whereas less progress was shown among the medium- and smaller-sized companies. This can be accounted for in part on the ground that the need for and the feasibility of doing something about accident prevention is more strikingly apparent where a large number of workers are concentrated in a single location.

It is standard practice among larger companies to assign responsibility for safety to specific individuals with special training in accident prevention work. Smaller companies, however, find it less practicable to make such assignments, often resulting in less favourable accident rates.

Public and private agencies of various kinds encourage and assist employers in promoting safety at work. The National Safety council, a private organization founded in 1913 and chartered by the U.S. congress in 1953, includes in its membership a high proportion of the nation's major industries, and makes available a great variety of publications and personal services in the industrial safety field. City and state safety councils perform somewhat related functions in the areas they serve.

Trade associations in the various industries showed an increasing tendency to make safety promotion work an important part of their activities. Their influence has proven particularly helpful in reaching and assisting smaller companies. which might not otherwise be well informed on safety methods and procedures. Insurance companies give major attention to the development and maintenance of effective safety programs and also participate with other groups in work safety programs generally.

Labour departments, industrial commissions and other government agencies, at local, state and national levels, share in the important task of work safety. Although basically concerned with law enforcement, many agencies provide assistance in accident prevention which goes far beyond the limits of legal requirements.

Labour organizations are able to exert an important influence on work safety. Through contractual arrangements with employers, support of company safety programs, and safety education among their members, they can contribute greatly to a safer work environment and safer working practices. An increasing number of safety committees in national, state and local labour groups is an evidence of a large and growing interest.

An interesting development on the part of many safety-minded employers has been the attention paid to off-job safety. For the United States as a whole, more than twice as many gainfully employed people are killed in accidents which occur away from their work as are killed in work accidents. Industries which have good job safety records find that the ratio of off-job to on-job fatalities is much higher. Faced with these facts, and realizing that the company suffers a serious loss, regardless of where an employee's accident occurs, many companies have undertaken extensive programs for the education of their employees in matters of traffic safety, home safety and general public safety.

One-quarter of all U.S. work fatalities and one-sixth of all work injuries occurred on farms in the mid-1950s. Special programs aimed at lowering the farm accident toll were developed. Farm safety committees, organized in about two-thirds of the states, carried on year-round programs aimed at reducing farm work accidents, as well as other accidents on farms. State departments of agriculture, farm youth groups and other influential agencies take an active interest in these activities. (*See* also PSYCHOLOGY, APPLIED; WORKMEN'S COMPENSATION.) (N. H. D.)

EUROPE

From mid-19th century the law of Great Britain required certain steps to be taken by employers for the protection of their employees against injuries likely to be sustained by them in the course of their work. For the second half of the 20th century, the Factories act of 1937 and 1948, together with the regulations made under the acts, provide. *inter alia*, a legal minimum of safety precautions to be taken in British industry. In many cases, however, factory owners have, on a voluntary basis, gone far beyond the legal requirements, and as a result of their efforts the number of industrial accidents is slowly decreasing: in 1937, out of every 1,000 people employed in industry, 30 were concerned in accidents; but by 1952 the proportion had dropped to 22.5%. Even so, in 1952, out of an industrial working population of approximately 9,000,000, nearly 800 were killed and 177,000 people had industrial accidents which were sufficiently serious to keep them from work for periods of more than three days. The distribution of these accidents is shown in Table IV.

TABLE IV.—*Distribution of Industrial* **Accidents,** *1952*

	Factories	Docks and warehouses	Building operations	Engineering construction	Total
Fatal	471		207	54	792
Non-fatal . .	154,995	6,969	12,325	2,325	176,718

By 1954 there were more than 237,000 registered factories in Great Britain. together employing about 7,352,000 workers. Of these factories, about 83% were small ones, employing 25 persons or less, that is, about 15.3% of the factory working population. At the other end of the scale, 24% of the working population was working in factories employing more than 1.000 workers. The conditions under which employment was held, therefore, varied very greatly indeed.

In addition to these factory workers, people employed in docks, warehouses, building operations and works of engineering construction are also subject to the Factories act; but the agricultural and mining populations are not, and no reference is made to them in this article.

The Factories act is administered by the factory department of the ministry of labour and national service, to whom reports of all accidents causing absence from work for more than three days must by law be reported. Many individual firms keep records of all accidents — however apparently trivial — and though these are not collected on a national scale, the experience of many firms who keep comprehensive records shows that they outnumber the reportable 3-day accidents by as many as 25–30 times.

At first the factory inspectors appointed by the factory department were regarded as policemen and informers by the factories under their jurisdiction, and in consequence for many years a large portion of industry was, to say the least, resentful and non-co-operative. By the 1950s, however, a great change had come about, and their duties in connection with accident prevention, considered to be their major problem, were becoming more and more advisory. The department has a staff of specialists much of whose time is engaged in research work, in providing material for the publication of technical pamphlets and in the solution of problems submitted to them by individual firms or industries.

The Factories act, accepted as a standard, is reproduced in a simplified fashion by all the members of the British Commonwealth; and in several of the British colonies (*e.g.*, the West Indies, Nigeria and the Gold Coast), factory acts have been passed and organizations similar to the factory department of the ministry of labour set up to supervise their enforcement.

Much of this progress has been the direct result of help and advice given by the factory department to the labour departments concerned in consultation with many voluntary organizations.

On the continent of Europe organizations similar to the factory department exist in most cocntries. Norway, Sweden and the Netherlands include also agriculture within their jurisdiction. The German, Swedish and Netherlands acts go into very much greater detail in their requirements than the British; and Germany, in particular, exercises a very close control over industry by a form of licence required by firms before they can start manufacture.

Legal control, however, can only reasonably be exercised in certain directions, where the specific action to be taken can be clearly stated by legal definitions; for example, the guarding of dangerous machinery and the methods of using, or protecting against, dangerous substances. However, a comparatively large proportion of accidents occur in connection with activities outside these categories (see below). To a very large extent these remaining hazards can be treated only very generally by legal definition, and a different approach has therefore to be made in regard to their prevention.

In Great Britain, the factory owner is responsible for the safety of his employees while they are at work. He is encouraged in his efforts not only by the comparatively high cost of accidents for which he is liable at common lam. having to pay compensation if the accidents occur through his negligence, but also by the social movements of the 20th century. Such influences, together with a belief in humanitarian principles, cause employers to support such organizations as the Royal Society for the Prevention of Accidents and the British Standards institution, as well as voluntary accident-prevention committees set up by industry and committees raised jointly with the government to define standards and to initiate research work on accidents. There is much evidence to show how this work has many times resulted in changes of methods and, through pressure on machine makers, in changes in the design of machine tools.

Within each industry, employers' organizations or joint organizations perform similar functions. In the more industrially developed section of the British Commonwealth, the position is similar. But on the continent of Europe there is considerable deviation from these methods; in Sweden, Norway and the Netherlands, regional committees are set up and are given statutory powers over the area that they control (the committees are sometimes employers' committees and sometimes joint committees of employers and workers); in Poland the formation of committees is usually on an industry basis. Proposals to force British industry to set up industrial accident committees by legal statute have been rejected on the grounds that voluntary work has a more effective driving force and that, where legal enforcement is used, progress is stultified and the mere letter of the law observed.

The influence exerted on accident prevention by the insurance companies differs in various countries. In Luxembourg, the work of factory inspection is done by the insurance representatives, and in Italy the insurance companies are the force behind the industrial accident-prevention movement. In the Netherlands, the insurance companies share the cost of accident-prevention research nith industry and government. In Great Britain, some insurance companies take a widely different view with regard to industrial injury risk: while suitably trained staff are engaged to act in an advisory capacity as to preventative measures to be taken by the insured in relation to the risk involved. these specialists are solely advisers and have only a limited duty with regard to undern riting.

Whatever organization of private enterprise supplements legal compulsion, the methods employed are rather similar. The case histories of industrial accident causes are first studied in careful detail and principles formulated to govern preventative methods. Information of this type, provided on a voluntary basis, is made available for the benefit of all industry by various central bodies. In Great Britain the information is generally disseminated by two principal bodies, the factory department of the ministry of labour and the Royal Society for the Prevention of Accidents. In addition, specialized knowledge for any particular industry is passed to those concerned through its particular association and made available to the two principals mentioned.

The Royal Society for the Prevention of Accidents is a voluntary nonprofit body of organizations and individuals concerned in the prevention of accidents of all kinds—on the roads and in the home as well as in industry. It is governed by a committee drawn from its members which, in regard to industrial accident prevention, consists of representatives of industrial firms and interested organizations such as insurance companies and employees' organizations.

Principles **of** Security.— The principles evolved by the Royal Society for the Prevention of Accidents deal with two facets of accident prevention. In the first place, six guiding principles have been enunciated for the organization of an effective accident-prevention campaign within individual industrial concerns: (1) that the driving force must come from the highest level of management; (2) that the direction of the campaign must be delegated to a single individual; (3) that comprehensive records and statistics must be maintained; (4) that the campaign must be directed by factual studies of inspection, investigation and job-safety analyses; (5) that much of the organization's work must be delegated to a works-safety committee; and (6) that the education of both workers and management through continuous propaganda is a vital part of the organization. These principles, evolved from the continuous experience of the society's members, have the support of the larger industrial firms in Great Britain who have organized for accident prevention successfully on these lines.

In the second place, general principles as to the method of preventing accidents have been established. If a method of work, a substance, a force, or a part of a machine or process is dangerous, then (1) the first consideration should be to do away with it and/or replace it by a safe method of work, substance, force or part of a machine or process; if this proves impossible or for the time being impracticable, then (2) the unsafe method of work, substance, force or part of the machine or process should be completely enclosed against the intrusion of any part of any worker's body, or so enclosed or controlled that any noxious substance is prevented from contact with the worker; if both these methods prove impossible or impracticable, then (3) all workers liable in any way to be adversely affected should be supplied with some form of protective clothing.

Action to be taken in accordance with the first of these latter principles would include the scrapping of mushroom-headed chisels, the use of which should be discontinued; the substitution of shot-blasting instead of sandblasting in many cases, because silica sand as dust in the atmosphere is a dangerous substance; and the substitution on occasion of gravity as a force instead of electricity which can be dangerous. Many parts of machines which have been in themselves dangerous, such as shafting, belts, spur gears, etc., have been either done away with entirely or replaced as a result of improvement in design.

In accordance with the second principle, that of enclosure, the practice of inserting blanks by hand between press dies has been almost entirely superseded by the fixing of guards which totally enclose the hazard at the time of operation and through which material to be processed is inserted either by mechanical means or by the use of a variety of holding tools. Likewise the filling of carboys with acid from drums by open pouring has been replaced by totally enclosed methods of transfer. The commonest case of a force's being totally enclosed is the insulation surrounding electric conductors.

In accordance with the third principle, an example of enclosing the worker instead of the work is to be seen when metal is ground with a portable grinder. This operation gives rise to danger to the eyes. but, as in many cases the wheel is difficult to enclose, goggles are provided for the worker. Again, the use of acid—when it cannot be enclosed—usually necessitates the workers' being totally enclosed by protective clothing of rubber or some similar material. When in exceptional circumstances it is essential to work on live electric circuits, the worker is protected by insulating mats, gloves, fuse holders, etc. Where objects may fall unexpectedly or splashes of hot metal cause injury, safety hats and boots and protective leggings or spats should be worn. These are some of the commonest examples, but it has been found that the principles apply

alone or in combination in every case in industrial practice.

Types of Accident.—Research has shown that the total number of industrial accidents may be analyzed according to the various causes as follows: handling goods, 27.8%; power-driven machinery, 16.4%; persons falling, 13.3%; use of hand tools, 8.8%; persons struck by falling objects, 8.7%; persons stepping on or striking against objects, 7.3%; molten metal or other hot corrosive substances, 4.2%; transport (other than railways), 3.3%; railway transport, 1.6%; and miscellaneous causes not specified above, 8.6%.

The handling of goods is at the top of the list because it is undoubtedly the most common industrial operation. The accidents which arise during this operation are commonly caused by lack of a clear path along which to move the goods, by lack of an intelligible direction when a gang is handling material together, by lack of accurate knowledge of the weight of the materials, by lack of knowledge of the correct way to grasp and to lift and by lack of correct placement and stacking. Obviously, the best means of preventing such accidents is not to handle goods, or at least not to handle them so much. Handling can often be reduced or obviated by studying layouts and methods of work with a view to reducing movements or improving supervision. Keeping workers better informed about weights and teaching them the best methods of lifting, placing and stacking will also reduce the number of handling accidents.

Power-driven machinery commonly causes accidents where it is not properly or adequately guarded. In Great Britain the real solution is to comply strictly with the law not only to guard machinery, but also to use the most effective guards and to maintain them properly in both condition and adjustment. In some countries, less reliance is placed on guarding and more on the training of operators. The best result will no doubt be derived from the intelligent use of both methods. Accidents other than those caused by lack of adequate guarding constitute a small proportion of those connected with power-driven machinery and are largely due to some unsafe method of using the machine; they usually can be prevented only by careful training of the operator.

Persons falling may fall on the same level as well as from one level to another. Building operations account for a high proportion of the most serious of such accidents because of the nature of the work. The most common causes are unguarded openings, platforms without guardrails; untidy, obstructed or badly maintained walkways; and slippery walking surfaces. The methods of prevention are to guard all openings, however temporary; to erect proper guardrails on all working platforms; and to ensure that walkways to working platforms are adequate and in good condition. Walkways should be designed to avoid obstacles and should be maintained in a clear condition free of obstruction.

The use of hand tools may give rise to accidents when the tools are in bad condition or misused. The preventative measures are obvious—to maintain tools in good condition and not to improvise.

Persons are most likely to be struck by falling objects, for example, when tools or materials are improperly placed on overhead working platforms or in unsuitable places where they are either shaken loose by vibration or knocked over the edge. The preventative measures, apart from the erection of toe boards where necessary, consist of careful consideration of the placement of such materials, the training of workers to use proper methods and the provision of suitable containers for tools, etc., when necessary.

Accidental stepping on or striking against objects is most often due to bad housekeeping; *i.e.*, haphazard placing of tools, materials and equipment in relation to walkways. The curative methods are better planning and insistence on maintaining the plan. Subsidiary causes which can be avoided by foresight in planning include the taking of unauthorized short cuts and unnoticeable projections into walkways from adjacent structures.

Accidents associated with molten metal or other hot or corrosive substances are usually caused by unsafe methods of handling such materials or a breakdown of the handling equipment. They are largely prevented by the redesign of methods. by the good maintenance of equipment and by provision of protective clothing for workers.

Transport (other than railway transport) tends to present an increasing problem as more handling is done mechanically. The most common cause of transport accidents is the failure to consider the movements of pedestrians when planning the movements of transport. This is to be expected because of the progressive introduction of mechanical transport vehicles within and about the factories, tending to allow their use on existing routes not originally designed for such purposes. The cure, often impossible economically, is the replanning and redesigning of the factories; the alternative is very careful training of transport operators and other workers and strict enforcement of factory traffic regulations by all grades of supervisors.

The cause of accidents associated with railways within and about factories are not greatly dissimilar from those of other vehicles. The only effective measures are: careful consideration of design and layout within the factory boundary; the introduction of a supervised compliance with operating codes; and the careful training of operators and workmen to meet the hazards in each particular factory.

To speak generally, it is not very difficult to plan preventative measures in connection with most of the causes of accidents in industry. The real problem arises when an attempt is made to put these measures into operation. Though the accident-prevention scheme may be perfect in theory, it can be put into practice only so long as it receives the co-operation of the working force. Without this co-operation on the part of the workers the best-planned safety precautions will be of no avail. (H. I. S.)

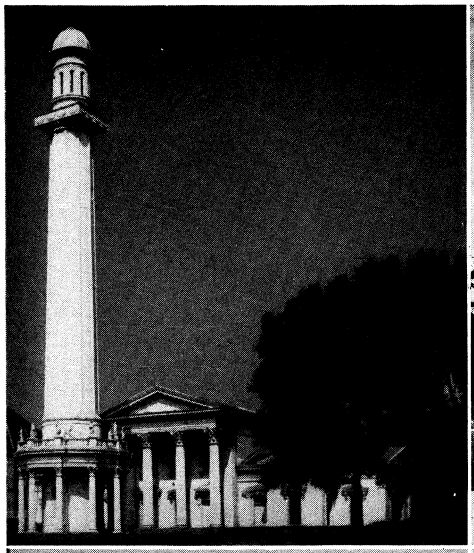
INDUSTRIAL ALCOHOL. In order to provide tax-free grain alcohol for use in industry, many governments have set up a special classification of industrial alcohol. In addition to a close watch on records to insure that industrial alcohol is not diverted to beverage production, laws provide that it be denatured, *i.e.*, made unfit for human consumption by the addition of a poisonous substance which cannot be easily distilled out. *See* ALCOHOL: *Preparation.*

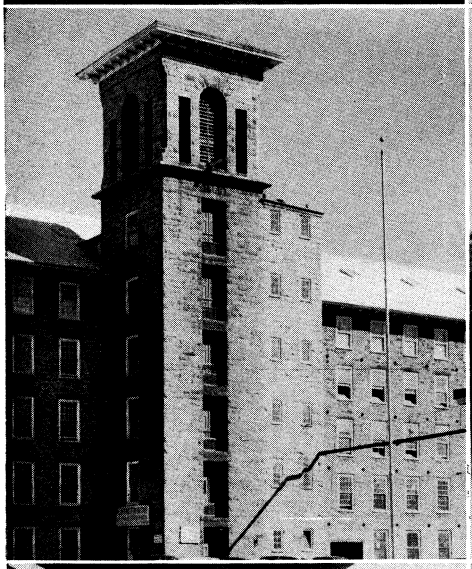
INDUSTRIAL ARBITRATION AND CONCILIATION: *see* INDUSTRIAL RELATIONS.

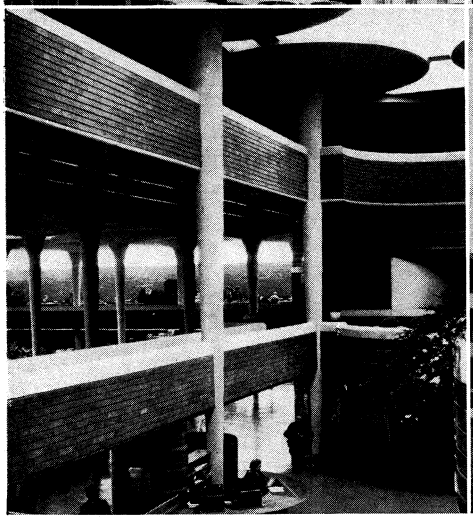
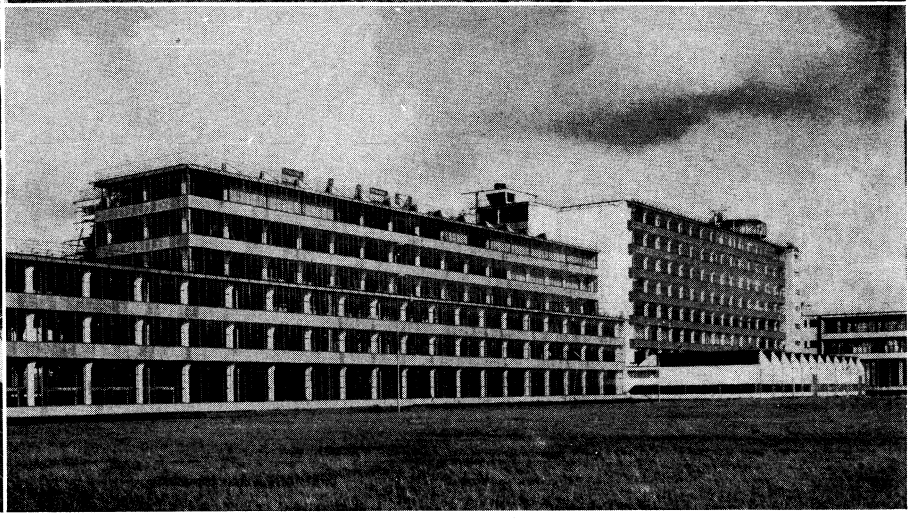
INDUSTRIAL ARCHITECTURE, in this article, refers primarily to the design of buildings, such as factories, administration buildings, laboratories, etc., for manufacturing and related operations from the time of the Industrial Revolution to the present.

GENERAL DEVELOPMENT

Architecturally, industrial buildings can be said to have had the following sequence of phases: water power was paralleled by buildings in wood and stone; steam power by constructions in brick and metal, at first cast and wrought iron, later steel; electric power by reinforced concrete construction. Externally, the late 18th-century mills were characterized by domestic scale and academic compositions, often with cupolas like public buildings. During the 19th century the facfbry followed contemporary stylistic fashions, Greek, Gothic and Italian villa. The same details and towers appeared on them as on the owners' houses. In the latter part of the 19th century, most architects devoted their talents to public buildings and palatial residences, leaving the inartistic factories to the engineers who, however, attacked the problem creatively and produced buildings of genuine integrity. The engineers showed so much vitality that in the early 20th century, when a new architecture based on functionalism was being born, it was the engineer-designed buildings that triumphed. They were rational and scientific; they directly and economically expressed the purpose for which they had been built, and their materials did not make irrelevant concessions to good taste. Grain elevators, factories and office buildings of Chicago, Ill., were hailed as masterpieces. By 1925 a new architectural style had been created, known as modern or as the international style. Nothing so wholly independent of the past had been found in western culture since the end of the middle ages; hence a belated consequence of the Industrial Revolution was, incongruously, the creation of a new art. This was to be seen in Peter Behrens' tube company at Diisseldorf, Ger., of 1911, his chemical factory at Hochst am Main of 1920–





BY COURTESY OF (CENTRE RIGHT) AVERY LIBRARY, W.P.A. PHOTOGRAPH, (BOTTOM LEFT) S C JOHNSON & SON INC., (BOTTOM RIGHT) MUSEUM OF MODERN ART, N.Y.; PHOTOGRAPHS (TOP LEFT, TOP RIGHT, CENTRE LEFT) WAYNE ANDREWS

DEVELOPMENTS IN INDUSTRIAL ARCHITECTURE, 18TH TO 20TH CENTURIES

Top ***left:*** Waterworks, Louisville, Ky. T. R. Scowden, arch.; 1860
Top ***right:*** Workers' unit and clerks' auarters of the saltworks at Arcet-Senans, France. C. N. Ledoux, arch.; 1775–79
Centre left: Durfee mills, Fail River, Mass.: 1887–88
Centre right: Mill at Davisville, R.I.; 1847
Bottom left: Lobby of S. C. Johnson & Son, Inc., Racine, Wis. Frank Lloyd Wright, arch.: 1938–49
Bottom right: Van Nelle tobacco factory, Rotterdam, Netherlands. J. A. Brinkman and L. C. Van der Vlught, arch.; 1920s

INDUSTRIAL ARCHITECTURE

BY COURTESY OF (CENTRE RIGHT) "ARCHITECTURAL REVIEW.' (BOTTOM LEFT) "ARCHITECTS' JOURNAL," (BOTTOM RIGHT) U.S. ATOMIC ENERGY COMMISSION; PHOTOGRAPHS (TOP) HEDRICH-BLESSING, (CENTRE, TOP) WAYNE ANDREWS, (CENTRE LEFT) GOTTSCHE-SCHLEISNER

U.S. AND BRITISH INDUSTRIAL BUILDINGS OF THE 20TH CENTURY

Top: Ohio Steel Foundry company, Lima. Albert Kahn, Inc., arch.; 1939
Centre, top: Styling building of the General Motors Technical centre, Warren, Mich. Eero Saarinen and associates, arch.; 1951–55
Centre left: Esso building, Baton Rouge. La. Lathrop Douglass, arch.
Centre right: Brynmawr Rubber factory, Brynmawr, S. Wales. The Architect's Co-Partnership, 1949
Bottom left: Factory for Messrs. Boots, Beeston, Eng. Sir Evan Owen Williams, arch.; 1933
Bottom right: Reactor area of the Hanford (Wash.) Works, U.S. Atomic Energy commission; during World War II

24, Hans Poelzig's chemical factory at Luban, Pol., of 1912, and Auguste Perret's clothing factory in Paris, 1919, with its elegant reinforced concrete arches. These reflected a vigorous expressionism, also dramatically presented in Eric (Erich) Mendelsohn's sketches of 1914–18. S. van Ravestyn's buildings for the Dutch railways combined clarity, lightness and a sensitive handling of scale and proportion.

This appeal was felt by a few discerning spirits in the 19th century, but the strangenesses of proportion and of scale became more familiar after World War I, and the aesthetic merits of the better ones were then forcefully publicized. Merz and McClellan's power station at Dunston near Newcastle, with its steel frame and glass curtain walls, seemed infinitely preferable to Sir Giles Gilbert Scott's Battersea power station with its inappropriate monumentality.

Of the thousands of meritorious industrial buildings all over the world from the U.S.S.R. to Brazil, it is possible to mention specifically only a few. However, many badly designed industrial buildings continued to be built, emphasizing mass instead of lines and planes—buildings which affected simplicity, buildings which clung tenaciously to tradition in a misguided attempt at beauty. Factories could be seen everywhere hiding behind fancy-dress Georgian or Tudor fronts.

Metal Construction.— The use of iron instead of wood for columns and beams was developing at the end of the 18th century so that by 1801 at Salford, England, the Phillips and Lee mill, designed by the engineers Matthew Boulton and James Watt, was a seven-story, fireproof building, its interior cluttered by a forest of columns spaced 9 ft. by 14 ft. The mills at Saltaire, Eng., built in 1853 by the engineer Sir William Fairbairn, marked the increased size attainable a half century later. The top floor was a single room 550 ft. by 50 ft. without any incumbrances to interfere with the most efficient disposition of the machinery. Other buildings there had saw-tooth roofs. These structures had an enclosing envelope of load-bearing masonry walls.

The first factory built without structural masonry, with all the load-bearing parts in metal, was the Menier chocolate factory of 1871 at Noisiel, Fr. In, the meantime the Crystal palace in London of 1851 by Sir Joseph Paxton had demonstrated the advantages of metal construction, glass walls and prefabricated, standardized, mass-produced parts. From 1848, James Bogardus, in the United States, developed ingenious iron-framed structural systems.

Steel, more available after the invention of the Bessemer process, was gradually substituted for iron and permitted wider rooms and larger windows. The daring use of metal trusses for wide spans in bridges, train sheds, and exhibition halls was one of the most notable developments of 19th-century engineering; spans of 200 ft. were being regularly achieved by 1860 and of more than 300 ft. by the end of the century. Masonry and wood throughout history had not often reached spans of 80 ft. These achievements did not influence industrial building until the 20th century. Meanwhile a totally new medium, concrete combined with reinforcing tension rods of steel, was being developed. After many years of experimentation, beginning about 1860, sufficient confidence was gained so that around the turn of the century the medium was being widely applied. François Hennebique's system was used at the Marconi factory at Genoa, It. After World War I, traditional masonry systems became obsolete for large buildings (See REINFORCED CONCRETE.)

20TH-CENTURY INDUSTRIAL ARCHITECTURE

Characteristics.— There were four notable developments in industrial building after 1900: (1) extensive one-story plans; (2) the use of light roof trusses in spans of 40–80 ft.; (3) the thinning down of the enclosing masonry shroud at first to glass and for some processes its elimination altogether; and (4) the dispersion of factory sites from town to open country, partly for security but chiefly because of inexpensive land costs and increased road transport.

One-Story Plants.— Great changes in production methods made possible Albert Kahn's automobile plants. The basic idea was assembly-line production in which, by means of conveyors, exactly machined parts were added until an endless stream of automobiles would roll out of the exit. This called for enormous spaces, preferably one story. The early examples occurred in Detroit, Mich., and in Turin, It., where Matte Truco's Fiat factory (1922) had an assembly line 2 km. long. The most expensive plant of this kind up to its time was built at Willow Run, Mich., during World War II.

Reduction of Roof and Wall Supports.— Although factory windows had been generous from the beginning (Stanley mill, 1813), full development of the glass wall as something separate from the structure was slow in coming. During most of the 19th century factories were long severe blocks, three or four stories high, the top floor lit by monitors, the brick walls monotonously punctured by windows at regular intervals. Toward the end of the century the columns which had been used for intermediate supports were also applied to the exterior walls, and the wall itself reduced to a thin, sometimes transparent, curtain against the weather. The structural skeleton, whether of metal or reinforced concrete, was revealed in such buildings as those of Montgomery Ward at Chicago (1909) and the Administration building of the Fagus shoe plant (1911) by Walter Gropius and Adolph Meyer. In such buildings the proportion of glass to wall was radically shifted from one-third to nine-tenths. This could also be seen in Peter Behrens' turbine factory of 1909 in Berlin, Ger., and in the later Van Nelle tobacco factory outside Rotterdam, Neth., by J. A. Brinkman and L. C. van der Vlught. There the supporting columns were set back from the plane of the wall and the glass ran practically continuously around the building. The final step in this sequence, up to mid-20th century, was the Bluebonnet plant in Corpus Christi, Tex., where it was found that some steps in the manufacturing process did not require either curtain walls or roofs because of the climate. The machines had, in a sense, become the building.

Site Dispersion.— In the early days of the Industrial Revolution factories were perforce located on river banks and at ports. Hence the industrial "cinder belt" spread along the coasts. The use of coal for power and the growth of railways opened up new sites, and finally the efficient transmission of electric power paralleled by the development of motor vehicles made the manufacturer even more geographically independent. If materials and finished articles could be shipped by truck, and if workers could be brought considerable distances by cars and buses, factories could be built on the cheap land outside cities as low, rambling, flow-line-shaped buildings. In some cases these advantages were sufficient to justify the creation of wholly new industrial towns complete with housing, stores and civic centres. This practice was accelerated during World War II when it was realized that the congested industrial area presented too vulnerable a target to long-range bombers; that camouflage was helpless against radar and that dispersion was the best defense. The atomic energy plant at Los Alamos, N.M., was an example of this trend, stimulated by the need for both security and secrecy.

A number of industrial cities had been built during the 19th century. Sir Titus Salt's Saltaire was once a model town of this kind, as was Alfred Krupp's community at Essen, Ger. Some of these offered wholesome living conditions as in the early days of Lowell, Mass.; some were in too subservient a position to the founding company, as Bournville, Eng. (1895). These industrially sponsored communities provided working models for the government-sponsored communities of the 20th century. Industrial towns of later date include Zlin in Czechoslovakia in which factories, stores, public buildings and housing were designed by one architect on one module, for one owner. One of the most important centres from the points of view of manufacturing, health and aesthetics was the group of buildings, factories, houses and stores on the island of Kvarnholm near Stockholm, Swed., designed in the late 1920s and in the early 1930s for the Swedish co-operative societies.

Among the solutions to the industrial city following World War II were the designs by Paul Lester Weiner and José Luis Sert for mining towns in the Venezuelan mountains. These towns, Puerto Ordaz and Ciudad Piar, were communities planned for the

pedestrian. They conformed to the economic and social structure of the region.

(See also CITY PLANNING.)

The **U.S.** and Great Britain. — Comparable to the magnificent factories built in the United States by Albert Kahn and the Austin company was Sir Evan Owen William's work in England. His best-known plant, that for Messrs. Boots near Nottingham, begun about 1933, was planned around a streamlined flow system, from raw materials at one side to packaged articles at the other. In post-World War II Great Britain the Brynmawr Rubber Factory at Brynmawr (1949), by the Architect's Co-Partnership, utilized a modular, domical, thin-shell concrete construction pierced by skylights to provide admirable, economical lighting and ventilation.

The postwar development of the atomic-energy industry showed that promising architectural achievements could be expected from the new requirements in this field. Plants in the U.S. at Hanford, Wash., and Aiken, S.C.. and the Windscale factory at Sellafield in England exhibited aggressive, even if utilitarian, architectural solutions. In the U.S. the postwar addition of the tower laboratory to the Racine, Wis., Johnson Wax complex (1949; earlier buildings. 1938) by Frank Lloyd Wright disclosed interesting and unusual planning and structural features. Among the other outstanding examples, special mention should be made of the General Motors Technical centre, Warren, Mich., a gigantic complex of buildings arranged on a palatial 18th-century scale with fountains that pump more water than those of Versailles. Somewhat less ostentatious, but done with equal precision, were the Heinz laboratories in Pittsburgh, Pa., by Skidmore. Owings and Merrill (1953) and the *Oregonian* newspaper plant in Portland, Ore. (1948), by Pietro Belluschi.

Elsewhere. — In the late 1940s and early 1950s Latin America and Italy excelled in the development of reinforced concrete structures. Felix Candela in Mexico was perfecting the warped shell (Rio's warehouse, 1955; Parasina textile plant, 1953; both in Mexico, D.F.), and was developing greater refinements on the catenary and barrel vault thin shell (Mexican custom's warehouse, Mexico, D.F., 1953; P.I.S.A. factory, S. Bartolo Naucalpan, 1951). In Argentina, the S.I.T. spinning shed at Pilar, by José Delpini (1950), provided exceptionally good lighting conditions by the use of curved concrete shells supported on concrete catenary arches.

In Italy. meanwhile. Pier Luigi Nervi continued the tradition of François Hennebique and Robert Maillart and converted the flat slab into a highly articulated and expressive structure (tobacco warehouse. Bologna. 1949; Lanificio Gatti factory, Rome, 1951), and invented methods for using prefabrication techniques in concrete construction (salt warehouse, Tortona, 1952; exposition hall, Turin, 1948).

Elsewhere in Europe distinguished solutions to all sorts of industrial building problems, including workers' housing. occurred in such small, integrated countries as Finland, Denmark, the Netherlands and Switzerland. In Finland, the sawmill at Varkaus, destroyed in World War II and rebuilt by Alvar Aalto (1947), was seen to be allied in its mildly expressionist phrasing to the earlier work of Eric Mendelsohn (hat factory, Luckenwalde, Ger., 1923).

See also ARCHITECTURAL ENGINEERING; ARCHITECTURE; ARCHITECTURE [ARTICLES ON]; MODERN ARCHITECTURE; and for separate articles on other types of industrial structures *see* AIRPORT; DAM; etc.

BIBLIOGRAPHY.—*See* bibliography in E. D. Mills, *The Modern Factory (1951)*; Kenneth Reid (ed.), *Industrial Buildings, the Architectural Record of a Decade (1952)*; Sigfried Giedion, *Space, Time and Architecture (1941)*; and architectural and engineering periodicals of each country. (C. L. V. M.; H. MN.)

INDUSTRIAL COUNCILS. By this name are usually meant joint councils formed by employers' associations and trade unions for the discussion of industrial problems. They range from general bodies intended to cover all or most industries on a national scale, through national bodies for particular industries, to regional and local bodies either for a number of industries or for a single industry. In Great Britain the name "industrial council" was used for a joint body set up in 1911 by the government to act as a general court of reference on industrial matters and also to act as a conciliator, without compulsory powers, in any particular dispute referred to it. This body never functioned effectively, and was discarded during World War I, when special machinery for compulsory arbitration was established under the Munitions of War acts, 1915 to 1917 (*see* INDUSTRIAL COURT). The name was revived in the reports of the Whitley committee on the Relations between Employers and Employed (1917), which recommended the setting up in all organized industries of joint industrial councils for the improvement of industrial relations and, in less well-organized industries, either of interim reconstruction committees, some of which grew into industrial councils. or of trade boards, later renamed wages councils. (Only these last were given any legal power to fix wages—that is, minimum wages.) The Whitley committee further recommended that under the industrial councils there should be joint regional councils similarly constituted, and also joint works committees. The original intention of the Whitley committee was that the councils should be primarily not negotiating bodies but meeting places for the joint discussion of wider economic and industrial issues. In practice, however, the councils were successful only when they turned into negotiating agencies for settling questions of wages and conditions, chiefly in lesser industries and in the public services: most of the major industries, which had already their own systems of collective bargaining, refused to set up councils of the new type. The government at first refused to introduce the system into the civil service but had to give way; and it was also successfully applied in local government. In 1919 the joint industrial councils asked for power to make compulsory settlements on wages and conditions which could be extended by order of the minister of labour to all firms in the industries concerned; but this proposal was rejected. At the same time the National Industrial conference called by the government in 1919 to consider post-World War I industrial relations proposed the establishment of a national joint industrial council representing employers' associations and trade unions in all industries; but the government did not act on this proposal. It was revived after the general strike of 1926 by a group of employers headed by Sir Alfred Mond (later Lord Melchett), who approached the Trades Union congress on the matter. The outcome was a report recommending such a body; but this was rejected in the form proposed by the main employers' organizations, and only a much reduced plan of occasional joint consultation emerged. War, however, changed the situation: in Oct. 1939 the minister of labour called a conference of representatives of the British Employers' confederation and of the Trades Union congress, which set up a National Joint Advisory council: in May 1940 this council established a smaller Joint Consultative committee, and similar bodies were set up to advise each of the main government departments concerned with labour questions. These joint councils and committees remained in being after 1945. The joint industrial councils for particular industries also continued to function, still without any compulsory powers. The joint works committees proposed in the Whitley reports were never set up in more than a few establishments, the main development of works committees taking place outside the industries covered by industrial councils. Only the post office and the royal dockyards and arsenals developed a full system of works committees on the Whitley plan. When joint production committees in particular works were set up in large numbers in the war industries from 1940 onward. they had no connection with the Whitley plan but were related to the joint consultative bodies set up at national and regional levels in the government departments concerned with war industries. These joint production committees in many cases turned into joint consultative committees after 1945, but survived mainly in the engineering, shipbuilding, electrical and coal-mining industries, none of which had joint industrial councils on the Whitley model. The establishment of joint consultative bodies at all levels was made a statutory duty of the boards set up after 1945 to administer the nationalized industries; and in these industries the national consultative committees are meant to do the work intended by the Whitley committee to be done by the joint indus-

trial councils, as distinct from negotiations about wages and conditions, which are conducted through different channels. (See also INDUSTRIAL RELATIONS; STRIKES AND LOCKOUTS.)

BIBLIOGRAPHY.—Ministry of Labour, *Industrial Relations Handbook* (London, 1944) and *Supplement No. 3* (1949; new consolidated ed. announced, 1951); *Reports,* (Whitley) Committee on the Relations between Employers and Employed (London, 1917); *Annual Reports,* Ministry of Labour; *Annual Reports,* Trades Union Congress, from 1927 (for Mond negotiations) and from 1939 (for later developments); *Report,* National Industrial Conference (London, 1919).

(G. D. H. C.)

INDUSTRIAL COURT. The name "industrial court" has been used with a number of different meanings, including its use to describe a proposed court of justice designed to take the place of the county court in Great Britain in dealing with legal cases arising out of conditions of employment, industrial accidents, etc., and to describe tribunals set up for similar purposes in other countries. In Great Britain a particular body, the Industrial court, was set up under the Industrial Courts act, 1919, not as a law court but as an arbitration tribunal to which industrial disputes can be referred by mutual consent of the parties. This court was a successor to the government arbitration tribunal established during World War I under the name of the Committee on Production (1915), which was reconstituted in 1918 as the Interim Court of Arbitration and a year later as the Industrial court. The government continued to appoint the members, drawn from trade unions and employers' associations; but after 1919 it had no power to refer any case to the court without the consent of the parties, though the minister of labour could, under part ii of the Industrial Courts act, refer any dispute to a specially constituted court of inquiry. Such a court of inquiry could only make a report on the circumstances of any dispute referred to it, and any recommendations for a settlement had no binding character. The Industrial court, on the other hand, issued awards on the disputes referred to it, which were formally binding on the parties, though no sanctions were provided for nonobservance.

The Industrial court was used by some industries throughout the period between World Wars I and II as a regular agency for the settlement of wage and other disputes (*e.g.,* railway shopmen) and by other industries as an occasional court of reference for particular disputes. It did not, however, establish itself as a general court of arbitration for all industries: nor was it meant to, for the Industrial Courts act allowed the minister to refer disputes, with the consent of the parties, to other forms of arbitration; *e.g.,* by *ad hoc* bodies. Cases affecting civil servants were kept outside its jurisdiction, and were referred to a special Civil Service Arbitration tribunal; and the railways (traffic grades), coal mines and certain other industries set up or were given special machinery of their own.

The court continued to operate during and after World War II; but when arbitration was made compulsory in 1940 a new body, the National Arbitration tribunal, was set up, and the minister was empowered to extend the awards of this body to cover firms not directly parties to the proceedings but engaged in the same types of work. Much of the work of the Industrial court passed over to the new tribunal.

After 1945 the wartime system of arbitration was continued, and the court and the tribunal continued to operate side by side. The minister of labour also retained his power to refer disputes to special or ad *hoc* tribunals. Strikes and lockouts were prohibited, unless a dispute had been reported to the minister and he failed to refer it within three weeks for some form of settlement. These provisions were reviewed in 1951.

See Ministry of Labour, *Industrial Relations Handbook* (London, 1944) and *Supplements;* also Ministry of Labour, *Annual Reports.*

(G. D. H. C.)

INDUSTRIAL DESIGN. Industrial design is, properly, design of wares produced by large-scale industry for mass distribution. Designing such wares means, first, planning their structure, operation and appearance; then planning these to fit efficient production, distribution and selling procedures. Clearly appearance is but one factor in such a complex process. Nevertheless, in consumer goods especially, appearance design is widely accepted as the principal virtue of industrial design; it is that portion of the whole least subject to rational analysis, and like craft secrets of the past, advantageous in commercial competition. On the other hand, design of equipment for production, for services and for sports is expected to demonstrate utility; but in these products too, appearance design is increasingly evident.

Practice. — Industrial design is supplied to manufacturers by three kinds of designers: staff designers, fully employed by one firm; designers under contract, who may serve several clients simultaneously, generally avoiding conflicts of interest; and free lances who sell designs, often with royalty agreements, to the best-paying manufacturer. A designer may practise these last two ways simultaneously. Free lances fit least well into big industry where gradual design development through group consultation is a usual precaution against monetary risk; staff designers often have been opposed effectively by fellow employees — salesmen and engineers; the most vigorous advances have been made by designers under contract. Some large manufacturers have raised the status and salaries of staff designers to match those enjoyed by designers under contract; outside designers are frequently called to consult with staff designers. Industrial design gains economic importance when both technological advance and commercial enterprise tend to become competitively equalized within an industry.

Development. — The first known industrial designer worked under admirable conditions: Peter Behrens (1868–1940) in 1907 was hired by the Allgemeine Elektrizitats-Gesellschaft in Germany to be their architect, industrial designer and graphic designer, in fact to give unified visible character to the numerous activities of a giant enterprise. Behrens had other clients and professional duties besides. A member of the architectural profession. Behrens applied its standards and ethics to his work as industrial designer, founding in 1907 with others an important association of designers and businessmen, the Deutscher Werkbund. As a direct result, the German and Swiss Werkbunds became well-established professional organizations of industrial designers. In the United States and Great Britain industrial designers have initiated legally recognized professional associations, nith codes of conduct, educational standards. etc. In other countries practice and organization are less advanced. In London the Royal Society of Arts designates qualifying practitioners as Royal Designers for Industry; in the U.S. both the American Society of Industrial Designers and the Industrial Designers' institute grant memberships only to those subscribing to codes and limitations of practice. In Britain the Council of Industrial Design was established in 1944 to advise on design, recommend designers, provide courses in design appreciation for trade and exhibitions for the public.

Industrial design in the U.S. began to grow after the 1929 depression, in Great Britain even later. Then and since, continual change has characterized the materials, power sources and production and distribution methods of the mass market. Everywhere industrial-design educators are seeking suitable curriculums; the national organizations mentioned furnish current information about schooling. Considering the short time, shifting situations and high stakes, professional attitudes in the English-speaking countries can be considered well advanced. Disputes among designers and with nearly related professionals nevertheless are usually resolved by economic competition rather than by appeal to vested rights, as in labour unions and many professions.

Style. — Industrial design has evolved no unified style, even for industries where handwork is minimized. There have been, however, four controversial style trends. The first is impersonality; here again Behrens established the precedent. Design for industry, whether determined by one man or by a group, shows a certain neutrality of expression. This impersonality has been acclaimed as the natural aspect of mass production and marketing, of average taste in a democratic community. It has been condemned as submission to the machine, contradictory to free individual expression and in consumer goods a cold substitute for the handicraft touch. The style has, so far, persisted. Secondly, industrial design is associated with the trend to provide an envelope for a product, leaving the inner workings to engineers. Complicated mechanical and electronic assemblies which have come into common use

require protective shells for safety, cleanliness and orderly appearance. Here industrial designers are accused of superficial embellishment, suitable in package design and fashion. But, in product design, appearance! structure and operation ideally should seem fused, an ideal perhaps too stringent. The third trend, streamlining, is widespread in industrial styling. Originally the term applied to shapes efficient in fast motion through fluids. Such shapes have typical, expressive, curved surfaces and smooth transitions between parts; speeding through their mediums these shapes may leave visible tracks, extending from their extremities like comet tails. Such teardrop shapes and speed whiskers became symbols of speed in an age fascinated by ever-faster motion. These symbols were seized by industrial designers and applied to objects intrinsically unassociated with speed; hence the criticism. But symbols frequently drift away from original significations; here designers may be merely more human than logical. The fourth trend is artificially accelerated obsolescence, that is, design that intentionally tempts owners to replace goods with new purchases more frequently than would be necessary as a result of normal wear and tear or established custom. Beginning in the field of fashion, artificial obsolescence has become something of a custom itself in industrialized countries, It operates through public opinion molded by advertising. through price changes and through improvement and change in utility as well as through appearance change provided by designers. Its assessment must be established on wide social and economic considerations, not on design values alone. Especially in automobile and large home appliance design, artificial obsolescence has aroused strong emotional and rational reactions; yet, because of its demonstrable economic effectiveness, it is used increasingly. At least in fashion, and as disposability in everything to d~ with cleanliness and health, the trend has been enthusiastically welcomed.

Industrial design is a growing force, influencing and influenced by world economy, private efficacy and enjoyment, the arts, engineering and, not least, education. It has contributed more to economic activity than to achievement in the arts; here lies its most challenging future.

Notable designers for industry in the mid-20th century include in Great Britain, Wells Coates and Gaby Schreiber; in Germany, Egon Eiermann and Wilhelm Wagenfeld; in Switzerland, Emil Guhl and Max Bill; in the U.S., Charles Eames and Harley J. Earl,

BIBLIOGRAPHY.—*Periodicals: Design; Domus; Industrial Design; Werk.*

Yearbooks: Society of Industrial Artists, *Designers in Britain* (biennially, 1947); Gerd Hatje (ed.), *Idea* (1953); American Society of Industrial Designers, *Industrial Design in America* (1954); Schweizerischer Werkbund, *Schweizer Warenkatalog* (1954).

Practical Guides: F. C. Ashford, *Designing for Industry* (195;); Arthur A. Houghton. *Design Policy Within Industry* (1951); Wilhelm Braun-Feldweg, *Normen und Formen industrieller Produktion* (1954); J. Gordon Lippincott, *Design for Business* (1947); Frank A. Mercer, *The Industrial Design Consultant* (1947); Nikolaus Pevsner, *An Enquiry Into Industrial Art in England* (1937); Michael Farr, *Design in British Industry* (1955); Harold L. Van Doren, *Industrial Design,* 2nd ed. (1954).

History and Theory: Herbert Bayer *et al.* (eds.), *Bauhaus, 1919–1928* (1952); Max Bill, *Form* (1952); Sigfried Giedion, *Mechanization Takes Command* (1948); Nikolaus Pevsner, *Pioneers of Modern Design, From William Morris to Walter Gropius* (1949); Sir Herbert E. Read, *Art and Industry* (1953); Henry Dreyfuss, *Designing for People* (1955); Raymond Loewy, *Never Leave Well Enough Alone* (1951); Walter Dorwin Teague, *Design This Day* (1940). (ER. K.)

INDUSTRIAL ENGINEERING is the branch of engineering technology primarily concerned with organizing and conducting the technical aspects of manufacturing operations. As a technology, industrial engineering utilizes not only mathematics and the physical sciences but also the social sciences (including economics) and the principles of engineering analysis and synthesis. Its primary tasks are to design manufacturing systems and to predict, control and evaluate the results obtained from such systems.

Three managerial groups commonly are found within an industrial organization: (1) management, a group that makes decisions directly affecting the operating divisions; (2) industrial engineers, who make plans for controlling and evaluating work in process and who also make plans for proposed work; and (3) industrial engineering technicians, or management technicians, who gather data upon which the industrial engineers' plans are based.

In addition to the primary area of activity in manufacturing the techniques of industrial engineering have been applied successfully to a wide range of activity including medical and dental work, farming, naval operations and household work.

Industrial engineering as a separate technology evolved in the 20th century. Although large-scale systems of men, materials and equipment were used previously in such instances as the construction of the pyramids, the building of the Roman roads and aqueducts, military and naval undertakings and large-scale mining, no use was made of complex equipment on such a large scale as in 20th-century industrial enterprises. Also, the economic and social factors were not as pressing in earlier times, and the degree of integration in early group undertakings was by no means as complex.

Scientific Development.—The development of quantitative measures with which to design the integration of men, materials and equipment realistically began almost simultaneously with the industrial revolution (*q.v.*). The amount of capital inherent in the machinery which then came into being required that care be exercised in using this capital effectively. Early attempts to predict accurately the man-hours of labour required for a given task reportedly were made by Jean Perronet of France in 1760 and by Charles Babbage (*q.v.*) of England in 1820; both dealt with the manufacture of pins. Early recognition of the need to pay attention to the human factor is implicit in the comments of Robert Owen (*q.v.*) in 1813 (reported in Anne G. Shaw, *The Purpose and Practice of Motion Study*, p. 1, Columbine Press, 1952):

> If then, the care as to the state of your inanimate machines can produce such beneficial results, what may not be expected if you devote equal attention to your vital machines, which are far more wonderfully constructed? When you shall acquire a right knowledge of these, of their curious mechanism, of their self-adjusting powers; when the proper mainspring shall be applied to their varied movements,—you will become conscious of their real value, and you will readily be induced to turn your thoughts more frequently from your inanimate to your living machines.

The need for the careful design of an integrated system combining men, materials and equipment toward a given objective was given greater urgency by the introduction of interchangeable manufacture by Eli Whitney and Simeon North in the United States during the 1790s. However, a statement of a method of systematically designing a time-integrated system of men, materials and equipment was not made until 1903, by Frederick W. Taylor. Taylor began the work leading to this paper in 1881 when, at the Midvale Steel company in Philadelphia, Pa., he systematically began to measure and plan the various factors related to such tasks as shovelling raw materials and machining metals. Taylor's work gave rise to a procedure later described as time study.

An analytical method of designing human tasks (with adequate consideration of the human problems—a phase neglected at times during the years which followed) was introduced by Frank B. and Lillian M. Gilbreth in *Motion Study* (1911). The Gilbreths' work was the basis for an industrial activity variously called motion study, work simplification or methods improvement.

During the period from 1903 until about 1917 the application of industrial engineering was known as scientific management. In a study of the applications of scientific management made during the period 1911–15 by C. Bertrand Russell *(The Taylor System of Scientific Management,* A. W. Shaw Co., 1917) 172 applications were reported in the twelve states between Maine, Maryland and Illinois. The author did not claim this as a definitive total; these were all on which he could obtain information. In these 172 applications, there were factories. railroad and steamship companies, public service corporations, department stores, banks, publishing houses, building and construction companies and a professional society.

It was during this same period that a group of men called efficiency experts entered the U.S. industrial scene. Lacking the full comprehension of Taylor, Gilbreth and the men associated with these two pioneers, these so-called efficiency experts created indus-

trial unrest to such an extent that in 1917 the U.S. congress added a rider to the appropriations act outlawing the use of a basic industrial engineering technique, time study, in government establishments. (This rider was last added in 1948.) The term efficiency expert was dropped from common usage in the 1930s.

Industrial engineering during the period 1910–30 achieved its primary development in the United States and Great Britain. The first university course in industrial engineering was introduced at Pennsylvania State college in 1908 under the guidance of Hugo Diemer, and the first two graduates received their degrees in 1910. By the latter 1950s approximately 33 U.S. universities offered undergraduates degrees in this field of engineering.

During World War II, methods of creating mathematical models of management problems were introduced. Under the name "operations research," these methods quickly found their way into industrial engineering activity, improving the accuracy of the design of systems and the predictions of how they would perform.

Current practice assigns much work to the industrial engineer between the time a product is designed and the time it reaches the customer. Processes must be planned, equipment physically arranged, work scheduled, workers' jobs planned, workers trained and procedures for the control of labour, production, material, quality and cost must be designed, installed and continually improved.

Industrial engineering activity commonly appears under the names of motion study, time study, production planning and control, procedure analysis, systems design, quality control, job evaluation, wage incentives, plant layout, organization analysis, work study, etc. By 1930 it was an integral and necessary part of the industrial routine in the western countries. *(See* also INDUSTRIAL ARCHITECTURE; PSYCHOLOGY, APPLIED; JOB EVALUATION; WAGES.)

Societies.—The Society of Industrial Engineers was formed in the U.S. in 1917 but merged with the Taylor society in 1936 to form the Society for the Advancement of Management. The American Institute of Industrial Engineers was formed in 1948.

(M. E. M.)

INDUSTRIAL INJURIES: *see* INDUSTRIAL ACCIDENTS.

INDUSTRIAL INSURANCE, known in Britain as industrial assurance, is a form of life insurance intended for wage earners. In the U.S. it is usually defined as life insurance under which premiums are payable monthly or oftener and in which the face value of the policy is $2,000 or less. Much the same definition holds in Britain, where the business is transacted by friendly societies and industrial assurance companies *(see* FRIENDLY SOCIETY).

Life insurance for industrial workers and their families in the U.S. originally was supplied by co-operative societies, many of which were financially unstable; in 1875 the Prudential Friendly society (later the Prudential Insurance Company of America) was organized largely after the pattern of the Prudential Assurance Company of London, and other companies soon entered the field. The number of policies in force in the U.S. passed 100,000,000 in the early 1950s. *See* also LIFE INSURANCE.

INDUSTRIAL MANAGEMENT: *see* SCIENTIFIC MANAGEMENT.

INDUSTRIAL MEDICINE. Industrial medicine is a specialized form of medical practice directed toward the prevention of disease to the industrial worker and the treatment of those diseases and disabilities which have a causal relation to the environment of the worker. In some industries workers are exposed to health hazards which may cause disease or disability. Where an illness is the direct consequence of some factor in employment or where a diseased condition can be traced to employment as the proximate cause. it is generally regarded as an industrial disease.

Loss of production because of illness and accident of workers totals millions of dollars each year and the conservation of the working capacity of the industrially employed is of major importance in maintaining a highly productive economy.

The most commonly recognized industrial diseases are those resulting from absorption of or from contact with poisonous or deleterious substances which may be in the form of liquids, vapours, gases. solids or oils. Most of these materials are inert, some are only slightly harmful, and a few are definitely poisonous. These substances enter the body through the respiratory system, through the mouth and gastrointestinal tract or by absorption through the skin. Although the healthy individual is able to eliminate most of the harmful substances nhich enter the body, acute poisoning takes place if the material is particularly toxic. For example, carbon tetrachloride is a clear, colourless liquid used extensively as a cleaning detergent. In industry it is used as a degreaser for metal parts, as a dry-cleaning agent and as a solvent for crude rubber, tar and resin; it is also used in fire extinguishers. in insecticide sprays and in certain soaps and fumigating solutions. The chemical may cause toxic effects by inhalation of the fumes, by contact with the skin or by oral intake. Poisoning may result from a single brief exposure to a high concentration of the vapour or from repeated small exposures. Alcoholics are particularly susceptible to the poisonous effect5 of carbon tetrachloride. Permanent damage to the liver and kidneys may occur or death may result within a few days after inhaling a heavy concentration of fumes.

One of the earliest recognized industrial health hazards was the toxic effects of lead absorption. This heavy metal has a wide variety of uses in industry, and workers who handle or use lead in any of its various forms should be alert against the dangers of lead poisoning.

The United States department of labour lists more than 150 occupations where lead poisoning might occur. The inhalation of fumes containing lead and ingestion through the mouth are the main sources from uhich poisoning occurs. Smelting, refining and burning of products in which lead is an ingredient give rise to fumes. Lead is used in most paints. and acetylene cutting of metals which previously have been painted may generate toxic fumes. The melting of old storage batteries has given rise to a number of cases of lead intoxication. The other dangerous source of absorption is by ingestion which might arise from the careless use of litharge. in mixing of paints, or inhalation of fumes through the mouth where the lead mixes with the saliva and is swallowed. When lead is inhaled or enters the body through the gastrointestinal tract it is carried by the blood stream and deposited in the bones where it exerts a harmful effect on the formation of new blood cells. Some workers are particularly susceptible to the effects of lead absorption and early in the disease suffer from abdominal cramps, headaches, constipation and a persistent metallic taste in the mouth. Mercury, arsenic, chromium, benzene and radioactive paints are a few of the other recognized poisonous materials used in industry which may cause an industrial disease and disability.

By the 1950s, the great increase in industrial uses of radioactive materials, and in the number of workers exposed to them, had added another difficult problem to the practice of industrial medicine. The monitoring of such plants must be extremely rigid, because no completely satisfactory treatment of irradiation sickness had yet been discovered

Numerically, skin affections form the most prevalent type of occupational disease. More than 50% of all disease claims filed with the industrial commission in some industrial states pertain to occupational dermatitis. Workers vary considerably in a sensitiveness to skin irritants, and frequently an allergy of the individual is a dominant influence in the cause of a dermatitis Many of the skin lesions are the results of direct contact in the handling of oils. chemicals. dyes. paints, solvents, metals, rubber or plastics and produce a characteristic type of skin condition. However, there are other types of dermatitis which do not take on a distinctive appearance, and the aid of an allergist and dermatologist is needed to determine the exact cause. Various protective creams and skin lotions are available for workers who show sensitiveness to mild irritants It is seldom that occupntional dermatitis causes a permanent disability and most cases clear up when the worker is removed from contact with the irritating substance.

In some types of industry dust is generated in large quantities within confined spaces or in the general atmosphere of the workshop. Fine particles sometimes become imbedded in the terminal

air sacs of the lungs of workers and remain there. Most dusts are inert and produce no change in the lungs other than a pigmentation that is characteristic of the colour of the dust inhaled—these include cement, carbon, talc and alumina. There are some. however, which cause a reaction or irritation in the lung cells and give rise to disease and disability.

Pneumoconiosis is the inclusive term applied to describe the effect of dust in the lungs. Diseases of the lung caused by dust are also designated by specific name; *e.g.,* silicosis, caused by the inhalation of silica dust. The hazards of silicosis are recognized in such occupations as quarrying of granite, quartz and slate, glass manufacturing, sandblasting, ceramic and pottery making or any occupation where fine silica dust is present in the air breathed into the lungs of the workers. Silicosis develops after years of exposure and is recognized by characteristic X-ray findings. The inhalation of asbestos dust such as might occur in the mining of chrysolite and the manufacture of asbestos products may cause asbestosis, which resembles silicosis and is also recognized by characteristic X-ray findings. In some occupations the dust generated is a combination of silica and other matter. In anthracite mining, for example. inhalation of this dust over long periods of time may cause anthrasilicosis, sometimes known as miner's asthma. These industrial lung diseases are not always disabling. but they may become complicated by tuberculosis of the lungs which greatly increases the seriousness of the illness. In any occupation where the inhaled dust has a high silica content the worker should be protected by a filter mask or a positive pressure helmet.

Cancer, alleged to be caused by substances originating in work, is of course a problem of major importance to industrial medicine. **A** few substances such as carbon black, aniline dyes, certain coal tar and petroleum products long have been suspected as carcinogenic agents. Considerable study is being given to all factors in the industrial environment which might have some relation to the cause and prevention of cancer.

Noise in the working environment has also received particular attention as a cause of impaired hearing and lowered working efficiency. It is the function of the industrial physician to conserve the hearing of workers and institute protective measures in industry to prevent occupational deafness. This requires audiometric testing as a part of the preplacement examination as well as periodic examinations of workers exposed to hazardous noise.

Medical Service.—The passage of state workmen's compensation laws placing responsibility upon the employer for medical care of the injured or ill worker was the major influence in the development of U.S. industrial medicine. Employers realized that the prevention of disability had an actual monetary value. In addition, management found that medical service in industry made an important contribution to the health and efficiency of the individual worker, to the effectiveness of the groups of workers in a plant and even to the standards of health in the community. The Council on Industrial Health of the American Medical association endorsed the following responsibilities within the scope of industrial medical service: (1) adequate medical care for workers disabled by reason of accidents or injury caused from work; (2) proper control over industrial environment for the prevention of disease or injury in industry; and (3) education of employees on problems of health by consultation, advice or guidance.

To a major extent the pattern of medical care in industry was developed by the employers of large groups, 5,000 or more workers in a unit. In addition to the care of cornpensable accidents and illness the medical departments of large industries render in-plant treatment for minor illnesses, preplacement examinations to determine fitness of applicants for work. periodic examinations of workers in hazardous occupations, medical opinions on questions of job fitness, disability retirement, etc.; and they also advise management and labour on questions relating to health. sanitation, hygiene and preventive medicine. An important function of an industrial medical program is the education of workers on such subjects as nutrition, personal hygiene and other aspects of accident and disease prevention.

Many small plants of less than 100 workers maintain a first-aid room under the care of a registered nurse, trained in industrial nursing, and working under the direction of a part-time physician. The doctor issues the standing orders and assumes responsibility for the medical program as set up by management. By the 1950s there were more than 2,000 physicians and 10,800 registered nurses working full or part time in industrial medical service. A number of both large and small companies were providing visual care, dental care and home visits by a plant nurse as a part of the medical program. It is significant to note that many companies, through the co-operation of their medical department had come to participate in community health programs such as mass X-ray surveys. cancer detection clinics, rehabilitation clinics and venereal disease control.

A few railroads and isolated plants operate hospitals for the care of employees disabled at work, with additional facilities for the care of employees' dependents under company insurance plans. In some instances companies provide medical service to employees beyond the recognized scope of industrial medicine; for example, where X-ray and laboratory facilities are maintained in a company medical department diagnostic study of disease or injury that has no causal relation to employment will be made upon request of the employee's personal physician. Where in many instances these various services were once entirely under the control of the employer, there was a later tendency to include the provisions of these benefits in the labour-management contracts of each company.

The prime purpose of these broad medical activities is not to replace or supplant the family physician, but rather to work in co-operation with him. Any procedure that will shorten the period of lost worktime, decrease the cost to the worker for necessary medical care and maintain a closer relationship between sick employees and the company medical department is consistent with sound business practice.

Another phase of industrial medicine is the rehabilitation of injured or disabled workers, applied as soon as possible to shorten the period of disability and restore the injured workman to employment suitable to his disability. This often requires assistance of consultants representing social service, clinical psychology, vocational counselling, as well as physical and occupational therapy.

A study of absenteeism resulting from nonoccupational illness and accident made management aware of one of the important causes of lost man-hours and decreased employee earnings. In some years of the 1950s, for example, it was estimated that 400,000,000–500,000,000 man-days of work were lost because of disability as a result of accident and sickness. Of this enormous loss, only 10% was attributed to occupational causes.

Such important organizations as the National Association of Manufacturers and the Cnited States public health service became interested in the establishment of industrial medical service throughout the country.

BIBLIOGRAPHY.—George W. Bachman *et al., Health Resources in the United States* (Washington, D.C., London, 1952); Federal Security Agency, *Occupational Health* (Washington, D.C., Aug. 1952); Federal Security Agency Public Health Service Bull. 21j, *Small Plant Health and Medical Program* (Washington. D.C., 1952); Federal Security Agency Public Health Service Bull. 15, *Industrial Health and Medical Programs* (Washington, D.C., 1950); C. O. Sappington, *Industrial Health Department Functions and Relationships* (Pittsburgh, Pa., *1948);* American College of Surgeons, *Medical Service in Industry and Workmen's Compensation Laws,* (Chicago, Ill., 1946). (J. H. Cs.)

GREAT BRITAIN

The adverse effects of employment on the physical, mental and social well-being of the individual. and through him on his family and the community. have been recorded throughout British industrial history. But the extent and seriousness of the problems did not impress the public until steam power was applied to the development of the factory system toward the end of the 18th century. Recurrent outbreaks of grave infectious diseases, including typhus. cholera and smallpox, especially among child apprentices in textile mills, compelled the attention of local justices. In Manchester the reports of the board of health. a group of physicians and leading citizens, forced the magistrates to take action not

merely to safeguard the health of child labourers but that of the whole community.

Amelioration was effected through legislation, and the Health and Morals of Apprentices act. 1802. was the first of a long series of statutes collectively named the Factory acts. The early legislation referred to cotton and woollen mills, but gradually other textile and nontextile factories and industries were brought in and benefits extended—largely indirectly—to adult male workers.

The Factory act, 1833, is noteworthy for the appointment for the first time of inspectors of factories and for the requirement that children between the ages of 9 and 13, employed in factories, should attend school for two hours each weekday. This was the beginning of compulsory education in Great Britain. Under the act of 1844 an attempt was made to remedy dirty conditions by requiring the limewashing of the interior of factory premises. Even more significant was the power given the inspectors to appoint certifying surgeons to examine persons for the "surgical certificates" of age required by the act. This was the beginning of statutory medical supervision in industry, which in considerably extended form came to prevail under the purview of the inspectors of factories and the appointed factory doctors. Meanwhile Edwin Chadwick's report, *The Sanitary Condition of the Labouring Population* (1842), had advanced the cause of public sanitation. As the apostle of the "sanitary idea" he may be regarded as the founder of the modern public health system, which is concerned with the prevention rather than merely the cure of disease and with the application of preventive measures to the group rather than to the individual.

Deaths and serious injuries, largely resulting from the use of horizontal shafting and unguarded machinery, led to the Employers' Liability act. 1880, and so to a series of workmen's compensation acts culminating in the National Insurance (Industrial Injuries) act, 1946. T. M. Legge was appointed the first medical inspector of factories in 1898. During his 28 years in this office he made outstanding contributions to industrial medicine, particularly to the control of lead poisoning and anthrax. Following the inquiries of Charles Booth in London and Seebohm Rowntree in York into the social circumstances of the working classes, and later those of the inspector general of recruiting into the defective physique of recruits during the South African War, compulsory medical inspection of schoolchildren, supplemented by the provision of school meals, was instituted in 1908. On July 15, 1912, the first National Health Insurance act came into operation and almost concurrently the new tuberculosis service.

The large number of ex-servicemen disabled in World War I focused attention on the employment problems of the disabled. Orthopaedic surgeons, notably Sir Robert Jones, concentrated on the restoration of function to injured limbs, while at Papworth village settlement P. Varrier-Jones concentrated-on the employment of tuberculous patients. The advances in the rehabilitation of all substantially handicapped persons were finally given statutory effect in the Disabled Persons (Employment) act, 1944.

From all the developments described above emerged, almost inevitably, the national health service—which included provisions for dealing with industrial injuries—on July 5, 1948

In 1937 existing factory legislation was consolidated in the Factories act, amended and extended in 1948. Whereas the earliest enactments were restricted in their application, the act as amended in 1948 was comprehensive in its general and particular provisions for health. safety and welfare and applies to many premises and outdoor places of employment not previously defined as factories. While the act itself prescribed minimum requirements and standards generally applicable to all factories (as defined), special preventive measures referring to particular processes and conditions were imposed through specific orders and regulations. The duty of enforcing the legislation constitutes the work of the inspectors of factories.

Industrial Medicine in Coal Mining.—Coal mining is the basic industry in Great Britain. Miners' work has always involved a high incidence of fatal and crippling accidents and such diseases as pneumoconiosis, nystagmus. rheumatism and a group of conditions known collectively as the "beats." Furthermore, all underground workers are subject to the adverse influences of high temperatures, humidity. bad air conditions resulting from mine gases, and the strain of arduous work in cramped conditions. It is therefore remarkable that the statutory provision of health, safety and welfare arrangements in coal mines lagged so far behind those made for factories. The hlines and Collieries act. 1842, prohibited underground work by women and young children. Thereafter, mostly as a result of the recommendations of various commissions, there was a series of acts culminating in the Coal Mines act, 1911, which with amendments, regulations and orders codified the law governing coal mining. This code of legislation imposed a duty on the employers—the National Coal board from Jan. 1, 1947—to provide and maintain in efficient order adequate supplies of materials and appliances (including ambulance transport) for first-aid and rescue work, and to train a suitable number of men in that work. At various centres specially trained full-time resident rescue brigades are maintained as mobile squads to operate in disasters resulting from explosions, flooding, fire or other causes. An important regulation permits the administration of morphia, in emergency, by certain nonmedical persons. The Miners' Welfare fund established by the Mining Industry act, 1920, marked a great advance in welfare arrangements not only for the miner but for his dependents and the local community. The act provided for a levy on all coal produced, the proceeds to be used for "purposes connected with the social well-being, recreation and conditions of living of workers in or about coal mines, and with mining education and research." The most generally acceptable innovations were pit head baths and changing houses and institutes for social recreation. Convalescent homes were established. and these became pioneer rehabilitation centres. Concurrently rehousing of miners in modern council houses was greatly advanced, while bus transport largely removed the need for them to live in isolated villages around the pit head. The growth of industrial estates provided more opportunities of employment near home for the miners' families and for aged and handicapped miners. Enforcement of mining legislation is the duty of mines inspectors under the ministry of fuel and power. The first permanent medical inspector of mines was not appointed until 1927. From 1943 additional medical inspectors were appointed to the separate mining divisions throughout the country.

Health and Welfare in Nonindustrial Employment.—Regulation of the working conditions of persons engaged in nonindustrial employment (for example, work in shops. offices, places of entertainment and domestic employment) is more difficult and correspondingly restricted. There are a number of shop acts regulating hours and conditions of work; these are enforced by the public health authority. Under the Merchant Shipping acts provision is made through the ministry of transport and civil aviation for the health and welfare of seamen. In Jan. 1956 parliament introduced a bill to safeguard the health, safety and welfare of agricultural workers.

Medical Supervision in Industry.—Medical supervision in industry is of two kinds, statutory and voluntary. Statutory supervision is limited to the enforcement of the law. In factories it is comprised in the duties of the appointed factory doctor—originally the certifying surgeon—covering the various administrative districts into which the country is divided. The work includes the examination of young persons—that is, those up to the age of 18 years—on engagement and thereafter annually until their 18th birthday; periodical examination of workers in certain prescribed dangerous processes, such as the manufacture and handling of lead compounds, chemical processes involving nitro and amino derivatives of benzene. the use of radioactive materials as in luminizing, and workers engaged in chromium plating; and, uhen requested by the inspector of factories, investigation into the circumstances attending cases of industrial accident and disease *(see* also DANGEROUS OCCUPATIONS).

Under the Coal Mines (Medical Examination) general regulations, 1952, all persons under the age of 21 years first employed, or about to be employed, in or about a coal mine were required to undergo medical examination, including X-ray examination of the chest, to ascertain their fitness for mining work. The ex-

aminations are completed by the full-time doctors of the National Coal board. The pneumoconiosis panels of the ministry of national insurance were made responsible for the initial and periodic medical examination of certain workers in the refractories, sandstone, pottery and asbestos industries. A grave defect of these examinations was that radiographic examination of the lungs was not made compulsory but entirely at the discretion of the examining doctor. Fitness examinations. specially directed to the nature of their duties, were also required for public transport drivers and for officers and men of the mercantile marine.

Voluntary Medical Services.—Whereas statutory medical services are strictly limited by prescription, the extent and scope of voluntary services are entirely at the will of the individual employer. Thus he may be satisfied that the statutory services are adequate. or he may supplement these by medical, nursing and ancillary services such as physiotherapy, dental examination and treatment, chiropody, ophthalmic examination and treatment and general welfare. The motive may be simply a general humanitarian interest in the workers; a recognition that a high incidence of accidents and disease leads to absenteeism and loss of output; or a realization that efficient production and good labour-management relations can be enhanced by regular care and attention to the fitness of the men as well as to the machines they operate.

From the beginning of the factory system the local doctor assisted during emergencies occurring at work. However, it was during the late decades of the 19th century that the increasing toll of machinery accidents made calls on his services at the factories more extensive and frequent. The employer found it expedient to retain the services of the doctor in claims for compensation in respect of injury from these accidents. Thus the doctor came to be looked upon as the employers' man and so was regarded with suspicion by the workmen and their unions. Even after the introduction of state insurance this attitude persisted, hindering the extension of private medical services in industry.

Modern Industrial Medicine.—The modern practice of industrial medicine in Great Britain probably originated during World War I when David Lloyd George formed the Health of Munition Workers' committee. This phase ended with the end of the war, but a few enlightened leaders of industry, realizing the importance of health in the factory, sought to promote this by the appointment in their organizations of full-time or part-time medical officers. The movement. however, was restricted and slow in advancing. In 1935 a group of 35 doctors employed full time in industry (almost all those so employed) formed themselves into the Association of Industrial Medical Officers, a body which by the mid-1950s had a membership of about 900, of whom 400 were full-time medical officers. A great forward impetus was given by the Factories (Medical and Welfare Services) order, 1940, which required the occupiers of factories engaged in munitions manufacture to provide, if so directed by the inspector of factories, such medical, nursing and welfare services as were deemed necessary by him for the health supervision of the workers.

During World War II the ministry of supply established medical departments in all government ordnance factories. This service not only made a great contribution to the war effort but provided tested patterns for medical units, staffing and organization suitable for adoption by industry as a whole. There was subsequently some expansion of the movement but chiefly in the large organizations. At the inception of the national health service in July 1948, the Trades Union congress strongly recommended the inclusion of an industrial health service, but chiefly for financial and administrative reasons such a plan had to be deferred. A comprehensive picture of services existing in early 1949 appears in the Report of a committee of inquiry on industrial health services (command paper 8170, H.M.S.O., London [1950]). Altogether there were 243,769 factories. and of the 4,884 factories with more than 250 workers, 2,018 (41.32%) had definite voluntary medical services, whereas only 845 (0.42%) among 202,868 factories with fewer than 26 workers had any such service. The report (generally known as the Dale report) recorded that medical services in industry do not overlap the national health service but are complementary; they must be regarded as a normal function of enlightened management and important by reason of the contribution they make both to the health of the workers and to productivity. The committee recommended that employers. individually and collectively, be encouraged to provide industrial medical services and that eventually there be some comprehensive provision (presumably through legislation) for occupational health covering not only industrial establishments of all kinds, both large and small, but also the nonindustrial occupations dealt with in the report of another committee of inquiry, Health, Welfare and Safety in Non-Industrial Employment: Hours of *Employment* of Juveniles (command paper 7664, H.M.S.O., London [1949]). Despite agitation for implementation of these recommendations there was still in the mid-1950s no prospect of a comprehensive industrial medical service. However, government pronouncements foreshadowed some statutory extension based on priorities determined by surveys of occupational conditions and hazards directed by the Industrial Health Advisory committee appointed in 1955.

Meanwhile private industry had shown a limited response toward expansion of such services. By contrast the National Coal board established a medical service in every mining district in the country, comprising 65 doctors, 300 nurses and 20.000 first-aid assistants. Similar schemes commencing about 1950 were instituted in other nationalized undertakings, such as dock, transport, electricity and gas services; and in the Atomic Energy authority.

Although the number of industrial medical officers is comparatively small, there is a much larger number of nurses (about 9,000 in the mid-1950s), of whom a large proportion was state registered; 900 hold the special certificate in industrial health.

The Industrial Medical *Officer.*—Experience proves that an efficient casualty service gains the confidence of management and workers more than any other type of service. Particularly acceptable to employers is the reduction of avoidable sickness absenteeism, and. in conjunction with other experts, the provision of a job placement system, based on job analysis, for newly engaged workmen and persons returning to work after illness or injury, thereby reducing labour wastage and turnover. For workmen temporarily or permanently handicapped for normal work by injury, disease, age or other cause, schemes for rehabilitation and resettlement are recognized as invaluable. Excellent examples of these were developed by the Austin and Vauxhall motor companies, and their methods were followed by government industrial rehabilitation units. The industrial doctor also provides advisory services to management on industrial hygiene, on conditions affecting the health of workers and on the location, cause and prevention of industrial diseases and accidents. Up to the 1550s practice tended to emphasize the clinical functions, while the environmental problems were somewhat neglected. However, this defect began to be removed along the lines of the work of P. Drinker and his associates at Harvard.

Industrial Health Services.—British industry is largely composed of small units employing only a few workers. It is recognized that these small groups could benefit from industrial medical services, but difficulty arises in organizing such a service. An experimental group service—the Slough Industrial Health service —was established in 1947. By the 1950s the service comprised a central health polyclinic, a mobile dressing station, an occupational hygiene team, a social service department and a residential rehabilitation centre. At Birmingham a special hospital was established to deal entirely with accidents, and the staff subsequently made outstanding contributions to the study of traumatic shock, the treatment of burns, the application of no-touch technique in the care of wounds and the development of dressings suitable for use under varying working conditions. Roffey Park Rehabilitation centre. Horsham, Sussex. treats patients from offices and factories suffering from subhealth, maladjustment and emotional problems. Haven Products Ltd . Glasgow, established an outstandingly successful experiment in the employment of severely handicapped workers—cardiac cases, paraplegics and amputees. The government through "Remploy" factories tried to provide sheltered work for similar cases at various industrial centres. But this project proved very expensive and not very successful in dealing with the problem. Elderly and tuberculous workers constitute two very

difficult groups for employment. Progress was made, however, and modern advances in chemotherapy and thoracic surgery gave promise that more and more tuberculous patients might be enabled to return, after treatment, to ordinary employment.

Industrial Accidents and Diseases.—An increasing number of firms in the 1950s were employing safety engineers, and in the design and construction of new machines greater emphasis was being placed on accident prevention. Among devices for use by the workman one of the most effective was the safety boot to prevent toe accidents. Despite the expansion which took place both in dangerous processes and in the use of noxious materials, the small number of authenticated cases of specific industrial disease emphasizes the effectiveness of measures of control and prevention. Pneumoconiosis, dermatitis, various cancers and the risks to health from radiation continued to present serious problems for study.

Teaching and Research.—Several of the large chemical firms maintain their own research departments. Generally, however, this work is undertaken through the various groups of the Medical Research council and the universities. Pneumoconiosis, poisonous insecticides used in agriculture, ionizing radiations and the rehabilitation of disabled workers have been main subjects of study. Departments of industrial medicine were instituted in the medical schools of the universities of Manchester and Glasgow and at King's college, Newcastle upon Tyne (Durham university), while the subject is comprised in the teaching of social medicine at most other medical schools. Postgraduate courses—full time for one year—are designed to prepare doctors for the diploma in industrial health. For state-registered nurses there is similar instruction leading to the nursing certificate in industrial health. The real need is ior continuous instruction of undergraduates by clinical teachers on the significance of occupation and fitness for work in relation to disease.

For employers and workers the Industrial Welfare society, through leaflets, a journal and special conferences, provides education in health and saiety. The Royal Society for the Prevention of Accidents undertakes similar propaganda in relation to accidents. Special problems are focused by the British Council for Rehabilitation, the British Epilepsy association and the Empire Rheumatism council. Special journals devoted to industrial medicine are the *British Journal of Industrial Medicine,* the *Transactions* of the Association of Industrial Medical Officers and the *Journal for Industrial Nurses.*

The designation industrial medicine was being replaced at mid-20th century by occupational health, signifying that this branch of medical practice is concerned with the care of all workers, whether employed in factories or not, and with the maintenance and promotion of health, physical, mental and social, in the individual and the group, as opposed merely to the treatment of patients suffering from accident or disease arising out of employment. (Aw. M.)

BIBLIOGRAPHY.—Sir Thomas Legge, *Industrial Maladies,* ed. by S. A. Henry (1934); T. A. Lloyd Davies, *The Practice of Industrial Medicine* (1948); J. A. Ryle, *Changing Disciplines* (1948); M. W. Thomas, *The Early Factory Legislation* (1948); W. M. Frazer, *A History of English Public Health, 1834–1939* (1950); "Industrial Hazards," *Brit. Med. Bull.,* vol. vii, no. 1–2 (1950); Medical Research Council, *The Application of Scientific Methods to Industrial and Service Medicine* (H.M.S.O., London, 1951); Ministry of Labour and National Service, *Factory Orders* (H.M.S.O., London, 1948); Slough Industrial Health Service, *Annual Report* (1948 *et seq.);* Chief Inspector of Factories, *Annual Report* (H.M.S.O.,London); Chief Inspector of Mines, *Annual Report* (H.M.S.O.,London): R. F. Tredgold, *Human Relations in Modern Industry* (1949); E. R. A. Merewether (ed.), *Industrial Medicine and Hygiene,* 3 vol. (1954); Donald Hunter, *The Diseases of Occupations* (1955).

INDUSTRIAL PENSIONS: see PENSIONS: Industrial Pensions.

INDUSTRIAL PSYCHOLOGY: see PSYCHOLOGY, APPLIED.

INDUSTRIAL RELATIONS. This is a general term for the relations of all those associated in productive work, including industry, agriculture, mining, commerce, finance, transport and other services. The main aspects are establishment of the conditions under which work shall be done, and the settlement of the ways by which the proceeds of the work are divided as dividends, salaries and wages between shareholders, employers, management and workpeople of various grades, manual, clerical and technical. Working conditions are not determined solely by direct relations between employers and workpeople: in many countries there began during the 20th century a growing participation by the state in the regulation of conditions in industry and in the prevention and settlement of industrial disputes. Because of their interest in the legislation enacted for these purposes and in the economic and social policies of governments. industrialists and trade unions undertook political as well as industrial action. The subject of industrial relations therefore includes individual relations and joint consultation between employers and workpeople at the place of work, collective relations between employers and their organizations and the trade unions, and the part played by the state in regulating these relations.

HISTORICAL DEVELOPMENT

Industrial relations as understood in modern times developed first in Great Britain, where the Industrial Revolution had its earliest impact upon relations between employers and workpeople. In mediaeval times businesses were small, contacts between masters and workmen were close and many craftsmen had opportunities to become masters, so that there was no sharp line of division between them. By contrast, many modern factories are large, capital is costly (and with minor exceptions workpeople do not share in its ownership) and few workers become employers. This separation of interests was accentuated when the limited liability system of investment in industry was introduced in the mid-19th century, thereby frequently distinguishing between the owners of a company's capital, its management and its workpeople. In these circumstances workpeople came to regard themselves as in a separate class from employers and shareholders. They recognized their weakness in individually negotiating conditions of work with employers, and they began to form trade unions to strengthen their bargaining power and to protect their interests. Until 1824 trade unions were illegal in Great Britain, and for the next half century they were handicapped by many legal restrictions, such as the laws on conspiracy and the common-law principle by which action in restraint of trade was illegal.

Not only were trade unions hampered by such laws and by the hostility of the courts, but they encountered bitter opposition from employers, many of whom refused to recognize unions and to enter into negotiation with them. In consequence, though many unions were formed, they were mostly short-lived; but from the middle of the 19th century unions of craftsmen in several British industries succeeded in establishing themselves permanently, first locally and then nationally. These unions were formed partly to secure better wages and working conditions by negotiation with employers but partly also to provide sickness and unemployment benefits and old-age pensions for their members and protection against unfair dismissal and other forms of victimization. Being relatively well-paid these skilled craftsmen could make considerable contributions for such benefits, and they were eager to retain membership in order to keep their rights to benefits. The craft unions were well administered, were generally opposed to violence and extreme demands, and were cautious in the use of the strike weapon. As a result of this moderation public opinion favoured the removal of some of the legal disabilities of the unions, and there were great improvements in their legal position during the years 1867–75.

Usually in the early stages of development the unions of skilled craftsmen did not admit unskilled workpeople to membership. The neglect and the low wages and poor conditions of work among unskilled labourers led in Great Britain to attempts to organize them into unions. This movement became significant during the last decade of the 19th century and the early years of the 20th century. In their struggle for recognition and for improved working conditions such unions adopted more aggressive policies than the craft unions. At this time also unions began to show interest in political action in the belief that working conditions could be substantially improved by legislation as well as by collective bargaining. Similar developments occurred in other countries. though often a decade or two later than in Britain. The British trade union movement gave support to the Labour party, with which it became organically associated, whereas in some other countries (*e.g.,* the United States) the unions kept free from party attachments, preferring to use their influence as pressure groups to obtain the best results possible from the political party in power.

By the beginning of the 20th century the three main methods by which workpeople can organize — the craft unions, industrial unions and general labour unions — were in use. These alternatives caused division in the movement, and conflicts arose between unions in recruiting members in disputed territories. During World War I membership of trade unions grew rapidly, while in the decade 1910–20 many employers' organizations were formed or increased their membership. In this period in most European countries national unions or federations of unions were formed, as were also industry-wide national organizations of employers, and negotiations and agreements were arranged in many industries. In Great Britain the Trades Union congress, formed in 1868, began in the 1920s to exercise a more effective co-ordinating influence on the trade union movement and to represent its views on policy to the government, and in international labour matters. In 1919 the National Confederation of Employers' Organizations (later renamed the British Employers' confederation) was formed as the counterpart of the Trades Union congress. Similar central bodies were formed in France, Belgium, Germany, Sweden, Denmark and other countries.

During the last years of the 19th century, consultation between trade unions in different countries led to the formation of international trade secretariats for each of the main industries. Early in the 20th century the International Federation of Trade Unions was formed; this brought together representatives of the central trade union organizations of many countries. In 1919 an international organization was formed of the national central bodies of employers. The establishment of the International Labour organization in the same year provided an official meeting place for representatives of the governments. employers and workpeople of more than 60 countries, and international standards of labour conditions were adopted which influenced labour legislation in many countries.

In Russia, where trade unions had hitherto been suppressed as criminal conspiracies, a trade union movement with a large membership was formed under government control after the Russian Revolution, the industrial basis of organization being adopted. In Germany in 1933 the Nazi government suppressed the trade unions and employers' organizations, and the government became responsible for the regulation of working conditions. After the collapse of the Hitler regime, however, trade unions, employers' organizations and collective bargaining mere re-established in western Germany. .In ltaly the Fascist government brought trade unions and employers' organizations under go ernment control in the corporative system in the 1920s, and this method was introduced in several other countries, including Spain and Portugal. After the fall of Benito Mussolini, the system was abandoned in Italy and freedom of association and collective bargaining were restored.

The close consultation established during World War II by governments in many countries with representatives of employers' organizations and trade unions was continued after the war. National advisory bodies in which these interests were represented were set up for consultation on industrial, economic and social matters. There was also a tendency for trade unions to recognize that higher standards of living depend upon increased production, and therefore more discussions than formerly took place with managements about ways of increasing the efficiency of industry while safeguarding the interests of the workers. High levels of employment in many countries during the early years after the end of World War II, by contrast with severe unemployment in the inter-war years, were associated with rising costs of living and increases in money rates of wages; inflation was feared by governments, employers and workers alike: and policies of wage restraint together with limitation of dividends to shareholders were sometimes voluntarily applied in critical periods.

RELATIONS AT THE WORKPLACE

The foundations of industrial relations are laid in the day-to-day association between employers, management and workpeople at the place of work. It is there that management and workpeople are in close continuous relations throughout their working lives, and a constant problem is to promote mutual understanding and co-operation between them. The basic relationship is the individual agreement or contract, whether written or not, between the employer and each worker, specifying wages and other conditions of employment. General conditions applicable to all workpeople in the undertaking may be set out in a booklet on work rules, a copy of which is given to each worker. The individual contracts must embody standards not less favourable to the worker than those in legislation applicable to the industry or in collective agreements to which the employer and the worker, through his membership in a trade union, are parties.

Employers in increasing numbers came to recognize the value of establishing and maintaining good relations with their workpeople. The adoption by management of enlightened methods of labour relations spread only slowly, though progress became more rapid during and after World War II, being marked by the establishment in increasing numbers of personnel and welfare departments with officers expert in the human problems of industry.

Personnel Management. — The main personnel functions in an undertaking are recruitment and selection, training, transfers, promotions and dismissals; conditions of employment and methods of wage payment; grievance procedures; consultations to increase productive efficiency; and welfare provisions. Though often undertaken by some member or members of management in addition to other duties, in many progressive firms they are the responsibility of the personnel department, headed by a personnel officer, which in large companies may include an employment officer, an education officer and a welfare officer. The department works in close co-operation with experts in time and movement studies and with the doctor and nursing staff in those companies which have established a factory medical service.

Minimum standards of health, safety and welfare for workpeople in factories. mines, merchant ships and other occupations, are defined by legislation, and observance is supervised by government inspectors, but many firms go far beyond the legal requirements. On the welfare side many firms help to create a sense of community by providing social clubs, sports grounds and facilities for hobbies and other forms of recreation. There are also financial schemes to provide sickness benefits and old-age pensions, while thrift is encouraged by providing favourable conditions for saving. Profit-sharing and copartnership were introduced voluntarily by firms in France, Belgium, Great Britain and other countries, but the number of workers employed by these firms is usually only about 1% to 2% of the total number of workers in the country, and the trade unions have usually shown suspicion or hostility. These social, recreational and financial schemes are generally administered by joint committees of representatives of workpeople and management, and committees similarly composed are set up for prevention of accidents.

Joint Consultation. — In small undertakings employers and workpeople are in frequent personal contact, and grievances, suggestions and other matters can be discussed informally, but in undertakings with more than 200 to 300 workpeople arrangements for consultation between representatives of the workpeople and of management have been found valuable. Consultation began by a spokesman or small deputation from the workpeople going to the employer or manager to request remedies for grievances or provision of welfare amenities, and this method became widespread. Often the shop steward or other active trade unionist is the spokesman for the workpeople of a department or shop. The need for more regular and systematic consultation led to the formation of works committees or councils. These may be of two main kinds! (1) committees consisting only of representatives of the workpeople who meet by themselves to decide what matters they shall raise with the employer; (2) joint committees of representatives of the workpeople and of management. Committees of the first kind were made compulsory by legislation in Germany, Austria, Czechoslovakia and other .European countries shortly after the end of World War I. But committees of the second kind were set up voluntarily, in Great Britain and France for example, in various firms. Joint committees were also set up voluntarily by firms in the United States (see below), where they

were often called employee representation schemes.

In undertakings and industries in which trade unionism is established, rates of wages, hours of work and other working conditions are fixed by collective agreement, and works committees should not interfere with these arrangements; but, as was indicated by the Whitley committee (appointed in Great Britain during World War I) in its report on works committees, "there are also many questions closely affecting daily life and comfort in, and the success of, the business, and affecting in no small degree efficiency of working, which are peculiar to the individual workshop or factory." These are the questions which can usefully provide a basis for joint consultation in works committees. The Whitley committee urged that such committees should be set up with the co-operation of employers' organizations and trade unions.

In some works committees the representatives of the workpeople consist entirely of individuals elected by ballot, secret or otherwise, by occupations or departments. Some are composed entirely of members of trade unions so elected. In large undertakings there is often a general committee comprising delegates from departmental committees. It is usual for meetings to be allowed during working hours and for wages to be paid for time so lost. Among subjects which are dealt with by works committees are welfare, benevolent, holiday (vacation) and loan funds, pension schemes, sports and recreation, accident prevention, share-purchase schemes. piece-price fixing and education. In some cases dismissals of individuals or, in case of slackness of business, of numbers of individuals are subject to review by works committees. This is greatly valued as it gives individuals greater security of employment and protection against victimization. At a time of depression prior consultation enables plans for the sharing of work or regularization of employment to be discussed. Methods of production, regularity of output and prevention of waste are other matters dealt with by committees. They are in some cases informed regularly of the state of business.

During and after World War II many firms in Great Britain and other countries set up joint production committees for consultation between management and workpeople on ways of increasing productive efficiency. In some works such committees exist alongside works councils. This seemed desirable where works'councils had the habit of dealing mainly with grievances and welfare and of giving little attention to productive efficiency; representatives with a different outlook were found to be more effective on questions of production.

The works council system in Germany differs from that in most other countries not only in being compulsory but in providing that on specified matters councils have the right of codetermination. This was accorded to them by an act passed in 1952. If, on specified issues, the employer and the works council disagree, the matter goes to mediation or arbitration by a mediation committee or by the labour court of the district. The act also provided for the setting up of economic committees in undertakings with more than 100 workpeople, consisting of from four to eight members employed in the undertaking, half of them being nominated by the works council and half by the employer, at least one of them being a member of the works council. The act further required that one-third of the members of the supervisory board (*Aufsichtrat*) of joint stock and limited liability companies shall be representatives of the workers elected by them.

The success of works councils and joint production committees depends upon a genuine belief by management and workpeople in the value of joint consultation. Where this is inadequate, apathy results and discussions are limited to trivial matters.

COLLECTIVE RELATIONS

Employers' Organizations. — The main reasons for the formation of employers' organizations were to ensure greater strength in dealing with claims by the unions and especially to deny to unions the opportunity of using piecemeal tactics with demands and pressure exerted successively on individual employers. The formation of employers' organizations and the development of collective bargaining between them and the unions proved more widespread in Great Britain, the countries of western Europe and in Australia and New Zealand than in the United States, where working conditions were more often determined by agreements between unions and individual companies. In Great Britain recognition of trade unions by individual employers and employers' organizations was almost universal at mid-20th century.

Collective Bargaining. — In its widest sense collective bargaining is negotiation between an employer or group of employers and a group of workpeople to reach agreement on working conditions. If negotiations are between an employer and a group of his own workpeople the dependence of the workpeople on the employer for their jobs weakens their bargaining power, and therefore collective bargaining is more usually understood to be negotiation between one or more trade unions and an employer or group or association of employers. Trade union organization gives the workpeople greater bargaining strength, providing means for the expert presentation of demands by skilled officials not dependent on the employers for their jobs. Further, a union has funds and means of obtaining information outside any one undertaking and can secure for the workpeople at any one firm the support of their fellows in other firms.

If negotiations result in an agreement the parties mutually undertake to apply'its provisions. In some countries, Great Britain for example, collective agreements are not legally binding but depend fbr their application on the good will of the signatories. In other countries, however, agreements may be registered with a government department or other authority, when their terms become binding. This system operates, for example. in France and Germany, whereas in Australia and New Zealand collective agreements registered with the arbitration courts have the binding force of arbitration awards. Collective agreements have effect beyond the membership of the signatory organizations as their provisions influence the terms of employment of nonmembers. Arrangements are made in some countries for the government or an arbitration court to extend to a whole industry the provisions of agreements reached between employers' organizations and trade unions representative of a large part of the industry. This extension of agreements is known as the "common rule" and prevents the agreements from being undermined by outsiders adopting lower labour standards. Agreements may be local, regional or national according to the range of membership of the negotiating parties. In small countries national agreements are more frequent than in big countries with widely separated undertakings.

National agreements often include procedure and general matters such as length of working hours, relation of piece rates to time rates, overtime and night-shift rates of payment, general adjustments of wages, sliding scales, holidays, apprentice questions, training and employment of workers. Detailed conditions of wages are sometimes settled nationally but it is more usual for them to be settled locally, the national organizations confining themselves to general changes and to acting as the co-ordinating and appeal authority. Thus the conditions in industries which are carried on in many parts of a country are adjusted both to local circumstances and to the required degree of uniformity. Wage-rates fixed by national bodies are often graded according to area. The existence of different types of unions with conflicting interests adds to the complexity of collective bargaining. The craft unions, for example, seek to obtain, as far as possible, similar conditions in each industry in which their members are employed. Where there are several unions having members in an industry there are sometimes federations of unions which act as a unit for negotiating purposes.

The adjustment of wage rates to changing conditions is a central problem in collective negotiations, and account is taken of the capacity of the industry to pay, changes in the cost of living and the relation between wages in different occupations and industries, unions in one industry often demanding a raise in wages because of increases in other industries. The cost of living is almost always a factor in wage negotiations, but in some industries agreements provide that wages be adjusted periodically by a sliding scale based on the cost of living index; the basic wage, however, is also changed at intervals to allow for other factors. In Great Britain the system has the advantage of reducing the frequency of

wage negotiations. Another form of sliding scale adjustment of wages is that based on the selling price of the product of an industry, this being for some industries a rough measure of capacity to pay. For many years collective agreements in the British iron and steel industry provided for sliding scales of wages based on the selling price of rails, bars and other representative products. In coal mining, wages in some districts were adjusted by sliding scales to changes in the selling price of coal, but in the period between World Wars I and II they were varied at intervals of two or three months according to the net proceeds of the industry, taking into account not only the selling price of coal but the quantity sold and also wages and other costs. In New Zealand the wages of sheep shearers have been adjusted by sliding scale based on the export price of wool, and in Malaya the wages of rubber plantation workers have been adjusted to changes in the price of rubber.

The enormous number of questions which arise is shown by the complexity and length of collective agreements. The constant association, however, of representative persons of experience, responsibility and negotiating ability on both sides increases the chance of reaching amicable settlements of the most difficult problems, and this, together with the adaptability and freedom from rigidity of the system, causes it to be recognized as the main means of regulating working conditions.

Collective bargaining demands for its efficient operation the possession by representatives of adequate authority to bind their members. Although some union executives have considerable authority. it is often necessary to take the opinion of the members either by a ballot or through a delegate conference before agreements are made. The effectiveness of a voluntary agreement depends upon its terms being in general accord with the views of those who are bound by it. In practice the recommendations of leaders carry great weight.

Collective agreements usually provide for a settled procedure for dealing with disputes in order to obviate stoppages of work. A common procedure is for the matter to be discussed first within the establishment. Failing settlement it may then be discussed between the local employers' association and representatives of the union, and then by the national executives, work continuing in the meantime. When action is taken in breach of an agreement, the organization whose members are at fault is expected to restore the status quo pending discussion of the matter in dispute. Stoppages without the sanction of an organization are called unofficial.

The rules of many unions provide that a strike shall not be called unless a ballot of members shows a two-thirds or three-quarters majority in favour. Many collective agreements provide that, if negotiations fail, the differences shall be referred to conciliation boards or in the last resort to arbitration machinery set up by the parties or to state arbitration tribunals. Agreements usually require that there shall be no stoppage of work during these proceedings.

STATE INTERVENTION

State intervention varies according to a nation's political doctrine, traditions and economic and social conditions. In the Soviet Union and other Communist countries the centralized political, economic and social controls involve government intervention in all aspects of industrial relations. Less complete but still widespread is the regulation of industrial relations by the governments of Fascist countries. The policy in many other countries is for governments to leave employers, workpeople and their organizations free to regulate their own relations, and to intervene only when they fail to do this satisfactorily. The countries in which this policy is applied in varying degree include Great Britain and other countries of western Europe, Canada. India, Pakistan. Australia and New Zealand. In most of these countries intervention was slight throughout the 19th century, but it increased substantially during the 20th century.

Intervention or participation by the state is undertaken to promote the health, safety and welfare of workpeople, to define the legal relations between employers and norkpeople and the legal status and functions of employers' organizations and trade unions, to facilitate the settlement of disputes, to provide for the regulation of wages and working conditions where this is not done effectively by the parties themselves. and to take a direct part in industrial relations as the employer of persons in the public services and in nationalized industries. In many countries the state also maintains consultative relations with employers' organizations and trade unions on questions of economic, industrial and social policy which affect their interests.

Conciliation and Arbitration. — In every country conciliation and arbitration are undertaken by the state, though with many variations. The main differences are between voluntary and compulsory systems. Compulsory arbitration is limited in some countries to public utilities and other industries in which stoppages would seriously affect the public interest. A further distinction is between systems of compulsory arbitration with awards binding on the parties and with prohibition of strikes and lockouts, and those under which the parties are free to reject awards and can engage in a strike or lockout after the end of the arbitration without incurring legal penalties. Conciliation is usually compulsory in countries which have compulsory arbitration, notably in Germany, Sweden, Australia, New Zealand, and in Venezuela and some other countries of Latin America. In Australia the parties in disputes must have made full use of the processes of conciliation before compulsory arbitration is applied.

Conciliation officers and arbitration tribunals may be appointed specially for each dispute, or a permanent system with full-time conciliators and arbitrators may be set up to whom successive disputes are referred. The latter has the advantage of continuity, and principles are evolved which make the settlement of disputes easier and may influence the parties themselves in their direct negotiations. Most governments appoint conciliation or industrial relations officials to assist in the settlement of disputes before they become acute. If the parties fail to agree, the next stage is usually for the dispute to go through a more formal conciliation procedure with equal numbers oi representatives from the two sides meeting under an impartial chairman who may be either a full-time conciliation commissioner or a person selected from a panel established by the government. If conciliation fails the dispute may go to arbitration either by a single arbitrator, or by a tribunal, which may consist of impartial persons only, usually three in number, or may include also assessors acquainted with the standpoints of employers and of workpeople. These assessors are not, however, from the industry involved in the dispute. Although arbitration has been highly successful in many countries. there are practical difficulties. One is to satisfy the parties in dispute that the tribunals are impartial, a difficulty which is greatest in small and especially underdeveloped industries where members of tribunals are often accused of having an interest in favouring one side or the other. Then if awards are binding there is the difficulty of enforcing awards by penalties where large numbers of workpeople are involved. Moreover, the fact that either side can force the other to arbitration tends to make direct negotiations and conciliation procedures less effective.

British policy is based on acceptance of the principle of regulation of working conditions by collective agreements and of minimum government intervention. Also, the government does not refer a dispute to arbitration unless agreed arrangements within the industry for the settlement of disputes have been fully used. Provision is made for voluntary conciliation and arbitration by the Conciliation act, 1896. Conciliators or arbitrators are appointed separately for each dispute, there is no continuity of tribunals and arbitration takes place only with the consent of both parties. In 1919 the Industrial Courts act, based on recommendations of the Whitley committee. provided for the setting up of a standing or permanent industrial court. This ensured continuity, and arbitration became voluntary (the consent of both parties being required) and awards were not made binding on the parties. The act, however, empowered the minister of labour and national service to set up a court of inquiry on his own initiative in any dispute. A court may consist of one or several members, and it can require any persons who appear to have relevant information to furnish such information and, where necessary, to

give evidence on oath, though there is no penalty for failure to do so. The value of these courts of inquiry is that their recommendations based on a thorough impartial examination of the facts are likely to lead to settlements. Their recommendations have no binding force but only rarely have the parties failed to reach agreement on their basis. The governments of many other countries have similar powers to use this method of courts of inquiry.

Compulsory arbitration. with binding awards and with strikes and lockouts illegal. was applied during both World Wars I and II in Great Britain and in many other countries. After World War II, with the agreement of the British Employers' confederation and the Trades Union congress, this system mas continued in Great Britain during the early years of postwar reconstruction. but in 1951 the general council of the Trades Union congress asked for modifications, particularly for removal of the provision making strikes illegal. The principle of compulsory arbitration was retained, but awards of the Industrial Disputes tribunal, which succeeded the National Arbitration tribunal, were not binding, and strikes and lockouts ceased to be illegal.

Regulation of Wages.—A main purpose of state intervention in wage regulation is to fix minimum rates in industries in which organization among workpeople and employers is inadequate for regulating wages by collective agreements and where in consequence wages in some undertakings are unduly low. In France, Germany, Norway and other European countries the earliest intervention was limited to home workers, while in Ontario and other provinces in Canada it was restricted to women and young persons. In Great Britain and in Victoria, Tasmania and other Australian states these restrictions to home workers or to women and young persons had not been applied by the mid-1950s.

The establishment of a wage board or council for each industry, or a central wage commission covering a group of industries are the most widely adopted methods for fixing statutorily enforceable minimum rates. In Great Britain, under legislation in 1909 and 1918, a trade board was set up in each of a number of separate branches of industry. This method was continued by the Wage Councils act, 1945, under which about 76 councils recommend minimum rates for the various grades of workers in more than 50 branches of industry employing nearly 2,000,000 workpeople; these rates are applied by orders of the minister of labour and national service. Each council consists of three impartial members together with representatives of employers and workpeople in the industry. A similar system applies to British agriculture, the road haulage industry and the catering trades.

In countries where a central wage commission is used it consists of three or five impartial members together with members representing equally the interests of employers and of workpeople, and the commission is often assisted by a committee in each of the industries in which wages are fixed, the committees having one or more impartial members and representatives from the industry. In a few countries, France and the United States for example, minimum rates of general application are announced periodically by the government, and in Australia and New Zealand the arbitration courts, in addition to dealing with disputes! periodically fix basic wages that apply to all industries. Wages fixed by statutory bodies are enforceable by law, and fines and other penalties can be imposed for failure to observe them. Also, statutory rates apply to all firms and workpeople in a defined industry, whereas rates fixed by collective agreements apply only to those firms which are parties to the agreements.

BIBLIOGRAPHY.—Ministry of Labour and National Service, *Industrial Relations Handbook* (H.M.S.O., London, 1944–51); J. H. Richardson, *An Introduction to the Study of Industrial Relations* (London, New York, 1954); A. Flanders and H. A. Clegg (ed.), *The System of Industrial Relations in Great Britain* (London, 1954); F. C. Bartlett, *What is Industrial Psychology?* (London, 1949); E. Mayo, *The Social Problems of an Industrial Civilization* (1945); *R.* F. Tredgold, *Hunzan Relations in Modern Industry* (London, 1949); C. H. Northcott, *Personnel Management* (London, 1950); C. G. Renold, *Joint Consultation Over Thirty Years* (London, 1950); S. and B. Webb, *History of Trade Unionism,* reprinted (London, 1950); Political and Economic Planning, *British Trade Unionism* (London, 1949); *K.* Braun, *The Right to Organize and Its Limits* (1950); *W.* Galenson, *Conzparative Labor Movements* (1952); Ministry of Labour, *Report on Collective Agreements Between Employers and Workpeople* (H.M.S.O., London, 1934); K. G. J. Knowles, *Strikes: A Study in Industrial Conflict* (Oxford, 1952); M. and D. J. Turner-Samuels, *Industrial Negotiation and Arbitration* (London, 1951); I. Sharp, *Industrial Conciliation and Arbitration in Great Britain* (London, 1951); D. Sells, *British Wage Boards* (1939); International Labour Office, *The International Labour Code* (Geneva, 1951), *Labour-Management Cooperation in France* (Geneva, 1950); W. Galenson, *Labor in Norway* (1949); J. J. Robbins. *The Government of Labor Relations in Sweden* (1942); O. de R. Foenander, *Studies in Australian Labour Law and Relations* (Melbourne, 1952); A. E. C. Hare, *Report on Industrial Relations in New Zealand* (Wellington, 1946); S. D. Punekar, *Industrial Peace in India* (Bombay, 1952); Ministry of Labour and National Service, *Annual Reports* (London), *Ministry of Labour Gazette* (London, monthly); Trade 'Union Congress. *Annual Reports, Labour* (London, monthly); *International Labour Review* (London, monthly); *Revue Française du Travail* (Paris, monthly); German Federal Republic, *Bundcsarbeitshlatt* (Stuttgart and Cologne, monthly); Canada, *The Labour Gazette* (Ottawa, monthly); *Indian Labour Gazette* (Simla, monthly). (J. H. RN.)

UNITED STATES

The long-term drift in the evolution of labour-management relations in the United States gave way in the mid-1930s to a cataclysmic change. The labour-management problem was catapulted to a peak of public concern which, in the past, it had reached only on brief occasions. Since the mid-1930s trade unions have been an important feature of U.S. society. The growing strength of the unions carried with it many significant consequences. Enhancement of the worker's sense of dignity and of psychological well-being and the elevation of his role in the community at large was made possible by according to him increased participation in the decision-making processes which affect the terms and conditions of his employment, by affording him increased job security, by providing him with an arsenal for mutual protection in his attempts to mitigate some of the abuses of industrial competition or to counteract some of the tyrannies which inhered in the use of employer weapons such as the black list, the lockout, the yellow-dog contract, the company union, labour espionage and the injunction.

But growing strength meant, too, that the consequences of the policies and practices of organized labour could have more than localized impact. Labour-management relations assumed a more intense and momentous aspect when unrest in the industrial relations arena could affect the health and welfare of the country's population or the operations of an entire industry; when success or failure in collective bargaining could reflect upon the entire economy's industrial output, technical progress or economic stability; when growing bureaucratization accompanying growing numbers could threaten internal union democracy; or when "accommodation" between labour and industry could mean collusion against the consuming public. The increasing importance of organized labour as a factor making for progressive change in U.S. society was accompanied, thus, by a host of issues real and alleged, which focused a variety of attempts at public control on the practices and procedures in labour-management relations. Throughout the pageantry of violence and battle and the turbulence of shifts in the balance of power and prestige there has none the less been emerging an unmistakable ray of reason to illuminate the path toward peaceful mutual survival. The many thousands of contracts negotiated without pitched conflict and the innumerable grievances adjusted peacefully and lawfully attest to the steady growth of mutual acceptance by two parties grown strong and well organized.

In attempting to understand the history of the growth of trade unionism and collective bargaining, the ideological orientations of labour and of management, the shifts and varieties in the structural arrangements and substantive scope of collective bargaining, the role of government in industrial relations and the consequences and issues emanating from this growth and development, it should be kept in mind that the evolution of industrial relations in the United States occurred against an environmental backdrop which has been in many respects unique. The strong tradition of political democracy and the achievement in the early 19th century of practically universal manhood suffrage helped to stave off the early radical tendencies which are inherent in a labour movement which has yet to achieve civil and political rights for its adherents. The pervasiveness of the "Protestant ethic," the emphasis on independence

and equality, the relative abundance of economic resources and o p portunity and the early fluidity and mobility among social and economic classes all imparted a flavour of individualism which helps to explain the belated appearance of social legislation and the more than a century of slow-gaited growth. This growth of the labour-movement was slowed by the fierce hostility of the individualistic employer, by the disinclination to join a union of the individualistic worker oriented to the chance to advance, and by the repressive interpretations of a judiciary which carried the individualistic strain to great lengths.

The alternations of prosperity and depression which marked the dynamics of industrial evolution in the United States were accompanied by an ebb and flow of proposed social panaceas and radical reform movements, but the remarkably successful progress of industrial productivity and the abundance of material goods and services which U.S. capitalism produced certainly helped to sustain the basically conservative, limited-ends, business-union credo which still characterized dominant sectors of organized labour in the early 1950s.

Growth and Extent of Trade Unionism.—Trade unionism grew from the several thousand members of its sporadic beginnings at the end of the 18th century to a force numbering approximately 15,000,000 in 1953. Trade union membership pursued a long and slow secular climb up past the 5,000,000 mark in 1920, but declined to less than 3,000,000 in 1933, largely as a result of the great depression. This membership trough was followed by a steep climb to 15,000,000 members by the end of World War II, and membership was stabilized at about that level in the postwar years.

Superimposed on these secular tendencies were numerous fluctuations around this upward trend. Before the Civil War there was no continuously functioning trade union movement. A series of revivals and collapses of organized trade unionism, generally of a craft nature, local in scope, restricted to relatively skilled artisans and emphasizing narrow economic objectives, alternated with an ebb and flow of a variety of political movements and social reconstruction programs during the pre-Civil War years. The peak in trade union membership for this period came in 1836 when 300,000 workers were members of trade unions.

The second half of the 19th century, despite the nationalization of the trade union movement, continued to witness these economic-political cycles. By 1872 the previous peak of 300,000 members had once again been attained only to be cut to no more than 50,000 under the impact of the 1873–79 depression. This peak was regained by 1884. The spectacular heights reached by the polyglot Knights of Labor with a membership of 700,000 in 1886 (achieved after remarkably successful strikes against the railroads) were surrendered almost as precipitously as they had been scaled. With the firm establishment in 1886 of the American Federation of Labor with its business union creed, total union membership began to expand steadily and multiplied fourfold, from about 500,000 in 1897 to more than 2,000,000 in 1904 (of which about 80% was affiliated with the new federation), and increased by another 700,000 in the following decade. Under the impact of World War I, membership spurted past the 5,000,000 mark by 1920, but the decade of the 1920s reversed the trend and the ensuing depression accentuated the decline. By 1933 trade union membership had declined to 3,000,000.

Two observations concerning the areas of employment included in this development may especially be noted. First, the fluctuations in membership from the 1890s through 1933 (with the exception of the World War I period) touched only a relatively few categories of industrial employment, particularly coal mining, the railroads, the building trades, and printing. With the exception of the miners, the vast majority of unskilled and semiskilled workers were still unorganized. Second, even the peak membership figure attained (1920) represented organization of less than 20% of the country's nonagricultural employees. In 1930, as in 1910, trade union membership accounted for only 10% of nonagricultural employment.

Social mobility, the pre-1842 application of the conspiracy doctrine to combat trade unions, the post-1842 judicial interpretations which stripped labour of many of its tactics, the recurrence of business depressions, the internecine clashes of ideology, the hostility of employers (whether manifested in the violence of a Ludlow massacre or in the open-shop drives and welfare capitalism plans of the 1920s), the divisions made possible by a stream of immigrants drawn from diverse backgrounds, the reluctance of leaders of labour to adapt trade union structure and policy to the dynamics of a rapidly changing industrial technology, and the continuing rise in real earnings and adverse popular sentiment were all factors in the retardation of trade union growth in that period.

Other factors, however, such as increasing mechanization, increasing concentration of industry accompanied by a loss of individual bargaining power, restriction of immigration and reduced social fluidity, were pressing for an eventual growth of large-scale industrial unionism. These factors were abetted by the New Deal environment of the 1930s in reversing the preceding decline and in stimulating the rapid resurgence of the labour movement. Favourable government legislation, a more hospitable judicial attitude and popular sympathy, all reflecting a disposition to permit the power of labour to grow to match that of business, and the birth of a new militance in labour's ranks pushed total membership from the 3,000,000 mark of 1933 to almost 9,000,000 in 1940 and to the 15,000,000 mark by 1946. As the growth of bona fide unions proceeded, the number of company unions declined. In 1929 less than one-fifth of union members were affiliated with industrial or quasi-industrial unions, by 1950 more than half were.

The extent of this new growth is reflected in the expansion of the areas of employment embraced by organized labour during the early 1950s. Between 80% and 100% of the workers employed in 22 major manufacturing industries (*e.g.*, steel, electrical machinery, meat packing, aluminum) and in 14 nonmanufacturing industries (*e.g.*, coal mining, building trades, maritime transportation, trucking) were covered by collective agreements. The number of unorganized workers, however, still far exceeded the number of trade union members. Barely one-third of all workers gainfully occupied in nonagricultural establishments were organized. The bulk of white collar workers, farm labourers and government employees and labour in the south generally were still unorganized. Total trade union membership was not concentrated in a single unified federation but split between the American Federation of Labor (with about 8,000,000 members), the Congress of Industrial Organizations (5,000,000) and several unaffiliated independent unions (2,000,000).

Ideologies of Labour and Management.—Although U.S. working class organization never constituted a unitary phenomenon motivated by a single ideology, the basic creed formulated in the days of the founding of the A.F. of L. continued dominant and largely unchanged. There were several short-lived rival ideologies as, for example, that of the Industrial Workers of the World, a few temporary abberations such as support of the Robert LaFollette presidential candidacy in 1924, and some changes in emphasis. But the core of the credo survived intact.

Before 1890, U.S. labour, encouraged by middle-class intellectual advisers, had (especially in periods of depression) advocated a variety of utopian programs and political panaceas which sought to implement the workers' faith in social, political and economic equality. Many of the pressures for political and social reform which were brought to bear upon government between 1827 and 1833 bore fruit in subsequent years. Free public education, mechanics' lien laws, reforms in the compulsory militia service regulations and abolition of imprisonment for debt were all achieved. But later interests in co-operatives, in self-governing workshops and in communistic colonies offered no satisfactory response to the challenge of an emerging industrialization.

Samuel Gompers, first president of the A.F. of L., read the lessons of these failing political panaceas and faltering utopian schemes very clearly, and his substitute program for the workingman well appraised the tone and temper of labour. After Gompers' ascendance to leadership, labour was motivated by a pragmatic, gradualist, "no ultimate ends," "here and now" philosophy seeking, within the framework of a capitalist society, to advance the interests of particular groups of workers organized in trade unions. It placed primary emphasis on economic methods such as collective

bargaining and the trade agreement rather than upon independent political action or co-operatives in making "today better than yesterday and tomorrow better than today."

For Gompers the natural unit of organization was the craft; later the growth of mass production industries called forth a shift in emphasis which made the industry as important a jurisdictional unit as the craft. The fear of hostile government and of unfavourable judicial attitudes evoked reliance on voluntarism or self-help; but the New Deal dispelled to some extent this fear of state intervention and left labour relying more than in the past upon government aid and legal enactment. The later expansion of political activity with the formation of the Political Action committee (C.I.O.) and the Labor's League for Political Education (A.F. of L.) indicated less skepticism about utilizing political action but still did not supplant the established policy of "rewarding friends and punishing enemies."

At mid-20th century the United States had only one significant form of working class organization — the trade union — and the important business of the day for the unions was collective bargaining within a capitalist framework. Labour's ideology, matured and grown with exigencies of internal and external changes, continued to define trade unionism as a bulwark of the fundamental institutional structure of the United States rather than as a revolutionary menace.

The strong Puritan ethic and the tenacious entrepreneurial adherence to a *laissez faire* philosophy led to an unrelenting and vigorous employer opposition to trade unionism which generally prevailed up to the decade of the 1940s. Employer techniques designed to quell the trade union threat ranged from crude violence to a velvet-gloved paternalism, from enlisting government troops to the use of public relations experts. After 1933 trade unionism and collective bargaining were gradually accepted by most employers as a permanent feature in labour-management relations. The sharp decline in the number of strikes for union recognition as a percentage of total strikes (from almost 60% in 1937 to less than 15% in 1951) was only one of several quantifiable affirmations of this acceptance. The transition toward such managerial acceptance was facilitated by government's externally imposed stimulus, but the gradual recognition of benefits deriving from collective bargaining further abetted this transition although there were still a number of exceptions to this conversion to collective bargaining during the early 1950s.

Despite labour's general acceptance of capitalism and management's increasing recognition of the collective bargaining process, there continued to persist separate union and business ideological conceptions of "workable" labour-management relationships which, taken together, might in fact not be consistent with permanent workability at all. Management, for example, might conceive of industrial relations as a matter relating to its own workers; might see the primary objective of workeble industrial relations as the enhancement of efficient and profitable operation of the enterprise; might feel that the capacity to exercise managerial responsibilities must be left unimpaired; and might expect unions to behave in "businesslike" or "responsible" fashion.

But these managerial guideposts might not be fully consistent with the simultaneous sovereignty and survival demands of the trade union. The union might be unwilling to limit its scope to issues which reflect only the particular problems of a particular company, holding that it must consider also the welfare of its entire membership and the security and strength of the union, Moreover, although few union leaders seek to "run the business," unions are employer-discretion regulators and the heart of unionism lies in the standard rule. Unionism inevitably imposes rules on management and reduces worker competition.

Such divergent orientations are giving way to revised and expanded conceptions of collective bargaining which permit mutual sovereignty, mutual security and mutual survival.

Role of Government. — The role of government in U.S. industrial relations may be described in terms of four general periods: ineffective legal repression, reluctant tolerance, encouraging support, and increasing control of trade unions and collective bargaining. Until the *Commonwealth* v. *Hunt* decision in Massachusetts in 1842, judicial common law doctrine held that trade unions were in restraint of trade and therefore illegal, although, as noted previously, they did exist. Between 1842 and the 1930s collective bargaining was given minimum legal recognition. The ability and occasional willingness of the courts to vitiate unionism's means of self-help (organization, the strike, picketing, the boycott) by declaring either the ends sought or the means utilized to be illegal coupled with the use of the injunction, damage suits, criminal prosecutions and obstructive presidential intervention stood as obstacles in the path of growth. The supreme court sustained in 1930 the constitutionality of the Railway Labor act of 1926 which enumerated a series of unfair practices as interfering with bona fide collective bargaining and established dispute-settlement machinery in the railroad industry, and this, along with the passage of the Norris-LaGuardia anti-injunction act by congress in 1932, presaged a reversal of earlier policy.

The National Industrial Recovery act in 1933 (invalidated by the supreme court in 1935) and the National Labor Relations (Wagner) act in 1935 (sustained in the Jones and Laughlin decision in 1937) were turning points in U.S. industrial relations history. They established, as a matter of national policy, that strong independent trade unions were desirable; that workers should be encouraged "to organize and bargain collectively through representatives of their own choosing"; and that employers should be prevented from interfering with such organization. Accompanying these legislative props to a hitherto weak trade unionism, the Social Security act of 1935 and the Fair Labor Standards act of 1938 improved and extended social security and protective minimum wage and hour legislation. This was the high water mark in governmental recognition of and assistance to organized labour in the United States. It marked the shift to the federal government of concern with the conduct of labour-management relations in industries in "interstate commerce," a boundary most broadly interpreted.

The Labor Management Relations (Taft-Hartley) act of 1947 marked a new trend toward more direct government intervention in and restriction of the collective bargaining process. Deriving from the efforts of those who had opposed the philosophy of the Wagner act and from public concern over the wave of strikes of the prior decade which reached a peak in 1946 when a total of 113,000,000 man-days lost due to work stoppages posted an all-time high, the Taft-Hartley act sought, by a variety of controls, once again to "redress" the balance of power among a now grown labour movement, the individual employee, the employer and the government. The provisions of the act (which restricted the collective bargaining area, controlled the internal affairs of trade unions, made illegal a number of union techniques, provided for direct government intervention in disputes threatening the public welfare, and limited the degree of trade union institutional security which legally could be obtained) made government a participant in industrial relations as well as an umpire.

Structural Scope of Collective Bargaining. — No standard structural caste developed in U.S. unionism. Historically, organization by a single union ranged from inclusion of members of a single craft to attempted coverage of "all productive labour." Structural forms also followed the lines set forth by coverage of amalgamated crafts, single or related companies, parts of industries, whole industries or related industries. Geographically, units (or amalgamations of individual units) embraced city-wide. statewide and regional areas and the nation itself. The distribution of power among locals, national unions and federations of national unions also varied greatly from authoritative influence residing in an all-powerful federation, to virtual autonomy for centralized national unions linked in a relatively weak federation, to great independence for the locals in a national union. This diversity in structural form persisted in the early 1950s, although the trend was toward a reduction in the number of separate national unions, an expansion of industrial (relative to craft) unions and a centralization of power in strong, relatively autonomous national unions. In 1951, of 172 national unions, 10 were craft (6%), 30 industrial (17%) and 132 intermediate between these classifications (77%) as compared with the 28 craft (21%), 5 industrial (4%) and 100

intermediate (75%) national unions which existed in 1915.

Because structure is intimately related to function and policy, diversities and shifts in structural form mirrored the diversities and shifts in the ideological, social, industrial and political environments with which union organizations were confronted. The Knights of Labor, for example, with its emphasis on "one big union," reflected the great social mobility of its era and the absence of a working class permanently delineated by craft or industry; the early craft emphasis of the American Federation of Labor, on the other hand, reflected the development of specialized groups of skilled workers surrounded by a heterogeneous mass of semiskilled and unskilled workers.

Changes in the industrial environment also resulted in structural adaptations: increasing concentration of industry encouraged combination and centralization in labour organization; secular changes in technology, mechanization and division of labour reduced the average degree of skill required and helped encourage the shift from local craft unions to national industrial unions. The nature of employment (whether casual or steady) in the industry, the stage of an industry's development or decline, the ease of substituting capital for labour, the nature of the product market and the proportion of total production costs which labour constitutes helped determine the preference for one structural form rather than another. The standard structural form, however, came to be a multicraft or industrial union which centralizes substantial authority in the hands of its national officers and which is affiliated in a loose multiunion federation.

The structural hierarchy within both the C.I.O. and the A.F. of L. runs from the local union to the national to the federation. The locals of the A.F. of L. unions generally exercise greater autonomy than do those of C.I.O. unions. National unions, perhaps because of the size of the country and the lack of class consciousness, are almost completely autonomous. The national federations are still "ropes of sand" limited in authority to a variety of activities (such as research, education and determination of jurisdictional boundaries) which do not usually restrain the autonomy of the affiliated national unions. Attempts at organic unity between the A.F. of L. and C.I.O., faced with severe jurisdictional and vested interest hazards: proved unsuccessful.

Common to all unions, despite the variations in form, is their essential political nature. Trade unions are more political than economic institutions. Trade union structure and policy are shaped by the union's concentration on maintaining and extending its institutional life, and by the union leader's attempt to balance and reconcile the variety of conflicting pressures imposed upon him by his own rank and file, the employers, rival leaders, internal factions, the state and the consumer. This aim of achieving institutional and leadership security is the most formidable moulder of trade union structure, policy, function and internal government. If trade unions attempt to maximize anything, it is more the security of the institution and its leaders than some economic variable such as money wage rates or employment opportunities.

Union structure largely determines the structure of collective bargaining. Local autonomy leads to local contracts with employers; concentration of power in the national union leads to nation-wide contracts. Craft unions cover the craft with their contracts; industrial unions, the industry. No "national bargain" was possible in the United States at mid-20th century because, first of all, there were two federations and, moreover, neither federation had disciplinary power over its constituent national unions.

Substantive Scope of Collective Bargaining.— Issues bargained over in the United States traditionally encompassed union security, job security, working conditions, hours and wages. The long historical tradition of employer hostility and the lack of working class solidarity made the union security provision in the collective contract of special importance in the United States. Consisting of some provision that the worker, as a condition of his continued employment, either must be a member of the union when hired (the closed shopj, or must join and remain a member once hired (the union shop), or may elect to join or not to join, but once having affiliated must agree to remain a member (maintenance of membership), a union security clause became the cornerstone of most contracts. After the enactment of the Taft-Hartley act, which banned the closed shop form of agreement (although many tacit closed shop provisions continued to be mutually enforced), the union shop gained relative to other forms.

Job control provisions which seek to define and make more secure the worker's tenure on the job include rules controlling entrance to the trade, rate of output, transfers, layoffs, discipline and dismissal of workers, the introduction of new equipment or methods, and even a guarantee of volume of employment. With the shift from craft to industrial unionism, rules governing apprenticeship (to control a skilled labour supply), excluding new equipment and limiting the volume of output became less important, and rules concerned with the distribution of work according to the principle of seniority more important. Make-work rules had their greatest impact in seasonal or declining industries. Guaranteed employment provisions had by the early 1950s affected less than 1,000,000 workers (mostly in small companies operating in stable or predictably fluctuating demand industries), but several large C.I.O. unions started in the post-World War II period to campaign for a guaranteed annual wage.

Diverse working conditions produced a wide range of specific work-rule provisions seeking to improve health, comfort, sanitary and safety conditions on the job. Wages and hours, of course, were significant issues from the earliest incursions into collective bargaining, and a steady pressure to reduce work-day and work-week hours was exerted. Once the 8-hr. work day and the 40-hr. work week were achieved, there was a strong tendency to include provisions for holidays and vacations with pay.

Wage objectives of unions encompassed efforts to establish systematic wage structures, to take individual wages out of competition by establishing standard rates for comparable work, and to improve real wages by seeking to negotiate ever higher money wage increases. Slogans and criteria for justifying wage demands have varied and have been called upon at propitious moments: "a living wage," "a fair day's pay for a fair day's work," "adjustment of inequities," "the cost of living," "ability to pay," "productivity"—all have been used to rationalize the justifiability of the wage demand.

A significant shift from wage to nonwage demands, especially toward bargaining for health and welfare and pension plans, began during the 1940s. Wartime restrictions on money wage increases encouraged negotiation for fringe benefits to which the National War Labor board generally acceded. By 1950 this conversion of the older unilateral union or management paternalisms into a jointly administered paternalism had progressed quite far. More than 5,000,000 workers were covered by various health and welfare plans in 1950 as compared with about 500,000 in 1945. The increased coverage of pension plans was about the same in scope.

Management-imposed contractual obligations continued to be concerned primarily with guarding against new or further encroachments into the domain of historical managerial perogatives and functions, and particularly with maintaining discipline and efficiency on the job.

Varieties of Collective Bargaining Patterns and Experience.— The heart of all collective bargaining lies in the joint negotiation and administration of a trade agreement. The trade agreement establishes working rules; describes worker; union and management rights and obligations; determines rewards and penalties; and clarifies the procedures to prevail in the effective administration of this mutually agreed upon code of behaviour.

Because the labour-management relationship treats with such important rights and obligations which shift over time, so severe a conflict may develop that no agreement results without battle. Even when open warfare is avoided. the trade agreement is not a final, static resolution of all conflicting differences or objectives but rather a better or worse compromise derived from the preceding "exercise in skilful retreat.'!

Differences in market conditions, the security of the trade union, face-to-face relations, origins of the relationship. dominant union or management personalities, ideological views and selection of bargaining techniques (*i.e.*, differences in the surrounding environment) resulted in a great variety of bargaining patterns and experi-

ences in the United States. The scope of a bargain may range irom coverage of an entire competitive area under a single agreement negotiated between the union and an employer association to coverage of only a single plant of a single employer. A grouping of bargaining patterns according to the scope of the agreement (with illustrations of industries in the United States in which each variety became prevalent) includes the following basic varieties: contracts relating to a single plant (machinery, precision instruments): contracts relating to more than one plant of the same employer (automobiles. steel, rubber, communications); and contracts negotiated with a group of employers bargaining as a formally organized or informal association (printing and publishing, clothing. coal, railroads, services). Within these categories, bargaining may be craft by craft (building), multicraft (railroads), or industrial (meat packing, aluminum). It may be local (baking, service trades), regional (Pacific coast longshoring) or national (railroads, coal). Within particular industries, key bargains may be struck which serve as a pattern for subsequent negotiations with other companies.

The trend in the United States was toward an increasing importance of multiemployer agreements, of locality-wide and company-wide bargaining, and toward a greater importance of the key bargain in the more important basic mass-production industries. The bureau of labour statistics found, in a study of more than 3,000 agreements, that, in 1950, although two-thirds of all agreements related to a single plant, less than one-third of all workers were covered by such contracts. Multiplant bargains, while involved in only one-eighth of all contracts surveyed, covered two-fifths of all workers. Multiemployer agreements (one-fifth of all agreements) covered about one-third of all workers. Association bargaining was especially important in the Pacific coast area, where about half the agreements negotiated were of the multiemployer variety.

Grouping bargaining systems according to the tone of the relationship, as contrasted with its scope, scholars identified a variety of patterns of experience in U.S. labour-management relationships: (1) containment-aggression, where ceaseless management attempts to contain in a narrowly restricted area or to eliminate the trade union result in persistent and intensified union aggression; (2) conflict marked by reluctant management recognition and a constantly combative attitude; (3) conflict emerging from basic ideological incompatibilities; (4) price-list bargaining, where terms of the agreement are unilaterally determined (illustrated in the case of a craft union offering its skilled labour to miscellaneous, minor or occasional purchasers who hire the labour according to an announced price list); (5) deal bargaining, involving a high degree of co-operation between top leaders but limited understanding or participation at the root levels of the relationship; (6) power bargaining between strong secure unions and well-organized employer associations; (7) mutual accommodation and real tolerance in negotiating the traditional terms of the trade agreement; (8) active co-operation and conscious promotion of relationships extending mutual concern and accommodation beyond the customary range of wages, hours and working conditions to include attempted improvement of managerial efficiency or solution of problems of solvency and permanent disposition of union security and stability issues; (9) collusive relationships involving mutually contrived supply or price controls to the advantage of producer interests over consumer.

Bargaining systems tended to move from some form of conflict (the first three types noted above) through tolerance (the second three types) to accommodation or co-operation (the last three). Co-operation frequently meant either retreat or market restrictions. Many of the pre-1933 union-management co-operation schemes were really equivalent to trade union retreats or concessions in the face of unemployment or nonunion competition; and co-operation, after the extended growth of trade unionism, tended in the collusive-restrictionist direction at the expense of the consuming public.

Consequences of Growth and Development.— The consequences of trade unionism and of collective bargaining before 1933 had only localized significance. Subsequent growth made the character and results of collective bargaining nationally significant. After 1933 repercussions of industrial conflict, of the interaction of trade union wage policy and general economic stability, and of restrictionist or collusive tendencies, provoked and sustained greater public concern over the conduct and consequences of labour-management relations than had existed at any time in the past. These and other real or alleged by-products of the growth of trade unionism have evoked both vigorous indictments and ardent defenses of collective bargaining and have bequeathed a much disputed range of remedial or ameliorative proposals and policies.

The minimizing of industrial conflict and the more positive goal of achieving industrial peace (where industrial peace refers to a continued state of mutually agreeable but noncollusive relations freely and amicably negotiated by parties of relatively equal strength) assumed a greater importance as collective bargaining became more pervasive. Though it may be true that as free collective bargaining systems mature they proceed toward a more accommodative or co-operative level, this did not resolve the immediate issue of minimizing the sometimes substantial transitional residuum of conflict. Nor did this theory offer even longer-run hope for industrial sectors which seemed not to be governed by this behavioural rule at all (*e.g.,* water transportation, coal mining). Varying emphases on causes of conflict resulted in different policy proposals to promote and maintain accord. Those who emphasized better "human relations" in industry as the crucial lubricant in the procession from conflict to co-operation sought to improve interpersonal relationships and communication lines within the factory social structure. This method of approach, which gained its impetus from the experiments conducted at the Western Electric company in the late 1920s and early 1930s sought the reform of management personnel policies and increased managerial concern with personnel relations.

Others stressed fundamental external as well as internal environmental circumstances and proceeded to describe typically favourable environments which prevailed where industrial peace had developed. These environmental forces, however, are essentially permissive rather than compulsive; and where environments are compulsive they may compel toward conflict as well as peace. Where workers, for example, form a relatively homogeneous group which is unusually isolated from the general community and which is capable of cohesion (*e.g.,* in maritime transportation and coal mining), they will be exceptionally strike-prone. Those industries where workers are integrated into the larger society are comparatively strike-free. This hypothesis, which singles out the location of the worker in society at large as the most significant variable in explaining interindustry differences in strike-proneness, suggests, as the greater strategy in reducing intensity of conflict, the fuller integration of the worker, his associations and the employer into the general society. Increasing vertical and horizontal mobility, the encouragement of many limited-function mixed associations, the substitution of the mixed community for the isolated mass become the gates to industrial peace.

Government implicitly accepted the conflict-to-co-operation generalization insofar as it generally sought to rely on voluntary instrumentalities to encourage labour-management co-operation and compromise. Reliance on state and federal mediation and conciliation services and on fact-finding boards which attempt to recommend to the disputing parties some reasonable basis for settlement reflected the prevailing belief in the potential harmony of interests. In attempting to avert the consequences of conflict in areas where interruption of operations resulting from a strike would endanger the 'public welfare or national safety, however, government employed more compulsive sanctions and penalties which remain the subject of much debate and controversy. Some states, in disputes involving public utilities, required compulsory arbitration; and for strikes designated by the president as national emergency disputes, the Taft-Hartley act established an injunctive procedure which was not always effective in settling or even in averting strikes. Within the realm of union-management self-government itself, there was widespread acceptance of voluntary arbitration in the settlement of grievance disputes. None of these measures, how-

ever, eliminated industrial conflict and the appropriate handling of emergency disputes remained an unresolved issue.

The issue of minimizing conflict is matched in importance by the issue which revolves about the consequences of trade union wage policy upon national employment and price levels. The more exaggerated indictments have charged collective bargaining with the ultimate destruction of the free enterprise system. It is alleged that unions, by exerting constant and apparently limitless upward pressure on the wage level, must create serious unemployment and or severe inflation which in turn are but preludes to the inevitable demise of a free "competitive" pricing system. Employer and government resistance are regarded as utterly ineffective in stemming the devastating consequences of the omnipotent union leaders' demands for "more, more and more." Collective bargaining, in brief, is viewed as simply not compatible with capitalism. Equally ardent defenders have, on the other hand, maintained that negotiated wage increases will almost always have a favourable impact on employment and price stability; that the roots of inflation never lie at the trade union's door; and that extended collective bargaining, resulting finally in a national bargain which will stabilize prices and wages, is absolutely essential to the proper functioning of a capitalist society since it is a key technique for preventing both mass unemployment and injurious inflation. Less extreme views have not entirely dismissed the problem of constant inflationary tendencies as a result of trade union wage pressures under conditions of full employment, but recognition is accorded the fact that power may beget power, that strong unions bargaining with strong employer groups have historically led to wage structures which tend toward a two-directional inflexibility as well as to generally more moderate demands, and that the rate at which wages spiral upward may be retarded by the increasing internal bureaucratization in union hierarchies. If it is true that union leaders do not seek to exploit the maximum economic monopolistic powers which they possess but rather seek the minimum gains requisite for political security and stability, then an ever more secure and self-perpetuating leadership may feel less pressured to secure maximum wage gains during periods of general economic prosperity.

The growth and development of collective bargaining provoked still other important grounds for concern. Is it not possible that equalization of power, instead of serving a stabilizing function, may result in collusive price fixing against the consumer and in higher wages for a restricted number of workers, and thus in a less efficient utilization of resources? May not increased internal centralization of leadership coupled with union security provisions and other restrictions on entry threaten a loss of freedom for the individual worker? How severely will the effects of various contractual provisions, such as pension and health and welfare plans and seniority rules, obstruct the mobility of the labour force and the fluidity which a dynamic economy requires? These several issues are the focal points for the continuing debate over the form and the performance of collective bargaining in the United States.

BIBLIOGRAPHY.—E. W. Bakke, *Mutual Survival, The Goal of Unions and Management* (1946); *E.* W. Bakke and C. Kerr (eds.), *Unions, Management and the Public* (1948); *J.* Barbash, *Labor Unions* in *Action* (1948); N. W. Chamberlain, *The Union Challenge to Management Control* (1948); *Collective Bargaining* (1951); *J.* R. Commons *et al., History of Labour in the United States,* vol. i and ii (1921), vol. iii and iv (1935); H. W. Davey, *Contemporary Collective Bargaining* (1951); F. R. Dulles, *Labor in Anzerica* (1949); *J.* T. Dunlop, *Wage Determination Under Trade Unions* (1950), *Collective Bargaining* (1949); *C.* S. Golden and H. J. Ruttenberg, *The Dynamics of Industrial Democracy* (1942); *F.* H. Harbison and R. Dubin, *Patterns of Union-Management Relations: UAW-CIO, General Motors, Studebaker* (1947); F. H. Harbison and J. R. Coleman, *Goals and Strategy in Collective Bargaining* (1951); *J.* B. S. Hardman (ed.), *The House of Labor* (1951); R. A. Lester, *Labor and Industrial Relations* (1951); *R.* A. Lester and J. Shister (eds.), *Insights Into Labor Issues* (1948); C. *E.* Lindblom, *Unions and Capitalism* (1949); *H.* A. Millis (ed.), *How Collective Bargaining Works* (1942); S. Perlman, *A Theory of the Labor Movement* (1928); F. Peterson, *American Labor Unions* (1952); P. Pigors and C. *A.* Myers, *Personnel Administration* (1947); *L. G.* Reynolds, *Labor Economics and Labor Relations* (New York, 1949); A. M. Ross, *Trade Union Wage Policy* (1948); *B.* M. Selekman, *Labor Relations and Human Relations* (1947); S. Slichter, *Union Policies and Industrial Management* (1941), *The Challenge of Industrial Relations* (1947); G. W. Taylor, *Government Regulation of Industrial Relations* (1948); C. Warne (ed.), *Labor in Post-War America* (1949); W. *F.* Whyte, *Pattern for Industrial Peace* (1951); S. T. Williamson and H. Harris, *Trends in Collective Bargaining* (1945); D. M. Wright (ed.), *The Impact of the Union* (1951); *Industry-Wide Collective Bargaining Series,* University of Pennsylvania Press, (1948–1949); *Causes of Industrial Peace Under Collective Bargaining Series,* National Planning Assn., no. 1–14 (1948–1954); M. Weber, *Protestant Ethic and the Spirit of Capitalism,* tr. by T. Parsons (1930); R. H. Tawney, *Religion and the Rise of Capitalism* (1929). (C. KR.)

INDUSTRIAL ARBITRATION

Industrial or labour arbitration is the process by which a labour dispute is submitted to an impartial person, or to a board of three or more, for a final and binding decision. When the parties agree to settle a dispute in this manner it is known as voluntary arbitration; where a law prohibits strikes and requires such arbitrament, it is compulsory arbitration. In the United States most arbitration is voluntary, but some states enacted laws making it obligatory to arbitrate controversies which threaten to shut down public service industries.

The parties to industrial arbitration are normally trade unions and employers or organizations of employers. Because they make collective agreements governing terms and conditions of employment, such arbitration (whether voluntary or compulsory) is necessarily of two distinct kinds. One deals with disputes arising out of grievances, or out of interpretation or application of agreements, the other with differences that arise when new agreements or proposed changes in existing agreements are being negotiated.

The first kind of arbitration adjudicates "rights," *i.e.,* the rights of employees, managements and unions established by the agreements. The second settles controversies about "interests," so-called because it deals with proposed new terms of employment when the parties are free to pursue their respective interests. They are not bound by any existing agreement, and the arbitrators, having no such agreement to control their decisions, are free to support, reject or compromise the proposals of either party. Such arbitration is, in effect, legislation rather than judicial determination, for the decisions fix rates of pay, rules and working conditions to be embodied in agreements on the basis of which future disputes about rights are adjudicated.

Adjudication. — This is the most frequent and successful form of industrial arbitration. It did not develop on any considerable scale until the last quarter of the 19th century when skilled craftsmen succeeded in establishing more or less continuous organizations. As these forced employers to make collective agreements with them, the practice developed of including a provision for a joint standing committee, equally representative of employees and the employer, to adjust differences as to the requirements of the agreements. If the representatives were unable to settle a dispute, they were authorized to select a neutral or impartial person to sit as a member of the committee so that a decision could be made by majority vote.

In the early years of the 20th century this form of arbitration spread to other trades and industries. Provisions were made for the appointment of the impartial arbitrator by some public authority when the party representatives were unable to agree on a neutral. A collective agreement in the anthracite coal industry in 1903 set up a conciliation board which, like the standing committees, was composed of an equal number of representatives of the miners' union and the mine operators. This agreement provided for the designation of the neutral chairman by a U.S. court of appeals. Later other boards with arbitrators similarly appointed were established in various districts of the bituminous coal industry. In other industries the more common practice was to have the arbitrator designated by the federal or a state labour department.

In 1910 an agreement known as the "protocol of peace," in the New York ladies garment industry, established a board of arbitration, and the parties agreed on an impartial chairman of the board at the time the agreement was made instead of waiting to select a temporary chairman for each case as it arose. A year later such a board was established in the men's clothing industry of Chicago, and during the 1920s impartial chairmen were presiding over arbitration boards made up of labour and employer repre-

sentatives in all clothing manufacturing centres and in other needle trades as well. In that decade the number of agreements providing for joint standing committees, with temporary arbitrators chosen for disputes they could not settle, also continued to grow. On the railroads such committees were known as adjustment boards, the practice being for each road to set up a separate board for each class of employees covered by an agreement with a union.

The Railway Labor act of 1926 extended this practice by authorizing such boards to be "created by agreement between any carrier or group of carriers or the carriers as a whole, and its or their employees." But while it stipulated that a majority of the members of an adjustment board should be competent to make a final and binding award, the act made no mention of a neutral member or arbitrator designated to sit with the board. In 1934, however, the law was amended to create a National Railroad Adjustment board to which grievances or disputes about rights not settled on the individual roads could be referred; and it further provided for appointment of a referee by the administrators of the act when the party members were unable to settle a dispute and could not agree on a neutral arbitrator.

The amended act also obligated the railroad managements to bargain collectively and to "exert every effort" to make and maintain working agreements with unions representing their employees. The following year (1935) congress adopted the first National Labor Relations act, which placed a similar obligation to bargain collectively on employers in all other industries engaged in interstate commerce. Thereafter arbitration became the normal method of settling disputes about grievances or rights under agreements in most U.S. industries. Studies by the U.S. department of labour in 1950 and 1952 showed that almost 90% of the agreements prescribed arbitration as the final step in the process of handling grievances or disputed claims under agreements (*Monthly* Labour ***Review,*** July 1951 and March 1953). Arbitration of this kind is a direct substitute for strikes or lockouts which collective agreements generally prohibit during the periods for which they are written. It largely eliminated work-stoppages as a result of differences about interpretation or observance of agreements; such arbitration became so common that decisions were regularly published in volumes like reports of court cases.

Legislative Arbitration.— Much less frequent and much slower in growth has been arbitration of disputes about new terms and changes in agreements, or disputes about "interests." But such arbitration was resorted to increasingly after the U.S. congress began to equalize bargaining power of employees and employers by the labour relations legislation of 1934 and 1935. It is a characteristic of this form of arbitration that the stronger party is usually inclined to oppose and the weaker to favour it. But as their strength approaches equality, both are more willing to accept arbitration as a lesser evil than a strike when they cannot settle disputes by collective bargaining, as they do most frequently.

Thus there was little of this arbitration in the 19th century, when trade unions were weak and employers generally had the upper hand. But after 1890 the American Federation of Labor (*q.v.*) (formed in 1881) devoted itself to building strong unions with ample treasuries, and in the early years of the 20th century, when these were able to match their strength with employers in protracted strikes, many arbitrations were arranged as a means of settlement and also to forestall work stoppages. The anthracite conciliation agreement mentioned above was the result of an award by an arbitration commission appointed by Pres. Theodore Roosevelt in 1903 after a long and bitter strike; and arbitrators' efforts were largely responsible for the so-called protocol of peace in the ladies' garment industry in 1910. Major labour disputes were similarly settled by arbitration during that period in the printing and building trades, on the railroads and in other industries. The International Typographical union made an agreement with the American Newspaper Publishers association in 1901 to arbitrate future disputes for five years, and it was renewed several times. About the same time the International Printing Pressmen's and Assistants' Union of North America entered into a similar agreement which, renewed from time to time, was still functioning in the early 1950s. During World War I the federal government established a National War Labor board to arbitrate disputes affecting war industries in return for a "no strike-no lockout" agreement entered into by representatives of the A.F. of L. and of national associations of employers.

These developments gave an impetus to arbitration of "interest disputes" which lasted through most of the 1920s and was stopped by the depression that began in 1929. It was revived again on a larger scale by the labour relations legislation of the Franklin Roosevelt administration in the 1930s; and during World War II it was greatly extended by another National War Labour board which arbitrated disputes in war industries pursuant to a no-strike pledge. The awards of this board, however, were technically only recommendations; they could be enforced only if the president used his war powers to seize a plant and put their terms in effect. But in most cases they were accepted by the parties, or formed the basis of settlements.

The method by which a government board hears the parties to a dispute, determines its merits and makes recommendations for an equitable settlement is rarely referred to as arbitration. It is variously known as fact-finding, investigation or emergency proceedings by boards of inquiry or emergency boards; but essentially it is arbitration without binding decisions. In the Transportation act of 1920 congress provided for a Railroad Labor board with authority to hear and decide disputes, and left its awards unenforceable. Nevertheless, during the six years of its existence, most of its 4,000 decisions were accepted by the parties. The board had jurisdiction over both disputes about rights and disputes on interests, and this proved a source of confusion, causing dissatisfaction among railroad managements and employees alike.

The Railway Labor act of 1926 clearly distinguished between the two kinds of labour disputes; for the first it provided arbitration with final and binding decisions by the adjustment boards previously mentioned; for the second it authorized legally enforceable agreements to submit such disputes to arbitration, but either party could refuse to arbitrate. After such refusal, however, if any dispute threatened substantial interruption of interstate transportation, the law empowered the president to appoint an emergency board to inquire into the dispute and make recommendations for an equitable settlement. After this law was passed several hundred such boards were appointed, and in a large majority of the cases strikes were prevented by the parties' accepting what was recommended.

In other industries where labour controversies threatened or created emergencies, the president appointed similar temporary boards on his own initiative, and in most of those cases, too, recommended settlements either prevented or ended strikes. Not infrequently, moreover, the parties themselves submitted their differences to an individual or a board of their own selection with instructions to make recommendations rather than binding awards, and usually these brought about peaceful settlements. (See also LABOUR LAW; TRADE [LABOUR] UNIONS.)

BIBLIOGRAPHY.—E. E. Witte, *Historical Survey of Labour Arbitration,* (1952); Frank Elkouri, *How Arbitration Works* (1952); Braden, "Current Problems in Labour-Management Arbitration," *Arbitration Journal,* N.S., vol. 6, p. 91 (1951); "The Function of Arbitration in Labour Relation Proceedings," *Proceedings,* Industrial Relations Research Association, part vi, (1951); Bureau of National Affairs, *Labour Arbitration Reports,* vol 18 (1952). (W. M. L.)

INDUSTRIAL RESEARCH: **see** RESEARCH, INDUSTRIAL.

INDUSTRIAL REVOLUTION, THE. When we say that a society has passed through the industrial revolution we have in mind a definite picture of its life and power. We are thinking of a society that makes great use of machinery and conducts its operations in industry and commerce on a large scale. The creation of any such society must be in some respects a gradual development. Certain features of our modern economic life can be traced back to the days when Columbus and the great sailors of his time put Europe in touch with the new world and the far east; others to the earlier history of Europe when classical Greece, and the Roman empire in turn exploited the wealth of the Mediterranean basin. There was large capital invested in industry as well as in commerce before the 18th century, and even so modern a phenomenon as mass production was not altogether

unknown before the industrial revolution. No people and no age could pass directly from a primitive and simple economy to a life so complicated as that of modern Britain or modern Germany. Some critics, surveying these earlier tendencies. doubt whether the term industrial revolution is appropriate, arguing that revolution implies sudden and catastrophic change. But a closer examination shows that the great inventions which distinguished the 18th and 19th centuries played so decisive a part in creating the new kind of society that the term industrial revolution, invented by a Frenchman and made familiar by Arnold Toynbee (1852–83), is not too violent a description of the changes they produced. It is now an established phrase. like the Renaissance, or the middle ages, with a well-understood meaning and content.

England the Pioneer.—We mean, then, by the industrial revolution the change that transforms a people with peasant occupations and local markets into an industrial society with world-wide connections. This change has come to different peoples at different times. It came first in England because the English people had favourable political institutions, internal free trade, advantages of climate and geographical position, considerable experience of foreign trading. special connections with the new world and abundance of coal. In the first phases of the revolution coal mattered much less than it did afterward, for the first great mechanical inventions in the textile industries were worked by water power, and rapid industrial development was possible at this stage without coal. This explains why France made such rapid progress as an industrial nation before the French Revolution. France had great inventors like J. M. Jacquard and Jacques de Vaucanson. and it had a richer foreign trade than Great Britain. But when a series of inventions had made coal the chief source of economic power, France was at a great disadvantage. As late as 1847 it produced only 5,000,000 tons of coal, whereas the English production so early as 1800 was 10.000.000 tons, and from 1845 it was over 34,000,000. If France had kept the frontiers established by the treaty of Amiens (1802), its history would have been different, for that treaty left it with the Belgian coal fields.

The Revolution in Iron.—The inventions which gave this predominant importance to coal began with the discoveries by the two Abraham Darbys and by Henry Cort of methods of using coal instead of charcoal in blast furnaces and forges. Before these discoveries iron manufacture depended on charcoal. It was therefore carried on mainly in counties like Sussex with extensive woodlands. But by the early 18th century the industry was in great difficulties, for the supplies of fuel were giving out. When the Darbys, Cort, John Wilkinson and James Watt had revolutionized the industry the difficulties vanished, coal took the place of charcoal, and the iron manufacturer could set up his plant in the neighbourhood of coal fields. So the industrial revolution created the black country. and enabled England to turn to account the good fortune which had given it abundance of coal, and coal conveniently placed near its ports. Between 1720 and 1788 the production of pig iron in England grew from 25,000 to 68,000 tons; between 1788 and 1839 it grew from 68.000 to 1,347.000 tons.

The Textile Revolution.— The revolution in the manufacture of iron which created the black country was accompanied by a revolution in the textile industries which transformed Lancashire and the West Riding of Yorkshire. This revolution was started by a series of inventions in the 18th century. The flying shuttle was invented by John Kay in 1733; the spinning jenny was patented by James Hargreaves in 1770; a roller spinning frame, worked by water power was patented by Richard Arkwright in 1769 and 1775; the mule which enabled English mills to match the delicate muslins produced by Indian fingers was invented by Samuel Crompton in 1779. The cotton industry established by these discoveries was conducted at first by water power, but before the end of the century its progress and its power received a great stimulus from the most important of all the discoveries of the industrial revolution.

Steam Power.—Profiting by the earlier pioneer work of Thomas Savery and Thomas Newcomen, Watt learned how to make steam the servant of man's will. By his invention of the separate condenser, patented in 1769, he produced a new type of engine. In his early engines steam was used to force a piston up and down, and they were mainly used for pumping water in mines, but Watt went on to devise a method by which steam could be applied to rotary movements as well, and this was in some respects the most important of his discoveries. From that time there was scarcely any limit to the range of the invention, which revolutionized one industry after another. In the textiles the new power was first applied to spinning; later it was used for weaving, as the result of a series of inventions, beginning with the imperfect power loom patented by the Rev. Edmund Cartmright in 1785, The effect was to give new freedom to the industry, which was now independent of water power, just as the iron industry was independent of woodland. The growth of the cotton industry was the most sensational event of the early revolution. In 1764 England imported 4,000,000 lb. of cotton wool, in 1833 it imported 300,000,000 lb. A table drawn up by the Chamber of Commerce at Mulhouse in 1835 shows that in that year England produced over 60% of the cotton goods consumed in the world; France 16%; the United States 7%; Switzerland, Saxony, Prussia and Belgium between them a little less.

This expansion of the industry involved, of course, a great increase in the demand for raw cotton. When first the industry began to grow England and France competed for a deficient supply. At that time the West Indian islands provided more cotton than the continent of North America. The United States had a great deal of short stapled cotton, which could not be exported profitably, because the cotton adhered so closely to the seeds that it was difficult and costly to prepare it for export. But in 1793 Eli Whitney invented a saw gin which enabled this cotton to be cleansed, and from that time the United States became the chief source of supply. This invention led incidentally to a great extension of slavery in the southern states, for slaves were especially suitable for the task of growing cotton in the river beds.

The woollen and worsted industries were older than the cotton industry, and in their case these technical improvements were introduced more gradually. They led to the concentration of both industries in the West Riding, the worsted industry declining in the eastern counties, and the woollen in the southwest.

Canals.— It is important to notice that the cotton industry was established on a large scale while England was still dependent on canals and roads for transport. There had been a great development of road making and canal making in the 18th century, in consequence, partly, of the agrarian revolution. This revolution, nhich increased rapidly the system of large tenant farming, with landlords applying their capital to improvement, made farming much more productive. It was effected partly by Enclosure acts which were passed through parliament, setting up commissioners to enclose the common fields and the common wastes. Under the old system individual freedom was limited by the rights of the commoners. By this change enterprising landlords could apply the lessons taught by Jethro Tull and other agricultural pioneers, who had discovered how to improve crops and stock. But the roads were in a bad state, much worse than in contemporary France, and it was necessary to construct new roads and reconstruct old ones, in order to enable corn and other agricultural products to be taken to the towns. So the governing class threw itself into road development, and turnpike trusts were set up all over the country for that purpose. Similar motives led to canal building. The most famous of the inventors in this field was James Brindley, who was commissioned by the duke of Bridgewater in 1759 to make a canal to connect his coal field with Manchester. His success gave a stimulus to the movement, and the industrial districts of the north and the midlands were rapidly connected with each other and with the ports by a network of waterways.

Railways.— But man's new servant. steam, was soon brought into use for the purpose of transport. The first steam locomotive was tried at the Merthyr Tydfyl iron works in the early days of the 19th century. The founder of the British railway system was George Stephenson, the engineer of the Stockton and Darlington railway, opened in 1825, and the designer of the engine which

won the prize in the competition held at Rainhill in 1829. The success of the Liverpool and Manchester railway opened in 1830 led to an age of feverish activity in railway building. and by 1848 nearly 5,000 mi. of railway line had been laid in Great Britain. This in its turn had a powerful influence on the metal industries. Sea transport changed more slowly; the first steamship crossed the Atlantic in 1819, and, by 1847, 60 or 70 steamships were turned out every year.

Engineering. — In some respects the most important of the results of Watt's discoveries was the use of machines for making machines. Mechanical engineering began to be important in English history about 1820 (the first textile machinery was made of wood), and with the rapidly growing demand for machinery from all parts of the world its importance grew at a rapid rate. The scope and power of the industry were increased by a series of inventions such as James Nasmyth's steam hammer in 1838, and by discoveries associated with the names of Henry Bessemer (1856), the brothers Werner, Sir William, Frederick and Carl Siemens (1866) and Sidney Gilchrist Thomas (1879), which created the modern steel manufacture. All the metal industries were helped further by the chemical discoveries of which Michael Faraday had made a beginning in 1826, discoveries that created in their turn the successful chemical industries of Lancashire and Cheshire.

The effect of all this energy in scientific pursuits and industrial enterprises was to make England the leading representative of the new civilization: the workshop of the world. Its early progress was all important. For, as we have seen. England had an industrial revolution before the railway era. In the two countries where industrial expansion was most rapid in the latter half of the 19th century, Germany and the United States, the industrial revolution began with the introduction of the railway. In earlier ages the chief obstacle to industrial development was the difficulty of land transport. In Germany and America this difficulty was resolved by the railways. In England, on the other hand, where the sea was nowhere very far distant, an industrial revolution was possible aithout the railways, because canals and roads could give access to the ports. It was mechanical engineering that received the greatest stimulus from the railways. Therefore, when the world wanted railways and docks, England was ready with the plant, the experience, the capital and the skill. Hence it was to English capital and English labour that the world turned for this task. But there was a difference between the early days of the revolution, when England sold piece goods all over the world, and the later days, when it sold railways; for the railways it sold sometimes helped to turn agricultural into industrial societies, and it was certain that when this change had taken place, England's preponderant share in the trade of the world would decline. When the 20th century opened England had ponerful industrial rivals both in and out of Europe, many of them with far greater natural resources to exploit, and one of them, the United States, with far greater supply of capital per worker.

After 1900 the industrial revolution went through new phases, many of them providing greater opportunities and affording more serious challenges than the early industrial revolution. New sources of power, such as electricity, the use of new and synthetic materials, the increased application of science both to techniques and to management, transformed industry in many parts of the world, particularly in the United States, which took the place of England as a world leader. Hitherto underdeveloped societies felt the impact of this new revolution, which took a planned form in the Soviet Gnion. The consumer has often benefited as much as the industrialist from the enormous increase in production.

Electricity. — The 19th century was the century of steam. Before its close man had discovered in electricity an even more valuable servant. A new industrial revolution was thus set in train, a revolution of which we cannot yet forecast the consequences. One effect is seen in the growth of motor industries in the home counties. The great industrial revolution concentrated industry in certain districts; Lancashire is the home of cotton, the West Riding of wool, Staffordshire of pottery, the great metal industries are found near the coal fields. Electricity gave industry again a wider choice, and the factory inspectors' reports for 1926 drew attention to the development of industries in the south of England. Transport was easier, and power could be made available in the country districts.

Social Results. — The conversion of an agricultural to an industrial society brings with it great changes in a nation's habits and manner of life. Of the changes that followed the first development of the new system, those that made the greatest impression on the thinkers and observers of the time were the great improvement in production, and the opportunities this new world offered to individual talent and character. The great cheapening of commodities made life easier, and the first impression made by this improvement led to a belief that the secret of progress was to allow every enterprising person to make what profit he could by any means that he chose. The revolution also gave great opportunities to the workman who could save a little money and was shrewd and daring in investing it. Most of the early cotton spinners were men who had made their way. Robert Omen, for example, one of the most successful of them, owed his success to a loan of £100.

The exhilarating atmosphere of a world in which men could make their own careers helps to explain the optimism of the time, and the disregard of evils which called for action.

Problems of Urbanization. — The industrial revolution created social problems as well as economic advances. In particular the new industrial towns, like Manchester and Birmingham, which grew rapidly in the early 19th century as the textile and metal industries expahded, were unable to handle the tasks of maintaining public health and law and order. Equipped with obsolete administrative apparatus, they were uncontrolled in their growth. Frequently the new town life was tough and squalid, in Edwin Chadwick's phrase, "in respect to cleanliness almost as bad as that of an encamped horde, or an undisciplined soldiery." The accumulation of numbers, however, frequently directed attention to social problems which had been concealed in villages and preindustrial communities, and the movement for reform was itself as much a product of the industrial revolution as the black spots on the map. In the 1840s, when a spirit of inquiry was active and philanthropists and statisticians were directing attention to the "condition of England" question, the state of towns was examined by committees and commissions, such as the Health of Towns commission, and their appalling condition was revealed. A national effort to reform these conditions was made by the Public Health act of 1848, but the problem proved difficult for technical, political and administrative reasons. The long history of urban improvement in the 19th and 20th centuries shows how heavy a social burden was imposed by early uncontrolled economic development.

Industrial Relations. — The revolution not only made the problems of urban life acute and pressing: it created industrial relationships which brought social conflict into the open. Before the textile industries passed into the factory, spinning and weaving were done either in the workers' homes or in the house of a small master. Spinning was woman's work and weaving man's work. In the mill, spinning was mainly men's work and weaving women's work, but both Beavers and spinners depended on the help of children. The early mills had difficulty in getting labour, for they were built on streams in districts where there was little population. The difficulty was surmounted by the supply of children from the workhouses. The hardships of these children led to an agitation and it was made illegal to apprentice children 40 mi. from home. But by this time the use of steam power had made it possible to put up factories in or near towns, and the apprentice children were no longer needed. The campaign against the long hours of children became a campaign against the long hours of the factory, for it proved in practice impossible to shorten the hours of children without restricting the hours of the factory, and this campaign was brought to success in 1847, when parliament passed the Ten Hours act, for which the 7th earl of Shaftesbury (then Lord Ashley) had fought since 1833. Factory legislation and factory inspection were gradually extended to other industries in the course of the century.

After 1900, and particularly after 1919, many industrial firms enormously improved their own factory conditions, although in new industrial countries, such as Japan, labour conditions remained unsatisfactory even in the mid-1950s.

Trade Unions.— Large-scale industry in engineering and mining as well as in the factory created a different relationship between employer and employee than the sort of relationship which existed in the days of the craftsman. The place of the guild was taken by combinations of employers and employees. Strikes and combinations were not unknown beiore the industrial revolution, but the revolution gave a new importance and a new scope to trade unions. Their rights and their liabilities became one of the acute questions of politics. The Combination act passed in 1799, modified in 1800, and repealed in 1824, hindered trade union development. The next year a new act defined the powers of the trade unions in such a way as to make effective combination difficult. Trade unions did not obtain full recognition until after the workmen had been enfranchised in 1867. After World War I they were given a new place in public life by the institution of Whitley councils and similar bodies, composed of representatives of organizations of employers and workpeople. By the middle of the 20th century they had become a powerful iorce in industrial relations both at the factory and the national level.

Unemployment.— Another result of the industrial revolution was periodic mass unemployment, a consequence of mass production. The revolution made industries interdependent, and by bringing the whole world into close economic relationships it made the industries of one country dependent on the conditions in remote places. A coal strike hits the textile industries; a deadlock in engineering holds up shipbuilding. The poverty or the quarrels of the continent affect all British export industries; a political or commercial crisis in the United States may throw the cotton industry of Lancashire or the engineering industries of Newcastle into distress. In addition cyclical fluctuations in the volume of investment and failures of effective demand lead to changes in the level of employment.

It is sometimes said that the industrial revolution has substituted unemployment for famine as the nightmare of mankind. The growth of planning and the welfare state has been the 20th-century response to this situation.

Problems of Industrial Civilization.— The industrial revolution has not had exactly the same consequences in all countries. For those consequences depended partly on the conditions preceding the revolution and those conditions varied. English experience has been peculiar in one important respect. In England peasant farming disappeared with the agrarian revolution that began in the 16th century and ended in the 19th century. In other countries the peasant survived. France, for example, possesses important industries, but its people are mainly rural. Germany, much more industrial than France, has still a large peasant population.

But the industrial revolution has produced certain results that are common to industrial civilization. Thus one country after another has been obliged to legislate for social welfare. Asia has followed Europe. Provision against unemployment by state or municipal insurance was first made in certain continental countries, notably Germany and Belgium. In almost every industrial country policies to protect labour have been adopted since 1919. If we want to realize how much the industrial revolution has done to create common problems and to suggest common remedies we have only to glance at the publications of the International Labour office or to consider what reforms it pursues by conference and convention. In every country the same problems and the same remedies are under discussion: unemployment insurance, factory acts, hours of work, minimum rates of wages, the rights of trade unions, family endowment. One effect of the all-embracing system which the revolution has established has been to standardize the occupations, the cares and even the amusements of man.

The movie theatre is as much the mark of the modern world as the factory; the railway as the football or baseball field; the radio and television as the trade union. It is by these institutions that the modern traveller is reminded, as the mediaeval traveller was reminded by cathedrals and monasteries, that he can leave his own country without passing into a wholly strange and separate world.

The institutions, however, are in constant flux. If it is difficult to say exactly when industrial revolutions begin. it is clear that they never end. The introduction of automation and the preoccupation with the use of atomic energy were likely at mid-20th century to produce far bigger social and economic transformations than the rise of factories and the invention of steam power.

BIBLIOGRAPHY.—Arnold Toynbee, *Lectures on the Industrial Revolution of the Eighteenth Century in England,* new ed. (London, New York, 1908); L. C. A. Knowles, *The Industrial and Commercial Revolutions in Great Britain During the Nineteenth Century,* 3rd rev. ed. (London, New York, 1924); J. A. Hobson, *The Evolution of Modern Capitalism,* new and rev. ed. (London, New York, 1926); J. H. Clapham, *Economic History of Modern Britain,* 2nd ed. (Cambridge, New York, 1931–32); J. L. and Barbara Hammond, *The Rise of Modern Industry,* 5th ed. (London, New York, 1937); Paul Mantoux, *The Industrial Revolution in the Eighteenth Century,* trans. by *M.* Vernon, rev. ed. (London, New York, 1928); J. U. Nef, *The Rise of the British Coal Industry,* 2 vol. (London, 1932); T. S. Ashton, *The Industrial Revolution, 1760–1830* (London, 1948); G. Friedmann, *Industrial Society* (Chicago, 1955). (J. L. H.; A. BRI.)

INDUSTRIAL WELFARE AND MEDICINE: **see** INDUSTRIAL MEDICINE.

INDUSTRIAL WORKERS OF THE WORLD, THE, commonly known as the I.W.W., a revolutionary labour union organization which played in the early 20th century a considerable part in U.S. and world labour history. It was founded in July 1905 at Chicago, Ill., as a result of a conference of Socialists and trade union leaders, of whom the most outstanding were E. V. Debs (*q.v.*), William D. Haywood, Daniel DeLeon, W. E. Trautmann, Vincent St. John and the Rev. T. J. Hagerty.

At the time of the formation of the I.W.W., there had been growing pressure among revolutionary elements in the labour movement both for independent political action and for industrial unionism, as opposed to the craft lines of organization followed by the American Federation of Labor (*q.v.*) and other existing unions. It was argued that without industrial unionism to match the growing concentration of control among the ownership class, the workers were helpless. As things were, they felt, the workers of any one industry were split up into the various craft unions with their own narrow interests and goals, and if the members of one craft or occupation went on strike, those of other crafts in the same industry were still attending their jobs so that the plant was still more or less able to function. Only an industrial union, they contended, could successfully exercise pressure for labour's demands by all workers' leaving the job together no matter which part of their ranks had demands at stake at the moment. It was further argued that under the existing craft union type of organization, no provision was made for the vast number of unskilled workers who could neither benefit by trade union membership nor lend the support of their numbers to the struggles of labour, either in the industrial arena or the field of political action.

Most firm and articulate in opposing these arguments were the spokesmen of the A.F. of L., headed by Pres. Samuel Gompers (*q.v.*). Trade unionism, they countered, would mean the suppression of all gains won by labour thus far, and an end of trade unions themselves. It was their belief that such a reorganization of unions on an industrial basis would bring about confusion and injury to themselves when force was pitted against force. In defense of their position they claimed that in the past it had been largely the craft union strikes which had brought gains, while most all-out industrial strikes known to them had ended in failure and were followed by repressive measures.

The backbone of the revolutionary union leadership at that time lay in the Western Federation of Miners, with a membership of about 27,000. Impatient with the slow methods of the more conservative unions, a convention was called in June 1905 for the purpose of forming a new and more militant organization. Other unions represented were the American Labor union, the United Metal Workers, the Journeymen Tailors' union of Pueblo, Colo., the United Brotherhood of Railway Employees and the Socialist Trade and Labor alliance. The convention lasted 12 days, with Haywood, then secretary and treasurer of the Western federation, as permanent chairman. It was Rev. Hagerty who provided the first organizational plan of the union (known by Gompers' derisive nickname of "Father Hagerty's wheel of fortune"). All workers of every trade were to be accepted by the union, which was to be subdivided into 13 industrial sections, craft unions not being allowed. That is, workers of a given industry in a given city would unite to form a local industrial union. These, in turn, would unite with the local industrial unions of the same industry in other cities to constitute a national industrial union. The national industrial unions of related industries would then make up a department. And, finally, the departments and their constituent unions comprised the national Industrial Workers of the World. The 13 industrial sections, such as the division of mining, the division of building, etc., were felt to encompass the basic industrial activities of the time, and of times to come. The methods to be followed by union members were to be "any and all tactics" that would "get the results sought with the least expenditure of

time and energy." It was felt that the long strike was no longer an effective technique and they sought no agreements with employers beyond what their own bargaining strength could secure in terms of concessions gained. In the event of the failure of a strike, they advocated a return to work for the purpose of resuming sabotage and forcing the employer to concede to their demands.

The initial growth of the organization matched all the optimism of its founders. Before its second convention in 1906, it numbered about 100,000 members and issued its own weekly, the *Industrial Union Bulletin.* But the I.W.W. comprised many varying factions of political thought, including Socialists: anarchists, syndicalists and trade unionists, and factional rifts within the organization on the question of political action led to a splintering of the group. As a result of the first split, the Western federation withdrew in 1907 on the unseating of Pres. Charles O. Sherman, its nominee, leaving the strength of the I.W.W. seriously undermined. Two years later the syndicalist element thrust out the followers of DeLeon. This second split resulted in two separate I.W.W.s, one of which had its headquarters in Detroit, Mich., and the other in Chicago, but the former soon became nonexistent. In the same year, the I.W.W. (*i.e.,* the remaining Chicago faction), altered its platform to eliminate all reference to a political base of action, and the preamble was rephrased as follows: ". . . Between these two classes a struggle must go on until the workers of the world organize as a class, take possession of the earth and the machinery of production and abolish the wage system." After the withdrawal of the Western federation, the strength of the I.W.W. varied greatly; the figures of paid-up membership in 1906 were 60,000 and in 1919, 35,000, but these figures give no reliable indication of its strength. After the defection of the miners, the I.W.W. membership became more and more predominant among the nomadic workers (partly foreign born) such as lumbermen, longshoremen and "hoboes," for whom the American Federation of Labor made no provision. This class of worker rarely paid dues, except on the occasion of first taking out an I.W.W. ticket. Of the innumerable strikes directed by the I.W.W. the Lawrence, Mass., strike of 1912 was the most famous and first brought the organization into prominence. About 30.000 textile operatives were involved and for the first time large bodies of non-English-speaking workers were led together to ultimate victory, their spirits being kept up partly by the use of the I.W.W. "red book" songs, of a coarse but vigorous character, which travelled across the world. In addition, many "free speech fights" mere undertaken; *e.g.,* in 1909 at Missoula, Mont., Spokane, Wash., Newcastle, Pa., and later more important struggles at Paterson, N.J., Aberdeen, S.D.., Old Forge, Pa., San Pedro, Calif., etc. These were mostly cases in which the municipalities objected to I.W.W. propaganda and arrested the "wobbly" (the slang name for I.W.W.) speakers, the I.W.W. replying by providing a continuous stream of speakers "until the jails burst." More than 5,000 "wobblies" were imprisoned. Elsewhere, especially in the western states, the history of the I.W.W. was violent and sanguinary. The facts which led, for example, to the shooting of the organizer and poet Joseph Hillstrom (Joe Hill) in Utah are greatly disputed; the murder of organizer Frank Little in Butte, Mont., was dealt with in a federal enquiry. (*See* the *Sixth Annual Report* of the secretary of labour.) In some of the states attempts were made to drive the I.W.W. out of existence.

During World War I, the I.W.W. was the only labour organization to oppose the war vigorously, and it was said to be one of the major targets of the antiespionage act passed by congress in 1917. After the war, the general attack on "red" organizations, together with a quarrel with the Communist International (*see* INTERNATIONAL, THE) gravely weakened the I.W.W. A large number of states passed "criminal syndicalism" laws, mostly held constitutional on appeal to the supreme court, with the object of suppressing the I.W.W. altogether. A mass trial of approximately 100 prominent I.W.W. members at Chicago in Aug. 1918 resulted in a number of heavy sentences. The less important position of the I.W.W. after the war may have been due to the immigration laws which cut off the influx of unskilled labour, its most fruitful source of recruits. But whatever the cause, its influence dwindled until by the end of the 1920s it had ceased to be of social consequence. Nevertheless, in 1949, it became the first labour organization to appear on the government's subversive list, although there were only about 1,500 workers. most of them in Cleveland, O., who still bargained with their employers through the medium of the I.W.W.

Australia.—I.W.W. locals existed in nearly every industrial country, especially in the ports. In Great Britain they appeared in London, Liverpool and Glasgow. But they only achieved importance, outside the U.S., in Australia between 1911, when the first local (Adelaide) was chartered from Chicago, and 1917–18, when the organization faded away.

BIBLIOGRAPHY.—P. F. Erissenden, *I.W.W.,* Columbia University Studies in History, Economics and Public Law, no. 193, 2nd ed. (1920); V. G. Childe, *How Labour Governs in Australia,* ch. x-xi (1923); J. S. Gambs, *The Decline of the I.W.W.,* Columbia University Studies in History, Economics and Public Law, no. 361 (1932); Ralph Chaplin, Wobbly (1948). (*See* also SABOTAGE; SYNDICALISM; TRADE [LABOUR] UNIONS.)

INDUSTRY, the quality of steady application to work, diligence; hence, employment in some particular form of productive work, especially of manufacture; or a particular class of productive work itself, a trade or manufacture.

INDUSTRY AND TRADE, WAR CONTROL OF. Government control of industry has appeared sporadically in every major war of modern times. It has taken the form of commandeering supplies and means of transport and production, and occasionally of price control. Except in rare cases of cities under siege, however, government control before World War I never assumed the form of a general system dominating the economic life of a belligerent nation. The conditions which made such control of industry essential were:

1. Universal conscription, with its tendency to disorganize all industries, essential and unessential alike, by withdrawing the most energetic workmen and key technicians and administrators;
2. The vast consumption of materials and equipment in modern warfare;
3. The insatiate demand for financial resources for maintaining and supplying armies in the field and their auxiliaries:
4. The maintenance of the health and morale of the civilian population by the provision of the necessities of life at reasonable prices.

GREAT BRITAIN

The control of trade and industry in Great Britain developed gradually through attempts to solve particular difficulties of supply as they emerged during World War I. For the first year of that war the service departments relied on the ordinary forces of the market for the provision of their requirements. Their competition with private demand, and also the competition between individual branches of the services themselves, led to congestion of order books, serious delays in deliveries and rising prices. The difficulties of industry were increased by the loss of workmen, both skilled and unskilled, to the services. These problems led to the establishment of the ministry of munitions in June 1915 with responsibility for organizing the production and delivery of munitions. including the setting up of state factories; the war office continued to procure its own supplies of food, clothing. etc., as distinct from munitions. The increasing demands of the services for men and equipment and weapons, the resulting shortage of manpower and difficulties of importing led to extensions of control to cover all the chief raw materials and many prices, and to intervention in the use of manpower and methods of production. By 1917 the service departments absorbed, directiy and indirectly, so large a proportion of the output of industry that special steps had to be taken to safeguard essential supplies for the civilian population. It was in this year that the ministry of food was set up, food rationing developed and the production of standard clothing at reasonable prices arranged. Extension of control continued, partly in the interest of civilians, until by mid-1918 virtually no industry was entirely free.

Preparations for World War 11.—In Great Britain preparation for World War II included provision for immediate control over some key economic activities. It was thought that, although

comprehensive control might ultimately become necessary, most economic resources would be relatively plentiful in the initial stages. Imports. for instance. were expected to be maintained at about the peacetime level. It was also assumed that the change-over from production for peace to production for war would come about automatically as the result of losses of export markets, changes in domestic demand and the incentive of government contracts. Finally, since there was a reserve of labour shown by persistent unemployment, no general shortage of manpower was feared.

The plans for those controls which would most directly affect industry may be summarized briefly. Resources of foreign currencies nere to be conserved by means of exchange control administered by the banks on instructions from the treasury. Imports and exports would be subject to licence by the board of trade, and responsibility for sea and inland transport was to be divided between a new ministry of shipping and the existing ministry of transport, respectively. The use of machine-tools and certain raw materials for which wartime demand would be abnormally great was to be controlled by another new ministry, the ministry of supply; the latter would also be responsible for the royal ordinance factories. All the controls would be recruited in part from the trades concerned in order to obtain both their co-operation and the advantage of expert knowledge. Matters concerning manpower would be the responsibility of the ministry of labour, to be transformed into a ministry of labour and national service to organize the call-up for the fighting services according to the schedule of reserved occupations; this had been drawn up to prevent undue loss by industry of essential types of workers. Plans were also made to establish a ministry of food.

Taken as a whole, these plans provided for departmental responsibility for many important sections of trade and industry. The actual extent of control to be exercised was, however, very limited. For instance, the ministry of shipping was to control ships by individual licensing and chartering and not by requisitioning shipping in general; and the control of raw materials was intended to cover only the most obviously important such as iron and steel, timber, industrial alcohol, etc.

First Nine Months of War, Sept. 1939–May 1940.—These plans were put into force either just before. or immediately after, the outbreak of World War II. Outside the limited sector specifically included in the controls planned, producers and consumers were free to do as they liked. Even within the controlled sector regulation was very loose for a number of reasons. Personnel had to be built up and experience gained; the necessity for rigid control was not accepted even for shipping, imports or raw materials; and raw material control was hampered by the existence of stocks already distributed to the users.

Already before the fall of France in the summer of 1940, however, there were signs that this stage of "business nearly as usual" was coming to an end. The serious falling short of actual imports compared with estimated imports was causing anxiety and hastening the depletion of stocks of every kind. Contracts placed by the war departments were already absorbing the slack in the economic system. For instance, by March 1940, progress on building and civil engineering contracts was far behind schedule owing to bottlenecks of particular types of labour and materials. The difficulties experienced by the air ministry in obtaining essential supplies led to the establishment in April of the ministry of aircraft production to take over its procurement work. The first step to impose a check on the output of consumers goods, other than food, was also taken in that month by the issue of the first Limitation of Supplies order; this order, issued by the board of trade, prohibited manufacturers of cotton, rayon and linen goods from supplying more than 75% of prewar quantities to the home market; supplies for export and government contracts were not restricted.

The entry of Italy into the war and the fall of France in June, 1940, cut off an important area of material supplies and also increased the difficulty of transporting them. Europe and French North Africa together had previously provided, for example, about two-thirds of Great Britain's supplies of iron ore; these were no longer available. The control by the axis of the whole west coast of Europe except Spain and Portugal and of much of the Mediterranean provided many more bases for attacks on British shipping and forced diversion from the Mediterranean route to the east. Dependence on North America for supplies was thus greatly increased and, with it, the problem of finding dollars became acute until the introduction of lend-lease in the autumn of 1941.

These difficulties in the supply situation which followed the fall of France, together with the new strategic situation necessitated complete mobilization of British industrial resources. Nothing could be imported or produced that was not essential for the pursuit of the war. To achieve this object, a system of interlocking controls of industry from the procurement of raw materials to the finished product was developed during the next 18 months from the foundations of limited control already established.

Development of Full Control, May 1940–Dec. 1941.—Control over raw materials by licensing was extended rapidly, and the ministry of supply also became responsible for their purchase and import in many cases. Pressure on the steel and timber controls for licences for purposes with high departmental priorities became so excessive, however, that responsibility for licensing was transferred to the user departments who were obliged to keep within total allocations made to them individually. Control over the demand for machinery for civilian production was also introduced by means of a licensing system operated by the board of trade.

The difficulties caused by excessive competing demands on the building and civil engineering industry has already been mentioned. To deal with this, a special ministry of works and buildings was set up in May 1940, responsible for arranging priorities and for licensing all civilian work. It also became the controlling authority for any building materials not already controlled. Control of the use of existing buildings was introduced at the same time, by requiring the consent of the board of trade for any requisitioning of premises. Later, board of trade approval was also required for changes in the use of buildings.

It was realized during 1940 that, however complete the controls over the use of machine tools, materials, machinery and buildings might become, this would not be sufficient. Control of the final product was also needed in order to prevent the restriction of civilian supplies caused by the war effort which deprived civilians of real necessities. The first step, the Limitation of Supplies order of April 1940, has already been mentioned; by the end of the year a wide range of consumers' goods had been covered by similar orders and the permitted quotas had become much smaller. To ensure fair distribution of declining supplies of textile and leather goods, clothes rationing was introduced in the summer of 1941 and extended at various times to cover household textiles such as sheets. Special permits were required for some particularly important goods as, for example, furniture. In order to ensure that the civilian goods produced were really essential, licensing was extended to production itself, making the production of certain types of goods illegal without a licence. Thus the board of trade, the licensing authority, was able to specify the quantity and quality of goods for which a licence to produce would be granted, and to prohibit entirely the production of others. This system was carried a stage further with the introduction of "utility" goods. Manufacturers' quotas of materials, and later of labour also, were made dependent on the production of utility goods designed according to specifications laid down by the board of trade to economize in materials and labour and strictly price controlled.

To avoid waste of the labour and the factory premises made redundant by these restrictions, many of the industries affected were concentrated. Suitable firms were chosen by the industry, or in consultation with it, to take over the remaining production of all other firms on a quota basis. The latter then ceased production for the duration of the war and as much as possible of their labour, equipment and buildings was used for war work.

Thus by the end of 1941 a method for the complete control of industry had been worked out. It proved capable of extension and adaptation in the changing conditions caused by Japan and the U.S. becoming belligerents and provided the main framework of control for the rest of the war. The development of manpower

control had been parallel to the development of control of industry and culminated in conscription and direction of the whole population of working age to industry and the fighting services.

The Problem of Central Planning. — Effective control of industry presupposes a coherent scheme of requirements. The overall strategic disposition of resources remained, of course, the responsibility of the war cabinet Translation of the strategic plan into quantities of goods and services involved the difficult task of reconciling departmental programs and priorities. This function was performed by a frequently changing group of interdepartmental committees of all types from the defense committee (supply) of the war cabinet to committees with purely official membership. Early in 1942, after much discussion, the ministry of production was established to provide for easier and more effective co-ordination of production programs and also to co-ordinate British with Allied programs. It must not be thought that the elaborate system of determining requirements and controlling industry was operated merely by instructions from London. From an early stage all the departments concerned with production set up regional organizations to watch over and help to organize production, to administer the controls and to maintain close contact with industry and deal as far as possible with the difficulties that inevitably arose. In this way the consent of industry to, and its co-operation in, control could be secured at each stage.

EUROPE IN WORLD WAR II

In Europe the problems of industrial control during World War II differed among the various belligerents not only because of strategic differences, but also because of differences in their prewar economic systems.

U.S.S.R.—At the one extreme, the U.S.S.R. before the war had not merely a completely controlled economy, but one in which the state owned the means of production. Russia's problem was, therefore, that of re-orientating its plans to the requirements of actual war rather than of evolving methods of control. The invasion of the U.S.S.R. by Germany led to the interruption of the third five-year plan, to the evacuation of as much equipment and labour as possible from the Ukraine, including the Donbas, to beyond the Urals, and to the loss of important factories, mines and productive resources generally. The strain thus placed on the economy necessitated severe consumer rationing and the disappearance of many consumer goods from the market. It also led to further emphasis being placed on incentives to increased output; the use of piece-rates, premiums and bonuses for exceeding production targets was extended and longer working hours became common. The extra earnings thus made possible would, however, have provided little incentive unless it were possible to spend them on goods. For this purpose an uncontrolled market was permitted on which extra rations and other goods could be bought at entirely uncontrolled prices. This most interesting, but not entirely new, feature in some ways resembled a legal black market.

Germany. — The German problem differed again. Although the German economy was based on private enterprise and private property, state intervention, direct and indirect, was much greater in peacetime than it was in the western nations. Foreign exchange control. price and wages control had been established in the years before the outbreak of World War II. Moreover, total government expenditure had been absorbing a large and growing proportion of the national income since 1936, so that German industry was more dependent on the government than was the case elsewhere. The extensive trade associations and cartels also formed an easy channel for government influence. When war broke out considerable use was made of existing cartels and new ones were formed compulsorily, so that by placing nominees on their governing bodies the government could secure complete control of individual industries. In other respects the steps taken to extend control of industry were not dissimilar in purpose to those used in Great Britain; but they wereintroduced earlier and many were highly developed early in 1940. Thus raw materials and labour were controlled and allocated, industries were concentrated, production of many goods was prohibited, specifications were laid down for others and consumers were severely rationed.

The severity with which the controls were administered was, of course, determined by the development of the war. Thus the first year of the war cut Germany off from the most important producers of such materials as oil, rubber and some textiles. Rigid economy in motor transport was therefore essential from an early stage and also diversion of resources to produce substitutes of many kinds. Since Germany was the centre of a continental system it was peculiarly dependent on inland transport, on which the course of the war placed a severe strain; this led to zoning of markets and numerous restrictions on private travel.

Occupied France. — In the case of Germany, occupation of other countries offered considerable addition to its economic strength provided that the occupied countries could be suitably organized. Direct benefit could be obtained by the transfer of equipment (e g., rolling stock for railways) and conscripted labour, as well as prisoners of war, to Germany itself; but use of the main factories and natural resources required control of output in the occupied countries themselves. In the case of France, the German government attempted to build up an elaborate system for the complete control of the economy on a corporstive method under the central office for the distribution of industrial products. Under this central authority, responsible to the minister of production, organization committees were established to control the various industries. The committees had extensive powers of supervision of individual businesses, means of production, stocks, manpower and programs. Terms of employment were laid down under the Labour Charter law of 1941, administered by a hierarchy of joint committees of both sides of industry and outside representatives. The difficulties of controlling the use of materials and production were greatly increased by two causes inherent in occupied territories: the ordinary inflationary tendencies of war were enhanced by the spending of the army of occupation troops and officials, and unwillingness to co-operate with the occupying government became a patriotic duty. A close study of the history of control in France would show, by contrast, how important was the basis of consent both of consumers and producers to the effective working of industrial control in the other countries referred to.

BIBLIOGRAPHY.—World War I. There is no book adequately covering the whole field of war control of trade and industry. Brief contemporary surveys are contained in the Reports of the war cabinet for 1917 and 1918 (Cd. 9,005 and Cmd. 325). Different aspects of war control are dealt with in the volumes contained in the Economic and Social History of the World War (British Series), *e.g.*, J. A. Salter, *Allied Shipping Control,* E M H. Lloyd, *Experiments in State Control;* H. D. Henderson, *Cotton Control Board.* The unpublished and official *History of the Ministry of Munitions* may be consulted at the London School of Economics and some other libraries.

World War II. Great Britain: *History of the Second World War,* United Kingdom Civil series, ed. W. K. Hancock (H.M.S.O., London); W. K. Hancock and M. M. Gowing, *British War Economy* (London, 1949); the following volumes are in course of preparation: M M. Postan, *British War Production; E.* L. Hargreaves, *Civil Industry and Commerce; J.* Hurstfield, *Raw Materials.*

Europe: Louis Baudin, "Outline of Economic Conditions in France under the Occupation," *Economic Journal,* vol. 55, no. 220 (Dec. 1945); H. W. Singer, "The German War Economy," a series of 12 articles, *Economic Journal* (1940–1944). *H.* Schwartz, "Prices in the Soviet War Economy," *American Economic Review,* vol. 36, no. 5 (Dec. 1946); N. A. Voznesensky, *The Economy of the U.S.S.R. during World War II,* issued in co-operation with the American Council of Learned Societies (1948). (M. E. A. B.)

UNITED STATES

In both World Wars I and II, the U.S. economy had to meet the problem of supporting the war economies of allied powers in addition to supplying the U.S. armed forces. Since industry and trade had to be engaged in the single purpose of winning the war, consumer and business demands had to be conditioned to a schedule of wartime requirements. Control was essential to effect maximum production and the best practicable distribution of supplies among the military, allied and essential civilian uses.

While World War I brought the first experience in wartime control of industry and trade under the War Industries board headed by Bernard M. Baruch, that experience paled before the far greater challenge of World War II. Steering the largest and most diversified industrial system of the world into full wartime per-

formance, balancing it under ever changing requirements of warfare and preparing for its release from war duty was a staggering task of statesmanship and administration. In 1940–41 neither organizational nor material preparations were abreast of the complexity to which the United States economy—in technical and social respects—and the task of war itself had grown. The experience of the government in economic controls, although enhanced by the recovery efforts of the 1930s, nevertheless was inadequate to the management of the all-out effort. The size of the armed forces, their equipment, the consumption of supplies in battle were vastly greater, the supply lines longer. In addition to oil, steel, copper, cotton and wheat that made up the bulk of supplies to the Allies of World War I, vast amounts of finished aircraft, tanks, trucks, electrical equipment, dehydrated foods and all types of highly fabricated products were supplied to the Allies in World War II, chiefly under the lend-lease system. The industrial effort required was correspondingly greater and more complex. In the beginning it staggered the imagination of the most sanguine production men.

The first measures to create a munitions industry and give economic support to friendly nations were taken through regular government departments and a set of new auxiliary agencies without effective control powers, on an economy that was beginning to enjoy prosperity after a decade of underemployment. Prior to the attack on Pearl Harbor, it had proved impossible to join industry and armed forces in a big common effort. Neither the National Defense Advisory commission of May 1940 nor the Office of Production Management of Dec. 1940 and their associated agencies succeeded in creating ample stockpiles of strategic materials, expanding the industrial capacity for basic products (steel, aluminum) and war goods (ships, planes, tanks, etc.), and effecting a conversion of mass-production manufacturing to military production. They laid the foundation of the priority, conservation and price control systems and the elementary statistical groundwork for the planning of munitions productions, and created a useful system of railroad traffic control. They also helped develop in 1940 the financial arrangement prerequisite to enlisting private capital in plant expansion—the five-year amortization deduction which permitted concerns to charge off the value of new plant in five years against income under the income tax law. But while congress was pruning military appropriations and armament plans were uncertain, industry could not be diverted from its peacetime pursuits.

The lack of preparation came to bedevil war production from 1941 through 1943. Steel plants, synthetic rubber plants and merchant ship construction were then to compete with tanks and fighting ships for steel. But the "all-out" war economy inherited unemployed resources that facilitated its expansion, and experience in pilot war production gained in co-operation with Britain. When there was an urge to produce for war, industry lived up to the startling demands for "45,000 tanks and 60,000 planes in 1942, 75,000 tanks and 125,000 planes in 1943" that President Franklin D. Roosevelt put forward shortly after the attack on Pearl Harbor.

Organization of Controls.—The wartime control of industry was placed chiefly in the hands of the War Production board (WPB), Donald M. Nelson, chairman, created by the president in Jan. 1942. With powers to requisition property, to stop production of nonessentials and to force the acceptance of essential orders by producers, the board's chief task was to weave the labour, material resources and business leadership of the American people into a new production pattern. Its governmental powers over the economy were of a degree unknown in peace; but to succeed it had to rely on the initiative of managers, designers and workers in independent industrial units.

In the transition to a full war economy, most of the control power was applied to divert production from civilian to military end uses, to keep the dangerously short stocks of certain materials from being frittered away and to stop waste. Tire sales to civilians and passenger car production were stopped at once. Conversion of the huge automobile industry to tank, jeep, aeroplane and gun production was a first necessity. Orders limiting the production of other civilian goods and housing were to follow, and under the direction of the Office of Price Administration (OPA), created in Feb. 1942 with Leon Henderson as head, the curtailment of supplies was carried to the consumer through the rationing of gasoline, fuel oil, tires, bicycles, meat, coffee, sugar and other products. But the stress on war production for the U.S. and allied forces had to be balanced by emphasis on essential civilian production to assure the people necessary food, clothing, shelter and transportation. Waste of production and scarce resources, the real plague of all-out effort, had to be dealt with in both the military and civilian fields, industrial needs to be screened by the commodity groups of WPB allocating materials to factories, and consumer needs by rationing boards composed of volunteers working under the direction of OPA, which had to tailor rations to fit individual conditions. Fortunately the vast expansion of productivity in industry and agriculture prevented any serious threat to the people's health and vigour. To many it brought more material goods than they had enjoyed before.

The primacy of military demands for goods and services could not fail to act as a continual challenge to civilian control. Throughout the war the army and navy did their own procurement and controlled specifications and inspection. Centralized procurement under civilian direction was not attempted and probably would have failed, but the power to contract tended to be the power to control. There was competitive procurement by the military authorities. Conflicts were unavoidable; many were solved productively, others were not. The preference of procurement agencies for large industrial concerns tended to leave large numbers of smaller concerns outside the war production program. By encouraging pooling of production capacities, subcontracting and other methods, however, WPB redressed the balance. Fluctuations in army procurement, delays, rush orders, over-ordering, then cutting back were a more serious problem, since they upset the complex time schedules and the balance of supply streams and output. Industry wanted stable designs of products for mass production; but battle experience repeatedly led the military men to change the designs of tanks and planes.

In 1944, after war production had passed its peak and some unemployment appeared in a few places, the problem of starting reconversion to peacetime production while the war was still on caused a sharp clash of views between WPB and the army. Experience showed that real differences of outlook based on differences in background and tasks were compromised and adjudicated, or fought out between agencies, but could not be resolved by the device of merging military and civilian control bodies. The task of settling the more basic conflicts fell in the last instance on the president.

Production Control Techniques.—The control devices used by the War Production board were varied and changing. Individual priority actions issued by WPB or the procurement agencies fixed the preference ratings of specific orders. Blanket priorities expressed preferences to be given to the orders of certain classes of users, say, to steel orders coming from machine tool makers. But priorities, once called by Bernard Baruch "the synchronizing force of war industry," showed a dangerous tendency to get in their own way. In the rush of army, navy, maritime commission and lend-lease orders. A-I priorities were superseded by AA-I priorities. Soon jobs rated AAA slipped in ahead of the AA ones. Of course a developing war program required the frequent readjustment of priorities to bring about the acceleration of some activities and the slowing down of others. But the upgrading and downgrading of orders by the various agencies, sometimes deliberate, sometimes the mere result of the invention of a new symbol of higher urgency, and the overissuance of high priority ratings caused much confusion in industry.

In July 1942, the organization of the priority system was somewhat improved; but the remaining complexity was apparent in an agreement between the WPB and the Army and Navy Munitions board (ANMB) then concluded:. "The ANMB continues as the primary military body for reconciling and presenting to the WPB the army and navy supply requirements. Acting in this capacity the ANMB is the 'advocate' for the allocation and priority needs of the military program. The ANMB will continue to exercise the

responsibility for granting priorities to the military services and their contractors, subject to the directives of the WPB." Simultaneously, a new control device, called the Production Requirements plan was put in motion to dam up the stream of priority orders emanating from the military procurement agencies. Contractors were forbidden to attach the military ratings for their products to their own orders of supplies. Instead they had to use the ratings set by WPB. Finally, in Sept. 1942 the War Production board took over the assignment of preference ratings on military contracts.

The Production Requirements plan called for periodic applications from each of the large metal consuming plants to WPB, listing the kinds and quantities of products made in the plant and the preference ratings against which they were to be shipped. Having established the importance of each claim the plant then had to demonstrate what it would amount to in terms of materials, and taking account of the stocks of materials on the spot, what new supplies it would need and when. After having attempted to match the total demand for and the total supply of each critical material, WPB would authorize the plant to buy materials in specific quantities over a period of time. But even before the plan had become the principal machinery of materials distribution, it was earmarked for replacement; for the flood of high-rating requirements that it brought down on the War production board stood in no reasonable relation to available supplies of production goods. The procurement actions of the services and the accumulation of priorities issued earlier made requirements run far ahead of supplies. The WPB was not in a position to rule between the services and to cut their procurement to fit supplies. Therefore, many of its authorizations to buy were invalidated by shortages and delays. The plan did not work.

To cope with these problems a new plan was developed — the Controlled Materials plan. After a short trial period it became the basic materials control system in July 1943. This plan designated a number of "claimant agencies," chiefly the army, navy, maritime commission, Aircraft Resources Control board, Foreign Economic administration, Office of Lend-Lease Administration, Office of Defense Transportation, War Food administration and the Petroleum Administration for War. Each claimant agency was required to translate its procurement program for a three-month period ahead into the common tender of the "controlled materials," carbon and alloy steel, copper, brass and aluminum. Programs for ships, tanks, ammunition and other military and civilian products were expressed in these units and presented to WPB. After total claims had been balanced against total supply, which often required the reduction of some claims, each claimant agency was allotted a share of the controlled materials. These allotments covered all programs of the agencies and were to be passed on to their prime contractors and by them in turn to the suppliers of components under a system of budgetary accounting.

The accounting in a few common units and the allotment of materials within the limits of supplies were of great value, and so was the decision to attach the control levers to programs rather than products. The distribution of materials outside of the controlled group and of components was expected to adapt itself more or less automatically to the allocations of the controlled ingredients. It did so to a fairly high degree; but contractors were often found to buy uncontrolled items in excess of their allotments of controlled ones, sometimes with the encouragement of the procurement agencies who hoped to stretch the supplies of controlled materials through savings in production or to obtain revisions of allocation subsequently. Thus lumber, textiles, chemicals, bolts, nuts and metal stampings were overordered and hoarded by shipbuilders, synthetic rubber producers, etc. This compelled WPB to introduce detailed scheduling controls over components and accessories, which probably meshed the control agency more deeply into the gears of industry than any other measure. The Controlled Materials plan was, at least in principle, the last word in industry control in World War II. It was never felt to be a perfect instrument and was criticized for regimentation and ineffectiveness; but it worked.

Price and Wage Controls. — Besides directing quantitatively the flows of essential goods and services, the control of industry and trade had to deal with the terms of exchange, prices and wages affecting all economic circulation. The vast demands meeting limited supplies had to be kept from causing a cumulative inflation of prices, wages and profits which would have proved disruptive to the pursuit of the war by causing hoarding, strikes and discontent in the armed forces. At the same time, stability had to be kept from impeding war production. In specific situations, price and wage increases were needed to provide the production incentive. Genuine costs of production had to be met, and in meeting them a great effort had to be made to keep the increases from breaking stability in general.

The first purpose was served by the General Maximum Price regulation of OPA (May 1942), which made it illegal for sellers to charge prices in excess of those in existence in March 1942. The broad price freeze replaced the piecemeal system by which individual commodity prices had been kept in check since 1940 while the economy moved toward full employment; but it did not cover most of the basic farm products which remained under the control of the department of agriculture, sales to the United States government under the control of the procurement agencies, and wages and salaries. The price ceiling was wide but not complete, and the pressure of the uncontrolled factors often came near to breaking it. This was particularly true in the field of farm prices where a strongly entrenched policy of price support inherited from prewar days often won out over stabilization.

The government's approach to wage control was less administrative, more judicial and political than was its approach to industrial prices. At first it relied on the restraining efforts of the trade unions which gave a no-strike pledge after Pearl Harbor. A National War Labor board (NWLB) was created in Jan. 1942 to settle disputes, and in July 1942 this board provided a valuable rule of thumb for wage control in its "little steel" decision. This decision limited wage increases to workers whose wages had not kept pace with the 15% rise in the cost of living that had taken place between Jan. 1941 and May 1942 (the date of the price freeze), or whose earnings were substandard or out of line. In Oct. 1942, the wage and salary stop was strengthened. The NWLB and the 12 corresponding regional boards, composed of representatives of employers, labour and public, assumed the function of wage stabilization, and an Office of Economic Stabilization under James F. Byrnes was created to co-ordinate all the price and wage controls of the various government departments.

These measures greatly slowed down the upward move of price and, reinforced by the president's "hold the line" order in 1943, prevented the repetition of the general price inflation of World War I. A rigid general freeze at the outset was neither politically nor economically practical. As it was, control probably reached too far into the field of nonwage civilian goods. Fuller employment and higher productivity often provided opportunities for production incentives even under price restraints.

Various rules and techniques were developed to cope with the price tensions. OPA gave subsidies to some producers (particularly in agriculture and mining) and traders whose cost had risen and whose prices were to remain stable. It "rolled back" the prices of goods that were about to force up other prices or wages. It fixed standards for profit margins and admissible price increases and developed methods of price supervision. While unable to prevent black markets entirely, OPA was effective in keeping the great bulk of essential supplies flowing through legal channels. The effectiveness of price and rationing controls was rather remarkable in view of the great excess of purchasing power over available supplies, generated by rising income and lagging taxation. It rested on the people's willingness to save increasing portions of their incomes, and in turn strengthened the will to save.

In the field of armaments and their specific components, price controls were chiefly exercised by the military agencies, the only purchasers of such products. Costs were analyzed and argued, risks examined and to a large extent assumed by the government. A large number of contracts were made on a "cost plus fixed fee" basis, a form well adapted to the widespread system of

government owned, privately operated production facilities; other contracts particularly for new types of products were made in terms of maximum prices, to be redetermined after some time. Renegotiation of contracts provided an instrument for the government to cut excessive profits that had arisen in past operations.

OPA controls, however, governed a large part of military purchases; *i.e.*, of goods that were not exclusively of military use, textiles, food, etc. To expedite procurement of such goods, OPA allowed more liberal policies for their pricing. But the problem of competence over prices in the war goods field was acute often between the civilian and military agencies. (See also RATIONING; WAR CONTROL OF FOOD; WAR CONTROL OF SHIPPING.)

BIBLIOGRAPHY.—Official histories of the two most important control agencies are given in *Industrial Mobilization for War, History of the War Production Board,* vol. i of which appeared in 1947, and in *A Short History of OPA,* (1947). Among a number of authoritative studies and reviews, the following are of special interest: Donald M. Nelson, *Arsenal of Democracy* (1946); D. Novick, M. Anshen and W. C. Truppner, *Wartime Production Controls* (1949); Thomas B. Worsley, *Wartime Economic Stabilization and the Efficiency of Government Procurement,* with an extensive bibliography (1949); J. K. Galbraith, "The Disequilibrium System," *American Economic Review* (June 1947). For World War I, *see* Bernard *M.* Baruch, *American Industry in the War* (1941). (Ho. ME.)

INE, West Saxon king, of the line of Ceawlin, succeeded Ceadwalla in 688. In the earlier part of his reign he was at war with Kent, but peace was made in 694, when the men of Kent gave compensation for the death of Mul, brother of Ceadwalla, whom they had burned in 687. In 710 Ine fought in alliance with his kinsman Nun against Gerent of West Wales and was victorious, and in 715 he repulsed an attempted invasion by Ceolred, king of Mercia. In 721 Ine slew the rebel Cynewulf, and in 722 his queen Aethelburg destroyed Taunton, which was held by Eadbriht, another rebel. In 725 Ine fought with the South Saxons, who had previously been subject to him, and slew their leader Aldbryht. In 726 he resigned the crown and went to Rome where he died shortly afterwards, being succeeded by Aethelheard in Wessex. Ine is said to have built the minster at Glastonbury. He issued a written code of laws for Wessex, which is still preserved.

See B. Thorpe, *Antient Laws,* i., 2–25 (1840); R. Schmid, *Gesetze der Angelsachsen* (1832, 2nd ed. 1858); *Anglo-Saxon Chronicle,* ed. J. Earle (1865); C. Plummer (1865); Bede, *Hist. Eccl.* ed. C. Plummer, iv., 15, v. 7 (1896); F. Liebermann, *Gesetze der Angelsachsen* (1898).

INEBOLI, a town on the Black sea coast, Turkey, 70 m. W. of Sinub (Sinope). Ineboli represents the ancient *Abonouteichos,* famous as the birthplace of the false prophet Alexander, who established there (2nd century A.D.) an oracle of the snake-God Glycon-Asclepius. Alexander obtained leave from the emperor Marcus Aurelius to change the name of the town to *Ionopolis,* whence the modem name is derived. (See ALEXANDER THE PAPHLAGONIAN.) It is the first place of importance touched at by vessels going eastwards from Constantinople. The roadstead is exposed and landing difficult. The exports are chiefly wool and mohair. Population 47,538.

INEBRIETY, LAW OF. The legal relations to which inebriety gives rise are partly civil and partly criminal.

I. Civil Capacity. — The law of England as to the civil capacity of the drunkard is practically identified with and has passed through substantially the same stages of development as the law in regard to the civil capacity of a person suffering from mental disease (see INSANITY). Unless (see III. *inf.*) a modification is effected in his condition by the fact that he has been brought under some form of legal control, a man may, in spite of intoxication, enter into a valid marriage or make a valid will, or bind himself by a contract, if he is sober enough to know what he is doing, and no improper advantage of his condition is taken (cf. *Matthews* v. Baxter, 1873, L.R. 8 Ex. 132; Imperial Loan *Co.* v. Stone, 1892, 1 Q.B. 599). The law is the same in Scotland and in Ireland; and the Sale of Goods Act, 1893 (which applies to whole of Great Britain), provides that where necessaries are sold and delivered to a person who by reason of drunkenness is incompetent to contract, he must pay a reasonable price for them.

Under the Roman law, and under the Roman Dutch law as applied in South Africa, drunkenness, like insanity, appears to vitiate absolutely a contract made by a person under its influence (Molyneux v. Natal Land and *Colonization Co.,* 1905, A.C. 555).

In the United States, as in England, intoxication does not vitiate contractual capacity unless it is of such a degree as to prevent the person labouring under it from understanding the nature of the transaction pending (see *infra*). The same rule is by implication adopted in the Indian Contract Act (Act ix. of 1872, s. 12). In some legal systems, however, habitual drunkenness is a ground for divorce or judicial separation (Sweden, Law of April 27, 1810; France, Code Civil, art. 231, Hirt v. Hirt, Dalloz, 1898, pt. ii., p. 4, and n. 4).

II. Criminal Responsibility. — Under the law of England, until early in the 19th century, voluntary drunkenness was never an excuse for criminal misconduct. Sir Matthew Hale (P.C. 32) took a fairly moderate view, viz., that a person under the influence of this voluntarily contracted madness "shall have the same judgment as if he were in his right senses." But the law on the subject was ultimately defined by the House of Lords in 1920, in the case of Director of Public Prosecutions v. Beard (1920, A.C. 479), in which all the earlier decisions were reviewed in the following terms: (1) Insanity, whether produced by drunkenness or otherwise, is a defence to the crime charged; (2) evidence of drunkenness which renders the accused incapable of forming the specific intent essential to constitute the crime should be taken into consideration with the other facts proved in order to determine whether or not he had this intent; (3) evidence of drunkenness falling short of a proved incapacity in the accused to form the intent necessary to constitute the crime, and merely establishing that his mind was affected by drink so that he more readily gave way to such violent passion, does not rebut the presumption that a man intends the natural consequences of his acts; (4) the test of criminal responsibility is not the same in the case of drunkenness as in the case of insanity, and upon a plea of drunkenness where insanity is not pleaded, the jury should not be asked to consider whether, if the accused knew what he was doing, he also knew that he was doing wrong.

The law of Scotland accepts, if it does not go beyond, later developments of that of England in regard to criminal responsibility in drunkenness. Indian law on the point is similar to English (Indian Penal Code, Act. xlv. of 1860, ss. 85, 86; Mayne, *Crim.* Law of India). See also the Criminal Code of Queensland (No. g of 1899), art. 28; the Penal Code of Ceylon (No. 2 of 1883), art. 79; the Criminal Code of Grenada (No. 2 of 1897), art. 51; and the Criminal Code of St. Lucia (1920, s. 22). Under the French Penal Code (art. 64), *il n'y* a *ni* crime, *ni* de'lit, *lorsque le prévenu était* en *état* de *démence* au temps de *l'action.* According to the balance of authority (Dalloz, *Rép.* tit., Peine, ss. 402 et seq.) intoxication is not assimilated to insanity within the meaning of this article, but it may be and is taken account of by juries as an extenuating circumstance (Ortolan, Droit *Pénal* i. s. 323: Chauveau et Hélie i. s. 360). Nor is it assimilated to insanity in Germany (Clunet, 1883, p. 311); but in Germany, as in France, intoxication may apparently be an extenuating circumstance. Under the Italian Penal Code (arts. 46–49) intoxication — unless voluntarily induced so as to afford an excuse for crime — may exclude or modify responsibility. In the United States the prevalent legal doctrine is similar to the English legal view.

There remains the question how far drunkenness itself is a crime. Mere private intoxication is not, in England, indictable as an offence at common law; but in all civilized countries public drunkenness is punishable when it amounts to a breach of the peace (see LIQUOR Laws) or contravention of public order; and modem legislation in many countries provides for deprivation of personal liberty for long periods in case of a frequent repetition of the offence. Reference may be made in this connection to the Inebriates Acts, 1898, 1899 and 1900 (see III. inf.), and also to similar legislation in the British colonies and in foreign legal systems (*e.g.,* Cape of Good Hope, No. 32 of 1896; Ceylon, Licensing Ordinance, 1891, ss. 23, 24, 29; New South Wales, Vagrants Punishment Act, 1866; Massachusetts, Acts of 1891, c. 427, 1893, cc. 414, 44: France, Law of Jan. 23, 1873, art. 6).

III. State Action in Regard to Inebriety. — This assumes a variety of forms. (a) Measures regulating the punishment of occasional or habitual drunkenness by fines or short terms of imprisonment. (b) Control in penal establishments for lengthened periods. (c) Laws prohibiting the sale of liquor to persons who are known inebriates: *e.g.,* in England (Licensing Act, 1902); Ontario (Rev. Stats., 1897, c. 245, ss. 124, 125); New South Wales (Liquor Act, 1898, ss. 52, 53); Cape of Good Hope (No. 28 of 1883, s. 89). (d) Laws regulating the appointment of some person or persons to act as guardian or guardians, or who may be endowed with legal powers over the person and estate of an inebriate. Thus in France (Code Civil, arts. 489 et seq.) and Germany (Civil Code, art. 6 [3]), an inebriate may be judicially interdicted if he is squandering his property and thereby exposing his family to future destitution. (*e*) Control for the purpose of reformation. Legislation of this character provides reformatory treatment: (1) for the inebriate who makes a voluntary application for admission; (2) by compulsory seclusion for the inebriate who refuses consent to treatment and yet manages to keep out of the reach of the law; (3) for the inebriate who is a police court recidivist or who has committed crime caused or contributed to by drink. The legislation of Great Britain (Inebriates Acts, 1879–1900) deals both with voluntary application and with the committal of criminal inebriates or of police court recidivists. A brief sketch of the English system must suffice.

The Inebriates Acts of 1879–1900 deal in the first place with non-criminal, and in the second place with criminal, habitual drunkards.

For the purposes of the acts the term "habitual drunkard" means "a person who, not being amenable to any jurisdiction in lunacy, is notwithstanding, by reason of habitual intemperate drinking of intoxicating liquor, at times dangerous to himself or herself, or incapable of managing himself or herself and his or her affairs," although when sober no such danger or incapacity exists (*Eaton* v. *Best,* 1909, 1, K B. 632). A person would become amenable to the lunacy jurisdiction not only when habitual drunkenness made him a "lunatic" in the legal sense of the term, but where it created such a state of disease and consequential "mental infirmity" as to bring his case within s. 116 of the Lunacy Act, 1890. Any "habitual drunkard" within the above definition may obtain admission to a "licensed retreat" on a written application to the licensee. stating the time (the maximum period is two years) that he undertakes to remain in the retreat. When an habitual drunkard has once been committed to a retreat, he must remain in the retreat for the time that he has fixed in his application, subject to certain statutory provisions similar to those prescribed as to leave of absence and discharge from mental homes; and he may be retaken and brought back to the retreat under a justice's warrant. The term of detention may be extended on its expiry, or an inebriate may be re-admitted on a fresh application, without any statutory declaration, and without the attesting justice being required to satisfy himself that the applicant is an habitual drunkard.

Licensed retreats are subject to inspection by an inspector of retreats appointed by the home secretary, to whom he makes an annual report. There are also statutory provisions as to offences — (~)by licensees failing to comply with the requirements of the acts; (2) by persons ill-treating patients, or helping them to escape or unlawfully supplying them with intoxicating liquor; (3) by patients refusing to comply with the rules. The home secretary may (1) authorize the establishment of "State inebriate reformatories," to be paid for out of moneys provided by parliament; and (2) sanction "certified inebriates' reformatories" on the application of any borough or county council, or any person whatever, if satisfied concerning the reformatory and the persons proposing to maintain it.

Miscellaneous. — Any person convicted on indictment of an offence punishable with imprisonment or penal servitude (*i.e.,* of any non-capital felony and of most misdemeanours), if the court is satisfied from the evidence that the offence was committed under the influence of drink, or that drink was a contributing cause of the offence, may, if he admits that he is, or is found by the jury to be, an habitual drunkard, in addition to or in substitution for any other sentence, be ordered to be detained in a State or certified inebriate reformatory, the managers of which are willing to receive him. Again, any habitual drunkard who is found drunk in any public place, or who commits any other of a series of similar offences under various statutes, after having within 12 months been convicted at least three times of a similar offence, may, on conviction on indictment, or, if he consent, on summary conviction, be sent for detention in any certified inebriate reformatory. Habitual drunkenness has been held to be a ground for the refusal of restitution of conjugal rights (Fisk v. Fisk, 122 L.T. 803). Where the husband of a woman is an habitual drunkard, she may obtain a protection order; where the wife is an habitual drunkard, the husband may obtain an order equivalent to a decree for judicial separation (Licensing Act, 1902, s. 5). A convicted inebriate of 60 years or upwards may be disqualified for an old age pension (Old Age Pensions Act, 1908, s. 3). A parent who is convicted of an offence under the Children Act, 1908, may be sentenced to detention in a certified inebriate reformatory (s. 26).

BIBLIOGRAPHY.—As to the history of legislation on the subject see Parl. Paper No. 242 of 1872; 1893 C. 7008. See also Wyatt Paine, Inebriate *Reformatories* and Retreats (1899); Blackwell, Inebriates Acts, *1879–1898* (1899); Wood Renton, Lunacy (1896). An excellent account of the systems in force in other countries for the treatment of inebriates will be found in Parl. Pap. (1902), cd. 1474.

(A. W. R.)

United States. — In the United States, by the decided weight of authority, the contract of a completely intoxicated person is voidable. It is capable of repudiation or ratification when the party becomes sober, and the ratification may be express or implied, the burden being upon him to take action within a reasonable period after he becomes sober to disaffirm it; otherwise ratification is presumed from his silence. The rule is the same in the United States as in England that a man may, in spite of intoxication, bind himself by contract, if he knows what he is doing and comprehends the consequences of his acts. If his intoxication utterly and entirely deprives him of his reason and understanding he may set his contract aside on the ground of drunkenness.

Voluntary intoxication carries with it the assumption by the drunkard of all criminal responsibility, while if the criminal act was committed when the intoxication was involuntary this is a complete defence to a criminal charge based on the act. However, the condition known as delirium tremens, when it has progressed to a degree establishing permanent insanity, which renders the person incapable of distinguishing between right and wrong, relieves him from criminal responsibility for his acts, even though the condition was voluntary in its inception. The theory and reason for the rule is that the man is insane, and his insanity is a defence even though it was produced by the voluntary excessive use of intoxicating liquors. (People v. Rogers, 18 N.Y. g; Flanigan v. The People, 86 N.Y. 554; State v. Haab, 195 La. 230.) Intoxication, even though voluntary, may be adduced in evidence in those acts which become crimes when done knowingly or *with* a specific intent or purpose, and the courts have held that in such cases the fact of intoxication is admissible to negative the existence of such knowledge or intent, which is a necessary element of the crime.

The manufacture and sale of intoxicating liquors for beverage purposes in the United States was controlled first under sanction of the war powers of Congress and later (from Jan. 16, 1920 to Dec. 5, 1933) under the eighteenth amendment to the Constitution. The prohibition act of Nov. 21, 1918, was upheld by the federal supreme court (Hamilton v. Kentucky *Distilleries,* etc. Co., 251 U.S. 146; United States v. Standard *Brewery,* 251 U.S. 210, *Ruppert* v. *Caffey,* 251 U.S. 264), on the ground that it was within the war powers granted by the Constitution. The act of Oct. 28, 1919 (known as the Volstead Act), elaborating upon the previous act and providing for the enforcement of the amendment as soon as it came into effect, forbade the manufacture, sale, and transportation of intoxicating liquors for beverage purposes, and narrowly defined the meaning of that term. The Supreme Court (*Ruppert* v. *Caffey,* supra) held that the provisions of this act

extending prohibition to malt liquors, with an alcoholic content of 0.5% by volume, whether actually intoxicating or not, was a proper exercise of the discretion of congress. The act made certain exceptions under a permit system, stating lawful uses of liquor; *i.e.,* for scientific, sacramental, medicinal, and mechanical purposes. (See PROHIBITION.) (J. P. EA.)

INERTIA MOTION. In meteorology and oceanography, inertia motion refers to the motion of air or water moving horizontally without horizontal forces. With respect to a co-ordinate system fixed to the rotating earth, such motion is circular, provided that the variation of latitude is small. This "inertia circle" can be most easily explained in terms of the fictitious Coriolis force (see MOTION, LAWS OF).

As long as no other forces act, and the variation of latitude can be neglected, a particle is deflected uniformly (to the right in the northern hemisphere) and describes a circle in the clockwise sense. The size of the circle depends on the initial velocity, and the period to complete the circle is one-half day divided by the sine of the latitude. In the southern hemisphere, the corresponding circle is counterclockwise.

The effectof varying latitude is to increase the trajectory curvature at high latitudes relative to that at low latitudes. Hence, under large latitudinal displacements, inertia circles are modified to spirals, in which a westward drift is superimposed on the inertia circle.

Pure inertia motion has been observed in the ocean, but not in the atmosphere. However, air motion subject to a uniform pressure gradient without friction can be described by the vector sum of geostrophic motion and inertia motion. Indications of damped inertia motion have been obtained from constant-level balloon trajectories.

Because of inertia motion, the atmosphere has a natural period of oscillation, which at latitude 30° is exactly one day. When daily heating causes a periodic force on the atmosphere, resonance occurs at this latitude, and the resulting motions are amplified. Such periodic forces occur at coast lines and cause land-sea breezes with large amplitude near latitude 30°. Over the interior of continents friction caused by momentum exchange is strongly enhanced by daytime heating; at night it nearly disappears. This periodic variation of frictional force results in large diurnal wind variations near latitude 30° with maximum amplitude about 2,000 ft. above the ground. At this height the nocturnal wind speed is substantially in excess of the geostrophic value. Therefore, the wind between midnight and sunrise frequently increases with height to about 2,000 ft. and decreases above, forming the so-called low-level jet stream near 2,000 ft.

Inertia Instability.—A configuration is stable when a particle has a restoring force acting on it after displacement. In meteorology or oceanography, inertia instability denotes the stability of geostrophic flow for displacement at constant entropy (nearly horizontal in most cases). (See also GEOSTROPHIC WIND.)

Geostrophic flow is unstable when the geostrophic current of air or water increases poleward more rapidly than $2\omega \sin \phi$, where ω is the angular velocity of the earth and ϕ the latitude. On the other hand, a poleward decrease of current is stable, no matter how great the variation of the current.

Inertia instability has been used to explain the observations that both for the atmospheric jet streams, and for fast ocean currents, the current profiles are asymmetrical: the poleward variation of speed can have extreme gradients, whereas on the equatorward side, the gradient of current rarely exceeds $2\omega \sin \phi$.

Some meteorologists believe inertia instability to be important in the formation of storms (cyclogenesis). There exists some doubt, however, about whether the motions set up by inertia instability are of sufficient scale and magnitude to be important in this connection.

Inertia instability is further enhanced for anticyclonic curvature of air trajectories (see GRADIENT WIND).

(H. A. A. P.)

INFALLIBILITY, the fact or quality of not being liable to err or fail (Med. Lat. *infallibilitas, infallibilis,* formed from *fallor,* to make a mistake). At the present time the idea of infallibility in religious matters is most commonly associated with the claim of the Roman Catholic Church. and more especially of the pope personally as head of that Church, to possess the privilege of infallibility, and it is with the meaning and limits of this claim that the present article deals.[1] The substance of the claim to infallibility made by the Roman Catholic Church is that the Church and the pope cannot err when solemnly enunciating, as binding on all the faithful, a decision on a question of faith or morals. The infallibility of the Church, thus limited. is a natural outcome of the fundamental conception of the Catholic Church and its mission. Every society of men must have a supreme authority, whether individual or collective, empowered to give a final decision in the controversies which concern it. A community whose mission it is to teach religious truth, which involves on the part of its members the obligation of belief in this truth, must, if it is not to fail of its object, possess an authority capable of maintaining the faith in its purity, and consequently capable of keeping it free from and condemning errors. To perform this function without fear of error, this authority must be infallible in its own sphere. The Catholic Church has expressly claimed this infallibility for its formal dogmatic teaching.

The infallibility of the pope (*q.v.*) was first defined in 1870 at the Vatican council. The exact formula for the papal infallibility is given by the council in the following terms (Constit. Pastor aeternus, cap. iv): "we teach and define as a divinely revealed dogma, that the Roman Pontiff, when he speaks ex *cathedra—i.e.,* when, in his character as Pastor and Doctor of all Christians, and in virtue of his supreme apostolic authority, he lays down that a certain doctrine concerning faith or morals is binding upon the universal Church—possesses, by the Divine assistance which was promised to him in the person of the blessed Saint Peter, that same infallibility with which the Divine Redeemer thought fit to endow His Church, to define its doctrine with regard to faith and morals; and, consequently, that these definitions of the Roman Pontiff are irreformable in themselves, and not in consequence of the consent of the Church." A few notes will suffice to elucidate this pronouncement.

a. As the council expressly says, the infallibility of the pope is not other than that of the Church; this is a point which is too often forgotten or misunderstood. The pope enjoys it in person, but solely qua head of the Church, and as the authorized organ of the ecclesiastical body united with him.

b. The late date at which the dogma was defined is explained by the fact that the mode of exercising authority on the part of the Church has varied since the time of Christ; but it is affirmed that the dogma was already contained in that of the papal primacy established by Christ himself in the person of St. Peter. A certain dogmatic development is not denied. nor an evolution in the direction of a centralization in the hands of the pope of the exercise of his powers as primate; it is merely required that this evolution should be well understood and considered as legitimate.

c. Infallibility is the guarantee against error, not in all matters, but only in the matter of dogma and morality; everything else is beyond its power, not only truths of another order, but even discipline and the ecclesiastical laws, government and administration, etc.

d. Again, not all dogmatic teachings of the pope are under the guarantee of infallibility ; neither his opinions as private instructor, nor his official allocutions, however authoritative they may be, are infallible; it is only his ex cathedra instruction which is guaranteed; this is admitted by everybody.

e. The last phrase of the definition is aimed at Gallicanism and kindred doctrines, political rather than theological, which placed the authority of the Church above that of its head.

But what is the extent and limit of an ex cathedra pronouncement? The direct and immediate object of this infallible teaching concerns those truths of faith and morals, revealed by Christ and passed down by Scripture and tradition. Of its nature, this deposit of faith is so intimately bound up with other truths, either by a historical or logical relation, that to deny these latter would destroy

[1] On the idea of infallibility in reference to a written revelation, see INSPIRATION.

the practical religious purpose of the deposit itself. This principle, that infallibility is extended to truths that are directly connected with the deposit of faith, is upheld by all theologians. In this category of connected truths or secondary objects of infallibility are: (1) logical conclusions drawn from premises, of which one is a revealed truth and the other a truth known with certitude by natural reason, *e.g.*, Christ had a human body and soul; (2) natural truths insofar as connected with revealed truths, *e.g.*, idea of person, substance, etc.; (3) facts historically connected with dogmas which, though not revealed as such, would, if denied, destroy the revealed dogma, *e.g.*, ecumenicity of a council; (4) ecclesiastical laws and precepts for the regulation of worship or guidance of the entire body of the faithful, *e.g.*, law of communion under one species. Further, not every official decree of the pope is protected by his infallibility. In the bull of Pius IX on the Immaculate Conception, the strict infallibility is confined to a sentence or two. There, as in every ex cathedra definition, the pope declares positively that the faithful must believe a definite proposition under pain of heresy.

The controversies occasioned by this question had started from the beginning of the council, and were carried on with bitterness on both sides. The minority, among whom were prominent Cardinals Rauscher and Schwarzenberg, Hefele, bishop of Rottenburg (the historian of the councils), Cardinal Mathieu, Mgr. Dupanloup and Mgr. Maret, did not pretend to deny the papal infallibility; they pleaded the inopportuneness of the definition and brought forward difficulties mainly of an historical order. The majority, in which Cardinal Manning played a very active part, took their stand on theological reasons of the strictest kind; they invoked the *tu* es Petrus and the *pasce* agnos of Christ; they showed the popes, in the course of the ages, acting as the guardians and judges of the faith, arousing or welcoming dogmatic controversies and authoritatively settling them, exercising the supreme direction in the councils and sanctioning their decisions; they argued that the few historical difficulties did not involve any dogmatic defect in the teaching of the popes; they insisted upon the necessity of a supreme tribunal giving judgment in the name of the whole of the scattered Church; and finally, they considered that the definition had become opportune for the very reason that under the pretext of its inopportuneness the doctrine itself was being attacked.

The definition once proclaimed, controversies rapidly ceased; the bishops who were among the minority one after the other formulated their loyal adhesion to the Catholic dogma. The last to do so in Germany was Hefele, who published the decrees of April 10, 1871, thus breaking a long friendship with Dollinger. In France, though no bishops abandoned it, a few priests, such as Father Hyacinthe Loyson, refused their adhesion. The most distinguished among the German dissentients was Dollinger, who resisted all the advances of the archbishop of Munich, was excommunicated on April 17, 1871, and died unreconciled, though without joining any separate group. After him must be mentioned Friedrich of Munich, several professors of Bonn, and Reinkens of Breslau, who was the first bishop of the "Old Catholics" (*q.v.*).

See Dom Cuthbert Butler, *The Vatican Council* (2 vols. London, 1930); L. Billot, S.J., *De Ecclesia Christi* (3 vols., Rome, 1898–1900); Acton, "History of the Vatican Council," *North British Rev.*, I, iii; *P.* J. Toner, art. "Infallibility," *Catholic Encyclopaedia;* and *C.* Mirbt, art. "Vatikanisches Konzil" in Herzog-Hauck, *Realencyklopadie* (full bibliography); *E.* C. Butler, *Life and Times of Bishop Ullathorne* (2 vols., London, 1926); H. E. Manning (card.), *Petri Privilegium,* 1871, and *The Vatican Decrees in their Bearing on Civil Allegiance,* 1875; *J. H.* Newman, *Letter to the Duke oj Norfolk,* 1875.

INFAMY, public disgrace or loss of character. Infamy occupied a prominent place in Roman law, and took the form of a censure on individuals pronounced by a competent authority in the state. Such a censure involved disqualification for certain rights both in public and in private law. In English law infamy as a cause of incompetency was abolished by 6 & 7 Vict. c. 85. The same has occurred in most of the codes which followed the Roman law in this relation; *e.g.*, the Spanish penal code of 1848.

The word "infamous" is used in a particular sense in the English Medical act of 1858, which provides that if any registered medical practitioner is judged by the General Medical council, after due enquiry, to have been guilty of infamous conduct in any professional respect, his name may be erased from the medical register. The General Medical council are the sole judges of whether a practitioner has been guilty of conduct infamous in a professional respect, and they act in a judicial capacity, but an accused person is allowed to appear by counsel.

See *Pratt* v. *British Medical Association,* 1919, 1 *K.B.* p. 270 and cited cases. As to dentists, *see* the Dentists act, 1921, establishing a dental board.

INFANCY. Infancy is usually regarded as extending through the first year of life or until the child begins to walk alone, at which time he is often referred to as a toddler.

In the mid-20th century infants were healthier and had a better chance of survival than they had at any previous time in recorded medical history. In England and Wales in the 1870s the infant mortality rate was approximately 150 per 1,000 live births; by mid-20th century it had been reduced to 25. The rate in the United States stood at approximately 150 as late as 1900; this had been reduced to less than 27 at mid-century. In Europe infant mortality rates range from as low as 18.2 per 1,000 in Sweden to 110.2 in Yugoslavia.

Important among the reasons for the greatly improved chance of survival was the advance in knowledge of foods and nutrition. Clean milk alone greatly reduced gastrointestinal diseases that formerly were the chief killers. Chemistry and biology contributed chemotherapeutic and biological agents to combat many infectious illnesses.

Any discussion of infant care must include a consideration of the mother and the unborn baby. It is often said that a fetus is a parasite on the mother. Unless the mother is a healthy person and unless the maternal diet is adequate, the fetus may not receive the essential nutrients necessary for optimum development. It has been demonstrated also that certain infectious illnesses during the early months of pregnancy can unfavourably influence the developing fetus. Good health and good nutrition thus are of utmost importance for motherhood, not only throughout pregnancy but presumably even before conception occurs. (See also PREGNANCY; MATERNAL AND CHILD HEALTH.)

DEVELOPMENT, HEALTH AND COMFORT

Newborn Infant. — The length of a normal male infant born at full term averages about 20.0 in.; females 19.5 in. The average boy baby weighs about 7.5 lb. and the average girl slightly less, about 7 lb The circumference of the head of a boy baby is approximately 13½ in., that of a girl approximately ½ in. less. The head grows rapidly during infancy. At the top of the head is a soft spot, the fontanelle, which is well protected by a very tough layer of dense protective tissue which is gradually replaced with bone; usually the spot is completely closed by the end of infancy.

Infants are usually, but not always, born without visible teeth. The first tooth erupts at about six months. The time of appearance of the first tooth may vary considerably but the place of its appearance is remarkably uniform: it usually appears just at one side of the middle of the lower jaw. By the end of the first year six teeth usually have erupted — four upper incisors and two lower incisors.

The skin of newborn white babies is reddish but rapidly fades to a light pink. Other babies have skin colourings characteristic of their races. By the third or fourth day the skin often takes on a slightly yellowish colour, which normally tends to disappear during the next ten days to two weeks. The skin of well-nourished babies soon takes on a smooth pink velvety appearance and is elastic to the touch. The amount of hair on the heads of newborn babies shows great variation in amount, colour and texture, although it tends to be much more delicate in texture than it is in later life.

Newborn babies are incapable of visual focus; their eyes are likely to move in any direction and their motion is not co-ordinated. Strong light causes discomfort. By the end of a month babies begin to focus momentarily on objects and during the next two months they gradually develop greater skill and begin to recognize objects; their eyes will follow a moving object.

Newborn babies are often quite deaf, but this tends to correct itself rapidly and soon they respond to noise, words and music.

Babies are readily disturbed when jarred or touched. Newborn babies are relatively less susceptible to pain than are older infants and children.

Sucking is a reflex act which is fully developed in babies born at full term but weak in premature infants. The ability to continue sucking is influenced by muscle fatigue. Rest periods and artificial assistance are sometimes necessary when the sucking reflex of a weak baby does not permit the taking of adequate nourishment. The ability to swallow, well developed at birth, is related to the sucking reflex.

The neaborn baby cries when hungry or cold or otherwise uncomfortable. When appetite is satisfied and the infant is warm and in a comfortable position he sleeps much of the time.

Progress of Development. — During the first year normal development follows a fairly uniform pattern but with considerable individual variation. It is generally not until the age of six weeks or two months that the baby smiles in response to a pleasant approach. Purposeful smiles are not to be confused with facial contortions apparently associated with abdominal distress in the young baby. At about three months the baby begins to use his fingers with purpose and by four months some skill has been acquired with arm movement. The baby laughs, turns his head in response to being spoken to and holds his head up well at about three months. Often he can roll himself over on a hard surface; this is an important point to remember. A baby should never be left on a table or a bed without due precautions to ensure that he will not push himself off and fall to the floor. At five months the baby reaches for objects and soon learns to pick them up. At about seven months he begins to sit alone. From ten months to a year the baby begins to use a few one- or two-syllable words, and his comprehension of words begins to be shown in response to a few simple commands. Toward the end of the first year he learns to pull himself to his feet and in about one year he begins to take a few steps with support.

Bowel habits and bladder control are matters that may be considered in relation to the child's general development. There is little use in trying to teach infants bowel and bladder control until their development has reached a point where it is possible for them to have enough success to be encouraged. It is often reported that babies have been trained to control bowel movement at the age of two or three months, but one must consider the possibility that this may be a trained mother rather than a trained child. It is seldom advantageous to start bowel habit training before a baby can sit alone comfortably and before he can understand the idea his mother is attempting to convey to him. Training with reference to bladder control habits is generally started after success has been obtained with bowel control. Physical punishment or scolding should never be the technique used to establish toilet habits. The alertness of the mother to create situations that will ensure successes that can then be praised is by far the most satisfactory method and least time consuming. Failures on the part of the child should be treated as unfortunate accidents.

Parental Love and Affection. — The importance of beginning early to develop in the child a sense of security can scarcely be overestimated. This sense of security is dependent on a feeling of being loved and wanted. Behaviour problems of childhood can be minimized or reduced by giving fully of parental love. Babies soon learn to enjoy being held by their parents; they enjoy play that is suitable for their age and they respond to the multitude of other little evidences of parental love.

However, there are a few cautions to be observed and suggestions that may be made. Babies cannot stand rough play with their fathers immediately after eating; it usually causes regurgitation of food, and, furthermore, this is the time for sleep. Infants should be protected from tickling. The morning bath can be a happy time for both mother and baby. Feeding time should be a pleasant experience without tenseness. The urgency that some mothers feel about the necessity of giving their infants a measured amount of food at each feeding time creates unnecessary tension and establishes bad eating habits. Well babies should not be forced to eat. Late afternoon is a suitable time for play; some regularity is desirable, for the baby must learn that he cannot be played with at any or every time he fancies.

Cleanliness. — Once a day a baby should be given a bath in water at normal body temperature (between 95° and 100" F.). The temperature should always be tested (using the mother's elbow) before placing the baby in the water; this will prevent accidents and enhance the baby's pleasure. There are a variety of acceptable tubs. It is essential, however, that the tub be firmly placed and incapable of being tipped over, and it should be of a kind that can be readily cleaned. In bathing an infant another point to remember is that the skin of a wet baby is slippery and that the mother must always have a firm hold of her baby when he is in the tub. First she lowers the baby's buttocks into the water. One hand firmly grasps the baby's right arm above the elbow near the shoulder; the remainder of her hand supports his back and her wrist and forearm support his neck and head. The mother's other hand is then free to cleanse the baby's body nith a dampened wash cloth and a small amount of a mild soap. A minimum amount of soap should be used. When baths are skillfully given babies soon learn to enjoy them.

Since it is a characteristic of infants to put objects in their mouths and since the mouth is one of the most common portals of entry for disease-producing microorganisms it is essential that hands, toys and eating utensils be kept clean.

Keeping a Well Baby Well. — Barring accidents or the occurrence of the few diseases of unknonn cause or those for which there is no known treatment, it is entirely possible through the application of known knowledge to maintain a baby in a state of optimum health throughout the first year and beyond.

The rules for keeping a well baby well are simple but important, as follows:

1. Proper feeding (see below).
2. Preventing infectious disease.

The rules governing the prevention of exposure of infants to infectious diseases are a direct application of techniques established years ago in contagious disease hospitals for the prevention of spread of infectious disease from one patient to another. The success of antibiotics has often led to carelessness in these matters; however, to ignore well-established, effective rules of sanitation because cures are available is comparable to being careless with matches because the city has a good fire department. The baby should have a room or a corner that belongs to him and him alone. The most convenient place in the daytime is a room adjoining the place where the mother spends most of her time, usually the kitchen. No one is permitted in the baby's room except well people with washed hands and clean clothes. If any member of the family is suffering from a common cold or other infectious illness he must stay out of the baby's room or corner.

In case the mother has a cold and it is necessary for her to take care of the baby during this period, she can prevent the baby from contracting the cold if she will observe the simple aseptic technique that is known to all pediatric nurses, modified for home use. While caring for the baby the mother wears a mask of gauze over her nose and mouth; she washes her hands with soap and water and dries them on a clean towel, and without touching contaminated objects outside the baby's room, she enters the room and slips into a loose cotton gown with sleeves which cover her clothing. With these precautions she is ready to take care of the baby, and it is perfectly possible for her to do so without transmitting her cold. The gown used in the baby's room should never be used for any other purpose than that for which it is intended and should be kept in the baby's room except when it is washed. After scrubbing her hands and getting into her gown the mother does not touch her face or things that she has handled with unwashed hands.

Young babies do best when kept at home; traveling with small babies invites the possibility of exposure to infections. Visitors are invited to look at but not handle babies. If the visitor has a cold the baby is not brought out for inspection. Persons with infectious disease should not come closer than six feet to a well infant and must cover coughs and sneezes.

3. Immunizations. These are available for diphtheria, tetanus,

whooping cough and poliomyelitis. Babies under six months are not susceptible to measles providing the mother had measles before she became pregnant. After babies lose their natural immunity they may be protected by the use of proper immunization technique, but known exposures must be promptly reported to the baby's physician with a request for assistance.

4. Cleanliness (see above). It is important to remember that not all bacteria are harmful and that it is not necessary to observe absolute surgical asepsis in order to prevent the occurrence of illness of infectious origin. Absolute cleanliness (asepsis) is necessary, however, when persons in the household are suffering from or have recently suffered from colds or other infectious illness, or when the baby may be exposed to persons whose state of health is unknown to the mother. When all members of the household are well and free from illness simple cleanliness suffices for all health purposes.

5. Preventing accidents (see below).

6. Good hygiene. This requires provision of opportunity for restful sleep, frequent changes of linen, daily outdoor airing (weather permitting), sun baths when recommended by the baby's own physician, opportunities for free play consistent with the age of the infant, an abundance of love and affection, together with the application of all the foregoing rules.

7. Pediatric care. The mother and the father can act sensibly and with good judgment only when they are informed concerning the above rules. The pediatrician will assist them with problems they do not understand.

Accident Prevention. — Accidents that can happen to the infants are relatively few, and if the subject is given a little thought most of them can be prevented. A thoughtful mother can invent most of her rules and they can be effective. However, the following are given as examples: (1) when carrying a baby always be sure to have a firm hold — babies wriggle, squirm and jump at unpredictable times; (2) never leave a baby alone on a bath table or examining table or any other surface from which he might fall; (3) when bathing a baby always hold him securely; (4) never hold or carry hot objects above a baby; (5) remove pointed or sharp objects from the baby's reach; (6) be sure the slats on the side of the baby's crib are close enough to prevent the baby from getting his head through; (7) do not give the baby easily breakable toys; (8) very small toys are to be avoided; the baby may choke on them; (9) toys covered with lead paint or water-soluble stains are to be avoided; (10) plastic sheets and bags must be kept completely out of reach of babies and small children, since they may be slipped over the head and may then cling to the face and cause suffocation.

Sun Baths. — When weather and temperature permit, sun baths are usually recommended, since exposure to the sun's rays, and to skyshine for that matter, transforms substances in the skin to materials which have vitamin D activity. While vitamin D preparations can be given by mouth when sun-bathing is impossible or impractical, it is believed that sensible exposure to the sun is beneficial. While there is no agreement with reference to the precise age at which sun-bathing can best be started, it is probable that most babies can be safely exposed outdoors, temperature permitting, after the age of two or three months. The baby's eyes should be protected from direct exposure to sunrays, and direct exposure to the glare of a cloudless sky on a summer day is also evidently unpleasant for the infant.

The time of exposure naturally varies with the season of the year, the time of day, the age of the infant and character of skin. It is safer to avoid exposure in midday when the sun is hottest. It is often recommended that first exposure be for as short a time as two minutes. Succeeding exposures can be gradually increased until tanning occurs. It must be remembered that babies do not tan so deeply as adults do and that they burn much more easily. The physician should be consulted on how much sun each baby needs.

Clothing. — The chief object of clothing is comfort. Babies should wear only a sufficient number of garments to keep them warm and comfortable. In newborn babies the temperature regulating mechanisms may not be fully developed and therefore they may need extra clothing to maintain body temperature. If there is doubt in the mother's mind that her infant is wearing too many clothes, it is usually possible to tell by observing the presence or absence of perspiration on the baby's back. The mother may pass her hand over the baby's back under the shirt and if she finds the skin wet with perspiration it is almost certain that the child is overclothed; if on the other hand the skin is warm and dry to touch and the baby is otherwise apparently comfortable and happy, the amount of clothing is probably appropriate. Cotton clothing is generally most comfortable next to the baby's skin and is easier to wash than most other materials. The baby should wear a hat or a bonnet on cool days out of doors.

Sleeping Out of Doors. — Fresh cold air is stimulating and invigorating even to quite small babies. However, good judgment must be used in placing babies out of doors to sleep. Weak or very small babies require control of external temperature and are best kept in the house. A healthy, vigorous baby gradually can be accustomed to cool or cold air provided that he is appropriately covered. Some overzealous mothers have permitted frostbite to occur in babies' cheeks and on the backs of their hands. While these usually are not serious, they are to be avoided. After frostbite hard lumps may appear beneath the skin of the frostbitten area and persist for weeks.

INFANT FEEDING

Breast Feeding. — The ideai food for the young infant is human milk. It supplies all of the nutrients in amounts and variety necessary for good growth and development provided the mother is in good health and is eating a nutritionally satisfactory diet. One possible exception to the nutritional adequacy of human milk is vitamin D, but this can be obtained from exposure to sunlight.

The yellowish fluid that is secreted before breast milk makes its appearance is known as colostrum. The amount varies greatly. Colostrum alone is secreted for a period of from two to four days; after this comes a transition to breast milk which is complete at the end of about three weeks.

It has long been held that colostrum may confer some degree of immunity on infants, but however that may be, its removal from the mother's breast by the infant is of importance to the establishment of lactation. Early nursing also encourages early contraction of the mother's uterus.

The composition of human milk varies, as does that of other foods, within a rather wide range. According to P. C. Jeans the approximate percentage composition of human milk is as follows: fat 3.5%; sugar 7.5%; protein 1.25%; lactalbumin 0.75%; casein 0.50%; total ash 0.20%; calcium 0.032%; magnesium 0.004%; potassium 0.041%; sodium 0.011%; phosphorus 0.013%; sulphur 0.014%; chloride 0.032%; iron 0.0001%; copper 0.00003%. In addition breast milk contains traces of other minerals plus identified and unidentified vitamins. In fact milk from healthy mothers who are themselves on a nutritionally adequate diet supplies all of the nutrient needs of the infant with the exception of vitamin D. The amount of breast milk is usually suited to the needs of the infant. Some mothers can nurse two babies when necessary.

Successful nursing implies that the mother must be free from debilitating disease, that she eat adequately (but not excessively so that she gains unneeded weight) and that she be emotionally adjusted. Adequate rest is necessary. Exercise should be moderate. Home surroundings should be as pleasant and as congenial as possible, and in all these things the husband plays no small part. Professional medical attention is also sometimes required and is always helpful.

In addition to the other good reasons for encouraging breast feeding it is emotionally satisfying to both the mother and infant. Nursing time is often the one time when the mother can relax and enjoy her baby. When she nurses her baby there is no formula to worry about and there is no concern when the infant does not take all of an alloted formula.

Cow's Milk. — When the nutritional needs of infants cannot be met with human milk, other means of supplying these needs are available. Infants who do not receive human milk, however, may require certain nutrients in amounts greater than are present in

breast milk. Cow's milk approaches a perfect food only for the baby calf. Furthermore, in no species of animal is milk alone the sole source of food for more than a relatively short period after birth. Soon infants require supplementary foods just as young animals do.

The milk formula for the newborn baby is generally made up of milk, added water and a carbohydrate (one of several sugars or mixtures such as lactose, maltose-dextrin mixtures, glucose and sucrose). It is common practice in the calculation of formulas to give from 1 to 1½ oz. of milk per pound of body weight. One and one-half ounces of milk supplies approximately 3.4 g. of protein and 0.12 g. of calcium per kilogram, together with other minerals, lactose, fat (apparently sufficient for the infant's needs), water and vitamins — notably vitamin A, riboflavin and some thiamine and niacin.

At first the total fluid volume of the formula is in the neighbourhood of 2½ to 3 oz. per pound of body weight. Later the volume is diminished. Thus after determining the amount of milk required, the difference between the calculated amount of milk and the calculated volume of the formula is made up by adding boiled water.

Babies need approximately 50 cal. per pound of body weight. This is easily calculated. The amount supplied by the milk in the formula is calculated on the basis of the fact that average cow's milk supplies 20 cal. per ounce. The difference between the total caloric need and the caloric value of milk in the formula represents the number of calories that need to be added to the formula to make it supply the necessary energy value. This is usually done by adding an appropriate amount of carbohydrate in the form of one of the sugars. Most sugars contribute approximately 120 cal. per ounce. More than 1½ or 2 oz. of sugar is seldom required.

The rapidly growing healthy infant soon is able to take whole undiluted pasteurized milk or unsweetened evaporated milk diluted to the equivalent of whole milk by the addition of an equal amount of water. Full-strength powdered whole milk also may be used.

In bottle feeding infants it is essential to observe strict cleanliness in the preparation of formulas and to refrigerate all bottles whose contents are not consumed at once. There are many ways of preparing formulas, but the object of all of them is to attain a clean (pasteurized or sterilized) product and to keep it safe until the time of use.

Goat's milk approximates cow's milk in nutritive value and generally may be used as a substitute, particularly if the infant is allergic to cow's milk. When using goat's milk it is especially important to be certain of the cleanliness of the supply and that it has been properly pasteurized. Powdered and evaporated goat's milk are also available. Soybean preparations may also be used as substitutes for cow's milk.

Supplemental Foods. — Except in the case of breast feeding, and then only for a short time, the infant can rely on no single food to supply his total nutrient needs. The early supplementation of the diet with nutrients known to be essential for good growth and development is necessary. Furthermore, it is desirable to start early the cultivation of good food habits with relation to foods other than milk.

The first supplement for babies fed both human and cow's milk is vitamin D. It may be started in the first week with the addition of vitamin D concentrates or the pure vitamin. The infant apparently needs no more than 350 units of vitamin D per day, although the dose usually given is 400 units. Doses above 1,500 units per day tend to inhibit the appetite when given over a period of time, with the result that the growth rate is impaired.

Because the vitamin C content of cow's milk decreases on storage it is necessary to supplement the infant's diet at an early age with foods containing this vitamin. In North America it is a common practice to use orange juice, tomato juice or other fruit juices blended with acerola (West Indian cherry) juice, which is by far the richest of all fruits in vitamin C. In Australia, black currant juice and papaw juice sometimes replace citrus juices. Orange juice can be started a few days after birth and increased rapidly up to two or three ounces at the age of three months. Advances in the technique of canning and freezing orange juice make it possible for these juices to supply an abundance of vitamin C at all times of the year, even during the season when fresh oranges are not easily obtainable.

In addition to supplying natural vitamin C, fruit juices contain other valuable nutrients.

Iron-bearing food supplements are also essential for the infant fed on cow's milk, because a baby fed on this type of milk alone will tend to develop an iron deficiency anemia after a period of several months. (See ANEMIA.) For this purpose and to encourage the baby to learn to like a variety of foods it is common practice to start strained vegetables and fruits, meat, egg yolk and cereal at an early age. All these supply needed iron. Good cereal sources of iron are the whole grain cereals, notably oatmeal, and specially fortified cereals.

Home-prepared strained fruits and vegetables for infants have been replaced largely by specially prepared, high-quality, commercially processed foods, available in jars and cans and, after 1960, also as instant dry frozen foods requiring only the addition of water before feeding.

The supplementation of the cow's milk diet with food sources of thiamine and possibly other members of the B-complex group of vitamins is generally regarded as desirable. Strained meat, whole grain cereals (oatmeal or specially fortified cereals) and many fruits and vegetables all provide supplements of thiamine. Egg yolk is a good source, and fruits and vegetables are better sources than highly refined cereals.

At about six months the baby has often developed sufficient skill with his hands to permit him to start feeding himself with a spoon. At this time he sits easily and comfortably and should be encouraged to feed himself. Supplemental foods have the added advantage of assisting in the cultivation of a taste for a variety of foods that later on are even more important in the diet. The smooth strained foods of early infancy may be gradually changed to coarser foods beginning at about six or seven months and to distinctively coarser foods soon after the baby is a year old. While it would appear that most babies tend to demand coarser foods voluntarily when given a choice, failure on the part of the mother to supply them sometimes results in the persistence of the desire for smooth foods long beyond the end of the first year.

It is important also to mention the fact that the parents' attitude toward foods is unquestionably recognized by infants at an early age. Thus it is very helpful for the parents to adopt the habit of regarding all good foods as pleasing and pleasant to eat. The opposite attitude often results in refusal on the part of the infant.

Water should be available at all times for drinking purposes and can be given at any time to satisfy thirst. Generally speaking it is desirable not to give water within 15 minutes before a regular feeding time.

A good working philosophy is to regard eating as a pleasure and not a duty. Well babies should never be forced to eat.

BIBLIOGRAPHY.—A. Brown and E. C. Robertson, *The Normal Child* (1958); W. McKim Marriott, *Infant Nutrition,* 4th ed. rev. by P. C. Jeans (1947); U.S. Department of Agriculture, "Food," 1959 *Yearbook of Agriculture* (1959); Sir Stanley Davidson, A. P. Meiklejohn and R. Passmore, *Human Nutrition and Dietetics* (1959); Council on Foods and Nutrition, American Medical Association, *Handbook of Nutrition* (1951); Report, Committee on Nutrition of the American Academy of Pediatrics, *Pediatrics,* 21:685 (1958). (J. R. W.)

INFANT, in law, a person who has not attained his full age or majority and is therefore subject to disabilities entailed by nonage or minority. At common law the age of legal majority for both sexes is 21 years. The same rule has been adopted generally in the United States, except in a small group of states which have fixed the age of majority for females at 18 years. See CHILDREN, LAWS CONCERNING. (M. DN.)

INFANTE, a title of the sons of the sovereigns of Spain and Portugal, the corresponding *infanta* being given to the daughters. (From Lat. *infans,* young child.) The title is not borne by the eldest son of the king of Spain, who is prince of Asturias, *il principe de Asturias.* While a son or a daughter of the sovereign of Spain is by right infante or infanta of Spain, the title, alone, is granted to other members of the blood royal by the sovereign.

INFANTICIDE. In sharp contrast with the modern anxiety to lessen child mortality is the extent, as vouched for by sound historical evidence, of the practice of infanticide or of putting newborn infants to death or of allowing them to die.

Thus it is recorded of the Nandi that "children are buried alive in cow-dung if they cry in their mother's womb or if at birth they present their legs first, or are born with teeth. as these events are considered unlucky." From every quarter of the world comes evidence of similar practices, supported by similar reasons. The horror of the abnormal explains many of the cases. Breaches of the rules regulating sexual intercourse may, as with the Nandi, lead to the immediate death of the offspring because the ancestral spirits seeking reincarnation can achieve their desire only by regular marriage. The birth of twins, as an abnormal occurrence, may be viewed as either an indication of future prosperity or of impending misfortune, and social attitudes conform with the view taken in the community of the incident. Some welcome twins as proof of divine favour, others deem them akin to animals and therefore to be destroyed.

Among the Tuski, Ahts, western Eskimo and the Botocudos newborn children were killed now and then if they were weak and deformed, without distinction of sex. Among the Dakota Indians and Crees female infanticide was rare. The Blackfoot Indians believed that a woman guilty of such an act would never reach the "Happy mountain" after death. but would hover around the scene of her misdeed with branches of trees tied to her legs. The Aleutians held that child murder brought misfortune on the whole village. Among the Abipones it was common, but boys were usually the victims, because it was customary to buy a wife for a son, whereas a grown daughter would always command a price.

Infanticide is sometimes practised for economic reasons, as when an Australian mother thinks she is unable to rear the newborn babe. In Africa, where a warm climate and abundance of food simplify the problem of existence, the act is not common. In Polynesia, while the climate ensures food in plenty, the relative smallness of the islands imposed the custom on all families without distinction. In the Hawaiian Islands all children, after the third or fourth, were strangled or buried alive. At Tahiti fathers had the right (and used it) of killing their newly born children by suffocation. The chiefs were obliged by custom to kill all their daughters. The society of the Areois, famous in the Society Islands. imposed infanticide upon the women members by oath. In other islands all girl children were spared, but only two boys in each family were reared.

Cases are known were a child has been killed in order that its soul may pass to a woman desirous of offspring. In India female infanticide was attributed to the custom of hypergamy (*q.v.*). To some superstition related to the social order is also attributed the rule of the Wataveta requiring the destruction of every child born to a woman after her daughter's marriage. The system of age grades which forms an essential part of the structure of that tribe is perhaps the factor in this connection.

Children, especially the first-born, were killed to cure barrenness. to ensure health, good fortune and general fertility. Reincarnation beliefs play a part, since if the son is the reincarnation of his father the son is put to death and the father lives. Again special sanctity, special virtue attached to the first-born and therefore the sacrifice of the first-born had special efficacy. In certain conditions the legitimacy of the first-born is dubious and his destruction may then be regarded as a special case of illegitimacy. There are many proofs of infanticide in religions possessing ethical potentialities such as druidism and Semitism as well as in advanced communities such as Egypt. Greece and Rome.

That the destruction of weak, deformed and unsightly children at birth mould have favourably affected the quality of the community is highly probable. Eugenic motives, however, were not present, and the destruction of such children was conditioned by the superstitions attached to them.

BIBLIOGRAPHY.—A. C. Hollis, *The Nandi* (Oxford, 1909); Sir B. Spencer and F. J. Gillen, *The Arunta,* 2 vol. (New York, London, 1928); A. M. Carr-Saunders, *The Population Problem* (Oxford, 1922); E. Westermarck, *History of Human Marriage,* 6th ed, 3 vol. (1925), and *The Origin and Development of the Moral Ideals* (New York, London, 1906–08); *Reports of the Census of India, 1901 and 1911.*

INFANTILE PARALYSIS (ANTERIOR POLIOMYELITIS) is an acute infectious disease caused by a filterable virus and characterized by symptoms which range from a mild nonparalytic infection to an extensive flaccid paralysis of voluntary muscles.

History. — There is evidence that the disease has existed for many centuries. However, the first clear description of it came from Jakob von Heine in 1840. It was not recognized in its epidemic form until nearly a half century later, when Oskar Medin in 1887 reported observations on an outbreak in Sweden. In addition to the usual spinal form, he recognized the bulbar and certain less common types of the disease. C. S. Caverly, in 1896, recognized that the disease may occur in an abortive or nonparalytic form, a fact confirmed by others later.

While earlier outbreaks centred largely in Sweden, epidemics have occurred in many parts of the world and became particularly prominent in the United States after the beginning of the 20th century.

Incidence. — Severe epidemics have been reported in many countries and islands including North, Central and South America, Europe and Africa. The disease reached epidemic proportions in some region of the U.S. almost every year after the beginning of the 20th century. The greatest recorded sustained incidence in the United States was in 1942–53; in 1950, for example, there were 33,344 cases in the U.S. In 1952 severe epidemics occurred in Denmark, Germany and Belgium. In Asia outbreaks have been reported in Bombay. Singapore. Japan, Korea and the Philippines.

Symptoms. — The commonest early complaints consist of mild headache, fever, sore throat. nausea, vomiting, diarrhoea, restlessness and drowsiness. The temperature rises slowly, reaching its peak in two to three days, and then rapidly subsides. Fortunately more than two-thirds of the patients who develop these early symptoms recover and remain well without any signs of muscle weakness. When the disease is severer, the patient develops pain in the back and limbs, muscle tenderness, stiff neck, irritability and fretfulness.

Spinal Poliomyelitis. — This is the commonest type of paralytic poliomyelitis and is caused by infection of the spinal cord. At about the third day of the illness, the patient develops weakness of the limbs. The paralysis may be of all grades of severity from transient weakness which soon disappears to complete and permanent paralysis. The lower limbs are more often affected than the upper limbs. Within a few months after the development of paralysis, the involved muscles begin to atrophy.

Respiratory Poliomyelitis. — The muscles of the chest that control breathing receive their nerve supply from the upper part of the spinal cord. When the virus injures this part of the spinal cord, the patient develops difficulty in breathing. Acts such as coughing, sneezing and sniffing cannot be carried out. When there is a definite loss of function to these muscles, it is essential that some mechanical device be used to aid respiration.

Bulbar Poliomyelitis. — That part of the nervous system situated just above the spinal cord is called the bulb or brain stem. In this region are situated the nerve centres that control swallowing and talking and when poliomyelitis affects this area the patient has difficulty mith these actions. Secretions pool in the throat. The voice becomes hoarse and develops a nasal twang. The accumulation of secretions in the throat may block the airway, causing the patient to suffocate. If this obstruction to the airway is not relieved, the patient loses consciousness and will die.

Diagnosis. — In the preparalytic stage of the disease, the diagnosis must depend on strong clinical suspicion supported by certain laboratory observations on the spinal fluid. This is particularly true of patients who become ill in the late summer and fall in an area where infantile paralysis is prevalent. In 1951 a rapid method for identifying the infection became available, based on the direct inoculation of tissue cultures with stools of ill patients. Virus growth is manifested within 24 hours by a breakdown of the growing tissue culture cells.

Prognosis. — Of all patients who develop infantile paralysis, more than 80% recover within three to four days without the development of paralysis. When paralysis has occurred, consider-

able restoration of normal muscle powers results under proper treatment, although some residual weakness remains in almost half these patients. The over-all fatality rate in the United States was estimated in the 1950s at 5%, while a death rate of 30% had been reported in Europe during periods of low prevalence.

Treatment. — Treatment during the preparalytic stages includes complete bed rest, isolation and careful observation. The patient should be permitted to assume whatever position he wishes. It is important to check carefully for evidence of limb paralysis or breathing or swallowing difficulty.

If paralysis occurs, good nursing care is of primary importance. The bed should be firm with a board under the mattress. Passive movement of the limbs can be used to avoid deformities. Moist heat usually makes the patient more comfortable. As muscle strength returns, exercises are increased. (See below, *Orthopaedic* Aspects.)

When there is paralysis of the breathing muscles, some form of mechanical breathing aid is necessary. The commonest one used in the United States is the tank respirator, or "iron lung." The patient is placed in the tank respirator with only his head emerging. and by a rhythmical increase and decrease of the pressure within the tank his chest is expanded and relaxed. In less severe cases it is possible to use a respirator that fits to the chest only (cuirass respirator) or a rocking bed.

When the patient develops difficulty in swallowing, with accumulation of secretions in the throat, it is important that the airway be kept open by removal of the secretions. This can be done by a mechanical suction machine. If suction of the machine is not adequate an artificial airway must be made from the outside into the throat (tracheotomy).

Aetiology.—In 1909 Landsteiner and Constantin Levaditi showed that the causal agent of infantile paralysis is a filterable virus (see VIRUSES). This virus cannot be cultivated on ordinary lifeless media but only in media containing living tissue cells. It is fairly resistant to physical and chemical agents and able to survive for some time in water, milk and sewage.

When the virus comes in contact with the defense mechanism of the body it elicits the formation of specific antibodies which act to neutralize its infectivity. Of importance, however, is the fact that not all strains are antigenically or immunologically alike. Many strains have been isolated from patients with infantile paralysis from all parts of the world; they can be divided into three immunologically distinct types, and infection with one type does not protect against reinfection with one of the other types. The three types are known as type I, or Brunhilde, type II, or Lansing, and type III or Leon.

Up to 1939 the virus could be transmitted to monkeys only. In that year, however, Charles Armstrong succeeded in transmitting the Lansing strain to eastern cotton rats and from these animals to white mice. In 1949 J. F. Enders and his associates demonstrated that the virus could be isolated and grown in tissue culture on non-nervous tissue cells, thus making it possible to study and grow this virus without the use of living animals. This inexpensive method of working with the virus greatly facilitated research and was directly responsible for the development of a vaccine against infantile paralysis (see below).

Pathology. — The virus probably enters the body through the throat and intestinal tract, since large quantities are excreted in the stools for a number of weeks before and after an attack of infantile paralysis. The disease is probably spread from person to person by intimate human contact. The virus possesses a marked affinity for the nervous system and migrates from the throat and intestines to the central nervous system along the peripheral nerves. Within the central nervous system also it spreads along nerve pathways (axonal transmission), and eventually reaches the more sensitive motor nerve cells in the spinal cord, medulla or brain. These are destroyed in varying numbers, and the destroyed cells are not replaced since nerve cells lack the power of regeneration. Not all cells attacked are destroyed, however, and those not severely injured recover their normal function in time. To the extent that they do recover a corresponding restoration of muscle function may be expected to take place.

Predisposing Factors. — Individual differences in the degree of natural susceptibility appear to exist. Many persons have acquired antibodies in their blood without having knowingly gone through a poliomyelitic infection. The disease commonly attacks those who seem to be in the best of health, so that undernutrition or faulty health do not appear to be predisposing factors.

It is generally held that a lasting immunity follows recovery from the disease. Second attacks are known to occur, however, some of which may be caused by strains differing immunologically from those which caused the first attack.

Among other predisposing factors, age has always been considered the most important. In earlier epidemics, most cases occurred in children under ten years of age. Later, however, there was a definite shift to the beginning of adult life.

Geographic areas appear to play little role in the disease. Although the majority of cases do occur in temperate climates, the disease has a world-wide distribution and has been reported in the tropics as well as in Iceland and Alaska.

Epidemics of infantile paralysis recur with considerable regularity during the summer in temperate areas. Although the disease persists throughout the year, the highest incidence is in the late summer and early fall. Active cases may extend into early winter.

Strenuous exercise, sudden chilling and pregnancy all seem to predispose to the disease. It is generally accepted that removal of the tonsils at the time when the disease is prevalent predisposes to the severer forms of the disease. There is also suggestive evidence that injections of any type (vaccinations) may predispose to the disease, particularly when it is prevalent.

Control. — The ultimate in the control of this disease is the development and use of a vaccine which can protect against infection (see The Salk Vaccine, below). Control measures must depend upon avoiding contacts so far as possible. This is exceedingly difficult, since during epidemic periods there are likely to be many who unknowingly spread the virus. There is no practical way of detecting these persons. All that is possible, therefore, is to avoid unnecessary contacts and especially new ones. A child in school may actually have fewer new and intimate contacts than one out of school.

Inasmuch as the stools of patients and of contacts have been found to contain the virus, often in large amounts, it seems clear that the same general sanitary precautions should be followed as those followed in the prevention of typhoid fever and dysentery. This includes, of course, rigid protection of food and water against possible faecal contamination, including contamination by flies, and the strictest personal and culinary cleanliness. Swimming, especially in public pools, should be avoided. The more serious late effects of infantile paralysis can be materially reduced by prompt medical attention. Proper treatment from the beginning is essential to this end.

BIBLIOGRAPHY.—Ludwig Hektoen and Ella Salmonsen (comps.), *A Bibliography of Infantile Paralysis, 1789–1949,* ed. by Morris Fishbein, 2nd ed. (Philadelphia, 1951); A. B. Sabin, "The Epidemiology of Poliomyelitis; Problems at Home and Among the Armed Forces Abroad," J.A.M.A., 134:749 (1947); H. E. Van Riper, "Poliomyelitis," *J.A.M.A.*, 135:74 (1947); International Poliomyelitis Congress, *Poliomyelitis; Papers and Discussions Presented at the First Conference, 1938* (Philadelphia, 1949); A. B. Baker, *Poliomyelitis,* "Disease a Month" Series (Chicago, 1955), "Poliomyelitis," *Neurology* 4:379 (1954); Expert Committee on Poliomyelitis, *First Report,* World Health Organization technical report series no. 81 (1954). (A B BR.)

The Salk Vaccine. — The state of immunity to paralysis that follows infection with poliomyelitis virus is associated with the presence of antibody specific against the infecting virus. Antibody, which is one of the normal serum proteins modified to possess antiviral activity, is present in the blood stream and acts by combining with virus, thereby rendering it ineffective. Thus, invasion of the cells of the spinal cord and brain is intercepted.

Antibody formation can be induced not only by infection but by inoculation with a killed-virus preparation; the latter is made in such a way that the virus no longer can multiply but does retain the property of stimulating antibody formation. Since there are three distinct immunologic types of poliomyelitis virus that affect man (see above), it is necessary for immunity to be induced to each. The diseases produced in man by viruses of the three immunologic

types are indistinguishable. In the 1950s type I virus accounted for approximately 80% of the paralytic cases, types II and III for about 10% each.

Since a rich source of virus is needed for the preparation of an immunizing agent, and since virus is propagated only inside living cells, the ultimate requirement for the immediate raw material—namely, the virus—is a rich source of susceptible cells. The latter is available in the form of cultures of monkey kidney cells that can be prepared in large flasks. Tissue from such cultures is prepared by reducing the monkey kidney substance to small fragments by cutting or further reducing these to small cell clusters or to individual cells. Then approximately 500 ml. of a dilute tissue or cell suspension is placed in a rectangular-shaped five-litre flask. The cells will settle and will attach to the flat glass surface, grow and then multiply. A suitable nutrient fluid is used, among the principal components of which are amino acids, salts and vitamins, as well as carbohydrates, proteins and fatty acids. Maximum cell yield develops in about one week. Since maximal virus yields are derived from cultures containing the greatest quantity of susceptible cells, the virus is inoculated into cultures at about this time. Infection of cells takes place promptly, soon after which the individual cells are disrupted and the cell sheet on the side wall of the flask is destroyed completely. As a result of the destruction of the cells in which virus multiplied, the fluid phase is then rich in virus. The virus is separated from the cell debris by passage of the fluid through filters that retain particles of the size of bacteria, yeasts and moulds. The virus, being much smaller in size, will pass through such filters, leaving behind the larger particles. This. then, is the starting material that is subjected to chemical treatment for destruction of virus infectivity.

The polio vaccine tested in the field in 1954 and first used for mass immunization in the United States in 1955 is composed of viruses killed by treatment with formaldehyde in which a concentration of 1:4,000 formalin (37% formaldehyde) is used at *p*H 7.0 and at approximately 37° C. for sufficient time to destroy all infectivity. This requires at least six to seven days, but in practice nine or ten days (sometimes longer) is employed to provide for a margin of safety. An entirely safe vaccine is created in this way, so long as precautions are taken to assure complete contact between virus particles and formaldehyde during the virus inactivation process. Since safety is dependent not only upon the absence of virus from samples of the final vaccine but also upon the reliability with which satisfactory vaccine is produced consistently, tests are made at several stages in the course of processing. First a determination is made of the rate of destruction of virus so that adequacy of treatment time can be established as a guide to provision of the desired margin of safety. Then, when it is believed that the process has resulted in the killing of all the virus, a sample is removed and. after an additional three days of treatment, still another sample is removed for test. These are examined for the absence of infective virus by inoculation into cultures of monkey kidney cells such as are used for multiplication of virus for vaccine. After the application of sufficient treatment to destroy infectivity, the material is then stored at refrigerator temperature. The three virus types. treated separately for killing the virus. are then combined in equal amounts and a sample is again tested to make certain that no infective virus is detectable. At this point. further action of the formalin is arrested by the addition of sodium bisulphite, or any other substance that combines with formalin, to prevent further action by this chemical. Further tests for safety are made by inoculation of monkeys, as well as a variety of other animals, and cultures. A test is made to establish potency by inoculating monkeys or other suitable animals in which antibody responses can be measured. Acceptability of vaccine for use depends upon its performance in this test and is indicated by the relative potency of the manufactured vaccine as compared with the performance of a reference vaccine that has been standardized for antibody-producing capacity in fully susceptible children.

Vaccine prepared and tested in the manner described is then administered to potential susceptibles to achieve protection for a number of years—the full extent of which had not yet been determined in 19jj. The objective is to create an immune state which will persist for life. This is approached by the use of two injections spaced not less than two weeks apart and preferably four to six weeks apart, follon-ed by a third not less than seven months later. Yearly booster shots have been advocated. Such divided doses induce much higher levels of antibody than could be achieved if the same quantity of vaccine were to be administered all at one time. Indications are that the prompt re-emergence of antibody, when the immunologic mechanism is restimulated by booster injections or upon later exposure to infection, provides the mechanism for resistance even when antibody has declined to low or to nonperceptible levels. (J. E. Sk.)

Live-Virus Vaccines.—Advances continued to be made and more effective vaccines constantly sought. Live-virus preparations. such as the Sabin, Cox and Koprowski vaccines, which can be given by mouth. are inexpensive to produce, theoretically confer long-lasting immunity and show promise of greater effectiveness over killed-virus preparations: Experiments, especially in the U.S.S.R., Great Britain and elsewhere, indicated the relative safety of such vaccines. (X.)

Orthopaedic Aspects.—The orthopaedic management of a paralytic patient is directed toward the prevention of deformities, correction of those which cannot be prevented and restoration of bodily function. Actually, 80% of patients with poliomyelitis require little more than general nursing care and recover without significant paralysis. Of the remaining 20%, not all require intensive orthopaedic care. During the acute phase of the disease the patient must be kept at absolute bed rest. Attention is given to the prevention of joint contractures by proper positioning of the extremities. As long as the patient is bedridden care must be taken to prevent the development of decubitus ulcers (pressure sores).

As muscle pain subsides active motion is begun. Frequently patients require assistance in certain movements to neutralize the opposing force of gravity. However, it is only through active contraction by the patient himself of those muscle groups which are still intact that sufficient strength can be restored to permit normal function of the part. In selected cases, supported walking or exercise in a water tank is of value. Other aides to the restoration of muscle power may occasionally be utilized. The relatively small group of patients who fail to regain enough muscle power to function independently can usually be taught to walk with the support of braces or crutches.

It is not until a permanent plateau of function is reached—usually 12 to 18 months after the acute illness—that surgical measures are considered. Surgery in poliomyelitis may be undertaken to (1) stabilize an unsupported joint, (2) correct fixed deformities, (3) adjust leg length inequalities or (4) restore function. A common stabilizing procedure involves arthrodesis (fusion) of a joint. In such cases motion is sacrificed for position and strength. Extensive fusion is sometimes the treatment of choice in scoliosis (spinal curvature) resulting from postparalytic imbalance of the spinal musculature. Another useful type of surgical operation involves transplantation of one end of a functioning but expendable muscle in the region involved to a new insertion where its contraction will then produce a movement or perform a joint-stabilizing function formerly the property of a paralyzed muscle group. Leg length inequality, rarely considerable enough to require treatment, may, when necessary, be compensated for by a growth-arresting procedure on the uninvolved extremity at an age calculated to permit equalizing but not excessive growth of the shorter leg. Clearly the purpose of surgical treatment, whatever the type, is to restore the paralytic patient to as nearly normal function as possible and free him from the use of artificial supports. (J. Dy.)

INFANTRY, the backbone of land forces throughout history, includes troops which fight on foot, even though transported to battle by horses, ships, aircraft, tanks, skis or other means. Troops armed with such hand weapons as the spear and sword in ancient times and with automatic rifles and rocket launchers in modern days; troops assisted in combat on land by cavalry, tanks and artillery, by air force fighter-bomber planes and by naval forces in amphibious warfare are all parts of infantry. As foot soldiers their objective has always been to seize and hold ground and, when necessary, occupy enemy territory. In the period following

World War II, infantry came to include elements of the former supporting arms of artillery and tanks as an integral part of Its organization. (See ARMY.)

Since ancient times the infantry has been the largest single element in armies, except during the feudal period. Infantry has fought on foot, on mountain and plain, in desert and jungle, in swamps and on landing beaches. This article will include a history of infantry from the time of Greece and Rome through World War II, and the special characteristics of infantry in the immediate postwar years.

A study of the history of infantry must take into account the social system which produced the armies of the period. At different ages in history, the same nation may produce an army which carries all before it, or fails to meet history's demands. Greece and Rome in classical history supply excellent examples of the changing character of soldiery.

In more modern times the difference between the French of the Revolutionary period and in World War II, or between Spain of the 15th and 19th centuries exhibits the importance of analyzing the social character of a people when discussing their army and its infantry.

The history of infantry through the ages should therefore include both the military factors of organization, strength, tactics, leadership and armament, and the social factors of the position of the soldier in the society. Two brief examples will serve to illustrate the point.

The Roman legion's battle formation—an interesting geometric design—could have been copied by other nations. Its tactics were not startlingly different from those of the Greek phalanx; its weapons were almost identical. The strength of the armies of the Roman republic was not greater than that of its enemies, and its leadership suffered by comparison with that of many of its adversaries. Yet again and again the Roman legion chalked up victories. The answer must lie outside the province of the purely technical military considerations, and probably in the social character of the people.

Napoleon's infantry was unbeatable during the first 15 years of his campaigns. Its organization, armament and tactics were duplicates of those in other armies. Its strength was usually less than that of its enemies; its leadership superior. However, during the early years of the Napoleonic campaigns the veterans of the grande *armée* were good, solid peasant and urban French stock, imbued with the glory of their part in the Revolution. When their numbers were decimated, and polyglot nationalities took their place, Napoleon caused the tactics to be changed to meet the lessened capabilities of the new levies.

EARLY INFANTRY

Infantry in a sense goes back to the first men who fought with clubs. When men fought on foot in groups, against other men or animals, they were fighting as infantry. Infantry undoubtedly existed in all the early tribes since they were an accepted part of the fighting force in the first nations such as Egypt and Assyria. Seven castes existed in Egypt at the time of the Pharaohs and the second caste were the warriors. They fought as infantrymen and were armed with bow and slings and, at one time, with bronze swords. In the Assyrian armies the predominant arm was cavalry which was reserved for the highest caste, the nobility. Lesser men served as foot soldiers.

From the beginning of organized warfare the infantryman appeared armed with sword and bow. As weapons improved and multiplied, tactics became more complex. But the general object of all change was to balance infantry capabilities more evenly in attack and on defense. Following the breakup of the Roman empire and the obliteration of European roads there was a 1,000-year period in which cavalry dominated the battlefield.

The history of infantry begins with masses of armed men trained to move and fight shoulder to shoulder. Its modern battle array in attack and defense is a succession of thinly deployed lines. The evolution of infantry formations, superinduced by changes in weapons, has required corresponding changes in infantry spirit. When ranks were closed, unity was achieved through the rule of blind obedience. With their thinning, infantry came to depend for cohesiveness on the inculcation of higher initiative and resourcefulness in its individuals. Charged with the basic mission of seizing and holding ground, the infantry has borne the brunt of human conflict through the ages and has been called Queen of Battles.

Persia.—In their heritage from the Egyptians and the Assyrians, the Persians utilized much the same method of warfare. The foot soldiers were armed with short spears and wicker shields but they depended upon the bow as their principal weapon. The Persians divided their infantry into heavy- and light-armed groups. The latter operated as a skirmish line ahead of the main force, expecting to be driven back on first contact with the enemy. On occasion. the light infantry fought on the flanks with the object of harassing the enemy flanks or rear.

Greece.—Mountains cut Greece into many cantons, preventing the growth of despotism. Hardy people, knowing both mountain and sea. the Greeks were natural infantrymen. The terrain of Thrace was more suitable for infantry than cavalry. Oddly, nature's advantages were the seed of civil conflict. Civil war led to self-destruction, the best men being killed in an irrational series of petty wars. The golden age of Pericles fell into ruin through the elimination of the elite in the Greek city-states.

The Greeks, being near the sea, were also traders. Their weapons and armour were borrowed from other Mediterranean peoples, skill in metal work being learned from others like the Phoenicians.

In the Greek city-states, the infantryman was a heavily armed pikeman, or hoplite. Spear and sword were his weapons. His protection was provided by shield, helmet, breastplate and greaves—the last a guard for the legs. The men fought in the phalanx, a mass formation created by the Greeks, which was also the basis for their tactics.

The military glory of the Greek city-states was ephemeral. and lasted for a mere century and a half before Alexander of Macedonia conquered them. In the interim, the Greeks won a great victory over the Persian invaders at Marathon (490 B.C.) on the plains north of Athens. Ten years later another Persian force invaded Greece with the aim of taking Athens. Though stopped momentarily at the pass of Thermopylae by the rear guard action of a valiant band of Spartans, Thebans, Phocians and Thespians, they were aided by treachery to reach Athens, which they sacked. A naval battle at Salamis compelled the withdrawal of the Persians, however.

Military service at that time was the duty and privilege of the city-state citizen-soldiers. The great proportion of the residents of states such as Athens and Sparta were not citizens, and therefore were not permitted to become members of the army. As each of the city-states attempted to spread its influence over the remainder of Greece, a warlike spirit became common throughout the peninsula.

Sparta was best known for the development of its warrior class, every effort of the state being devoted to turning out the finest infantry soldiers. For 13 years after being sent to a military camp at the age of 7. Spartan males were trained in military duties in preparation for entrance into the army at the age of 20 years. As long as they remained physically fit, they followed that calling.

The Athenian warriors were not trained in such a rigorous system, but they were liable to army service from the ages of 16 to 60. The other city-states like Thebes followed the Athenian system.

Constant civil war drained the Greek states of their best manpower, its place being taken by mercenaries and by slaves who fought to merit citizenship. Athens grew wealthy from its trade, and utilized that wealth to provide mercenaries as substitutes for its citizen army. Despite the high intelligence of the Greeks, their contributions to warfare were meagre: the phalanx, and the stepladder oblique tactics of the Theban commander, Epaminondas. The phalanx was a mass formation of heavily armed hoplites. initially eight ranks deep, who moved forward with their long spears waist high and straight ahead in a solid

bank of spear points. Spartan and Theban phalanxes met at the battle of Leuctra (371 B.C.). Against a Spartan army of 10,000, Epaminondas had a force of only 6,000, half of them doubtful allies.

Epaminondas, from his knowledge that previous battles had followed a set course with each side successful on the right wing, weak on its left, decided to align his forces in a new tactical formation. He placed his strength on the left, employing his Theban hoplites in a phalanx 50 ranks deep, and echeloning his remaining troops to the right and to the rear. His cavalry was placed well to the front of the weaker and "refused" right wing. This tactic was based on the simple fact that each Greek warrior instinctively sought to gain the protection of the shield on his right. As a consequence. the line inevitably dropped back on the left wing. Epaminondas' tactics were to strike the strong Spartan right with a greater-than-usual shock effect, while sending his cavalry to roll up the left of the Spartans. The Spartan right was thrown back, its demoralization being communicated to the left wing simultaneously under cavalry attack. Panic ensued. and the Thebans won a quick, overwhelming victory.

The traditional enemies, Athens and Sparta, leagued against Thebes, engaging its army ten years later in a battle in which Epaminondas died. His tactics shattered the Spartan right, but in the moment of victory he was killed and his troops left the field demoralized. Philip of Macedonia, having learned military art from Epaminondas in Thebes. returned home to train his own hardy mountaineers. He brought them south against Athens and Thebes, winning a total victory over the mercenary and inferior troops of these two states.

The Greek infantry and the Greek system of fighting reached the highest point under Philip and his son, Alexander (see ALEXANDER III, THE GREAT; PHILIP II of Macedonia). The latter placed his army, as was the custom of the time with the phalanx of heavily armed Greek and Macedonian infantrymen, in the centre preceded by slingers and archers; the cavalry protected the flanks.

The phalanx was modified by Alexander so that the human fortress nas 16 men deep and had 16 men on the front. Alexander armed his hoplites with a spear between 18 and 21 ft. long. With this weapon the heavily armed infantrymen, shoulder-to-shoulder, were able to present a solid front of spear points to an enemy. The first five ranks held their spears horizontally or with the points slightly depressed while the remaining ranks carried their spears vertically or rested them on the shoulders of the men in front. Though Alexander's phalanx mas an improvement over that of his predecessors, its close formation of 256 men was broken when marching over rugged ground. Alexander drilled his phalanx constantly, teaching them to form wedges or "V's" upon signal, and to make a flank movement or a countermarch as if they were a solid mass.

Alexander's battles with the Persians in Asia Minor and in Persia followed a similar pattern. His army of 30,000 to 40.000 was more manoeuvrable than the bulky forces of Persians numbering in the hundreds of thousands. At Granicus. Issus and Arbela. he struck with his strong right, employing heavy infantry as the holding force in the centre. He himself led the cavalry on the right flank in a tactic uniformly successful.

The campaigns in Asia Minor gradually used up the Macedonian and Greek forces, their plàces being taken by subject races and mercenaries. Alexander's successors, recognizing the deterioration of the infantry, concentrated their better soldiers in the cavalry, and built their tactics around flank attacks by horsemen.

Later wars between the Greeks and Romans indicated that heavy infantry was still the backbone of forces, honever. Dependence was placed upon the shock attack of the phalanx, and the available Greek soldiers were concentrated in that formation. The quality of the Greek armies steadily declined until the unimproved. inflexible Macedonian phalanx was defeated at Pydna (168 B.C.) by the legions of the great power of the west, Rome.

Rome.—The Italian peninsula, like Thrace, presented natural barriers to invasion; mountains cut it into isolated areas where city-states grew. Rome, one of these city-states, was originally the home of a peaceful people, but constant strife and a natural aptitude for military life eventually made them extremely warlike.

The Italian countryside, like that of Greece. was not conducive to the development of cavalry. The people depended upon their feet for mobility, and became in time a hardy foot soldiery. Like Athens' army, Rome's was composed originally of citizen-soldiers, who believed it their privilege to serve as warriors. Every citizen was liable for military service, but freedmen and slaves were not accepted in the army.

The history of Roman infantry may, for convenience, be divided into three periods: (1) the Punic Wars and the struggle with Greece; (2) the period of civil war from about 146 B.C. to the formation of the empire in 29 B.C.; and (3) the long period of empire.

For six centuries the Roman legion, an infantry organization, was supreme in warfare. Its composition changed from the citizen-soldier to the professional and eventually to the mercenary and barbarian. The weapons—the two-edged Roman sword and the lance—changed but little; the tactics were revised to suit the capacity of the various elements which made up the legion.

In the early period of the Roman republic, the legion was made up of the finest men in the state. Unlike the Athenian army, the Romans furnished their own arms and equipment. Wealth, usually in property, determined which one of the five classes of infantry a man might enter. The wealthiest class, other than those who joined the cavalry, were the infantry élite with good weapons and heavy armour. The last class was practically unprotected though armed with sword and spear.

Because of the constant warfare, the Roman militia became strong in veteran soldiers. In addition the recruits, eligible at the age of 17. had been trained from boyhood for the profession of arms. Active service, required until the age of 45, was followed by service in the home guard. Though the Romans of the early republican period were imitators of the Greek infantry and the Carthaginian cavalry, their basic organization, the legion, was superior to the phalanx. However, it was tailored to the spirit of the Romans, allowing them more freedom of movement and more flexibility in combat.

At the time of the Punic Wars, the Roman legion formed for battle in what looked like three rows of a checkerboard. Groups of legionaries, comprising 120 men each on a 12-man front and 10 files deep, formed in three lines 250 ft. apart. The width of ten of these maniples. as they were called, was 1,200 ft. The vigorous young Romans were in the front line (hastati), the battle-nise veterans in the second line (principes), and the oldest men in the third line (triarii). The maniples of the last line had a strength of 60 men. The recruits, from 17 to 2j years of age (velites), normally occupied a post in front of the hastati, until driven back by enemy attack. They then fell back to occupy the intervals between the maniples of the triarii.

From a tactical standpoint, the Roman legionary was in a loose formation compared with the Greek phalangite. His place in the maniple was about five feet from his nearest neighbour. When under heavy attack, the maniples of the hastati could fall back into the intervals of the principes, or conversely, on the offensive, the principes could move forward to utilize the intervals between the front-line maniples.

In combat an enemy would often filter through the Roman front line and become engaged with the second line. The Romans usually threw their javelins upon their first contact with an enemy and then resorted to swords for close fighting.

Normally the strength of the legion was about 4,200 infantrymen and 300 cavalrymen. However, since the term "legion" usually meant one Roman and one allied legion, the combined consular army of four legions numbered almost 20.000. This army employed the two Roman legions in the centre, flanked by the allied legions. and with cavalry on either of the wings. A small reserve and the general's bodyguard were in the rear.

Command of the Roman army was centred in two consuls, serving on alternate days. This system, while it gave Rome weak

leadership and was greatly responsible for such defeats as that by Hannibal at Cannae, was a safeguard against the rise of an Alexander.

Ordinary legionaries commanded the legion in battle, these men having risen slowly through experience to the positions of leadership. They were not aristocrats but the best disciplined and most competent professionally of the citizen-soldiers who made up the legion. The Roman centurion, or small unit commander, became famous for his bravery and his willingness to die fighting at his post.

Discipline among the legionaries was extreme; cowardice was punishable by crucifixion. Disobedience on some occasions also received the same punishment. For instance, wherever the legion moved throughout Europe its camp was laid out in exactly the same formation at all times. No matter when the legion was called to action every man knew where his tent and his equipment were located. Failure to conform to this rigid system and to appear at the bugle call was punishable by death.

The Punic Wars were fought by Roman legions manned by this middle-class militia. Opposed to them was the Carthaginian army, superbly led in the field and built around a modified Greek phalanx. Aside from the excellent cavalry which was Carthaginian, the remainder of the army was a mixture of Gauls, Iberians and Liby-Phoenicians. Hannibal, poorly supported at home by a merchant people who placed the army a poor second to the navy, led these undisciplined, plundering soldiers to a number of magnificent victories. Unaware of patriotic motives for fighting, the Carthaginian army won battles from the Roman legions but lost the three Punic Wars. After the destruction of Carthage, Rome became affluent, and the citizen-soldiers, mostly of the farming class, lost their land to the wealthy who brought in slaves to do the work.

In the second period, that of the civil wars and the wars against the Gauls, the Roman legion became a professional force. Impetus was given to the professionalization of the legion when citizenship was granted to Italian allies. Voluntary enlistments, replacing compulsory service, brought in freeborn Romans and even slaves. Capacity for soldiering and willingness to garrison the outposts of Rome became the criteria for service. The Roman infantryman thought of plunder and fought for his own legion, while giving allegiance to his commander.

Such were the infantry soldiers of Julius Caesar who conquered the Gauls. Men of stamina and patience, wedded to soldiering, they fought well whether in the open, in sieges, or in outpost fortresses. The heavy infantry continued to form the main line of battle in their centre position, with cavalry and light infantry on the wings. Under Caesar, the Roman legion extended the bounds of the republic to its greatest extent. Hardship was the lot of the soldiers, whether fighting in long-drawn-out campaigns or engaging in the building of the great Roman roads and garrison forts at the outposts.

In the period of the empire, the nature of military service was changed by the requirements for long-term garrison duty on the frontiers. The objective was to protect the empire from barbarian forays. In this new service, barbarians were increasingly enlisted in the legion; the Roman legion became a polyglot band of infantry, relying more upon cavalry and upon new tactics. Consequently formations and weapons were changed. The pike was adopted in lieu of the javelin, and the tactical formation became tighter. The three lines gradually disappeared until the Roman army was a combination of infantry, cavalry and garrison units protecting the frontier.

For six centuries the Roman legion was the supreme foot soldiery but it was annihilated by the heavy cavalry of the Goths at Adrianople (A.D. 378). For the better part of 1,000 years infantry was replaced by cavalry as the heart of armies, though the infantry of the east Roman, or Byzantine, empire lived on until A.D. 1071. (See CAVALRY.)

MIDDLE AGES

The **Feudal** System.—Rome's greatness in developing the legion was passed to the Frankish tribe of Germany whose soldiers had been trained by the Romans. Here again every man was responsible for military service. The Franks under Charles Martel defeated the Moslems at Tours in A.D. 732. Under the Franks a system of landholding and military service developed into what became known as feudalism (*q.v.*). The conquerors were lords; the conquered, serfs. As in ancient Rome individual wealth was a mark of the soldier's class; the serf became the despised, unwanted foot soldier, more servant than fighter. His service for 40 days a year was required by the lord of the manor, each lord being the vassal of other lords on up to the king. All eyes were upon the knight in armour mounted on horseback. The foot soldiery was poorly armed and its part in conflict almost negligible. The serf as foot soldier fought in the sieges and defense of castles and many of them accompanied their lords to the crusades.

England remained the last country where foot soldiers predominated. Behind the barrier of the channel the islanders retained the old military customs, supplementing their weapons with the two-handed axe adopted from the Viking invaders. At the battle of Hastings (A.D. 1066), the Norman cavalry assisted by infantry archers drove the English infantry from the battlefield in panic. However, as feudalism neared its end, the age of gunpowder opened. It "made all men alike tall." The serfs became peasants and burghers. Infantry regained its supremacy and the armoured knights gave way to the more numerous and better armed yeomanry.

During the long centuries of feudalism, the English people maintained a feeling for independent action. English kings understood that feudal levies produced a poorly trained, undisciplined infantry, whose service in the field was limited to 40 days a year. The alternative of accepting money payments in lieu of service and using it to hire foreign mercenaries was checked by Magna Carta. Eventually English kings found it desirable to pay wages to the fighting men.

Military service became the acknowledged duty of freemen, the foot soldiery being drawn by county levies. By the beginning of the 14th century, the English foot soldier was a man of some independence of spirit, assured of payment by acts of parliament.

Likewise on the continent, the burghers found that they possessed the capacity for combat on foot against the knights, particularly when money would hire mercenaries as crossbowmen to support them. French knighthood, in attempting to put down a revolt in Flanders, found the Flemish burghers a worthy foe at Courtrai in 1302. Armed with a clublike staff and the pike and protected by a marsh to their front and streams on the flanks, the Flemish infantry cut the knights to pieces when they waded in disorder in the swamp.

Historians generally date the downfall of the mounted man from the battle at Crécy (1346) when the English longbowmen defeated French cavalry. For the following century the English longbow, which was five or six feet long and shot arrows a yard in length, dominated the field even after the appearance of the first firearms. Though the French cavalry was defeated by the longbow, the latter weapon did not of itself restore the supremacy of infantry. The bowmen were dependent upon the shock action of massed infantrymen to defeat cavalry. It was the Swiss pikeman who confirmed the decision in favour of the foot soldier. The pike brought about the return of the Greek phalanx in a Swiss model which was later developed into what became known as the Spanish square.

For the infantryman it meant that his firepower and the shock of massed action had been substituted for the mobility which had given the cavalry predominance for 1,000 years. The Swiss, a well disciplined people, copied the phalanx of Alexander, utilizing pikes 20 ft. long as their shock weapons. At this time many of their opponents still wore armour and were mounted. To cut these men down the Swiss used a halberd, an axe with a handle about eight feet long. This style was much imitated, and Swiss troops were readily hired as mercenaries throughout Europe.

The Swiss were rugged mountaineers, unused to horses, and unaccustomed to knightly armour. Peasants and townsmen rose up to protect their cantons from the invasions of the Austrians.

Courage, endurance and patriotism were their main strengths, though their tactical formations and weapons were admirably suited to the character of their infantry. Not only did they defeat the Austrians but they also were victorious over the duke of Burgundy. As a result of these wars, the Swiss peasants became renowned throughout Europe as the ablest fighters. Their capacity in battle without armour and fighting on foot established infantry as predominant over the last of the feudal knights.

It being proved that foot soldiers could win in combat, the relatively inexpensive foot soldier came into demand throughout Europe. But because the kings were constantly at war, the burghers and peasants found such service distasteful. Mercenary forces grew in favour since the people preferred to pay for a trade guild of war rather than take time from their own occupations. The Swiss helped meet the demand by supplying foot soldiers for hire.

Free Companies.— Trade in mercenary soldiers became a major business in Switzerland, the youth being trained and desirous for strife. Their services were offered either in independent bands or through the cantons. Their rules required that no Swiss mercenary could fight against his own banner. Other free companies sprang up in competition, and the German *Landsknechts* demonstrated their abilities as did the Italian *condottzeri.* From the 14th century to the Thirty Years' War, free companies of mercenaries. fighting under a commander and ready to sell their services. were present on practically every battlefield in Europe. Their purpose was to prolong wars, while engaging in as little bloodshed as possible. In time they reaped the scorn of governments, though not before French cannons at Marignano (1515) destroyed the invincibility of the Swiss.

The free companies brought to warfare the value of drill in infantry combat. the importance of *esprit de corps,* and the first beginnings of organization. Since they fought in the Swiss phalanx or Spanish square, their usefulness declined when fire and movement brought an end to that method of fighting.

Gunpowder and the early matchlocks were becoming improved though it took something like 95 operations to load and fire one of them. After the battle of Pavia in 1525 in which the Spanish musket defeated the French there was a slow development in firearms until the next improved version, the arquebus, became a common weapon. This lighter firearm marked the end of both the longbow and the crossbow, though the pike still held its place along with the sword and halberd as battlefield weapons. The Spanish armies grafted the new firearm onto the Swiss phalanx in developing a Spanish square with 50 men on a side. Its claim to distinction was its combination of the pike, sword and arquebus. Behind the front rank pikemen were the usual number of swordsmen while at the corners of the formation were the musketeers. One single laborious shot was all they could get off; the musketeers would then file to the rear to reload.

TO WORLD WAR I

Spanish and Dutch Infantry.— In the 16th century, the Spanish and Dutch infantry were imbued with the spirit of professional soldiers. The excellence of the Spanish infantry was ascribed to the strong sense of discipline, good leadership and the capacity for withstanding fatigue and privation. A hardy, temperate and apt people furnished recruits for the Spanish army, one that refused to concede defeat. Spain had just been through the long struggle against the Moors, had discovered America and was animated by a passion for church and king.

The wealth of the new world passed through the hands of the Spaniards into those of the Dutch burghers. The Spanish army, which had become increasingly filled with mercenary troops while the command and hard core remained Spanish, was unable to put down insurrection in the Low Countries. Though the Dutch were unable initially to confront the Spanish troops in the open, they fought with indomitable courage behind the walls of their cities. Artful in the creation of practical fortifications, the Dutch burghers formed a citizen-soldiery reminiscent of the classical age. Antwerp, for example, held off the duke of Parma's Spanish army for 14 months, and Ostende for 3 years. City after city defied the Spanish in aggressive defenses which included sorties on ice skates, in ships and by land.

The hardy spirit of the Dutch was utilized to advantage by Maurice of Nassau. Establishing the first standing army in Europe, he schooled it in tactics similar to those of the Romans and employed the latest types of firearms. Long-term enlistments, strong discipline and superb battlefield strategy enabled him to employ his Dutch forces in warfare that avoided pitched battles. Capturing city after city which had been taken by the Spaniards, he was vindicated in his confidence in his rugged Dutch infantry. The independence of the nation was won by Maurice and his foot soldiers.

Standing Armies.— The Dutch and Spanish had given armies a new appreciation for organization into battalions and regiments. Both nations had also placed their country's security in the hands of standing armies composed largely of infantry troops drawn from substantial middle-class and peasant stock. The combination of good soldiers and well led fighting organizations had changed the character of armies and warfare.

Meanwhile, the free companies were disappearing and cavalry was no longer dominant over infantry. The pike was rapidly being replaced by firearms; cannon were becoming important. All these new developments were drawn together by the Swedish king, Gustavus Adolphus. With an expeditionary force of 13,000, largely infantry, he arrived in Germany in 1631 to assist the Protestant north against the Catholic south in the Thirty Years' War (1618–48). His sturdy foot soldiers were organized into companies, 4 to a battalion; 2 battalions of 400 men each comprised a regiment.

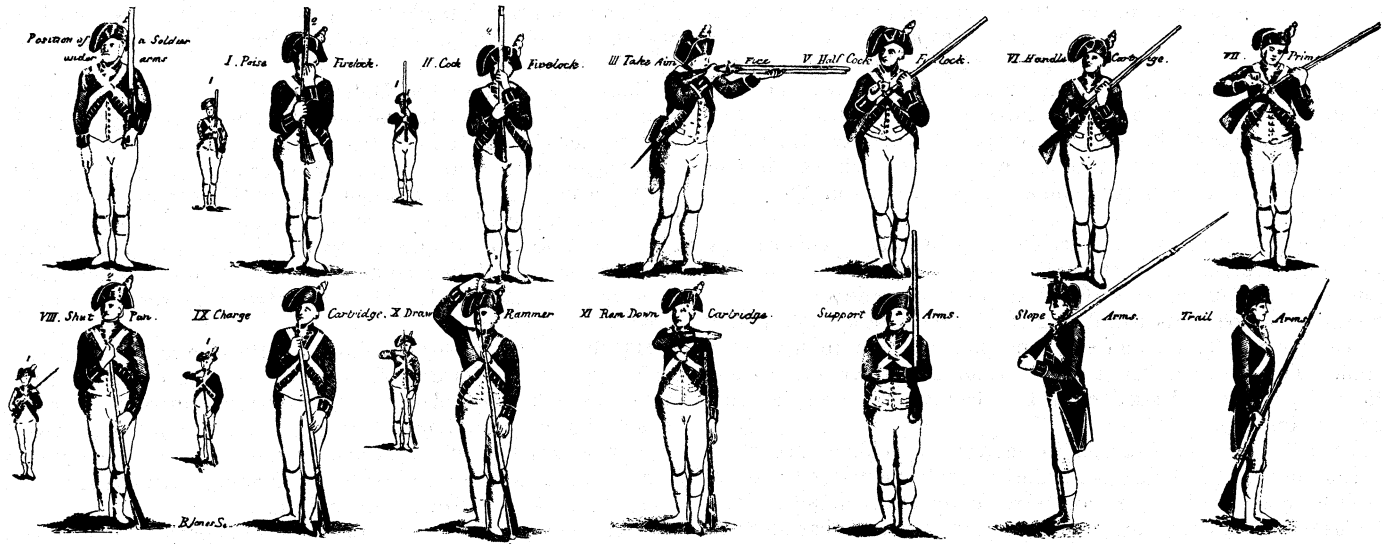
Gustavus also brought to the battlefield a lighter musket, capable of speedier loading through the use of a paper cartridge containing a prepared charge of powder and ball. For the first time. artillery was combined with infantry and cavalry. His tactics included an artillery preparation to soften up an enemy, followed by a cavalry charge to crack resistance, and an infantry assault to mop up a disorganized enemy.

Later in the 17th century Louis XIV replaced the matchlock with the firelock and his great siege engineer Sebastien de Vauban introduced the bayonet. He produced a socket bayonet which did not prevent firing or loading since it was attached around the barrel of the firearm. It had none of the disadvantages of the earlier bayonet which was fixed in the muzzle of the weapon. This contribution enabled the infantry to employ volley fire; troops would move forward, fire a volley, repeat the process and use the bayonet on the final assault.

The opportunity of marching close to an enemy while firing volleys, reloading and then moving to the bayonet assault resulted in heavy losses. Understandably, military leaders sought some new tactical formation which would prove less costly if compelled to meet an adversary in the field. The science of fortification underwent a revision, stress being put upon the desirability of safeguarding troops from the firepower of new weapons. Among the European nations long-service enlistments and the greater professionalization of armies relieved citizens of the necessity of military service. Only in one country, Prussia, were citizens required to perform compulsory service.

Modern Foundation.— Three celebrated soldiers of the 18th century made a permanent imprint on infantry tactics, training and organization, leaving an inheritance of knowledge and understanding which formed the basis of modern methods.

Maurice de Saxe (*q.v.*), marshal of France, rediscovered cadenced marching, lost since Roman days. It changed European armies from straggling mobs into disciplined soldiery. De Saxe also became the first advocate of conscription, the first great opponent of volley fire, the initiator of the company mess, the pioneer of sniper tactics and the first reformer to insist that infantry dress should be designed for field utility rather than show effect. Far in advance of his age in tactical concepts, with deeper insight into leadership than any soldier since the Romans, Saxe also knew the heart and mind of the fighter as profoundly as any general since his day.



CULVER SERVICE

THE MANUAL OF ARMS FOR AN INFANTRYMAN FROM A RECRUITING POSTER OF THE AMERICAN REVOLUTION

Data on the caption was: "Position of a Soldier under arms: I. Poise Firelock, II. Cock Firelock, III. Take Aim (and) Fire, V. Half Cock Firelook, VI. Handle Cartridge, VII. Prime, VIII. Shut Pan, IX. Charge Cartridge, X. Draw Rammer, XI. Ram Down Cartridge, Support Arms, Slope Arms, Trail Arms." The notice offered a "truly liberal and generous" encouragement to enlist

Gen. Sir John Moore (*q.v.*), British soldier, extended what Saxe had taught. Unexcelled as an infantry trainer, he brought to it an enlightened humanism. In an age when other disciplinarians favoured the lash and the gallows, Moore stood for methods which won loyalty and heightened the moral qualities. The system gradually bent to his influence.

Frederick the Great of Prussia took over the pattern set by Gustavus. His infantry was recruited by compulsory service. Frederick scorned the individuality of his infantrymen, preferring to mould them in a mechanical form, held by fear of their officers. His major tactical contribution was greater firepower on the battlefield. Iron ramrods and constant drill doubled the fire of his infantry.

Prussian drill was imitated throughout Europe and was taken to America by Baron von Steuben, who became George Washington's drillmaster at Valley Forge, Pa. Steuben's system, however, excluded Frederick's iron-handed discipline and sought to mould infantry spirit and unity by adhering to the humane principles that guided Moore and Saxe. The influence was permanent. What Steuben taught became the cornerstone of American military discipline.

Napoleon's Infantry. — The infantryman in France, like his American predecessors, was a citizen-soldier in contrast to the professional soldier of Prussia, Austria and Britain. Napoleon's idea of battlefield tactics was to formalize what became known as the holding attack, while employing reserve infantry and artillery in an assaulting flank manoeuvre. Thus he utilized initiative common to his men and obtained a flexibility in the employment of small columns.

Napoleon's men were formed into three ranks in the infantry and placed trust in the bayonet as a good French method of making the final thrust at an enemy. As the war continued and the citizen-soldiers were replaced by more and more impressed soldiers from other European nations, Napoleon had to rely increasingly upon massed infantry.

While the tactical operations in battle were excellent, the reason for the spirit of the troops was more than one of good leadership. The infantry of the French republic had an *élan* inspired by republican enthusiasm; they had the mental and physical alertness and the initiative to make any system of tactics workable. Though their discipline was not one of fear of their officers, nor the habitual kind of the Prussian, it was a higher form later to become common in democratic armies. Discipline included the will to anticipate orders, to do the necessary things on the battlefield to make victory more assured. Rewards and honour were the reasons impelling soldiers to fight.

Conscription produced Napoleon's armies. At the age of 20 all Frenchmen became liable for four years' service, but the backbone of the army was the old soldiers induced by various means to remain. Nor could his men forget that free men could rise through promotion to become marshals of France. The infantryman was released from the bonds of his servitude common to standing armies of the previous century. But as incessant war wiped out the solid French peasant and townsman in the armies of Napoleon, their place was taken by nationals of conquered countries impressed into service. The infantry of Napoleon became debased, its morale declining steadily as Napoleon suffered his great defeats, particularly in the invasion of Russia.

The 19th Century. — For 99 years from Waterloo to the German thrust into the Low Countries in 1914 there were relatively few changes in the tactical organization and administration of infantry. The main change was in infantry weapons: first the substitution of the rifle for the smoothbore musket, then the invention of the percussion cap. (*See* SMALL ARMS, MILITARY)

Increased weapon range made untenable the old battle order in which artillery worked within, or forward of, the infantry line, with cavalry disposed to the flank. These other arms were forced back to save the guns and the horses. From this separation of the lines arose the new command problem of controlling all forces of the battlefield when no longer joined immediately under the eye of the commander.

In the American Civil War the northern armies were gradually armed with breech-loading rifles which multiplied the fire of each soldier. The course of that conflict, with its futile bayonet charges, established the reign of the bullet on the battlefield before the first appearance of automatic weapons. Cannon played their part in supporting or resisting attack but it became almost impossible for infantry to close on infantry while the defense was sustained by steady, aimed rifle fire. Every range increase in infantry weapons widened the displacement between artillery and the covering infantry line, thereby inducing the development of cannon with greater range. Yet the battle crisis was still resolved at close range. Taking to ground, the infantryman became more elusive. Even so, better protection and increased range did not give him commensurate effectiveness. Such were his human limits that massed rifle fire did not have stopping effect beyond 300–350 yd.

Approach to World War I. — During the years from 1870 to 1914 it became common practice to make every able-bodied man liable for regular army service. Since this continental system brought most men into uniform it made the infantry soldier the symbol and the prototype of the common or average man in

European nations. In some ways he was a common denominator of the people of his country. His reactions to service, his ability to handle new weapons, and his like or dislike of organizational methods became increasingly important. He was not a professional soldier in the full sense of the term, nor was he a mercenary.

In the relatively minor wars of this period—such as the Russo-Turkish, the Boer, and Russo-Japanese wars—military leaders had an opportunity to analyze the effects of new weapons, tactical and organizational changes and technical improvements. Unfortunately, the lessons taught by these wars were not wholly assimilated by major nations. In spite of successful defensive stands, the attack was still expected to dominate the battlefield. The ghosts of Frederick the Great and Napoleon still hovered over the infantry of the great powers.

The rifled breechloader in the hand of the Turks assured defensive success against the Russians. who closed their skirmish lines to form a mass target as they advanced. They attempted to advance at Plevna, Bulg., in a close formation without firing their rifles or without taking advantage of the natural cover of the ground.

In the Boer War, the British found their adversaries an unseen foe. Again and again the lines of British infantry assaulted positions against Boers hidden in the folds of the ground and behind vegetation. Smokeless powder made them a cunning enemy safeguarded from easy detection. On the other side of the world, open-order tactics and improvised field fortifications employed by both the Japanese and the Russians were a preview of the infantry combat of succeeding years.

Open-order tactics and the increasingly devastating firepower of breech-loading rifles augmented by machine guns altered tactics to some extent, though mistakenly in favour of the offense rather than the defense. The inclination toward close formations still existed in the major armies. Seemingly, the preponderance of the new potential in firepower coupled with movement was to assure victory to the attacker. As further evidence, the field telephone and telegraph would assure the control necessary for the co-ordinated attack of the immense numbers of infantry troops in the pre-World War I armies.

Organizationally, armies were becoming changed in this period with the increase in strength of technical troops and staffs. Signal, quartermaster and engineer troops were needed in growing numbers as an adjunct to the combat iniantrymen. Furthermore. larger staffs were needed to co-ordinate the complex armies totalling close to 1,000,000 men in France and Germany, and even more in Russia. The basic purpose of all such augmentations was to further the infantry battle and reduce infantry losses, but only a relative few shared infantry danger.

Developments in all arms in the wars before World War I called for increased individual initiative from the infantry, with emphasis on personal mobility and protection, according to a few writers and soldiers of that period. They argued that quick-firing artillery and the automatic rifle would wither the infantry assault and defeat control. Whereas safety lay in spreading and moving, from fear infantrymen would converge and huddle. The new weapons could be countered only by a rifleman who would guard. move and fire on his own, exploiting any opening, but using protection when needed. The warning went unheeded. Every general staff remained convinced that a conquering will in the iniantry mass could prevail over the new multiplied fires and would insure victory.

WORLD WAR I INFANTRY

The defensive power of modem firearms had been underestimated by the infantry combatants at the outset of World War I. In a short time tactics were altered by the need for defense against machine guns. Each nation had its own machine gun which fired bullets of the same calibre as its rifle, at a rate of 250 or more a minute. Though this rate could not be maintained, short bursts of 10 or 15 rounds aimed knee-high across a field in a scythelike sweep made exposure by the infantry extremely hazardous. Tremendous efforts were made to break through the power of the machine gun and the modern rifle at the cost of high casualties. On both sides commanders added machine guns to their infantry units as fast as they could be procured. Failing of decision in repeated efforts to win by mass manoeuvre, confronted at last by a solid enemy array from Switzerland to the sea, the two sides settled to trench warfare. Artillery numbers and ranges were multiplied in the hope of smashing the dominance of automatic fire and countering the opposing artillery build-up. This thickening of supporting fires only clamped the vise tighter by making indecisive the infantry's closing power.

In the four years of drawn battle the two sides persistently sought new methods to insure infantry survival and restore its mobile and decisive role. To minimize artillery effects. defending infantry fought in small groups separated by the bays of deep, heavily revetted and traversed trenches. Infantry lived in dugouts 20 ft. below ground. In the attack under fire, riflemen advanced in short individual rushes, looking for defilade or the unguarded flank of the opposing weapon. Their own main weapons were often mounted in concrete emplacements called pillboxes.

At first the commanders tried to break the deadlock by sheer weight of preparatory artillery fire, thousands of guns firing millions of rounds for days prior to the infantry jump-off. This proved futile because of the great depth in the entrenched systems and the diffusing of the infantry attack before it could cut through. Later came the tactics called infiltration, the artillery pounding the main bastions in the line opposite, the infantry seeking the weak spots and advancing over indecisive ground in an effort to envelop or take in rear main positions. Infantry tactics have adhered to this pattern down to the present.

The Germans introduced the use of poison gas with the object of neutralizing infantry defense. The British invented the tank, or land battleship, so that infantry could advance behind a strong shield and breach the line. In both cases the new weapon was first used experimentally on a small-scale with only marginal effect. Subsequently, both weapons were put into full-scale development and use by the two sides. These changes compounded battlefield danger and radically altered the problem of infantry survival and movement. They were not decisive until toward the close of the war the authority of massed armour restored mobility to the accompanying infantry.

To blast the opposing infantryman out of his trench. the lightweight infantry mortar mas added to the weapons family. It provided high-angle fire. The grenade was brought back into use for much the same reason, though it was also useful for trench and dugout mop-ups.

The supply function in World War I gathered tremendous proportions in order to fill the need ior ammunition and equipment for the entrenched millions living underground between Switzerland and the channel. The long supply line of the U.S. forces across the sea into French ports and by railroad and truck to the front-line units required much man power. For the first time, total warfare made it possible for a man to go to war and, in the wartime expression, "never hear a shot fired in anger." Understandably the infantrymen who lived under the tension of the battlefield, its dangers. and its grime took offense at the recreational facilities and more normal life of the rear echelon serviceman. The gap between the soldier and the technical or administrative serviceman widened rapidly.

BETWEEN TWO WORLD WARS

By the end of World War I, however, iniantry prestige was higher than ever before. Historians took note that the tide had not turned until the winning side could at last muster superior strength in infantry divisions. General staffs drew the broad conclusion that automatic fire and the ne reinforced structure of direct support artillery had made the infantry defensive array all but invincible. Among the victors, the armies suffered from postwar neglect, but in such development as took place, infantry fared better than did armour and air power, although compared with these infant but promising arms, its potentials were proved and well understood. Only the vanquished state. Germany. saw the main lesson that infantry, hitting in combination with armour, had restored mobility to the offensive order. The British tactician-

historian, Maj. Gen. J. F. C. Fuller, originated this theory and became its most powerful world advocate. The idea won some backing in France and became accepted doctrine in the Russian army. But only in postwar Germany existed the will and the means to build upon this pattern a wholly new military foundation which in time would transform infantry usage.

Infantry weapons and tactics in the armies of the world changed little during the two decades between World Wars I and II, but firepower was increased severalfold. The automatic rifle, a self-loading weapon, larger calibre machine guns and bigger mortars were added to the hand weapons of the infantry. Great changes were going on around him, most of them affecting his combat potential considerably. Motor transportation delivered him to the combat area, and armoured tanks supported him closely. Artillery guns could be moved on their o n vehicles, or were towed by trucks.

In the skies the fighter-bomber supported the tank in breaking holes in an enemy line. The job of the infantry was still to be the exploitation of the attack, by employing the usual tactics to push back the enemy on the shoulders of the breakthrough. Also in the air there was some hint of the possibilities of parachute infantry flown to battle in air transports. Before World War II the future for the infantry soldier was much obscured, and the magnitude and extent of infantry combat was unforeseen even by the prophets.

WORLD WAR II INFANTRY

World War I had proved difficult for the infantry soldier but the new devices, new weapons and increased firepower developed during the second world conflict made his job tougher. In the prior war. artillery calibres were extremely large, but the tanks were lightly gunned and the infantry soldier had to undergo little bombardment from the air. The trenches and the pillboxes which had offered some shelter to the doughboys of all armies in the previous war gave less protection because of the bazooka, flame thrower and mortar fire. The infantryman's lot was a rugged one since everything was being done to weaken his will, induce him to surrender or annihilate him. No other group in the armed forces took the sustained beating which was expected of the doughboy. Day after day he remained in the line, and added to his burden were all the new developments in tanks, rockets and land mines. Not only did he undergo isolation and loneliness, great physical discomfort, constant danger as was expected of most other soldiers but he had also to fight aggressively under all kinds of conditions.

In some ways it was a marvel that infantry survived. Because of new developments in weapons it steadily changed its mode of fighting. No longer did a massed infantry unit go forward under its commander with sabre held high as was common in the wars of the 19th century and as occurred even in World War I. The infantryman needed to be constantly alert to act instantaneously and be mentally ready to meet any new situation. He was under constant strain of the pressure brought by artillery fire, the incessant danger and certain death for some of his comrades. He withstood the burden of being wet, muddy and tired most of the time. While soldiers in other forces went into the danger zone in tanks, planes and ships, they could return readily from the battle zone to comparative comfort. The difference was that the doughboy had to wade in the mud, eat in it, sleep in it and oftentimes die in it.

No matter what army, the problem for the infantryman was similar.

Organization. — Infantry units in all armies during World War II were organized similarly. The potential power on the march or in the line was centred in the tremendous firepower which had been given by new weapons. The infantry regiment (brigade in the British army) was normally the basic fighting unit and varied from 2,100 to 3,300 men. the soviet army having the lower figure and the U.S. the higher. In practically all armies the strength of the regiment was in its three rifle battalions, varying in size from 550 to 900 men each. The triangular type of organization was carried out through all infantry organizations to include the division with its three infantry regiments. The difference in the numbers in a battalion and regiment was usually in the number of rifle companies and the weight of the artillery weapons assigned to the unit.

All armies had infantry divisions composed of three regiments, the total strength varying from 11,000 in the soviet army to 15,000 in the United States army. For supply and all maintenance functions, infantry divisions were almost wholly motorized in western armies. German and soviet armies continued to have divisions with some horse-drawn equipment. In all armies the infantryman remained afoot. Technical troops invariably accompanied him. Medical aid men, signallers, engineers and supply troops shared with him the dangers of the forward zone of fire—the first 2,500 yd. from the enemy. Mines, artillery and armour made movement anywhere in this zone hazardous for supporting troops. But these were small risks compared with infantry danger.

Gen. George C. Marshall, in his *Biennial Report* (1945), stated that the United States infantry sustained 70% of all casualties in the nation's armed forces. though it comprised only one-fifth of the forces overseas. But even within the infantry division, there were degrees of hazard. The rifle and heavy weapon companies suffered the heaviest losses, followed by the artillery, signal, engineer and other supporting units.

To return to the organization of the infantry division, its regiments usually comprised three battalions, and each battalion three or four rifle companies and a headquarters company which included heavy weapons like mortars and large-calibre machine guns, or the heavy weapons were grouped in a heavy weapons company. The triangular system was further carried out in that infantry companies contained three rifle platoons, and each platoon three rifle squads (sections in the British army).

All armies included some heavier weapons in the rifle platoons or added an additional machine gun unit. The squads (sections) of nine or ten men were the real fighting soldiers of the infantry—the shock elements of the men first in line in battle. Their perennial job was to seek out the enemy. The British rifle section comprised ten men—a leader, a light machine gunner, a submachine gunner and seven riflemen. The soviet army and U.S. army had five riflemen in their squads, the machine gunner or automatic rifleman having an assistant. While the U.S. army squad had an assistant leader, the soviet army made up its nine-man team with a *Panzerfaust* infantryman.

There was no relaxation for these forward infantrymen; they had to seek cover and concealment, know how to handle a large array of weapons and how to work together as a team. In the U.S. army the weapons platoon armed with 60-mm. mortars and light machine guns stayed up close to give fire support to the infantrymen, who were armed with automatic rifles and submachine guns. Again this organization was common to practically all armies of the world, slight variations occurring in the types of weapons and in the number of men assigned to the platoons and squads.

In the battalion of most armies supporting fire was furnished by a heavy weapons company containing mortars and heavy machine guns. As a family, infantry weapons had the dual purpose of defense against tanks and against aeroplanes. Likewise, in combination, they were suitable for either defense or attack, though the heaviest mortars and machine guns could not be hand-carried forward.

Task Forces. — World War II fighting required tremendous firepower. Even with all his organizational weapons, the battalion commander needed more fire to assist his infantry. On his call, or assigned, were artillery units which worked closely with the infantry battalion. The system used in the U.S. and in several other armies was to group a combination of infantrymen and artillery along with tanks and engineer troops into battalion combat teams.

In like manner the regiment was assisted by such additional firepower units as the cannon and antitank companies. Here again the infantrymen's 75- and 105-mm. guns were often augmented by other artillery batteries assigned to the regiment. In the western armies the regimental combat team was strong enough and complete enough in service units to be sent off on missions as a separate force. This was also true of the German and Japanese armies, but the soviets incorporated the artillery, engineers and service units

as an integral part of their rifle regiment.

This grouping of infantry battalions and regiments with additional elements into task forces for the accomplishment of a specific task was one of the significant developments of the war. A task force could be tailored to fit each special operation, the infantry battalion or regiment being assisted by attached tank units, artillery, engineers, all drawn together under the control of the basic headquarters. When the operation was completed, the task force elements were returned to their former commands.

Training. — The preparation of infantry soldiers for the intense, often prolonged combat of World War II required an elaborate training system. Universal liability for service produced a steady flow of physically fit recruits, usually between the ages of 18 to 3j years. The universal system was to train the recruits in the basic knowledge of weapons and orientation to military life at a gigantic training centre. After from 8 to 14 weeks, the soldiers were then incorporated into divisional units where tactical training progressed from that of the squad and platoon to the regiment and division.

When the infantryman had been thoroughly trained in his own tactics. training was expanded to include artillery, tank and air support. Realism was given to training through manoeuvres in which live ammunition was used. Not only did this require that the infantryman learn to seek cover instinctively but also made him aware of the sound of battle.

Throughout the war entirely new divisions were introduced into combat, preferably in a quieter part of the front. A gradual introduction to warfare gave the infantryman an opportunity to acclimate himself to battle. Later in the war when the full supply of divisions had been committed to combat there was a constant requirement for replacements. Individuals who had been trained in the centres mere sent in groups to join battlewise divisions.

The human factor in the placement of the right man in the right job was considered in most armies. Aptitude for combat was determined for individuals entering the infantry and the other fighting services. Men were given a military occupational specialty (MOS) but, unfortunately, the fighting tasks were not so labelled that infantry profited greatly by the workings of the classification system. That was its main shortcoming. It did not permit tapping the erstwhile bookkeeper or truck driver who potentially was a born platoon leader or weapons mechanic.

Infantry Weapons. — In number and size the weapons of the infantry steadily had increased through both world wars. Whereas in World War I the doughboy had only a rifle, pistol, machine gun, grenade and bayonet, he added in the second war submachine gun, carbine, automatic rifle and rocket-firing tubes known as bazookas in the United States army and as *Panzerfausts* in the German army. Other infantrymen fired mortars, large calibre machine guns and antitank guns. Later in the war the flame thrower, used in World War I, was restored to infantry usage. The bangalore torpedo, a long explosive tube, used to cut through obstacles, first developed in the 19th century, was brought back. The average infantry company employed 20 different weapons. The average rifleman was expected to be master of at least four or five; relatively few were the men in line who could operate all. As in all wars past, infantrymen also utilized captured enemy weapons, the German Schmeisser automatic pistol becoming highly favoured by United States troops. The "Molotov cocktail," a glass bottle filled with gasoline and supplied with a burning wick, was used to incinerate tank crews. There were numerous variations of this armour-stopping grenade, both handmade and formalized. One thing remained unchanged: the basic infantry arm was still the bolt-operated rifle.

In the combat zone the infantryman had to be able not only to use his weapon but to know what to do to get through wire entanglements and around pillboxes. His fighting was against tanks, in mountains and in the jungle. The unexpected was normal for him and his weapons had to be usable against anything that moved on land, or that flew in the air. Therefore his weapons, though best suited to a particular use in battle, had to be effective for general use.

The picture of the infantrymen had been for many years the man with the firearm and a bayonet. For hundreds of years he had been a complete fighting unit, abie to take cover, move anywhere, and stand up under difficult conditions. His courage and brains and his weapons made him a one-man army. This was the great difference between the foot soldier and all other men who fought in warfare. It was his individual will and his movements which won battles.

Some armies continued during World War II to use rifles designed before World War I. Others turned to more modem, semi-automatic, rapid-fire weapons such as the U.S. army M-I. The carbine came back into use as the arm of personnel likely to need a quick burst of rapid fire at-close range; its performance was not conspicuously successful. The bayonet was rarely used except for guard duty; as a weapon of the attack it virtually vanished from operations. The grenadier was no longer the highly trained specialist of World War I days, and in all western armies the art of the sniper also visibly declined.

During the early part of the war the infantryman had to fight tanks at a great disadvantage, armed only with rifle and grenade. The answer to this problem was the bazooka or *Panzerfaust*—a lightweight arm which could be handled by one man. It was capable of stopping light armour at 40 yd. or less and was effective against medium armour at close range when fired from the rear or flank. The automatic rifle and the submachine gun provided the fire base of the infantry squad, the action of individual riflemen developing around the heavier volume of these weapons. Of the two, the automatic rifle was more accurate but less demoralizing in night action.

The armament of an infantry division of approximately 15,000 men included 7,000 rifles, 375 automatic rifles, 327 machine guns of .30- and .50-calibre, 60 37-mm. antitank guns, 117 mortars, 8 75-mm. guns and 48 105- and 1 jj-mm. howitzers. While these totals differed in armies and even within the same army, it was representative of the firepower available to the U.S. infantry division commander in World War II.

With the above armament, and helped by minefields and other obstacles which canalized the armoured attack, the infantry could occasionally make a successful stand against tanks by the mid-period of the war. Infantry weapon power did not permit engaging armour directly on a broad front. The infantry either sought foxhole cover or folded flankward, allowing the penetration, then attacked the tanks from flank or rear. Until war's end the infantry array remained vulnerable to armour attacking in line.

Despite the increased firepower of weapons, however, and their greater mechanical convenience, many infantrymen did not fire in combat. S. L. A. Marshall, in Men Against Fire, explored the psychological aspect of modem war. and concluded that in the isolation of the battlefield of World War II men were gripped by a fear and an inertia which he believed prevented them from employing their weapons to capacity. He stated that 75% of the trained, seasoned troops would not fire or persist in firing against the enemy. In the light of his conclusions, training establishments in western armies re-examined the problem of stimulating maximum fire rates in the infantry line by new methods. The undertaking was phenomenally successful. By the time of the Korean war infantry fire rates had approximately doubled.

SPECIAL TYPES OF INFANTRY IN WORLD WAR II

Air-borne. — During the 1930s the soviet army had a number of air-borne units, but they were never used as such; rather they were employed as infantry in the defensive battles of 1941 when Moscow was almost taken. Air-borne units were present in all armies of the major powers, though it was not until late in the war that the U.S. and British armies produced the most spectacular and largest drops.

Air-borne units were usually smaller than their counterparts mainly because they did not have the trucks, guns and heavy equipment common to infantry units. The soviets and the British had air-borne brigades of four parachute battalions totalling approximately 3,500 and 5,000, respectively. In the U.S. and German armies the organization was similar to that of the infantry division, with three regiments of three battalions each. Air-borne regiments

were either parachute or glider types with the proportion varying from two parachute and one glider regiment as the normal formation, to be replaced later by the reverse. The main weapons of the paratroopers were automatic rifles, machine guns and mortars. The air-borne troops were handpicked men and considered themselves the élite infantry in all armies. They were highly trained physically and knew how to employ their weapons. They were trained to jump from planes, usually at an altitude of 1,000 ft., or to drop in gliders which rode to earth and skidded to a stop. The gliders carried some supplies and in the U.S. army included the jeep for transportation. Other supplies were dropped by parachute to be reassembled by the men who had dropped ahead of them. Air-borne troops once they had jumped fought like their line infantry comrades. They were basically infantry, in weapons and tactics, but. with higher small-group initiative.

The Allied air drop in Sicily was made at night. Many units were misdropped and far scattered. In srnall bands, wherever men collected, they hit the enemy, thus widening his disorganization. In the Allied drop in the Netherlands (Operation "Market-Garden") the invasion was staged in daylight. British air-borne troops were dropped north of the Neder Rijn at Arnhem. The United States divisions dropped south of the river between Nijmegen and Eindhoven. All assemblies were achieved in rapid order. But the Arnhem landing became trapped by a German armoured division and was smashed. South of the Rijn the U.S. air-borne consolidated its corridor and held firm. The most ambitious air-borne undertaking of the war, the Netherlands invasion failed of its strategic purpose, capture of a bridgehead into Germany's western plain. In air-borne operations during World War II the length of time which the air-borne troops were expected to hold out was estimated at 72 hr., at which time their ammunition and food were exhausted. They needed the support of the heavy firepower of regular infantry units in order to continue to operate effectively.

Armoured Infantry. — The setting up of armoured divisions brought about the creation of a specialized armoured infantry to accompany tanks. It was armed and attired as any other infantry. Its particular missions were to outguard tanks, fight off foot forces threatening the tank encampment and temporarily hold ground which the armour had captured. However, these were relatively small components within the armoured organization and their separate character was not strongly expressed. Line infantry also accompanied tanks into battle, riding on the armour and providing local security for it when the situation favoured such tactics.

In the soviet army infantry was used behind tanks on sleds both in snow and on normal ground. Other units which might be called a type of armoured infantry operated on skis in conjunction with tanks. In some ways the tank of World War II became a battering-ram for use against enemy infantry in trench positions or foxholes much like the battering-ram of old against soldiers in a fortress. Another development which came out of the improvised use of tanks by infantry was the personnel carrier, a low-silhouetted, tracked vehicle with a box on top. A number of infantrymen carried in such a tank-type vehicle operated with the same mobility as the tank and yet dismounted and fought as infantry in holding ground or in assistance to a tank attack.

Mountain Infantry. — Practically all armies of World War II contained a few specialized mountain infantrymen. Recruited from mountain areas where they had learned how to live on snowshoes and skis, these men had the rugged physique developed in an outdoor life. Like the paratrooper their arms mere necessarily light weight so that they could be carried by skiers. However, some sled-type vehicles were developed which could be moved by man power to carry mortars and machine guns as well as ammunition. Mountain infantry tactics varied considerably from those of regular infantry units because of their increased mobility and their usefulness in small groups for isolated attacks. Except in the Russo-Finnish war during the 1939–40 winter, there were no large-scale operations staged by ski troops. The western mountain divisions were used as other line troops.

Commandos, Rangers and Raiders. — World War II saw the development of special infantry units which quickly adopted the traditions of historic units of Indian fighters and guerrillas. In the Soviet Union after the German advance had bitten deep into the Ukraine. the soviet army organized partisan units behind the German lines. From swamps and forests and in snow-covered wastes they operated in small groups under the direction of soviet army leaders. They were rugged, hardy infantrymen and infantrywomen, who utilized only light weapons such as the rifle and carbine, though occasionally machine guns were found in the larger guerrilla bands. Their tactics, rooted in Russian history, mere based upon the idea of a split-second move against the enemy, the carrying off of a few prisoners, the killing of a few soldiers, and a quick disappearance. They were extremely effective against small units or the rear echelons of larger units, but they avoided regular infantry battles as a matter of course.

The special infantry of the British and U.S. forces were the commandos, rangers and raiders. The British commandos, trained to the peak of efficiency, employed the swoop tactics of the guerrillas but stayed to fight an infantry battle when they chose to do so. They were especially adept at amphibious raids behind the enemy lines in the Mediterranean area where they implanted fear in the German and Italian forces fighting in Africa. The greatest commando raid of the war was at Dieppe, where 7,000 Britishers landed on the shores of France, scaled the town walls, and fought a pitched battle against the German defenders. The commandos lost heavily in getting into the city and in so doing alerted the German supporting troops so that the defenders were stronger than anticipated. After a night ashore the commandos slipped through to their landing craft after suffering heavy losses; but they had demonstrated that a heavy amphibious assault against the German defenders on the channel approach might be successful if supported by sufficient firepower.

The U.S. counterparts of the commandos were known as the rangers. In battalion strength, they participated in all the major landings in the Mediterranean and were the first to go ashore. In addition they made several forays in Tunisia, striking miles behind the axis lines with the objective of taking prisoners in a manner reminiscent of Indian warfare in America. The rangers were lightly armed and possessed practically no transportation in combat. They did, however, increase their firepower by efficient use of the 4.2-in. mortar. In their campaigns they fought in amphibious operations. in deserts and in mountain warfare, exemplifying the flexibility of the infantry and its weapons.

In the Pacific there were U.S. marine raider units, amphibiously trained, which carried out operations similar to those of the commandos. The Allies other than the Soviet Union seemed to specialize in these extraordinary infantry units including in addition to those mentioned, other units fighting in Burma and China knonn as Wingate's raiders and Merrill's marauders, both of which were trained in jungle warfare as a speciality.

OFFENSIVE TACTICS IN WORLD WAR II

The infantry, of all land forces, had the primary mission in combat of coming to grips with the enemy, capturing him, defeating him. Their weapons, tactics and role in the combined land team were designed to bring about victory on the battlefield.

The uncertainties of infantry combat called for moral strength. Normally infantry fought where fire was most intense; tactical formations, even in the squad, were spread over a considerable area. No matter how excellent his training, nothing prepared the infantry soldier for battle where he saw practically nothing moving and had no sense of large numbers of men being engaged in combat. Local clashes made up the battle; each leader carried forward his own particular part of the panorama of modern battle. Consequently, infantry action demanded fighting spirit and initiative.

Offensive action was needed to obtain decisive results in infantry combat; the spirit of attack was basic to good fighting. But in World War II, local actions by infantry units rarely were continuous attack or defense. While neighbouring units were attacking, some infantry formations were on the defensive. However, for sound and spirited defense, the swift, disorganizing counter-attack was essential. In this particularly testing aspect of opera-

tions, German World War II infantry was unexcelled.

Rapid movement on the offensive made it possible to exploit the effect of firepower. This was one of the key principles of infantry action. If an infantry platoon or company reached its objective before the enemy reserves had been brought into battle, it saved itself casualties. As a result every wile and stratagem was employed to concentrate against an enemy weak point, or to conceal the time and place of attack.

When the advancing infantry unit, large or small, met strong resistance, overwhelming fire superiority was a necessary adjunct to movement and surprise. Infantry action was made over all kinds of ground. Accordingly, terrain had to be made to serve the interests of the fighting foot soldier. In the attack, every fold in the ground. every tree and bush became important in his mission of advancing by bounds while other soldiers kept up fire against the enemy. The picture of the battlefield was therefore one of small groups constantly moving forward, firing their weapons, seeking cover preparatory to the next dash. In all these attacks there was a common pattern.

Attack Manoeuvres.— The triangular organization of infantry from the regiment to the squad was peculiarly adapted to the offensive. The normal formation was to place two units in the main attack, with one in reserve or support. Such attacks were rarely frontal, in the tradition of the close formations of the 18th- and 19th-century infantry, but always sought to slide around enemy strong points by enveloping them from both flanks, or by striking on the flank. Therefore, the main attack most often was a hitting operation by one or more units while the elements to the flanks supported the movement with a pinning fire, thus creating a holding effort such as that used by ancient phalanxes. The reserve or support unit was used at an appropriate time to drive home the flank attack or to back up the holding force if it was counter-attacked in strength. In some ways the offensive tactics of infantry were similar to those of a prizefighter, always striking with the left or right hand at the side of the opponent's jaw.

Infantry offensive tactics, like those of entire armies, did not always effect an envelopment aimed at an enemy flank or his rear. On occasions, the terrain did not permit such a tactic for every unit in the combined army or army group offensive. Consequently, a frontal or penetration attack had to be made. This required careful preparation, like the envelopment, and demanded a follow-through. Small infantry formations often entered this type of battle by placing their three units in a column, the infantrymen being of course deployed as in other offensive fighting. The first unit attacked. If it broke through, the second unit was available to exploit the breakthrough. If the first unit was held up, the second unit was brought up to add to the firepower, or even passed through the lead unit to make a fresh assault on an enemy position. These tactical methods applied to divisions and other units down to even the infantry squad. In all these manoeuvres, the infantry was almost never left to fight alone; artillery, tanks, and even fighter-bombers were available to add power to the team attack.

Preparation for Attack.— In all armies the sequence of moving to the attack followed a similar pattern; the U.S. method used in World War II was typical. The battalion or the regiment was the basic infantry combat unit. Orders came from the next higher headquarters to prepare for an attack. Subordinate commanders were gathered together to receive the attack order, which included the objective to be taken, a line of departure or jump-off line, a zone of action, a direction and time of attack and information about supporting artillery and heavy weapons fire.

Having received the order from the superior headquarters, the commander then had to develop his own method of attack. Before he could analyze the many factors of importance to his own attack plan, he had to make a reconnaissance of the ground. Without the information thus obtained, he could not know the dispositions of the enemy or the approaches which would best serve his own advance. Very rarely was battlefield intelligence more detailed than that. Usually the scheme of manoeuvre was determined without having exact knowledge of strong points in the enemy line, although in some notable instances, such as the Normandy invasion, the defensive pattern was developed with almost blueprint accuracy. The actual situation of the enemy, in contrast with what had been surmised, was most often revealed in the preliminary phase of battle when forces began to exchange flat trajectory fires. So general was this rule that initial skirmishing, aimed to develop the enemy profile, was called reconnaissance by fire.

This and all other forms of reconnaissance were the keys to infantry combat success. Lacking knowledge of the intermediate ground and of the general use made by the enemy of the high ground or any fortified area, the infantry commander was not properly prepared. Familiarity with the scene was the touchstone of efficiency. One method of gaining information was to send out patrols at night, either to capture enemy soldiers or to examine ground beyond the area surveyable from an observation point during daylight. Failure to reconnoitre led almost invariably to wrong estimates, unsound deployments and tactical failure.

Having gained information from all available sources, the infantry commander issued his own attack order, which included a map designation of the objective, the line of departure, the zone of action, the scheme of manoeuvre, the location of the reserve, the protection of the flanks and the avenues of approach to be utilized by the subordinate units. In addition the fire support plan of the heavy weapons was worked out. This included the emplacement of mortars and antitank guns, and designation of priority targets. Certain key spots in the zone of attack were given to the supporting artillery as possible targets so that they might calculate their firing data and thus be prepared for instantaneous shelling of those points when a telephone call for assistance was received.

The zone of action of an infantry unit in attack gave it a frontage for which it was responsible. A regiment, for example, might be responsible for a frontage of from 1,000 to 2,000 yd., with each succeeding subordinate unit responsible for a front half that extent. The company usually had a frontage of from 100 to 200 yd., and the squad from 50 to 75 yd.

While a battle reconnaissance was in progress, the units of the attack were made ready. If located in assembly areas too far rearward they were moved forward by motorized transport.

During World War II, in the average situation, the infantry assembly, preparatory to attack, was already within light artillery range, or less than 6,000 yd. from enemy weapons. When advanced to the line of departure, where they deployed for the attack, the formations usually came within enemy small arms range. Sometimes the final lunge was made under cover of dark. More times than not, it was in broad daylight. Frequently assemblies had to be made under observation and small arms fire.

Usually a successful infantry attack was conducted in a sequence which obviously required changing to fit the situation. As in World War I, artillery concentration was normally the first move. Artillery also included air bombardment and the infantry mortars so that concentration on the enemy came from three unco-ordinated or partially co-ordinated directions. The infantrymen moved forward during the concentration, keeping under cover as much as possible until they got within a few hundred yards of the enemy. Not only were they faced with wire entanglements similar to those of World War I but also mine fields. They had to send ahead groups to clear mines or at least make a path through them. The mine field had become one of the primary aids to defense since great quantities of them could be put a few inches under the ground in a field which blocked normal access to the defensive positions. Mine fields not only forced attacking troops into unfavourable terrain but also brought them under the fire of presited machine guns, artillery concentrations and defense lines in depth. When they got within a short range of the enemy the attacking troops brought up all possible firepower in mortars and machine guns and obtained the help of the artillery which placed its shells upon the enemy infantry. In many cases tanks were brought up to the line of departure and led the infantrymen through the gap or prepared lanes in mine fields. The last few yards were gained by the infantry, on its own, using the automatic rifle and covering machine gun fire to bound forward and kill final resistance with rifle and grenade fire.

At the time set for attack, the infantry assault units crossed the line of departure and moved aggressively ahead toward the objective. After the attack was launched the commander had only moderate control over his men. Their individual initiative and abilities determined in large measure how well the attack went. However, the infantry commander had partial control over the action by radio and telephone, with which he endeavoured to manoeuvre his units, direct supporting fire and seek help from the elements to his flank and rear. His hold upon his reserve was final insurance against the battle crisis.

Infantry assault units were in many cases assisted by tanks, which fired their artillery guns from concealed positions in extremely close support of the infantry, or preceded the infantry from the line of departure and acted as a land battleship for their protection. On some occasions tanks followed the infantry units, passing through them just before the assault on the objective, or perhaps, moving down other avenues, arrived simultaneously from the flank to assist in the assault.

When enemy resistance was too strong, the infantry advance was halted while neighbouring units assisted by attacking the objective from a flank. Meanwhile, the infantry in attack had to dig in and attempt to build up enough fire superiority to beat down the enemy. In such a situation, the ability of the infantry soldier was put to the test to improvise means of getting the attack under way even if it meant altering the plan. Sometimes, the support unit was brought in on a wide flanking movement, while the main attack continued to move forward aggressively.

Before the final assault on the enemy was made, the infantry commander called off the supporting fires by a prearranged signal. It was the task of the infantry to move through the enemy position so as to work through its complete depth and prevent reorganization and counterattacks.

After the assault, the attacking infantry had to reorganize its own units before swinging into a pursuit, a tactical action often made by truck or by infantry carried on the tanks.

This entire system of the conventional infantry attack, as presented in sequence, was rarely so well ordered. The "fog of war" often obscured what later was obvious. At such times the aggressive action of a few infantry riflemen or machine gunners pushed the attack through to success. There were also many variations in this conventional sequence and form of infantry attack, particularly where the action took place in towns, or mountains, or desert. The special characteristics of infantry action in such cases is noted below.

DEFENSIVE TACTICS IN WORLD WAR II

Infantry tactics were almost as often defensive as offensive in World War II; even a spirited attack called for momentary defensive tactics by certain units in the line. Even when there was a general advance on a portion of a front, other units were in a holding or defensive position. Also, whenever a rifle unit had made an advance, it was compelled to dig in temporarily to gather itself for the next move forward. A defensive position properly laid out was a safeguard against counterattack; selection of a position on the ground was of great importance though often the infantry commander had no choice but to make the best possible use of the front assigned for defense.

As in the attack, co-ordination of troop locations and firepower with respect to the ground to be defended was the best assurance of success. The position was organized in a group of key points, the intervals between them and the approaches covered by the maximum fire. The selection and preparation of these key points into an integrated system was the crux of defensive infantry tactics.

Any defensive position could be penetrated if the enemy wanted to pay the price. Therefore, defense in depth was the solution since it often made the price of attack too high. When an enemy penetrated the main line of resistance, he was certain that he would be met by fire and by reserve infantry units from other defensive key points to the rear. Other principles in the establishment of a defensive position were the necessity of assuring mutual support, a co-ordinated plan for firing all available weapons, an antitank defense and flexibility.

Units across the front of a defensive position and from front to rear were charged to dispose men and site weapons to provide mutual support. The aim was to have all units so placed as to assist any unit with fire. Thus stated, the object was elementary. But because of irregularities of terrain and the chronic overextension of infantry forces, the ideal was seldom achieved.

In World War II. because of armoured mobility, attacks often came from the rear as well as from the front and flanks. This was particularly true of air-borne operations and of desert and jungle fighting where the defense was often a closed perimeter or hedgehog. Troops likely to be cut off or enveloped attempted to secure an all-around defense. But because automatic firepower was seldom sufficient to complete the tight-knit circle, the rear continued weak.

A co-ordinated plan for firing weapons on signal was absolutely essential to a good defensive position. Not only was the fire of unit machine guns, mortars, and antitank weapons co-ordinated, but they were supplemented by additional artillery support on call of the infantry commander. The objective was to be able to bring down the maximum fire on a certain area where an enemy attack was being organized, or prepared to make an assault.

The antitank defense was all-important for the infantry, even after bazookas became a regular weapon. Against tanks, the defense included the co-ordinated fire mentioned above, assisted by mine fields and obstacles like antitank ditches.

A combination of the foregoing methods of defense did, oi course, provide for flexibility. Other than the massing of supporting fires, and the withholding of a reserve or support force, one of the greatest aids to flexibility was in the preparation of alternate positions. For example, it was common practice for units to have different positions for day and night. In general, however, western forces did not prove adept at forest fighting, and the tactics of using or refusing forest cover advantageously remained unclarified.

In defense, the infantry commander studied the ground by reconnaissance, seeking high points for observation, noting covered avenues of approach open to an enemy, looking for places to emplace his heavy weapons, and assuring supply routes to the rear.

The infantry defense order took into account the amount of time available before an attack was expected, giving emphasis to the most essential elements of defense when time was short. In addition to information of the enemy and of neighbouring friendly infantry units, the order gave the defensive mission, areas assigned to each subordinate force. the tasks for the heavier weapons, the plan for control of fire, security of flanks and rear, priority of construction, location of mine fields and other obstacles already in existence or to be set down and administrative details.

Frontages for defense were usually from two to five times the width of attack frontages, contingent on the nature of the ground. An infantry company was usually assigned a front in rolling country of 600 to 1,200 yd., and was expected to defend in depth to whatever limit the fight required.

If time was available, extensive defensive preparations were usually taken, not only to dig foxholes but to link them with shell-resistant tunnels, prepare deep shelters covered over with earth for safety from artillery barrages, and dig several alternate positions for each key point in the defensive system. Similarly, the heavy weapons were first dug in, then the hole covered over with just a firing slit remaining, and then brush and tree branches on the lines of fire cut so that maximum effect was attained.

Ditches, obstacles, mine fields and wire entanglements were added, their number and complexity increasing the longer an infantry unit was located in a defensive position. Time and machinery were the main limitations on the organization of a defensive area. While the infantry was digging foxholes and trenches and laying out obstacles, artillery observers in the front line arranged their schedules for fire support. They selected danger areas such as a valley leading into the position and gave it a number on their map which in turn was communicated to the artillery batteries. In this way artillery support could be called

for rapidly without mentioning map co-ordinates.

Defensive positions in many areas were complicated by the soil. On many of the atolls in the Pacific, for example, the matting of tropical roots made digging foxholes impossible. In addition, the jungles raised new problems for the defensive formations of infantrymen. Night noises and the various methods used by the Japanese to prevent sleep made life extremely difficult in the jungle. Defensive positions were fluid, and the men had to be kept fairly close together because of the dangers of losing contact.

Early in World War II infantrymen came under heavy fire from strafing aeroplanes though anti-aircraft weapons attached to an infantry division later made such attacks costly. Ground fire by the infantry from its multiplicity of weapons sometimes brought down enemy planes. As the war wore on the infantry paid less and less attention to dive bombing and strafing aircraft, leaving protection to their own anti-aircraft. Also it was found that infantry firing against aircraft gave away positions to enemy artillery. It became common practice in all armies for the infantryman to dive for a foxhole in a plane attack, which was normally short-lived and did little damage to him.

The conduct of the defense offered greater opportunity for control by the infantry commander than did the attack. Usually, he retained the heavy weapon support, the reserve troops, and the antitank guns under his central direction so that the entire weight of the defense could be thrown against a critical enemy penetration.

SPECIAL OPERATIONS IN WORLD WAR II

Infantry offensive and defensive tactics were not always as conventional as indicated in the foregoing description. However, the principles for such tactics were applicable in special operations, revisions being made as directed by the judgment of the infantry commander.

Attack of Fortifications.— During World War II, the normal infantry action was against enemy field fortifications. Their strength depended largely on how long the infantry had had to prepare the defensive position, on the will of the defenders, and on the combined support obtained from the other land forces and from the air forces. In many cases German and Japanese machine gunners held out until infantrymen had actually killed every man. Japanese infantry were also adept at cover and concealment, particularly in cave warfare, and normal infantry weapons were insufficient to dislodge the defenders. Grenades and 25-lb. explosive blocks called satchel charges were used against these refuges, as were flame throwers, but they sometimes failed to shake the enemy's will to resist. After outposting such obstacles, the infantry assault waves usually advanced past them, leaving the task of destroying them to the support elements.

The 1940 attacks by the German army against Low Country fortresses were carefully planned manoeuvres carried out by task forces comprising engineers and paratroops as well as line infantry. The most famous attack was against the Belgian fort at Eben Emael, where flame throwers, artillery, and air-borne and ground infantry were employed in a co-ordinated, overwhelming effort. Rehearsals against a mock-up of the fort had assured the task force of co-operation on a split-second attack schedule.

Infantry in Inhabited Communities.— Advances inevitably brought infantry troops in contact with villages and towns which seldom could be by-passed since all armies utilized such communities as fortresses, By sandbagging windows and doorways, setting up machine guns in rubble, laying mines under debris, or preparing booby traps in unoccupied buildings, a town was made into a fortress. Air attacks and artillery only increased the amount of rubble, and tanks were at a disadvantage in enclosed areas. Consequently, small infantry teams were the most potent attacking force. Usually one infantryman proceeded ahead to open doors, pry into heaps of rubble under cover of the guns of his fellow soldiers. Grenades and submachine guns were the preferred weapons in villages. Grenades could be thrown into open windows, and tommy guns were employed to spray an area with bullets.

House-to-house fighting was the most dangerous kind of combat, since at any moment enemy fire might come from front or flanks, or from the rear. A systematic attack was used to take building after building, establishing a general line through a city. Then moving forward on a wide front, the advance in time reached the far edge.

Combat in Woods and Jungles.— Wooded areas were also left to infantry combat. Occasionally a small wood could be by-passed, to be mopped up later by forces following the advance elements. However, large woods like that of the Hurtgen forest in Germany west of the Rhine had to be taken by infantry troops. It was slow going, complicated by lack of control and observation. Artillery and air bombardment were not usually effective.

The edge of large woods was usually the first objective, followed by later attacks when the infantry were organized to move forward. Trench systems, mines and ambush were common to fighting in woods. Much of the battle consisted of man-to-man fighting, with grenades and submachine guns of the greatest use as in towns.

Jungle warfare demanded the greatest resourcefulness of infantry. The dense growth compelled foot soldiers to remain on the roads and trails where there was the greatest danger from enemy attack. The heavy rainfall, debilitating climate, and the noises of the jungle were added impediments to the infantryman. Cover and concealment were afforded the enemy, and often a strong point was by-passed unknowingly. Advance elements, after moving forward, were surprised by firing in their rear, usually against larger parties moving up in support or bringing supplies. Painstaking efforts had to be made by infantry in outflanking resistance and, when halted, to assure all-around defense of their position. Again the hand weapons were the main reliance of the infantry, artillery and tanks being useful only when the jungle area was not a mass of dense undergrowth.

Amphibious Assaults.— Prior to World War II amphibious attack by infantry had been limited largely to battalion assaults against relatively light opposition or none at all. There was no considerable doctrine for amphibious attacks by units of a division or larger. The foot soldier was put ashore from landing craft and fought his way inland in typical infantry fashion. Training for amphibious assault was a long and involved process in which the armies of the western Allies necessarily took the greatest interest. There were two types of movements by water for the infantryman, one known as ship-to-shore and the other as shore-to-shore.

In the former case the infantrymen and their supporting arms were sent into the combat zone in ships especially loaded so that all their necessary supplies and equipment were immediately available. At the appointed hour the ships dropped anchor several miles offshore and let down their small boats. The infantrymen then climbed down huge rope nets which covered the sides of the ship and dropped into the landing boats. They were escorted ashore by navy boats and landed in a number of assault waves. The primary objective of the troops was to get inland as quickly as possible since in many cases the landing beaches were under the fire of infantry weapons on the heights above them and from artillery several miles to the rear.

In some respects the landing was similar to land attack since there was an artillery concentration ahead of the landing troops, furnished by aircraft bombardment and by naval gunfire. Later in the war the landing boats were supplemented by small rocket ships which fired dozens of rockets simultaneously from what: the troops called "the organ" since it was a mass of pipes.

The other type of amphibious operation, the shore-to-shore, began at a port or beach where the infantry troops walked onto landing craft, the various sizes holding from 20 to 500 soldiers. A World War II development which revolutionized the sea-to-shore assault, outdoing all previous amphibious progress, was these craft, small and large, which were capable of moving onto a beach and virtually dry landing their companies. Some of the smaller types had wheels that enabled them to continue with the attack as it moved inland. They were used mainly for supply, communications and casualty evacuation. It was no longer necessary to

attack a well-armed port, for expeditions could be both landed and supported across a beach. However, the weakest point in attack continued to be at the water line. The defense resorted to elaborate obstacle building. Once ashore, infantrymen took up a line. dug in and then, as beachhead supply became firm, attacked inland.

Infantry attacks across rivers were similar in some respects to shore-to-shore amphibious operations. Reconnaissance for the best crossing area was absolutely essential. Usually these operations were commenced at night so that leading elements could get established on the far bank before daylight. A further build-up of forces was then essential so that the attackers could fan out and obtain a bridgehead. Later, various types of prefabricated steel bridges, as well as the pontoon bridge, were used to facilitate movement.

Mountain Warfare.— Throughout World War II there was considerable fighting in mountains. It developed mainly into dogged infantry combat, advances being slow and painful. Artillery and air attacks were useful in bombarding enemy strong points, and the infantry flanking tactics were particularly adaptable.

Though most armies had mountain-trained troops, they were insufficient in number for the widespread fighting in mountainous areas. Usually infantry divisions were given this combat duty, and expected to improvise their tactics to suit the situation. Supply was a continuous problem, though pack mules were found in considerable numbers in such areas.

Night Operations.— Infantry combat was replete with night operations, usually involving small patrols and combat teams. In the jungle. the Japanese had a special liking for infiltration at night. Furthermore, all armies found that incessant artillery and small weapon firing served to unnerve the opponent by causing loss of sleep. Night attacks were often necessary to consolidate ground won the previous day, to initiate an operation by the seizure and occupation of an enemy strong point which might hold up a general attack. Night operations required resourceful infantry, well rehearsed in what was expected of each man. Control was obtained by keeping men close together, and by the wearing of a distinguishing armband or headband.

Arctic-type Operations.— There were no true arctic operations in World War II. though winter combat was common throughout Europe and in the Aleutians. It was true infantry combat, with camouflage by white clothing and the wearing of warm equipment absolutely essential.

The mobility of machines was considerably decreased in cold-weather operations, shifting greater dependence on the foot soldier. In a few cases skis and snowshoes were used, but generally the infantry soldier fought the same kind of warfare he did under more favourable conditions. However, it was much more difficult to dig in, compelling the infantry to depend for cover on trees and walls.

Desert Operations.— The British, German and Italian infantry fought in the North African desert for the better part of two years. Desert combat was sometimes compared with naval combat. Forces were visible for long distances by the dust clouds they raised. Long sweeping flank movements were common, vehicles being utilized almost entirely. Only when halted did the infantrymen dig into the sand or build up a rock breastwork for protection. Surprise through deception was particularly useful in desert warfare. Water supply was always deficient, and many of the battles were fought for the possession of waterholes. There was no particular finesse possible in this type of warfare, most attacks becoming slugging matches in which the force with the greater strength and staying power was victorious.

Partisan Operations.— The partisan, or guerrilla, warfare behind the German lines in Europe was a special adaptation of infantry tactics. The basic principle was never to stand up and fight a pitched battle. Rather the best tactics were raids conducted against supply columns, trains and against small parties of the enemy. In the occupied areas, Russians, French, Belgians, Dutch, Norwegians and Danes conducted an incessant partisan warfare, utilizing the small-unit tactics of infantry. The principal weapons of the partisans were submachine guns, rifles and grenades, supplies being smuggled inside the German lines or dropped by aircraft.

In the Pacific, the Chinese and Filipinos had similar success in disrupting Japanese supply lines, and in conducting a campaign of fear among the occupying forces.

Commando, Ranger, and Raider Tactics.— The organization and objectives of these peculiarly British and U.S. forces were discussed earlier. Their tactics were a combination of typical infantry tactics, of partisan methods of silent warfare, of amphibious assault techniques and of jungle tactics. These specialist infantry groups served a useful purpose during the early years of the war to show that any physically fit individual, highly trained in the use of weapons and in stealth, could become a superb infantryman. Later the fighting qualities of these special units became the goal in all infantry units, the great mass of infantrymen approaching close to the high standards set by the commandos, rangers and raiders.

Air-borne Tactics.––Parachute and glider infantry were organized and equipped as mentioned earlier in this article; their tactics were somewhat different from those of regular infantry, since they did not have available the supporting heavy weapons. The individual fighting capacity of each soldier had, in part, to make up for this lack. Also, admission of the necessity for such heavy weapon support, as well as by tanks, was made in operations where the air-borne infantry was relieved as soon as possible, or heavy weapon support furnished them.

The soldierly abilities of the air-borne infantry, their *esprit* de *corps,* ability to fight and to fire their weapons steadily and accurately, made them the Clite infantry.

Supply.— The usual system of supplying the front-line infantrymen was to bring up food, ammunition and other requirements at night by truck or horse-drawn wagon from regimental dumps several miles behind the line. At dusk each night the U.S. and British troops used jeeps to rush supplies forward to the troops before complete darkness set in. The jeeps were often able to bring supplies to within roo yd. of the front. Eventually however, supplies had to be carried by man power the last few yards. The rifle companies in many cases furnished their own members to bring forward supplies. Horses and mules were used wherever possible. particularly in the mountains of Sicily and Italy. The bringing up of supplies was usually a difficult job because routes soon became known to the enemy. A heavy shelling could be expected during the time the enemy reckoned supplies would be moving forward.

Morale.— In all armies greater efforts were made to keep up the spirit of the soldier. particularly those in front-line combat, than in any previous war. Radio programs, motion pictures, newspapers and theatrical shows were brought to the soldiers overseas. Even the front-line troops got their news by radio. They also were the subject of enemy interest, being propagandized by the playing of nostalgic music and reporting of news items stressing events at home which would make the soldier lonelier or would cause him to ask himself the question "Why do I fight when others at home have an easy and safe life?" These broadcasts became so persistent that in all armies efforts were made to educare the soldier to the justice of his nation's cause and the necessity to continue the fight until victory was won.

The soviet army through its political commissars featured a system of indoctrination so persuasive that even the soviet leaders of the fighting units claimed that their authority was subverted by the political representatives. Though commissars were withdrawn when the fighting was particularly severe on the defensive they returned when the soviet forces took up a general offensive.

The U.S. army had particular difficulty early in the war in the assignment of men to the infantry. The majority of draftees preferred the other arms and services. Moreover, the early policy was to deny the infantry a fair proportion of superior men. At one time the disequilibrium was such that 72% of the ranks in the air force were educationally qualified for infantry commission while only 16% of infantrymen were so qualified. The system was changed and infantry prestige was raised when finally it was

realized that infantry was still the decisive arm. Infantrymen were given additional combat pay and a special identifying badge. The British and German armies had difficulty with the same problem but in lesser degree.

CHARACTERISTICS OF INFANTRY AFTER WORLD WAR II

Organization. — The triangular organization throughout the infantry from platoon to division was maintained as it had been at the close of World War II. Such changes as were made had either the object of further increasing infantry firepower against other foot forces or of giving it better protection against infantry fire. Bulletproof vests and jackets were perfected for combat issue. Organic armour was brought into the infantry division. A new family of infantry weapons, the recoilless rifles, was developed. These relatively light tubes could be man-carried and gave infantry the equivalent of a highly mobile light artillery, invaluable for point-to-point firing in rugged country. *(See* ORDNANCE).

Other weapons developments included an infra-red device called the sniperscope, designed to enable the firer to see his target at night. It proved only moderately successful. More helpful was the addition of the large-size rocket launcher which for the first time enabled infantry to attack medium armour with a fair chance of destroying it at ranges up to roo yd.

Tactical reform and organizational change did not keep pace with the over-all advance in weapon power which threatened the existence of the conventional defensive order. For at least five years after the first atomic bomb was dropped in World War II, western general staffs took scarcely a step to measure what changes the new conditions required in infantry training, structure and theory to insure success, or even survival. There was talk among infantry tacticians about the necessity of achieving maximum spacing between deployed men and units, while making infantry more elusive, mobile and aggressive. But no exercises were held and little staff work was done to bring doctrine and practice abreast of the new realities in total war.

From the experience of World Wars I and II had come two dominant tactical ideas, the flankless front in defense and the breakthrough by massed armour on the offense. These defined and limited the infantry approach in future operations. The military schools continued to emphasize the avoidance of open flanks, the correctness of the closely joined order of battle and the preponderant mobility of armour as an offensive shield covering infantry. In this brief twilight period, military thinking proceeded as if nothing had changed radically.

Korean War. — Although the doctrinal lag incurred no immediate penalty, the first limited war of the atomic era, in Korea, 1950–53, presented unique problems for all infantry forces. Not only did the Communist armies possess at all times superior infantry numbers, some of which were always in position to harass the rear of the United Nations army and cut its communications, but the latter side was never in strength sufficient to form a continuous, closely knit forward line, supported in depth.

During the highly fluid operations of the first year, the Communist armies, after their initial drive, used little artillery, air power or armour. But in all operations they made prodigious use of ground protection and night cover. In the attack, they advanced against the entrenched ridge tops with hand-carried weapons, relying heavily on the machine gun and slightly less on the mortar. Or else, under cover of darkness, their infantry moved forward through openings in the main line of resistance, either to attack artillery and other rear installations or to set up roadblocks behind forward infantry battalions to compel their withdrawal. These were the chief unorthodoxies in their method of making war.

Against a strongly armed opponent, with ample air and artillery weapons. the defensive system ultimately developed by the United Nations forces to counter these tactics would not have availed. Perimeter defense, by infantry blocks of battalion size or larger, proved to be the correct solution. Its success derived primarily from organic unity within the position, combined with maximum union-by-communications with all higher headquarters and co-equal tactical bodies to the right and left. Mutual fire support was supposed to exist between each block and its nearest neighbours. Such was the infantry shortage and the resultant stretching of the rifle line — understrength battalions sometimes covering 4,000 yd. of front — that this defensive technique was more theory than fact.

In the attack by UN forces, air and artillery preparation and the thrust by armour opened the way for infantry wherever possible. Because the Communist defense was hinged usually to the higher and rockier ridge tops, distant from the valley roads and beyond reach by any vehicle, much of the time infantry had to make its closing rush with little or no effective support except the fire of its own machine guns, recoilless rifles and rocket launchers. For infantry on both sides, it was an infighting war, with an extraordinary incidence of hand-to-hand combat. The hand grenade was heavily used by both sides as a finishing weapon. Because the rugged terrain limited fields of fire and because morale needed stimulating in the crisis of the first winter, the UN command restored active use of the bayonet as an attack weapon. The war saw more bayonet charges than any conflict since the American Civil War.

Tactical Change. — Basically there was little change in infantry weapons use or the tactics of fire and movement except as old methods were modified in conformity to the difficulties of the terrain. The main advance tactically came in the form of new and greatly diversified forms of support provided to the infantry by the younger services. When defensive perimeters became cut off and besieged, infantrymen were sustained by air resupply and their casualties were taken out by helicopter. On many occasions battalions and larger units were saved by flying prepackaged supplies from Japan. More numerous were the incidents in which a platoon or company was rallied in a desperate situation by one or two liaison planes coming in to make a free drop. The rifleman wounded in a fight for a distant and unroaded mountain peak frequently was flown to a base hospital within 10 min., receiving plasma and first-aid while still air-borne. Such innovations came of the inspiration of the moment, but they were characteristic of a new tendency under pressure to find wider use for all equipment.

The light liaison plane became a jack-of-all-trades in support of infantry. It served in artillery direction, did observation work over enemy lines, acted as relay and guide for long-range infantry patrols, led in the air strike and became an intermediary in long-range radio communication.

The employment of armour was not less diversified, and many of its most decisive services to infantry ran counter to the orthodox teachings of the schools. In night defense, it formed roadblocks covering critical approaches to the main infantry positions. In the face of fire, it ferried infantry onto the ridge tops when the slopes were negotiable. It acted as escort to patrols. It worked as artillery from within the infantry defensive circle, firing its cannon from 20 yd. or less behind the rifle line. When the infantry was hard worn and the night situation uncertain, armour occasionally outposted the position. If the position became lost, armour was used to retrieve the infantry dead and wounded. When the infantry numbers became too thin, tanks were spliced directly into the rifle line.

During the last two years of position warfare, armour was consistently employed in that role because of the infantry shortage. Armour was set up to enfilade main roads running laterally behind the key ridges; it mounted guard over first-aid stations and supply points. The conservation of both forces was most perfect only when there was perfect reciprocity between them, and the commander considered one just as expendable as the other when the position became threatened as a whole.

Infantry hardship in Korea was not more than in the earlier wars of the century but on the whole less, though the subject was more fully publicized. Viewing the extraordinary work load which devolved upon mfantry, there was obvious need for a pioneer or engineer company within the infantry regiment. The rifle companies always had their hands full, if supply was to be moved

forward, if telephone lines were to be laid, if foxholes were to be dug. Still. the wounded had better prospects for survival than ever before and the terrain which made every advance arduous also proved a shield against the heaviest fires. Infantry losses from nervous exhaustion, combat fatigue and desertion became minimal.

Communist Chinese Infantry. — Historically the salient military development of the war was the proof of tactical and moral competence in Communist China's almost unlimited infantry mass. Its trained formations could withstand the shock of massed fire despite the fact that its own tactical methods in attack and defense were inflexible. Except for the machine gun and mortar, which the Chinese used expertly, the use of organic weapons, while persistent, was not markedly skilled. Their physical endurance proved adequate.

During the final two years of position warfare, the Chinese Communist defensive system had far greater depth and elaboration than the UN line. The army lived and concealed itself in deep subterranean works, using the surface trench system as an alarm net to rally forces to the ridge tops when attacked. Artillery also was tunnelled into the ridge tops. Bombproof, these works, unlike the opposing defenses, would have been strongly resistant to atomic weapons. Operations consisted mainly of infantry patrolling. By keeping divisions in line until troops were thoroughly seasoned, Chinese Communist forces became unexcelled in this furtive and essential activity.

Tactics tried and proved in Korea by the Communist forces were exported to north Indochina during the concluding phase of a war which until then had been a struggle between elusive guerrilla bands and a conventional army basing on blockhouses along fixed lines of communication. The new methods made firm and decisive the Communist counter to the French invasion by airhead at Dien Bien Phu.

Atomic Exercises. — On Nov. 1, 1951, the first test of the behaviour of infantry in the vicinity of an atomic explosion was held at Yucca Flat, Nev. It was not a tactical exercise designed to work out specific infantry problems, such as mass evacuation, preliminary reconnaissance and reorganization of ground forces following atomic attack. The object was to determine whether normal infantry suffers an abnormal psychological or physical reaction when within sight of but at a safe distance from a nuclear explosion. The findings were negative. Since then all tests of infantry forces when disposed toward an atomic explosion have had similar limitations, and the results bear only marginally upon the main question of battlefield reactions.

Atomic exercises, in which corps and armies manoeuvred and a number of atomic strikes against the battle order were simulated, were conducted regularly by western armies after the summer of 1953. During the first years of experiment, no radical change in conventional organization and practice resulted. Getting a late start, the development of theory about the character of the front, the regulation of movement and the problem of infantry deployment under the new conditions remained in a highly fluid state, awaiting further exercises, more committee study and a breaking down of traditional resistance to change.

By 1957 came the first clean break with infantry structure in the pre-atomic age. In the U.S. army the change preceded systematic field testing to determine what form infantry organization should take to meet the new conditions. Regiments and battalions were eliminated and for the old triangular division was substituted a five-sided structure composed of battle groups. Each battle group was formed of five heavy companies, both within air-borne and line infantry divisions. By this reform both types of division became reduced in size. The general purpose of reform was to make the holding structure less rigid, thereby increasing the elusiveness of its parts on the atomic battlefield. Supporting organic artillery was greatly reduced in numbers of men and guns, thereby placing greater reliance on heavy mortars and rocket batteries. Communications (signals) support was heavily increased by the addition of a new division group which was to maintain wire nets, etc., for the fighting groups. The combat supply problem was similarly handled through the forming of a logistical support group which would carry the load for the infantry fighters. With the ordering of this change, it was not expected that the weapons requisite to it would be more than 25% complete by 1960.

BIBLIOGRAPHY.—Oliver L. Spaulding, Hoffman Nickerson and John W Wright, *Warfare* (Washington, 1937); Lynn Montross, *War Through the Ages* (New York, 1946); S. L. A. Marshall, *Men Against Fire* (Washington, 1947), *The River and the Gauntlet* (New York, 1953); J. B. Sweet (ed), *Tactics and Technique of Infantry* (Harrisburg, Pa., 1950); Russell A Gugeler, *Combat Actions in Korea* (Washington, 1954); J. F. C. Fuller, *Decisive Battles of the Western World, and Their Influence Upon History* (London, 1955); issues of *Army* (formerly *The Infantry Journal* and *Army Combat Forces Journal*).

(W. H. BAU.; S. L. M.)

INFANT SCHOOLS (GREAT BRITAIN). The first significant landmark in the development of infant education in Great Britain was the pioneer effort of Robert Owen at New Lanark in Scotland. As managing partner of cotton mills there he was determined to provide a happy, healthful upbringing for the young children of his employees and with this object he established a school in 1816. His two ideals — pleasant, harmonious conditions and a life of interesting activity — had a profound influence in spite of many setbacks.

The circumstances of the industrial revolution tended to encourage the provision of schools for infants because early legislation prevented the employment of young children while the factories took their parents and older brothers and sisters away for long hours. In 1824 the London Infant School society was founded with Samuel Wilderspin as superintendent; another notable pioneer was David Stow, who in 1836 founded the Glasgow Normal seminary in which teachers were trained for service in infant schools. Wilderspin and Stow attached importance to memory drill and moral training, and the restricted playgrounds and fixed galleries in large classrooms, characteristic of schools in which their methods were used, reflected an attitude quite different from that of Robert Owen.

Soon other and more wholesome influences intervened. In 1837 the Home and Colonial society was founded to train teachers in methods advocated by J. H. Pestalozzi. Much influenced by Jean Jacques Rousseau, this great Swiss educator revolutionized ways of infant teaching, stressing nature study and learning by doing. But his disciple, Friedrich Froebel, made an even deeper impression on British educational tradition; rejecting the term infant school because he did not believe that little children should be schooled, he coined the name kindergarten (*q.v.*), later widely used in the United States for the first unit of primary education, to describe an environment in which children grow freely like plants tended by a good gardener.

In 1854 the prince consort opened in London an exhibition of Froebel's "gifts and occupations," and ever since there have been training colleges and schools in which his principles have been held in high regard. It was not until the 1920s, however, that the last of the galleries, characteristic of the Wilderspin technique, disappeared from infant classrooms.

Several influences contributed to make the modem infant school the happy community that it usually is. Most important, perhaps, was the growing appreciation of the psychological and physical attributes of childhood. Child study associations came to flourish on both sides of the Atlantic, and there was increasing co-operation between parents and teachers. Maria Montessori's emphasis on self-education and her criticism of old-fashioned classroom rigidities won her many adherents in Great Britain, although there was some dislike of her graded apparatus. About the same time support for new methods reached Great Britain from the United States as a result of John Dewey's powerful influence, especially his stress on the educative value of practical activities and experience. The Dalton plan also came from the United States reinforcing conceptions of freedom and self-learning. A most effective contribution to the new outlook was that of Rachel and Margaret Macmillan who, appalled by the ill effects of bad housing conditions upon young children, set to work at Deptford, London, in 1911 where three years later they established a nursery school consisting of well-warmed open-air shelters grouped round a garden. The nursery school movement became an influence which also affected the infant school.

Administratively it is often difficult to provide satisfactorily

for the education of infants. The aim in Great Britain is to have a separate school or department for infants. But, especially in villages, numbers are frequently too small to justify separation, and there are many primary schools which infants as well as juniors attend. Less defensible were the many all-age unreorganized schools. There are also many schools outside the state system with various age ranges. *See* also ELEMENTARY EDUCATION.

BIBLIOGRAPHY.—E. R. Boyce, *Play in the Infants' School* (1947) and *Infant School Activities* (1945); *D.* M. Gardner, *Education under Eight* (1949) and *Testing Results in the Infant School,* 2nd ed. (1948); A. Gesell *et al., The Child from Five to Ten* (1946); S. Isaacs, *The Intellectual Growth of Young Children* (1938) and *The Social Development of Young Children* (1939); E. Lawrence (ed.), *Friedrich Froebel and English Education* (1952); E. Mellor, *Education Through Experience in the Infant School Years* (1950); *T.* Raymont, *A History of the Education of Young Children* (1937); R. R. Rusk, *A History of Infant Education* (1933); Board of Education consultative committee, *Report on Infant and Nursery Schools* (1933); Advisory Council on Education in Scotland, *Primary Education* (1946).

(W. O. L. S.; X.)

INFANT WELFARE: *see* INFANCY; MATERNAL AND CHILD HEALTH.

INFECTION: *see* BACTERIAL AND INFECTIOUS DISEASES; PARASITIC DISEASES. For infection in the sense of boils, abscesses, etc., *see* INFLAMMATION.

INFECTIOUS FEVERS: *see* CHICKEN POX; MEASLES AND GERMAN MEASLES; SCARLET FEVER; TYPHOID AND PARATYPHOID FEVERS; WHOOPING COUGH; etc.

INFECTIOUS MONONUCLEOSIS (GLANDULAR FEVER) is a common infection of man. The cause is probably a virus (still unknown by the 1950s). The disease, which has been observed in most areas of the world, occurs predominantly in people from 10 to 35 years of age but may appear at any age.

Glandular fever is probably contagious and usually appears about 5 to 15 days after contact. Malaise and sore throat are the commonest symptoms. Enlargement of the lymph nodes in all parts of the body is frequent; the "glands" in the neck are most often affected. Fever of varying degree is usual. In some cases the only signs of the disease are fever and generalized discomfort; in these, the diagnosis is made by study of the blood.

In about one-third of patients with the disease, the spleen is enlarged. A rash consisting of multiple, small hemorrhages or resembling that of measles or scarlet fever sometimes appears. Pneumonia is present in about 2% of the cases. Severe involvement of the liver with jaundice, which is rare, may persist for several weeks. Encephalitis, meningitis or peripheral neuritis occur; death has followed the encephalitis. The heart is rarely affected. Swelling of the upper eyelids is observed occasionally, and a small amount of blood may be present in the urine. Glandular fever usually lasts for about 5 to 10 days. In some instances, it may persist for several weeks, especially when the liver or nervous system is affected.

Glandular fever is suspected, therefore, when fever, sore throat and enlarged lymph nodes are present. A presumptive diagnosis is made from study of the blood. The white blood count is usually elevated; there is an increase in the relative number of lymphocytes, a varying percentage of which appear abnormal. In from two to seven weeks after the disease begins, there appears in the blood a substance which causes clumping of sheep red blood cells. This is responsible for the "heterophile agglutination reaction" which is diagnostic and positive in about 95% of the cases.

There was still no specific therapy for glandular fever in the 1950s. Antibiotic agents proved of value only for the commonly occurring secondary infections of the throat. (*See* also BLOOD.)

BIBLIOGRAPHY.—Andrew W. Contratto, "Infectious Mononucleosis, a Study of 196 Cases," *Arch. Int. Med.,* 73:449 (1944); Louis R. Limarzi, Jerome T. Paul and Henry G. Poncher, "Blood and Bone Marrow in Infectious Mononucleosis," *Jour. Lab. and Clin. Med.,* 31: 1079 (1946); H. Wechsler, A. H. Rosenblum and C. T. Sills, "Infectious Mononucleosis, Report of an Epidemic in an Army Post," *Ann. Int. Med.,* 25:113, 236 (1946); Alfred S. Evans and Elizabeth D. Robinton, "An Epidemiologic Study of Infectious Mononucleosis in a New England College," *New Eng. Jour. Med.,* 242:492 (1950); Russell L. Cecil and Robert F. Loeb (eds.), *Textbook of Medicine,* 9th ed. (1955); J. E. Stevens, E. D. Baird and F. J. Heck, "Infectious Mononucleosis, a Study of 210 Sporadic Cases," *Amer. Jour. Med.,* 11:202 (1951); R. J. Hoagland, "Infectious Mononucleosis," *ibid.,* 13:158 (1952).

(Ls. W.)

INFERENCE: *see* INDUCTION; PROBABILITY. For oblique inferences *see* LOGIC, HISTORY OF: *Modern Logic: Jungius.*

INFERIORITY COMPLEX, a term used by some psychiatrists and psychologists, particularly the followers of Alfred Adler, to denote a feeling of inferiority that is wholly or in part submerged in the unconscious. The term "inferiority feeling" was used frequently by Adler, who held that many outstanding achievements, some antisocial behaviour, and other continuing aspects of the personality could be traced to overcompensation for this feeling. The use of "complex" later gained acceptance to denote the group of emotionally toned ideas, partially or even wholly repressed, organized around and related to such feelings of inferiority. The term "inferiority complex" has lost much of its significance through imprecise, popular misuse—for example, as an attempt at a facile explanation of any show of ambition by a man of small physical stature. *See* ADLER, ALFRED.

(H. F. HT.)

INFINITE PRODUCTS. The expression $a_1a_2a_3\ldots$ formed by multiplying together in a definite order numbers a_1, a_2, a_3, ... is called an *infinite product.* If at most a finite number of factors vanish, so that $a_p \neq 0$ for $p \geq n$, where n is sufficiently large, and if the limit

$$\lim_{p=\infty} a_n a_{n+1} a_{n+2} \cdots a_p$$

exists and is a finite number different from zero, then the infinite product is said to *converge.* Otherwise it is said to *diverge.* In case the infinite product converges, then the limit

$$\lim_{p=\infty} a_1 a_2 a_3 \cdots a_p$$

is its *value.* According to this definition of convergence, the value of an infinite product is zero only when a factor is equal to zero. Infinite products such as $(1/2)(2/3)(3/4)\ldots$ are counted as divergent since the product of the first n terms, namely $1/(n+1)$, has the limit 0 for n infinite. In case of convergence, if n is sufficiently large we must have

$$\lim_{p=\infty} \frac{a_n a_{n+1} a_{n+2} \cdots a_{n+p+1}}{a_n a_{n+1} a_{n+2} \cdots a_{n+p}} = \lim_{p=\infty} a_{n+p+1} = 1.$$

Hence, if we put $a_p = 1 + b_p$, the infinite product takes the *normal form* $(1+b_1)(1+b_2)(1+b_3)\ldots$, and $\lim_{p=\infty} b_p = 0$ if the infinite product converges. The notation $\prod_1^\infty (1+b_p)$ or simply $\prod(1+b_p)$ may be used for an infinite product. The product of consecutive factors from the nth to the mth inclusive, $m > n$, is denoted by $\prod_n^m(1+b_p)$. One may suppose for the sake of convenience that $|b_p| < 1$, $p = 1, 2, 3, \ldots$. This can always be realized for any convergent infinite product by omitting at most a finite number of factors and renumbering those which remain. There are several important convergence theorems.

(A) *If the b_p are real and positive, then the infinite product $\prod(1+b_p)$ converges* if *and only if the infinite series $\sum b_p$ converges.*

For

$$\sum_{p=1}^{n} b_p < \prod_{p=1}^{n} (1+b_p) = \prod_{p=1}^{n} \operatorname{Exp} \log(1+b_p)$$

$$= \operatorname{Exp} \sum_{p=1}^{n} \log(1+b_p) < \operatorname{Exp} \sum_{p=1}^{n} b_p.$$

The statement follows at once from this inequality.

Example. The infinite product $\prod(1+\frac{1}{p})$ diverges inasmuch as the product of the first n factors is $n+1$ and therefore tends to, ∞ as n tends to ∞. From (A) it therefore follows that the series $\sum \frac{1}{p}$ is divergent.

(B) If the infinite product $\prod(1+|b_p|)$ converges then the infinite product $\prod(1+b_p)$ converges.

In accordance with an earlier remark, we assume that $|b_p| < 1$, $p = 1, 2, 3, \cdots$. Let $P_n = \prod_1^n(1+|b_p|)$, $Q_n = \prod_1^n(1+b_p)$. Then,

$$|Q_{n+m}-Q_n|=|Q_n|\cdot\left|\prod_{p=n+1}^{n+1}(1+b_p)-1\right|$$
$$\leqq P_n\left(\prod_{p=n+1}^{n+m}(1+|b_p|)-1\right)=P_{n+m}-P_n.$$

Since, by hypothesis, $\lim_{n=\infty}P_n$ exists and is a finite number, it follows that for every $\epsilon>0$ there exists an N depending only upon ϵ such that for $n>N$, $m=1, 2, 3, \cdots$, $P_{n+m}-P_n<\epsilon$, so that $\lim_{n=\infty}Q_n=Q$ exists and is finite. To prove that $Q\neq 0$, consider the infinite product $\Pi(1+c_p)$, where $c_p=-b_p/(1+b_p)$. Clearly $\Sigma|c_p|$ converges, so that $\Pi(1+|c_p|)$ converges by (A). Hence, from what we have just proved, it follows that $\lim_{n=\infty}\Pi_1^n(1+c_p)$ exists and is finite. But this limit is equal to $1/Q$. Therefore $Q\neq 0$, as was to be proved.

When $\Pi(1+|b_p|)$ converges, then $\Pi(1+b_p)$ is said to be absolutely convergent. From (A) we have:

(C) The *infinite* product $\Pi(1+b_p)$ is absolutely convergent *if* and *only if* the *infinite* series Σb_p is absolutely convergent.

The notion of absolute convergence furnishes one reason for introducing the normal form of the infinite product. The infinite product $\Pi|a_p|$ has no interesting relationship to the infinite product Πa_p. In fact, the former may converge when the latter diverges, *e.g.* if a, $=(-1)^p$.

An infinite product may converge without converging absolutely. This is shown by the following theorem.

(D) If the b_p *are* real and the infinite series Σb_p and Σb_p^2 are convergent, *then the infinite* product $\Pi(1+b_p)$ *is* convergent.

For, supposing that $0\leqq|b_p|<1$, we have $1+b_p=\mathrm{Exp}[\log(1+b_p)]=\mathrm{Exp}(b_p-b_p\theta_p)$, where $|\theta_p|<M$, a constant independent of p. Therefore, $\Pi_1^n(1+b_p)=\mathrm{Exp}(\Sigma_1^n b_p-\Sigma_1^n\theta_p b_p^2)$, and consequently $\Pi(1+b_p)$ converges.

If the series Σb_p is non-absolutely convergent, then its sum may be made any assigned value by suitably rearranging the order of the terms. We then conclude from the preceding that the value of an infinite product depends in general upon the order in which the factors are taken.

The problem of convergence of an infinite product can always be reduced to the problem of convergence of an infinite series, in accordance with the following theorem.

(E) *The* infinite *product* $\Pi(1+b_p)$ converges *if* and only *if* the infinite series $\Sigma\log(1+b_p)$ *converges*. This holds also for complex b_p provided we take the principal values *of* all the *logarithms*.

Supposing the b_p are real, $|b_p|<1$, put $P_n=\Pi_1^n(1+b_p)$ $L_n=\Sigma_1^n\log(1+b_p)$. Then $P_n=\mathrm{Exp}\,L_n$, $L_n=\log P_n$, and hence if $L_n\to L$ then $P_n\to\mathrm{Exp}\,L>0$; and if $P_n\to P>0$, then $L_n\to\log P$, and the theorem is proved for this case. If the b_p are complex, some further considerations are needed.

One of the most important theorems on infinite products is the *Weierstrass* factor theorem. This theorem concerns functions $f(x)$ having power series expansions $\Sigma a_p x^p$ convergent for all values of x, and having infinitely many zeros $x_1, x_2, x_3, \ldots$ The theorem states that any such function is equal to a convergent infinite product made up of one nonvanishing factor, and one factor corresponding to each zero x_p, vanishing if and only if $x=x_p$. This generalizes the analogous theorem on polynomials. If $f(x)=\sin\pi x$, then the infinite product is $\pi x(1-x)(1+x)(1-\frac{1}{2}x)(1+\frac{1}{2}x)(1-\frac{1}{3}x)(1+\frac{1}{3}x)\cdots$. If, in particular, $x=\frac{1}{2}$, this gives Wallis' famous formula

$$\frac{\pi}{2}=\prod\frac{(2p)^2}{(2p-1)(2p+1)}=\frac{2\cdot2\cdot4\cdot4\cdot6\cdot6\cdots}{1\cdot3\cdot3\cdot5\cdot5\cdot7\cdots}.$$

An important function which can be conveniently represented as an infinite product is the *gamma function*, $\Gamma(x)$. This function serves to define $n!=1\cdot2\cdot3\cdots n$ when n is not a positive integer. We have: $\Gamma(n+1)=n!$ if n is a positive integer, while $\Gamma(x)$ is defined and continuous for all positive values of x as well as for all other values with the exception of $x=0, -1, -2, \ldots$. This function is given in terms of an infinite product by the formula

$$\Gamma(x)=\frac{e^{-Cx}}{x\Pi(1+\frac{x}{p})e^{-\frac{x}{p}}},$$

where C is *Euler's* constant.

Infinite products of the form $\Pi(1-x^{n_p})$, $n_1<n_2<n_3<\cdots$ being positive integers, occur frequently in mathematics. One of the most interesting is $\Pi(1-x^p)$. Euler found a remarkable theorem on the sum of the divisors of n involving the exponents in the power series for this infinite product.

BIBLIOGRAPHY.—T. J. Bromwich, An Introduction to *the Theory* of Infinite Series, and K. Knopp, Theorie *und* Anwendung der *unendlichen* Reihen (available also in English translation) contain sections on infinite products. For the Weierstrass factor theorem, see E. Borel, *Leçons* sur *les* Fonctions *Entières* (Paris, 1921). Philip Franklin, *A* Treatise on Advanced Calculus (1940), has a chapter on the gamma function. (H. S. WL.)

INFINITESIMAL, a number or magnitude which, though not zero, is less than any finite number or magnitude. This rather vague definition may be rendered more precise by denying the axiom of Archimedes. This axiom states that, if A and B are any two numbers or any two measurable magnitudes such that zero is less than A and A is less than B, then there is a natural number n such that nA is greater than B. The denial of this principle yields the following definition of infinitesimal: if A and B are any two numbers or any two measurable magnitudes such that zero is less than A and nA is less than B for every natural number n, then A is infinitesimal relative to B.

Prior to the 19th century it was generally believed that infinitesimal~were necessarily involved in the notion of continuity and of the infinite, and hence were essential to the development of the differential and integral calculus. When, in the 19th century, adequate definitions for irrational numbers were discovered and an arithmetical theory of limits was worked out, it was possible to show that no real number is infinitesimal with respect to any other; but, on the other hand, it was found that the calculus could be based on the real numbers and the arithmetical theory of limits.

After it had thus been shown that the earlier view was erroneous, the use of the term infinitesimal began to disappear from the writings on the calculus, being used only occasionally to describe a variable (not a number) whose limit is zero.

The proof of the absence of infinitesimals from the system of real numbers and the subsequent discussions of the subject inspired the German mathematician David Hilbert to seek systems in which infinitesimals could occur. He succeeded in defining systems for which the axiom of Archimedes is false. In these systems one element can be infinitesimal with respect to another. (R. W. BD.)

INFINITESIMAL GEOMETRY: see DIFFERENTIAL GEOMETRY.

INFINITY AND THE INFINITE. These terms (from Latin in, "not," and finis, "end" or "limit") in common usage express our felt inability completely to carry out the procedures of counting, measuring. comparing, etc., by means of which size, number or degree can be assessed. Thus we say that there are an infinity of stars in the heavens or of colours on a bird's wing, that someone has been infinitely kind, etc. With this inability to assess go strong emotional overtones; the infinite usually astonishes, wearies or confounds us. In stricter contexts a predication of infinity implies a considered belief that the repeated application of procedures of counting, measuring, comparing, etc., will always be demanded by the material on hand and will never lead to a final assessment of size, number or degree. Thus we say that there are an infinity of fractions between 0 and 1, implying that we shall always be able and obliged to discover new fractions between these limits. In more religious and metaphysical contexts, the notion of the absolutely infinite is developed, the idea of something whose size, number. degree, etc. cannot be assessed in any respect whatsoever and which is therefore omnicomprehensive and omnicompetent: this notion is obviously of greater difficulty and of more doubtful consistency than that of the simply infinite. We may note that there are always both positive and negative aspects to our notion of the infinite: a predication of infinity is. from one point of view. negative. being a confession of our inability to assess size, number or degree; but it tends also, from another point of view, to be regarded as a positive as-

sessment, one demanded by the character of our object and one that is, in many respects, extremely hard to understand or to justify.

The Infinite in Ancient Thought.--Infinity appeared to ancient Greek thought in two contradictory guises. To the thinkers of Ionia it was attributed to the boundless environment of our cosmos and was an object of honorific assessment. Thus Anaximander (*q.v.*) set our world, together with countless other similar worlds, in a boundless environing material medium, "that becoming might not fail"; he also spoke of this medium in laudatory and religious terms. Even Melissus the Samian, whose notion of unchanging Being was Italian rather than Ionian, felt obliged to hold that "that which is" was infinite in magnitude, while Anaxagoras (*q.v.*) of Clazomenae constructed his world out of an infinity of particles called "seeds," which were also infinite in variety and in "smallness." As opposed to this positive, favourable attitude to the infinite, the Italian attitude (represented by Pythagoras) was unfavourable and negative: the infinite was put into the class of things obscure, variable, unfinished and therefore bad. It stood in essential opposition to the "limit," whose work was the simplifying ratio or the precise mathematical proportion. The infinite showed itself in the "boundless breath" of darkness from which the starry units were separated, in the boundless variability of the crooked line or of the oblong as opposed to the constancy of the straight line or of the square, in the irrational and in the incommensurable of which the Pythagoreans (in search of a simple ratio between the diagonal of a square and its side) had had bitter experience. This unfavourable view of the infinite was passed on to Parmenides of Elea (*q.v.*), who refused to make his unchanging Being infinite "since it is in need of nothing, and since what is infinite is in need of everything"; and to Parmenides' disciple Zeno, who found a sufficient reason for denying that "things are a many" in the fact that, if such plurality were admitted, it would lead to the admission of an infinity of units between any two distinct points, and that such an infinity was not a number at all. Zeno also based his famous proofs of the impossibility of movement on the fact that it involves passing through and completing an infinity of successive stages.

This negative, Italian view of the infinite was adopted by Platonism, for which the infinite was essentially the irrational, flowing or formless principle, capable of indefinite increase and diminution which has to be subordinated to the "one" or the "limit" in order to give rise to whatever is intelligible and good. It is the indefinite element in the ideal world, which has to be bounded by the One in order to give rise to those precise, quantitative patterns with which Plato ultimately identified his "ideas." It is also the indefinite element in the world of the senses, whose bounding by numerical ratios gives rise to whatever is healthful, strong, musical or visibly excellent. In itself, however, it admits only of a contradictory characterization: it is essentially "the others," "the great and small." It shows itself, particularly, in the way in which quantitative parts evanesce into other parts without end and in the way in which a new beginning, middle or end always appears before, within or after any beginning, middle or end that we try to fix. (For Plato's attempt to describe the continuum, see his Parmenides. For further interpretation of his doctrine, see the works cited in the bibliography below.)

This mystical Platonic view of the infinite was replaced by the clear formulations of Aristotle which have, to a large extent, remained definitive for western thought. For Aristotle the infinite exists only "after a fashion": after another fashion it does not exist at all. It never exists in the sense that we ever actually have an infinitely large number of things or of parts of things or anything which exceeds in size all things of limited bigness. The infinite is something potential or facultative: its presence in a field means that one always can go on to ever larger sizes, divisions or number in that field, that one can go outside of any given size or number to one that lies beyond it. So understood the infinite is incompatible with wholeness and perfection; for something to be infinite means that one never can have 'all of it, only more and more of it. Mathematicians, Aristotle observes, talk as if they needed infinite quantities in their calculations; in reality they need only finite quantities, but as large as they require. Nor can our world contain anything infinitely great, since Aristotle shows it to be finite and spherical, It is not actually, but only potentially infinite by division: this fact is used by Aristotle to refute Zeno's "disproofs" of the possibility of motion. Time, indeed, goes on endlessly in either direction but it is not infinite in the sense of ever being there all at once. Even the potential being of the infinite is. for Aristotle, a queer sort of potentiality: unlike the potentiality of the statue in the block of stone, it can never be translated into actuality.

The Infinite in Modern Philosophy.—Modern post-Renaissance thought shows the same tension as does ancient thought between the acceptance of an actual and a merely facultative view of the infinite. In the main, the continental European rationalists espoused the former, while the British empiricists favoured the latter. Thus Descartes held infinity to be a positive notion: it is only by contrast with the infinity involved in my inborn idea of God that I can become conscious of my own finitude. In Spinoza the infinite becomes the omnicomprehensive or absolutely infinite: reality or substance is for him infinite in a sense which renders illusory any division of it into clear-cut finite parts and which entails its including, not merely infinitely many finite "modes," but also all possible modes in each basic kind or attribute. In Leibnitz, too, there is a ready acceptance of the view that in every organized part of nature there is an actual infinity of subordinate parts, each expressing a governing monad or entelechy. He is careful to explain, however, that (apart from God) he does not believe in a single substance which is infinitely great or infinitely small: the infinitely great and small (as employed by him in the calculus) are for him merely useful mental fictions not admissible in philosophy (see his letter to B. des Bosses, March 11, 1706). But if Leibnitz had reserves in this regard, his contemporaries or successors had none: they talked without scruple about infinitely small or vanishing quantities and spent much time over such problems as that of the value of the infinite sum $1-1+1-1+1-\ldots$.

As opposed to this uncritical acceptance of an actual infinite, the British empiricists were more wary. Thus Locke spoke of our idea of infinity as an "endless growing idea" and denied, as against Descartes, that we could ever form a positive and distinct idea of infinite magnitude In like fashion Berkeley, in The Analyst, subjected contemporary mathematical treatments of the infinitesimal to a devastating critique. Hume, too, refused to allow that we had an impression, and could consequently form an idea, that admitted of the infinite division demanded by the mathematicians. It is this critical approach to the infinite which is, in the main, characteristic of the German idealists. Thus Kant gets round his antinomies involving infinite series—the antinomy, for instance, as to whether the world ever had a beginning in time or not, or as to whether its series of events goes back to a first cause or admits of an infinite regress in causation—by holding that, while we are obliged to go back indefinitely from any empirical feature of the world to other features presupposed as its conditions, it makes no sense to try to sum up the totality of conditions thus involved. For Kant as for Aristotle. infinity is incompatible with completeness. The same point of view is given a somewhat mystical expression by Hegel, when he contrasts his own "true infinite" with the "bad infinite" of the mathematicians, the bad infinite being characterized by an endless vain effort to transcend the finite, which it only succeeds in reinstating, whereas the "true infinite" is achieved when the finite is seen in its place in the whole system of finites, as expressive of a unity which pervades them all.

The Mathematical Infinite.— Modern mathematical thought has devised various conceptions which have enabled it to avoid confused and self-contradictory views of the infinite. Thus the useful phrases "tending to zero" and "tending to infinity" have been, since the time of Augustin Cauchy (1789–1857) (*q.v.*), so interpreted that they no longer seem to involve a reference to single quantities which are infinitely large or infinitely small. To say, for instance, that a certain function of a variable x "tends to infinity" as x "tends to zero" is merely to say that one can make

the value of that function of x exceed any finite number, however large, provided that x is given a value sufficiently close to zero. In the same way, useful geometrical talk about points, lines and planes "at infinity" involves no reference to anything infinitely remote. Thus to say that parallel lines intersect at a point at infinity is only to say that the point of intersection of lines which are *not* parallel will recede to any finite distance, however remote, the more nearly such lines approach the parallel.

In another region, however, modern mathematical thought has tended to reinstate the actual infinite; *i.e.,* the field of Georg Cantor's transfinite numbers. This development rests on a view of number which connects it with the establishment of one-one correlations between the members of different classes and which applies this notion to the case of series or progressions which lack a final term; *e.g.,* the series of positive integers 1, 2, 3, 4, etc. If we now ask ourselves what number can be assigned to the whole set of terms belonging to such a series or progression, it will be plain that we cannot assign to it the number of any subset reached in the successive running-through of such a series or progression. We shall have to widen our notions of number and assign to it a number differing from, and also exceeding, any such successively reachable number. It will have to be the number of an ordered progression lacking a final term, not any number exemplified *in* such an ordered progression. Though such a number cannot be reached through stepwise increases by unity (which Cantor calls his first principle of the formation of numbers), it can be reached by considering the whole set of terms which are reachable by such stepwise procedures (this Cantor calls his second principle of the formation of numbers). The functioning of this new type of number will be in many ways peculiar. Thus a transfinite aggregate will not be increased by the addition of a unit or by that of a finite number of such units: it can even have infinitely many units added to it or taken away from it, while remaining as infinite as ever. Thus the series of odd integers can be put into one-one correlation with the complete series of integers and is therefore of the same number. This capacity to have proper parts which are equal in number to the whole can be taken as definitory of transfinite aggregates. It can, however, be shown that not all transfinite aggregates can be put into one-one correlation with one another: there are some (*e.g.,* that of the real numbers in the continuum) which elude reduction to an ordered list or progression and which must therefore be said to be of a higher, nondenumerable type of infinity. The theory of Cantor deals with many distinct orders of nondenumerable infinity.

The Cantorian theory has built up an account of transfinite number in which no inconsistency is discoverable. There are, however, profound obscurities in regard to the precise meaning of the theory: it gives rise to problems deeply involved with questions concerning the foundations of mathematics and the analysis of numerical statements. On certain views (*e.g.,* the somewhat different views of Ludwig Wittgenstein and L. E. J. Brouwer), we can make use of the idea of infinity only in cases where we have a rule to guide us through its labyrinth: it is senseless to talk as if we could ever have an infinite aggregate before us or could ever complete a process involving an infinite number of steps or cases. Such views give small meaning to Cantor's denumerable type of infinite and no obvious meaning at all to his higher, nondenumerable types of infinity. On other views (*e.g.,* that of Bertrand Russell), talk about the infinite involves us in finding some actual class somewhere in the universe, correlation with which will constitute the infinity of any class; such an "axiom of infinity" is, however, profoundly dubious, more particularly in view of the findings of modern physics, which make the world finite in extent and in divisibility. It may, however, be argued than there is no more to the "existence" of transfinite numbers than the *possible* existence of aggregates exemplifying any and every finite number in their proper parts, and that we perfectly understand what this means. On such a view, the main use of Cantorian concepts is to dispel the atmosphere of awe and mystery attaching to the mathematical infinite and to restore it to those ethical, aesthetic and religious objects to which it more properly belongs.

BIBLIOGRAPHY.—J. Burnet, *Early Greek Philosophy,* 4th ed. (London, 1952); F. M. Cornford, *Plato and Parmenides* (London, New York, 1939); Plato, *Philebus;* W. D. Ross, *Plato's Theory of Ideas* (Oxford, 1951); Aristotle, *Physics,* iii;, H. Cherniss, *The Riddle of the Early Academy* (Berkeley, Los Angeles, 1945); Spinoza, *Correspondence,* tr. and ed. by A. Wolf (London, New York, 1928); Leibnitz, correspondence with Des Bosses, in *Die philosophischen Schriften,* ed C. J. Gerhardt, vol. ii (Berlin, 1879); George Berkeley, *The Analyst;* Kant, *Critique of Pure Reason,* div. ii, bk. 2, ch. ii, section 7; Hegel, *Lesser Logic,* sections 94, 104; A. E. Taylor, *Elements of Metaphysics* (London, 1903); W. T. Stace, *The Theory of Knowledge and Existence* (Oxford, 1932); A. M. Farrer, *Finite and Infinite* (Westminster, 1943); L. Couturat, *De l'infini mathématique* (Paris, 1896); Bertrand Russell, *Principles of Mathematics,* new ed. (London, 1951), and *Introduction to Mathematical Philosophy* (New York, 1919; London, 1952); F. Klein, *Elementary Mathematics from an Advanced Standpoint,* Eng. trans. by E. R. Hedrick and C. A. Noble (London, 1932–40); B. Bolzano, *Paradoxes of the Infinite,* Eng. trans. by F. Prihonsky (New Haven, London, 1950); F. Waismann, *Introduction to Mathematical Thinking,* Eng. trans. by T. J. Benac (New York, 1951; London, 1952); S. C. Kleene, *Introduction to Metamathematics* (Amsterdam and Groningen, 1952); G. Cantor, *Contributions to the Founding of the Theory of Transfinite Numbers,* Eng. trans. by P. E. B. Jourdain (New York, 1952); A. Ambrose, "Finitism in Mathematics," *Mind,* vol. xliv (1935); W. V. Quine, "Steps Towards a Constructive Nominalism," *Journal of Symbolic Logic,* vol. xii (1947). (J. N. F.)

INFLAMMATION. Inflammation is the characteristic response of animal tissue to injury Whenever tissue is injured, whether by burning, tearing, chemicals. bacteria, viruses or parasites, there follows a series of reactions at the site of injury. Certain portions of the inflammatory reaction are common to all types of injury. Thus redness, heat, swelling and pain are known as the cardinal signs of inflammation and as such were first clearly recognized and described by Celsus (A.D. 34). Although there is a fundamental similarity in the pattern of the response to injury. there is also a nide range of variation in the appearance and course of events following trauma. The four cardinal signs are all evident in cuts, burns, insect bites and boils. The duration, the amount of tissue destruction and proliferation and the residual disability, however, differ in each instance. These differences are functionally related to the following factors: (1) the nature of the irritant (burn, chemical, bacteria, etc.); (2) the structure of the tissues in nhich the event occurs; (3) the condition of the host at the time of injury and during the subsequent process. All three factors, each complex in itself, must be accounted for in arriving at an understanding of the inflammatory process. The general pattern of the inflammatory response can be divided into four major parts: (1) cell and tissue injury; (2) the blood vessel (vascular) response; (3) the exudate; and (4) restitution or repair.

Tissue Injury.— The amount of tissue injury and cell death (necrosis) which occurs depends upon the nature of the irritant. This injury or death may be brought about by physical agents, chemical substances or living agents, including microorganisms and parasites. Physical agents include violent force. heat, ultraviolet and X-irradiation. Chemical poisons may be the salts of simple inorganic substances, such as mercury, silver, arsenic. acids and alkalies, simple organic molecules such as formaldehyde and turpentine or complex organic molecules such as bacterial toxins, enzymes. etc. Viruses are essentially large complex organic molecules which grow only in living cells and operate by interfering with cell metabolism. Bacteria and parasites produce, as a result of their metabolism, substances chemical in nature which kill or injure cells. This cell injury or death leads to the release and degradation of materials normally contained within the cells. These substances in turn produce effects on local tissue structures and. nhen absorbed into the blood stream. affect distant organs. This is illustrated in the following situation: When the blood supply to an area is shut off. as in thrombosis of an artery, the local tissue supplied by the artery frequently dies. The dead cells release substances which diffuse into the adjacent living tissue and into the blood stream. In the marginal zone the characteristic changes of inflammation occur. Similar phenomena occur when physical agents, chemical agents or living pathogenic organisms cause tissue damage or death

Blood Vessel Response.— The redness, suelling and heat in an area of injury are an expression of alterations in the blood vessels —dilation of the smallest vessels, capillaries, arterioles and venules, accompanied by leakage of the blood plasma and its proteins into the surrounding space. The redness is accounted for by the increased quantity of blood in the dilated vessels, the heat is an indication of the associated increased blood flow. while the swelling is caused by the excess fluid in the tissue spaces. More severe alteration in the vessels is associated with accumulation of formed elements and coagulation of the blood.

Exudate.— In some inflammations simultaneous with or shortly following the alterations in the blood vessels the white blood cells and sometimes the smaller structures known as platelets begin to adhere to the walls. The white blood cells. particularly the polymorphonuclear leukocytes, are capable of amoeboid movement and migrate through the endothelium of the blood vessels.

Other white blood cells — lymphocytes, monocytes and eosinophiles — also migrate from the blood stream in some conditions. Additional cells are contributed from the local site by elements in the connective tissue associated with the blood vessels. The combination of cells and fluid containing the various plasma proteins is called the exudate.

The exudate has a variable composition, in terms of its protein and cell population. which is related to the nature of the irritant. Thus the mild irritants lead to a serous exudate composed mainly of fluid and smaller blood plasma proteins. Some irritants cause rupture of blood vessels with leakage of red blood cells; these are called haemorrhagic exudates. Pus is an exudate composed of dead tissue, many white blood cells in various stages of disintegration. and a small quantity of plasma. It is associated usually with bacterial infection.

The cells of the exudate have several functions. The polymorphonuclear leukocytes engulf (phagocytose) bacteria and digest large numbers of them. The monocytes do likewise. The polymorphonuclear leukocytes when lysed rclcase enzymes capable of digesting various products of dead tissue. The lymphocytes also produce enzymes: plasma cells produce antibodies. The plasma component of the exudate has many constituents including fibrin. antibodies, enzymes, nutrients, hormones and products derived froni degraded cell structures. Of particular importance are the opsonins, which occur normally or are formed in response to the presence of an infectious agent. These substances, one class of which is known as antibody, enhance the effectiveness of the engulfment (phagocytosis) of bacteria by the white blood cells. In the absence of sufficient numbers of polymorphonuclear leukocytes, infection may become rampant. Likewise the absence of sufficient opsonin or antibody is associated with lack of usual control of infection and inflammation.

Restitution and Repair. — In situations in which cell death and tissue destruction are nil or minimal the return to the normal state is by resorption of exudate. This process is known as resolution. When cell destruction is extensive there may be regeneration of those tissues which are capable of regeneration. such as epithelium. liver cells. certain types of tissue fibres and bone. In general the more complex a tissue the less likely it is to regenerate. Certain tissues such as nerve cells do not regenerate, although the nerve processes may if the cell body is not injured. In those tissues n-here regeneration does not occur the repair is by fibrous tissue replacement and is known as scar formation.

VARIATIONS IN THE INFLAMMATORY RESPONSE

Properties of the Irritant. — Irritants may be physical or chemical. or they may be living biological organisms, including bacteria. viruses. fungi and parasites such as worms of various types. The character of the irritant is important in conditioning the type of reaction which ensues. An important difference between living and nonliving agents is in the fixed quantity of the latter as opposed to the reproductive capacity of the former. Thus a sufficiently small amount of chemical substance lethal in larger quantities may produce only a mild reaction. but even a single bacterium may, in a susceptible host, multiply and cause overwhelming disease.

Direct physical trauma, a blow or cut, damages and kills tissue cells. The damaged cells then release chemical substances, some of which are excitants of the inflammatory reaction. The types of substances released are ions of the cell sap. products of the degradation of cell proteins, and cell metabolites not normally present in any large quantity in the cxtracellular space. These liberated materials affect small blood vessels either directly or through the activation or release of such substances as histamine or by way of the nerves which control the vessels.

The cardinal signs of inflammation can be reproduced by injecting into the skin a small amount of histamine. The mosquito bite and nettle sting produce a similar phenomenon. Such reactions can he prevented wholly or in part by an antihistaminic. Histamine is present in most body tissues in special cells known as mast cells. Damage to these cells by substances liberated from bacteria, from damaged tissue cells or from extraneous sources liberates histamine and probably other substances. Several chemical substances have been isolated from inflammatory exudates which are capable of causing capillary dilation and increased permeability, of inducing elevation of the white blood cell concentration. of producing fever and of causing damage and death to other cells. These appear to be partially hydrolyzed derivatives of protein and other tissue substances. Thus simple mechanical tissue damage of sufficient extent may produce the total constellation of inflammation including both the local and general manifestations.

Heat applied for a sufficient time and at a sufficient intensity (about 45° to 50° C. [113°–122° F.] for a few minutes depending on size of part. rate of blood flow insulation, etc.) will cause the appearance of pain. redness, heat and smelling. This results from the liberation of chemical substances from the injured tissue. Higher temperatures and more prolonged exposures (scalds, oil burns, etc.) cause more extensive tissue injury and death. Blistering is the result of the accumulation of fluid exudate between the layers of epidermal (superficial skin) cells. Sunburn is due mainly to the effects of the ultra-violet in the sun's radiation. Mild exposure causes only the redness and slight swelling associated with mild injury. Longer exposure or exposure to more intense radiation causes a more severe reaction. which on the skin is seen as blistering. Ionizing irradiation such as X-ray or other products of nuclear fission can also elicit reactions varying from simple erythema (the redness reaction, to extensive tissue destruction. From the standpoint of the inflammatory reaction the process is similar to the others. In addition subtler changes occur in irradiated cells.

Chemicals such as mustard gas, strong acids or alkalies applied to the skin surface or injected into tissue cause alteration in cells which may vary from mild, microscopically indiscernible changes to necrosis. Associated with this there may be mild reactions such as erythema or more severe reactions including tissue death, blistering and formation of a purulent exudate.

Bacterial incitants of inflammation are ubiquitous in the environment and within animals. They are in the soil, floating in the air. on the skin surface and in the gastrointestinal tract from mouth to anus with the possible exception of the stomach (in the stomach the high acidity and digestive enzymes provide an inclement milieu for bacteria). Many bacteria are normal inhabitants of the skin surface and gastrointestinal tract; under ordinary circumstances they do not cause inflammation unless there is an alteration in the balance between the animal host and the bacterium. Such is the case for example with many staphylococci and streptococci and with the colon bacillus. The factors which maintain this balance are in two categories: those of the host which prevent excessive multiplication of the bacteria, and those of the bacteria which promote its virulence or invasiveness. The host factors involved will be considered later.

Bacteria produce a variety of chemical substances which in part account for their virulence or invasiveness. Some of these substances are enzymes, complex sugars. proteins and fats. while others are simpler derivatives of amino acids such as histamine. These substances formerly were classed together under the term toxins. It later became clear, however, that all these chemical agents can. each in a relatively specific fashion. alter the structure or the metabolism of the host cells. Thus the protein toxin of diphtheria bacillus interferes with the formation of certain respiratory pigments of tissue cells, the cytochromes. This leads in turn to impairment of cell metabolism or death, or both. Some bacteria (streptococci and pneumococci) produce an enzyme known as hyaluronidase. which causes breakdown of hyaluronic acid. an important constituent of the ground substance of connective tissues. This allows spreading of bacteria and other substances through the tissue spaces. Many microorganisms produce enzymes capable of attacking and splitting the proteins of the cells and tissues; including the collagen and reticulin fibres of the connective tissue. Such enzymes also liberate fragments of protein which in themselves are capable of inciting portions of the inflammatory reaction including the vascular injury and the ingress of leukocytes.

Viruses are obligatory intracellular parasites; that is, they need

a complete cell such as a tissue cell or a bacterium in which to grow. In this respect they differ from many bacteria. which if supplied with a simple or complex set of nutrients in a cell-free medium will multiply. Viruses damage tissue by interfering with the metabolic processes of the cells which they parasitize. The reaction of tissue to viruses and other agents involves cell damage or death with the attendant vascular, exudative and reparative phenomena.

Site of Inflammation. — The nature of any inflammatory process depends in part upon the site of occurrence in the host; the site depends in turn upon the nature of the organism and its portal of entry into the host. Certain organisms are air-borne and usually are inhaled or taken in with food or other objects introduced into the nose or mouth. The pneumococcus, streptococcus, meningococcus and many of the viruses enter the body in this way. They are specially adapted to invade the membranes of the nose, throat and tracheobronchial system. Some organisms taken in with food or other objects are capable of surviving passage through the stomach with its acid digestive secretions and of invading the mucosa of the bowel; included in this group are the organisms causing typhoid fever and the various dysenteries. The virus of poliomyelitis likewise survives passage with the food and invades via the gastrointestinal tract. In contrast with typhoid and dysentery bacilli. the polio virus finally causes its main disease manifestations after passage through the blood stream to a distant site, the central nervous system. Many disease-producing microorganisms exhibit this predilection for principal growth in a certain tissue.

Inflammation in a tightly confined tissue, such as the marrow of the bones or the pulp of a tooth, produces more extensive necrosis than does inflammation in a soft tissue. This is due to the pressure of the confined exudate. which restricts the flow of blood. In certain spaces such as the peritoneal and pleural cavities the exudate spreads freely and may be voluminous. In the meninges of the brain the exudate may spread freely on the surface but its volume is restricted by the cranial bones.

The site of an inflammatory process conditions not only the character of the local reaction but also its consequences. An abscess in the brain leading to destruction of a small vital area may spell severe disability or even death. On the other hand, a lesion of the same extent in skin, muscle or even liver may have little serious consequence.

General Host Factors Conditioning Inflammation. — Normally there are chemical substances in the sweat and sebaceous secretions of the skin which prevent bacteria from excessive multiplication and invasion of the body. Saliva and other secretions and cellular activities of the gastrointestinal tract act similarly. Changes in the physiological state of the host may lead to alterations in the host's tissues and secretions which allow proliferation and invasion of bacteria such as staphylococci. This happens. for example, in adolescent acne. Similar though usually less drastic changes may occur at other times with appearance of crops of boils. Some of these changes are due to alterations in endocrine gland secretions; the amount of antibody formed in response to an infectious agent can be important in conditioning the pattern of inflammation. Practically all humans and animals have the capacity to form antibodies. Some persons. however. are unable to form antibody to certain types of agents. Severe starvation or dietary deficiency of protein may restrict antibody formation. Hormones of the adrenal cortex in sufficient amounts depress formation of certain types of antibody.

The adrenal cortex secretions are capable of altering the inflammatory reaction in several ways: excessive amounts of the hydrocortisone type of secretion reduce the quantity of exudate formed and the amount of fibrous tissue and capillary proliferation. The adrenal cortex is under the control of the pituitary secretion and the pituitary is controlled by many factors both humoral and nervous. Thus many factors which regulate the general state of a person can modify inflammation.

SPECIFIC EXAMPLES OF INFLAMMATION

Boils.—A typical and common inflammation is the boil, occurring on the skin following invasion of bacteria through a natural channel such as a hair follicle or sweat gland or through a break in the surface. The type of bacterium most frequently causing boils is the staphylococcus, which multiplies and induces death of a few cells locally. Both bacteria and dead tissue cells then liberate materials which engender formation of exudate. In this case large numbers of polymorphonuclear leukocytes are the main cellular elements. From the vessels come plasma and its fibrinogen which clots and forms a fine fibrin network which helps prevent spread of bacteria in the local tissues. With the formation of more exudate the boil progressively enlarges and follows the path of least resistance toward the skin surface. Finally. in most instances, it ruptures, and the pus and bacteria are evacuated. The walls of the cavity collapse and, if the growth of bacteria is sufficiently checked by the combination of antibodies and phagocytes, repair by fibrous tissue replacement occurs.

Abscesses.—When a similar focus in deeper tissues is started the reaction is similar to that in a boil and is called an abscess. This may reach considerable size and last for some time, becoming chronic. There is a central focus of necrosis and pus. Around the pus is a layer of fibrin which lies upon a surface of newly proliferated and dilated capillaries known as granulation tissue. In a chronic abscess this is encapsulated by fibrous tissue. With time the bacteria may become attenuated, either spontaneously or with the help of administered antibacterial agents, and die off. The dead material is absorbed slowly unless evacuation occurs spontaneously or by surgical incision and drainage. The result again is repair by scarring.

Ulcers. — An ulcer is an inflammation on a surface — the skin or the lining of the gastrointestinal tract. It may be acute (of recent onsetj or chronic. The open surface or crater of an ulcer usually contains a mixture of dead tissue cells, leukocytes and fibrin, resembling the pus of an abscess. In an acute ulcer there is a characteristic congestion of blood vessels in the underlying live tissue. In a chronic ulcer there is also granulation tissue and fibrous tissue with some inflammatory cells. In the inflammatory cell population lymphocytes and plasma cells usually predominate. When the stimulus to ulceration is removed the fibrous tissue fills in the gap and epithelium grows from the margins to cover the surface.

Fever Blisters; Common Cold. — The virus which causes fever blisters is present in the body in the epithelial cells of skin and mucous membranes; when conditions in the host are altered by the presence of a mild infection such as a cold. or a severe infection such as pneumonia. the virus proliferates and produces obvious inflammation. The chief manifestation is blistering due to changes which include death of some epithelial cells and fluid separating the layers of cells in the skin. Associated with it is a mild hyperaemia and an exudate composed of white blood cells. A secondary bacterial invasion may occur with pus formation.

The agent of the common cold, presumably a virus, causes redness and swelling of the nasal mucous membranes and an abundant watery exudate containing, in addition to plasma constituents. considerable quantities of dilute mucus and a sparse population of exudate cells. This process is usually self-limited in a few days. Frequently it becomes secondarily invaded by bacteria, and pus is then formed. No serious tissue loss occurs and the return to normal is by resolution and regeneration of lost epithelium.

Allergic Inflammations. — Hay fever induced by pollens, house dust, horse dander and other stimuli is a source of great discomfort to a substantial proportion of the population. Many persons are sensitive to the products formed following ingestion of certain foods. In these cases another injury mechanism is introduced; the appearance of certain kinds of foreign materials in the body engenders the formation of antibodies. Foreign proteins are the main stimulants to antibody formation (antigens), but complex sugars and fats and certain chemicals which react with proteins will also cause formation of antibodies. The latter circulate in the blood and are frequently deposited widely in the body tissues. When the specific, or a very closely related, foreign substance is reintroduced it reacts with the antibody. In the process of this reaction substances including histamine are set free from

the tissue cells and produce the inflammatory process. Thus the irihalation of pollen causes hay fever; another type is allergic asthma. Urticaria (hives) is produced in a similar manner by antigen which is absorbed and distributed via the circulation or applied locally to the skin. In some instances (for example, following local reinjection of foreign protein), the antigen-antibody (allergic or hyperergic) reaction can be severer. with extensive tissue and cell destruction. Formation of antibody and the attendant allergic reaction appear in the later stages of some chronic bacterial and fungous infections; *e.g.*, tuberculosis and ringworm. The exudates in allergic inflammation characteristically contain a large number of eosinophilic leukocytes.

An aberrant antigen-antibody reaction is thought to be involved in rheumatic fever and glomerulonephritis. A factor common to both diseases is the occurrence two to three weeks before their onset of an upper respiratory infection, usually with β-haemolytic streptococcus. This infection is long past its peak when the disease makes its appearance. The inflammation of rheumatic fever involves the joints. heart and lining of small blood vessels. In its acute or early phase there is small blood vessel dilatation and an exudate with leukocytes. Characteristically there appear in certain sites Xschoff's nodules. special forms of the inflammatory process in which there are no demonstrable bacteria. There is swelling and fragmentation of the connective tissue fibres (collagen bundles) and the appearance of large, frequently multinucleated cells. Similar formations. called verrucous vegetations, form on the heart valves and have a large component of fibrin and platelets from the blood. Excessive proliferation of the fibroblasts of the connective tissue of the valves frequently occurs: this leads to thickening and stiffening of the normally thin and flexible heart valves and fusion of their separate parts or cusps. The result is restriction of valve function — one form of heart disease.

In glomerulonephritis there is a somewhat similar process with swelling of the blood vessel tufts of the glomeruli and later fibrous tissue proliferation which may destroy some glomeruli.

Pneumonia. — In pneumonia of the lobar type. caused by pneumococci. an exudate is formed in the air spaces of the lung. At first the exudate cvntains many red blood cells (haemorrhagic exudate). Later a large population of polymorphonuclear leukocytes move in and are enmeshed in a fibrin network. There is little tissue destruction. and when the body produces a sufficient concentration of antibodies or when sufficient antibiotic or chemotherapeutic agent is administered to stop bacterial proliferation the fibrin is digested by enzymes from the white blood cells; the exudate is removed as sputum by coughing. At this time another class of phagocytic cells makes its appearance, the macrophages, and these ingest and dispose of residual debris. The end result is resolution of the pneumonic process, usually without evidence of alteration of lung structure or impairment of function.

Tuberculosis. — Tuberculous inflammation differs in certain respects from the acute pyogenic inflammations described above. Here there is a minimal early exudation with polymorphonuclear leukocytes. Very soon monocytes appear and become transformed following ingestion of the bacteria into epithelioid cells. These. along with some lymphocytes and giant cells. are the common cells of a fully developed tuberculous exudate. Tubercle bacilli proliferate much more slowly than do staphylococci and streptococci and related bacteria: tuberculosis is a disease with a slower tempo than the diseases caused by the pus-producing bacteria. It falls in the class of inflammations known as granulomatous because of the abundance of granulation tissue and fibrous tissue usually present. The tubercle bacillus produces no soluble exotoxins of the kind which kill tissue cells. Substances have been extracted. including some fats. some complex sugars and some proteins, which when injected into animals produce the various cellular responses.

The course and outcome of tuberculous infection has been clearly shown to be highly conditioned by the host. Experimentally strains of rabbits have been bred with a high, low or intermediate resistance to this infection. Given the same strain of bacterial organism in the satne dose, one strain produces a moderate degree of inflammation and considerable fibrous tissue and the lesion becomes arrested: another strain of host gets a rapidly progressive, tissue-destroying inflammation with little fibrosis and dies quickly. The same pattern can be seen in humans. Groups of men who have lived in close quarters and in the presence of tuberculous infection for centuries are usually relatively resistant, whereas those who have not been in contact with the organism or have lived in uncrowded areas have a more rapidly progressive disease and a higher death rate. Susceptibility to tuberculosis is not only an inheritable trait but can be modified by the endocrine system. Xdministration of adrenal cortical steroids of the type of cortisone causes an apparent improvement of the patient's symptoms and a sense of well-being but a more rapid progression of the disease process.

BIBLIOGRAPHY.—W. A. D. Anderson (ed.), *Pathology*, 2nd ed. (St. Louis, London, 1953); H. Florey (ed.), *Lectures on General Pathology* (Philadelphia, London, 1954); R. J. Dubos, *Biochemical Determinants of Microbial Diseases* (Cambridge, Mass., 1954). (E. P. BT.)

INFLATION AND DEFLATION. There is no single, generally accepted definition of inflation. Following World War I the term was widely applied to the enormous increases in money arid prices in central and eastern Europe, notably Germany, Austria and Russia. Inflation thus connoted a breakdown in the value of the monetary unit. arising from a vast increase in the supply of money issued to finance government spending in excess of tax revenues. Until the 1930s inflation was generally defined as an abnormal increase in the supply of money without a corresponding increase in goods and services available for purchase, resulting in a rapid rise in the price level (fall in the purchasing power of the monetary unit.)

Following the work of John Maynard Keynes during the 1930s, however, economists placed less emphasis on the quantity of money as the major determinant of total spending and prices. Instead. current consumer and business spending was considered to be largely a function of income received. Wide variations in total spending and in prices could thus result from changes in the public's decisions to invest or consume, quite apart from changes in the quantity of money. More money would not necessarily lead to higher prices.

Definitions of inflation thus focused on the rise in the price level itself. Many but not all writers continued to emphasize the increased money supply .underlying inflation and to dissociate price increases from monetary expansion. Inflation was now often used to describe slow or moderate. as well as rapid, increases in the price level. Violently rising prices, with a rapid decline in the value of the monetary unit. were often termed runaway, hyper- or open inflation, in contrast with creeping or repressed inflation (the latter referring to prices held down by direct government controls on prices and wages). Serious inflation seldom occurs until substantially full employment is reached, and sometimes price rises in underemployment periods are excluded. Disapprobation almost invariably attaches to inflation, but confusion often arises because of failure to define the term precisely.

Measurement. — If inflation is defined as a rise in the price level, and deflation as a corresponding decrease. a price index or average of individual price movements is needed to measure these changes. Diiferent prices change at different rates in inflation and deflation. Thus. any price index provides only a central tendency of the many individual price changes in inflation and deflation. The change indicated by the index number may be markedly influenced by the particular prices included in the average. If the index is intended to measure changes in the value of the monetary unit. it should ideally include all prices on which the monetary unit is spent, but this breadth of coverage is never attained. (See INDEX NUMBERS; PRICE.)

Causes. — All the major inflations of moder'n history have been associated mith large increases in the quantity of money. created to finance government expenditures in excess of tax receipts during or following major wars. The severest inflations have occurred in defeated countries. suffering from serious disruption of productive capacity, from postwar disillusionment and from lack of confidence in the government's ability to restore economic stability. Faced with the problem of financing large war or post-

war rehabilitation and reparations expenditures, the government needs to collect taxes roughly comparable with its expenditures in order. to avoid inflation. Under such circumstances, however, it is difficult to obtain popular support for increased taxes, especially from a public already impoverished by a long war effort. Thus the government resorts to borrowing to cover its excess of expenditures over tax receipts.

Borrowing from the banks creates new money, whose expenditure represents a net increase in total spending in the economy. Unless production can be increased; this leads to higher prices. Higher prices in turn require higher government outlays and further increase the deficit which must be financed by borrowing. Tax collections lag behind rising incomes. Recourse to more money creation further increases the inflationary pressure. Such an upward spiral of hyperinflation is very difficult to check unless the government can somehow restore confidence by establishment of a new, generally accepted monetary unit. as was done with the rentenmark ending the great German inflation after World War I. Whether the government resorts to direct printing of new paper currency or borrows from the banking system (thereby creating additional bank deposits) is of no major importance in the inflationary process. The type of new money created depends largely on the financial institutions and habits of the country concerned.

In the great German hyperinflation, for example, the quantity of paper marks in circulation increased from about 2,000,000,000 marks in 1914 to about 500 quintillion (500,000,000,000,000,000,000) at the end of 1923. At the peak of the inflation in 1923, 1,000,000,000,000 paper marks had about the same purchasing power as 1 prewar German mark—about 24 U.S. cents. Postage for a local letter cost 100,000,000,000 marks. To conserve paper and printing press time, notes were printed in billion- and trillion-mark denominations. Prices rose so rapidly in late 1923 that paper money lost half or more of its value in an hour, and wages and salaries were paid daily or oftener to facilitate quick spending of earnings. Rising prices outdistanced increases in the money supply as people greatly increased the rate at which they spent their receipts. With the introduction of the new German rentenmark to re-establish confidence in 1924, the preceding paper currency was in effect completely repudiated.

Similar, though less severe, inflations occurred after World War I in Russia, Austria, Hungary, Poland and other nations. Other great inflations in modern history were that in China during the 1940s, in the United States following the Revolutionary War (where the paper Continental fell to one-thousandth of its previous value) and in France during the 1790s (when the paper assignat fell to about one five-hundredth of its former value). Such hyperinflations were comparatively rare, but milder inflations have been commonplace throughout modern history. Price-level fluctuations as part of business booms and depressions have never reached the magnitudes of the major inflations associated with large government deficits, and modern economists emphasize the favourable impact of rising prices in helping to end depressions.

In nearly all countries, control over the supply of money (paper currency and bank deposits) is directly or indirectly under the government. Thus important inflations can occur only with the acquiescence or active support of the government. In business cycles, however, variations in the money supply may arise out of private decisions on borrowing, if the government permits a banking system that expands and contracts its loans in response to varying public demand for borrowed funds. Price fluctuations also reflect variations in the rate at which money is spent. Such milder price fluctuations are particularly disruptive when deflations are accompanied by mass unemployment, which is usually the case if prices fall sharply.

During part of the 19th and early 20th centuries, the prevailing gold standard limited the issue of paper money and bank deposits to the amount the public would hold instead of gold; gold could be obtained freely in exchange for other money. With the virtual elimination of free domestic gold conversion following World War II, this provision was replaced in some nations by legislation limiting the amount of money allowable per dollar of gold reserve held. Elsewhere, there was no formal metallic limit on money issue. As long as either free gold convertibility or a fixed money-to-gold ratio prevails, there is an ultimate limit on the government's power to acquiesce in runaway inflation. though substantial inflations and deflations have occurred under both types of gold standard. Under the war and postwar pressures which have led to hyperinflation, public support for government adherence to any metallic standard has not been strong enough to make the metallic standard a serious barrier to inflation. From the end of World War I onward there was a strong world-wide tendency to place major reliance on discretionary government control over the supply of money, instead of on a rigid metallic system, to attain the economic ends desired by the country.

Governments. whether democratic or dictatorial. almost invariably find inflationary policies easier than deflation. Strong deflationary pressure on total spending generally causes unemployment and reduced output as well as lower prices; this leads to strong political pressures for expansionary measures. Many observers feel that, particularly in the democratic nations, the political process is likely to produce gradual inflation as a continuing development; labour, business and agricultural voting blocs put pressure on legislative bodies to obtain larger money incomes, through such politico-economic devices as minimum wage laws, supported commodity prices and other indirect income subsidy or support measures. Modern business and labour mores lead to strong resistance to substantial price cuts. The increased power of organized labour in many nations also increased the likelihood of strong upward "cost-pushes" on the price level, as union wages are bid upward in bargaining with management.

Effects.—The economic effects of inflation and deflation can be analyzed by considering the effect on the current and future levels of total output, on the current distribution of income and on the distribution of wealth (claims on future income).

Moderately increasing prices are generally considered a stimulant to employment and output in periods of less than full employment of resources. As such, they are widely supported by economists and businessmen. Once substantially full employment is reached, however, inflation can have little effect in stimulating greater current output. There is, on the other hand, little evidence that inflation has seriously disrupted and reduced total production until hyperinflation is reached. In the German inflation, for example, total output continued to rise until 1923, when rising prices finally led to disruption of business relationships and to great speculative rather than productive activity. Many observers believe, however, that even moderate speculative, price rises during business booms increase the likelihood of a quick downturn in business activity and prices. There is some supporting evidence for this position, but little evidence that deflations correspond in size to immediately preceding inflations.

Hyperinflation produces a violent redistribution of income and wealth, in general away from fixed to flexible income receivers and away from creditors to debtors. Landlords, bondholders and fixed income middle-class employees have been the most drastically injured large groups. Entrepreneurs in business and agriculture generally, and adept speculators in particular, are the major gainers. The income share of wage earners, the largest income group, appears often to have remained relatively stable, though with wide variations between individuals depending on the type of wage contract and on adeptness at bargaining up wages with rising prices. Over-all, it is not clear whether inflation substantially alters the shares of the national income going to the rich and the poor. Creditors, who are largely in higher income groups, suffer directly while debtors gain. The superior understanding and speculative opportunities of higher income groups and large entrepreneurial incomes provide strong countereffects.

The extent to which expectations become adjusted to continuing inflation largely controls inflation's impact on the distribution of income and wealth. Money contracts tend to be adjusted to expected inflation. Except for long-term contracts, terms restricted by government policies and cases where some individuals or groups have superior anticipations or bargaining power, the redistributional aspect of inflation is greatly mitigated.

The effects of deflation are generally the converse of those of inflation. except that substantial deflation has seldom occurred without mass unemployment and falling total output. Deflation is thus socially and economically painful. and is unlikely to be followed for long as a conscious government policy.

(See CURRENCY; MONEY; WAR FINANCE: COST OF WORLD WARS I AND II.)

BIBLIOGRAPHY.—Constantino Bresciani-Turroni, *The Economics of Inflation* (London, 1937; New York, 1940); League of Nations, *The Course and Control of Inflation* (New York, 1946); Lester V. Chandler, *Inflation in the United States, 1940–1948* (New York, London, 1951); Lionel Robbins, *The Great Depression* (New York, London, 1934); A. J. Brown, *The Great Inflation, 1939–1951* (London, New York, 1955). (G. L. BH.)

INFLORESCENCE, the arrangement of the flowers on the axis, or the ramification of the floral axis, composed of the rachis, which forms the stalk supporting the flower or cluster of flowers, called the peduncle. A flower having no stalk is called sessile. The floral axis may be shortened, assuming a flattened convex or concave form and bearing numerous flowers as in the artichoke, daisy, etc. There are two distinct types of inflorescence: (1) indeterminate, indefinite or axillary; and (2) determinate, definite or terminal.

A third series of inflorescence is termed mixed. In the compound indefinite inflorescence the lateral shoots develop centripetally upon a primary axis into a group of racemes or compound racemes. *See* FLOWER.

INFLUENZA is an acute infectious respiratory disease caused by a filterable virus. The disease commonly occurs in epidemics; they develop quickly, spread rapidly to as much as 25% to 40% of the population, with low fatality, and terminate abruptly. Within a short period of years the illness reappears in the same geographic area. It is abrupt and of brief duration. characterized more by prostration and aching than by obvious signs of respiratory disease. Complications of bronchitis and pneumonia are common. At times the epidemics become world-wide or pandemic, and during these periods. as in 1918, the severity of the disease and the frequency of complications may attain terrifying proportions. Some authorities have considered the severe pandemics a different disease from those of intervening years. but the resemblances between the two are so great as to suggest that they are of the same basic nature. The specific cause of epidemics previous to 1933 was not known. After that time, however, viruses (*q.v.*) were identified as the primary agents of influenza A and influenza B. Snine influenza, studied extensively by R. E. Shope, is caused by a virus related to type A influenza virus, in conjunction with a bacterium. *Hemophilus influenzae.*

History of Epidemics. — Influenza has a long history. An epidemic described by Hippocrates in the 5th century B.C. has been called influenza, but the first clear description is that of the epidemic of 1610. The descriptions of numerous outbreaks through the succeeding centuries reveal a tendency to surprising uniformity of behaviour but considerable variation in time of occurrence and severity. The severer outbreaks have been the most completely described, culminating in the extensive reports of the pandemics of 1889–goand 1918.

Many of the epidemics were thought to have arisen in Russia. where a reservoir of influenza was said to exist and to have spread into Europe by the routes of travel. As rates of travel increased it became more and more difficult to trace a progressive extension until in 1918 the disease seemed to erupt almost simultaneously in widely separated geographic areas. In Oct. 1889 influenza was recognized in Siberia; in November it had reached Berlin, Ger., and Paris. Fr.. and in December extended to Spain. Italy and England. In the same month the cities of the Atlantic seaboard of the United States were involved; in early January the cities of the middle west and. somewhat later, San Francisco, Calif., on the Pacific coast, had their peaks of incidence. In the autumn of 1918 much of the northern hemisphere was blanketed by influenza in approximately one month. Australia and certain rather isolated areas were not affected until later. These examples clearly illustrate the rapid, widespread distribution of the severe outbreaks; evidence indicates that in its milder forms the same tendency exists.

Epidemics of influenza commonly affect a high percentage of the population although accurate data have been uncommon. In pandemic times incidence rates as high as 30%–40% were repeatedly reported; in milder epidemics estimates of 10% were common. The frequency of illness is greatest in children, although the impression widely prevails that adults are most commonly attacked. It is true, nevertheless, that young adults are prominently affected.

Despite the high incidence, mortality is commonly low, and deaths from uncomplicated influenza are infrequent. On the other hand, there is usually an increased mortality from complications such as pneumonia, and excess mortality among patients with cardiac or other debilitating disease, especially at ages over 50 years. The 1918 epidemic was the most destructive in history; in fact it ranks with the plague of Justinian and the Black Death as one of the severest holocausts of disease ever encountered. It was estimated by E. O. Jordan that more than 20,000,000 persons perished of influenza in a few months and more than 50 times as many were sick. In India 12,500,000 persons, or 4% of the total population, are said to have been killed by influenza in the autumn of 1918. In the United States 548,000 died. In contrast, the pandemic of 1889–90, which also had a high attack rate, had a mortality of less than one-tenth that of 1918.

Influenza is most commonly a disease of the colder half of the year, but it is not strictly limited. The severer episodes appear to be less controlled by season than those of intervening years. In tropical and subtropical areas, epidemics occur with a frequency similar to that seen in the temperate zones.

Another feature encountered prominently in the pandemics of 1889–90 and 1918, as well as in earlier ones, is the tendency toward "waves" of infection. This is seen by the appearance of an epidemic, the first wave, in the winter of 1889–90; the second wave, a severer episode, 14 to 1j months later in the spring of 1891; a third mild disease in the late fall and winter of 1891–92. A mild, world-wide epidemic in the spring and early summer of 1918 was followed by the astoundingly severe epidemic in the autumn; a third rise in the spring of 1919 was quite irregular and was of doubtful relation to the preceding two. Reports are confusing as to whether an attack in the first wave gave resistance to the second.

Later Epidemics. — In 1933 influenza virus, type A, was first isolated by W. Smith, F. W. Andrewes and Patrick Laidlaw in London, and the following year in the U.S. by Thomas Francis, Jr. Thereafter a number of outbreaks of influenza A were observed at intervals of two to three years. There was variation in the extent of the epidemics; some were extremely mild and irregularly encountered, but those of 1936–37 and 1940–41 spread throughout the world. In most instances the influenza A epidemics were sharp and brief, beginning in the late autumn or winter of the temperate zones, while areas such as Hawaii and the West Indies were often affected earlier. Data of the percentage of population attacked are inexact, but 8% to 15% appears to be a reasonable estimate in the more clear-cut epidemics. It was shown, however, that the disease may be encountered in small, localized, almost sporadic outbreaks which sometimes precede the epidemic wave. The mortality has been low; scarcely 1 case in 1,000 was fatal. Nevertheless, an excess in mortality from pneumonia and in the general mortality accompanies the disease.

Influenza B was first identified in the U.S. in 1940 by Francis, who demonstrated also that an epidemic in that country early in 1936 was caused by the same virus. It also gave rise to an extensive epidemic in 1945. Influenza B seems to have been more scattered in its distribution, and the epidemics, which recurred at intervals of four to five years, were less sharply defined in scope. The incidence tends to be somewhat lower than with influenza A, and the accompanying mortality is proportionately reduced.

In some epidemics a proportion of cases have not been identified as influenza A or B, but no definite epidemic has been observed which might be attributable to still another type of influenza. Swine influenza virus has not been reported in the human population. The fact that these two types recur at intervals of a few years offers a possible explanation of the so-called three waves of a pandemic period.

It seems likely, with the appearance of these diseases in the

northern and southern hemispheres in alternate halves of the year and with the recognition that they may exhibit limited, spotty tendencies. that influenza is maintained by a constant circulation in the human population, reaching epidemic proportions only when a sufficient number of susceptibles has reaccumulated to furnish fuel. (*See* BACTERIAL AND INFECTIOUS DISEASES: *Virulence.*) Chronic carriers of the virus have not been demonstrated. Under this interpretation the severer pandemics represent variations in scope of a basic disease and may be related to the circulation of modified strains of virus and to the frequency and virulence of bacterial accompaniments. Laidlaw suggested in 1936, and the suggestion was supported by Shope. that swine influenza represents the human disease of 1918, which became established in hogs and persisted there. Shope presented evidence that the swine disease is maintained in a concealed form in worm parasites of that animal from which it erupts when the animal's physiology is disturbed.

The idea that there are geographical foci in Russia and the east in which influenza is maintained is a similar concept of a limited reservoir.

The epidemic of Asian influenza of 1957 apparently began in China early in the year. It was detected in Hong Kong among refugees early in April and extended soon to Singapore and Taiwan. From there the distribution became quite wide and by June 10 the disease had circled the globe. Its course was readily traced along lines of transportation and numerous foci were described developing from affected groups.

The incidence was high. particularly in crowded areas of the orient; it was generally mild although, as usual, an increased mortality from respiratory disease took place. It appeared that the highest frequency was in adolescents and in people generally under 30 years of age.

In the United States a distinct increase in respiratory disease was noted beginning in August; the peak, both of incidence and excess mortality was reached by the end of October, after which a progressive decline took place. A significant proportion of the deaths apparently was associated with staphylococcus, and also cases of rheumatic heart disease with mitral stenosis.

The severity of the disease was reported to vary somewhat in different countries, but experience generally was that of a mild illness with high incidence and low mortality. In all regions crowding appeared to have been a significant factor in morbidity.

The virus, belonging to type A influenza virus, exhibited antigenic characteristics different from those of recent years, but serological evidence indicated that it is related to strains circulating earlier. Sera from the older segments of the population contained antibodies to the strain, suggesting that it may possibly have been prevalent in the 1889–90 pandemic period.

Intensive efforts were made in the United States in 1957, through the collaboration of all agencies concerned, to prepare for the epidemic. Large scale production of specific vaccine was instituted and became available in significant amounts before the epidemic developed. Data indicated that with the proper concentration of virus, protection of 80% could be obtained. Much illness and mortality were prevented by widespread use of vaccine.

Aetiology.—The name influenza was introduced by John Huxham in 1743, apparently derived from the Italian phrase which ascribed the origin of the disease to *un influenza* di *freddo*, the influence of the cold. It was not until 1890 that the idea that influenza was borne by the prevailing winds was dispelled. In 1892 Richard Pfeiffer described the influenza bacillus. *Hemophilus influenzae,* commonly a tiny organism, but of varied forms, which requires for its proper growth substances present in blood. Subsequent studies appeared to support Pfeiffer's conclusion that this organism was the cause of influenza. The pandemic of 1918 resulted in extensive studies of its role. It was generally concluded that while this organism was of considerable importance, perhaps greater than that of other bacteria. it did not satisfy the requirements of a primary causative agent. The concept of a filterable virus gained in prominence, and as a result studies in England, France! Germany, Japan and the United States were made in an effort to transmit the disease to human subjects and experimental animals. Results were quite variable, and. even in instances which were apparently successful, no agent was well established. As a result the cause of that epidemic was not clearly demonstrated.

In 1931 Shope demonstrated that swine influenza. hog flu, was caused primarily by a virus which in conjunction with a bacillus similar to that of Pfeiffer's produced extensive disease in hogs throughout the United States.

In 1933 Smith. Andrewes and Laidlaw produced an experimental infection in ferrets with a virus from the throats of influenza patients. This was confirmed in 1934 in the United States by Francis. It was then found that the virus infection could be transmitted to mice. In both species of animals continued transfer gave rise to extensive fatal, nonbacterial pneumonia. The virus produced infection only when given by the respiratory route. Animals which recovered were immune for a period of months to reinfection. and their blood serum contained immune substances (antibodies) capable of protecting normal animals. It was shown that a high percentage of the human population had immune bodies in the blood as a result of earlier infection and that the recovered person developed more. This fact could be used for diagnosis and studies of the distribution of the disease. designated influenza A. After 1939, following studies of F. M. Burnet, the incubating egg containing the embryonic chick was an increasingly effective tool for isolation of virus and studies of the disease. G. K. Hirst. L. McClelland and R. Hare observed that influenza virus caused clumping of the red blood cells of chickens and that the phenomenon could be applied to the measurement of virus and antibodies.

The virus of influenza B was isolated in 1940 by both Francis and T. P. Magill. Its general characteristics are similar to those of influenza A. It is. however, more difficult to establish experimental disease in ferrets, mice and frequently in eggs than with type A virus. Aloreover. infection with one gives no immunity to the other. so that in this sense they represent two different diseases. The strains of type A or of type B also differ among themselves. Swine influenza virus is related to type A.

Infection does not give permanent immunity. but in experimental animals it can be renewed by reinoculation. In the general population there appears to be a decline of immunity between epidemics and thus an increase of susceptibles. Even after induced infection under experimental conditions the immunity may be of only a few months' duration. However, a good percentage of the population develops a resistance effective for a much more prolonged period. as shown by the fact that only a minority takes sick during epidemic periods.

Clinical Features. — Influenza spreads through a population by the transfer of virus by sneezing. coughing. etc.. of the excretions from the respiratory tract of the infected person to that of a susceptible. In the majority of instances the process is a direct infection. although indirect transfer through contamination of hands, handkerchiefs or eating utensils is obviously possible. There is little reason to consider the disease air-borne except in crowded, poorly ventilated quarters when contamination of the air may be marked. As the virus gains entrance to the respiratory tract of the susceptible. it selectively attacks and destroys the cells lining the respiratory tract. These cells are superficially situated. not intimately bathed in the fluids of the blood stream, and apparently protected to a great extent by their own physiologic mechanisms. Following injury of the cells. fluid from the blood is poured out, and the supporting tissues give evidence of acute, inflammatory changes. The changes are essentially limited to the nose and the larger respiratory passages. When pneumonia ensues, the type of subsequent injury will depend upon the character of the bacteria encountered. If the pneumonia is related to virus iniection alone. which is uncommon, the injury is usually an extension of that previously mentioned with a considerable amount of fluid accumulating in the lungs. areas of collapse and a few cells of a large type. Specific changes in other organs are not ordinarily observed although toxic effects are evident.

Symptoms and Clinical Course.—The incubation period of epidemic influenza is one to two days. The majority of cases present a striking uniformity of symptoms and clinical course. The onset

is abrupt with sudden chilliness or distinct chill. fatigue and achiness. Severe prostration is noted early. The temperature rises rapidly in 12 to 24 hr. to a level of from 101° to 104° F. Diffuse headache and severe muscular aches throughout the body become prominent features. Whereas the patient may experience a feeling of nasal irritation or a sense of rawness in the nasopharynx, symptoms referable to the respiratory tract are few. In this respect the disease is sharply different from the usual common cold in which congestion and runny nose with little or no fever are customary. Sore throat similar to that of acute tonsillitis is rare. In the next 24 hr. the temperature reaches a sustained level. Aches and pains may be the chief complaint. Laryngitis and hoarseness may be present and a short, hacking, unproductive cough may become annoying. Symptoms referable to the gastrointestinal tract are ordinarily no more common than in other acute upper respiratory infections. and the so-called intestinal flu is a misnomer. A nervous form has been described which seems to be essentially a designation of the severe prostration or delirium which may occur.

In three to four days as the temperature begins to fall the patient's general symptoms improve and recovery from the acute phase begins. In 90% to 95% of the cases. even in the severest outbreaks, the disease is a "three-day fever" followed by relatively rapid convalescence; but protracted weakness and exhaustion in adults are traditional. In children. except infants, the disease is generally mild. while in older persons it is severer than the average. When the temperature remains elevated beyond the fourth or fifth day. involvement of the loner respiratory tract is usually present and is ordinarily evidence of complications resulting from associated bacterial infection.

In addition to the usual course of the disease, a number of cases present a much severer infection from the onset. In these there is early evidence of respiratory distress and pulmonary disease. The course is stormy and unpredictable. On the other hand! there is a large group of cases in which the evidence of infection is negligible. These patients may experience nothing more than a mild apathy and a slight discomfort in the upper respiratory passages for a period of 24 hr. The temperature is either not elevated or elevated slightly. In others the symptoms may be so slight as to be unnoticed. Nevertheless, these inapparent infections constitute a serious menace in that they can transmit infection. In some instances, by appropriate tests it was shown that during the course of an epidemic 20% to 25% of persons were actually infected with influenza virus without significant signs of illness.

Complications.—By far the greatest number of and most important complications of epidemic influenza involve the respiratory tract. The various forms of bronchitis and pneumonia may ensue, and in some instances pneumonia apparently begins with onset of the disease. They are usually associated with invasion by pneumococci, streptococci. H. *influenzae* or other bacteria which invade the lungs. In the U.S. army camps in 1918 purulent or capillary bronchitis was observed in as many as 35% to 40%, and pneumonia occurred in 10% to 20% of the cases. The incidence of complications varies in different epidemics; it is usually low but the frequency may depend upon the amount of virulent bacterial infection prevalent at the time. Paranasal sinusitis is not uncommon. Otitis media similarly occurs. Influenza acquired during pregnancy often results in miscarriage or abortion. There is consequently an increase in both maternal and infant mortality. In many respects influenza is one of the most dangerous complications of pregnancy.

Treatment.—There is no specific treatment for influenza virus infection. Drugs are used to relieve discomfort or control fever. Confinement of the patient to bed in a warm room conserves his resources and limits the possibilities of complicating infections. Although sulfonamides, penicillin and streptomycin have no effect upon the virus disease, they do have a therapeutic, possibly some prophylactic, effect upon the bacterial pneumonias which are the chief causes of death.

Control.— The continued recurrences of influenza clearly demonstrate that there has been no effective procedure for control. Rigid isolation may limit infection under special conditions. But under epidemic conditions the amount of infection to which the person may be exposed and the high infectiousness of the virus clearly nullify minor precautions. In the presence of virulent influenza. crowding may increase the risk of picking up secondary infections as well.

Efforts to control respiratory disease through sterilization of the air by installations of ultra-violet light or by bactericidal vapours (aerosols) were investigated.

Prophylactic Inoculation.—The fact that influenza virus produces disease only when it enters the body by the respiratory tract led to the demonstration that if given subcutaneously or by other routes. illness did not occur in animals or humans but that in the former a resistance developed and in both the accumulation of immune substances in the blood was stimulated. Various studies were undertaken to ascertain the effect upon susceptibility to the natural disease with no more than suggestive results.

The ready growth of influenza virus in the chick embryo results in the accumulation of virus in the allantoic fluid surrounding the embryo. This has served as a bountiful source of virus for vaccine. In 1943 the commission on influenza of the U.S. army epidemiological board carried out studies with a vaccine of virus concentrated from the egg fluid. The virus was obtained from the fluid by permitting it to become attached to the red blood cells of the chicken and then removing it into a reduced volume of sodium-chloride solution. The virus was inactivated by treatment with formalin. Both type A and type B influenza viruses were incorporated into a dose of one cubic centimetre to be given subcutaneously to adults. The results of the study showed that the incidence of influenza A in a vaccinated group of 6,250 men was about one-fourth that observed in a similar group of unvaccinated men. In 1945 the entire U.S. army was vaccinated with this material. Observations during the epidemic of influenza B that winter showed that 1% or less of vaccinated army personnel took sick while 10%–13% of unvaccinated service groups were affected.

The duration of resistance induced by vaccination is not known. It seems improbable that available preparations would have a uniform effect beyond three to four months. The antibodies developed from vaccination reach their peak in two weeks, decline somewhat in four months and still further in one year, but it is not established that the resistance is retained to the same extent as the immune substances. Moreover, the strains of virus encountered in different epidemics vary in chemical constitution, and this may limit the efficacy of vaccine until more strains or a collection of suitable ones are placed in the vaccine. Nevertheless, the information points to the probability that prophylactic vaccination would be effectively developed for use in the control of influenza—a disease which has been called the last of the unconquered scourges.

BIBLIOGRAPHY.—T. Thompson, ***Annals of Influenza*** (London, 1852); A. Hirsch, ***Handbook of Geographical and Historical Pathology*** (London, 1883); S. W. Abbott, "Influenza Epidemic of 1889–90," ***21st Annual Report,*** Massachusetts State Board of Health (1890); H. F. Parsons, ***Further Report and Papers on Epidemic Influenza 1889–92*** (London, 1893); R. Pfeiffer, "Vorlaufige Mittheilungen uber den Erreger der Influenza," ***Deutsche med. Wchnschr.,*** 18:28 (1892); W. T. Vaughan, "Influenza: Epidemiologic Study, Baltimore," ***Am. J. Hyg.,*** Monographic Ser. No. 1 (1921); J. McIntosh, ***Studies in Aetiology of Epidemic Influenza,*** Med. Research Council, Special Rep. Ser. No. 63 (London, 1922); British Ministry of Health, ***Report on the Pandemic of Influenza, 1918–19*** (London, 1920); E. O. Jordan, ***Epidemic Influenza*** (1927); Pickett-Thompson Research Laboratory, "Influenza," ***Annals,*** vol. ix and x (1933–34); C. H. Stuart-Harris, C. H. Andrewes and W. Smith, ***Study of Epidemic Influenza With Special Reference to 1936–37 Epidemic,*** Med. Research Council, Special Rep. Ser. No. 228 (London, 1938); F. M. Burnet and Ellen Clark, ***Influenza*** (1942); Thomas Francis, Jr., "Factors Conditioning Resistance to Epidemic Influenza," ***The Harvey Lectures,*** series 37, pp. 69–99 (1941–42); R. E. Shope, "Old, Intermediate, and Contemporary Contributions to Our Knowledge of Pandemic Influenza," ***Medicine,*** 23:4 (1944); Reports of the commission on Influenza, Board for the Control of Influenza and Other Epidemic Diseases in the United States Army on Vaccination Against Influenza, ***Am. J. Hyg.,*** vol. 45 (July 1945); Thomas Francis, Jr., Jonas E. Salk and William M. Brace, "The Protective Effect of Vaccination Against Epidemic Influenza B," ***J.A.M.A.,*** 131:275–278 (May 25, 1946); George K. Hirst, Antonio Vilches, Orville Rogers and Clarence L. Robbins, "The Effect of Vaccination on the Incidence of Influenza B," ***Am. J. Hyg.,*** 45:1, pp. 96–101 (Jan. 1947); Thomas Francis, Jr., "Influenza: The Newe Acquayantance," ***Ann. Intern. Med.,*** 39:2, pp. 203–221 (Aug. 1953); Fred M. Davenport and Albert V. Hennessy, "A Serologic Recapitulation of past Experiences with Influenza A; Antibody Response to Monovalent Vaccine," ***Jour. Exper. Med.,*** vol. 104, no. 1, pp. 85–97 (July 1, 1956); Keith E. Jensen, ***et al.,*** "Characterization of Influenza Antibodies by Serum Absorption," ***Jour. Exper. Med.,*** vol. 104, no. 2, pp. 199–209 (Aug. 1, 1956); Fred M. Davenport, ***et al.,*** "An Evaluation of an Adjuvant Influenza Virus Vaccine Tested Against Influenza B in 1954–1955," ***Amer. Jour. Hyg.,*** vol. 64, no. 3, 304–313 (Nov. 1956). (T. FR.)

INFORMATION, in English law, a proceeding on behalf of the crown against a subject otherwise than by indictment is either criminal or civil. Criminal informations are ex officio or by the master of the crown office. An-ex officio information is a proceeding in the queen's bench by the attorney general without the intervention of a grand jury.

The attorney general or, in his absence, the solicitor general has a right ex officio to file a criminal information in respect of any misdemeanour, but not for treason, felonies or misprision of treason. It is, however, seldom exercised, except in cases which might be described as "enormous misdemeanours," such as those peculiarly tending to disturb or endanger the government; *e.g.,* seditions, obstructing the queen's officers in the execution of their duties, etc.

There are informations also which are the first step in proceedings in permits of summary jurisdiction leading to the issue of summonses or warrants. They relate to proceedings of a criminal nature as opposed to complaints which are the initiatory steps to proceedings of a civil nature in these courts.

Civil informations are of two kinds and are filed on the revenue side of the queen's bench division. The Latin information is the way in which the crown recovers money or other chattels. and these informations are either *in* rem or *in personam.* Informations *in rem* are used chiefly where the crown lays a claim to property and are usually resorted to where such property is alleged to have become forfeited under customs or inland revenue statutes. Informations *in personam* are largely used to recover a debt to the crown whether such debt is payable by penalty or in another way.

The other form of civil information is the English information and is generally used to recover corporeal or incorporeal hereditaments and also debts to the crown where discovery and an account are sought

In the United States the federal constitution (amendments. art. v) forbids the use of informations by providing that "no person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury," with certain exceptions in the land or naval forces and the militia. Attempts at evasion of the revenue laws and other minor offenses are sometimes prosecuted by information in the federal courts. In a number of states all misdemeanours except misprision of treason may be prosecuted by information. This process may also be used in civil cases. such as a proceeding against a corporation for violation of charter.

INFORMATION AGENCY, THE UNITED STATES, was created on Aug. 1, 1953 to conduct the overseas information program of the U.S. government. Foreign information activities formerly conducted by the International Information administration and the Technical Cooperation administration of the department of state and by the Mutual Security agency were consolidated in the new agency. The foreign information program was established to promote support among other peoples for the foreign policies of the United States. Field operations of the agency were carried out by the U.S. Information service, which established posts throughout the world. The posts, under the general direction of the U.S. chief of mission in each country, were staffed by public affairs officers and specialists in news, radio, film, library and other cultural activities.

The agency provided field posts with various services: the "Voice of America", which broadcast on a world-wide network in many languages and serviced field needs for recorded film and television programs for use by local stations; the press service, which provided news and prints; the motion-picture service. which prepared documentary films on the United States in various languages; the information centre service, which supplied materials for library programs and community activities and also was responsible for the translation and distribution of U.S. books overseas. The agency also co-operated with private U.S. organizations and individuals.

INFORMATION THEORY. One of the most prominent features of 20th-century technology is the development and exploitation of new communication mediums. Concurrent with the growth of devices for transmitting and processing information, a unifying theory was developed and became the subject of intensive research.

This theory, known as communication theory, or, in its broader applications. information theory, is concerned with the discovery of mathematical laws governing systems designed to communicate or manipulate information. It sets up quantitative measures of information and of the capacity of various systems to transmit, store and otherwise process information.

Some of the problems treated relate to finding the best methods of utilizing various available communication systems, the best methods of separating signals from noise and the problem of setting upper bounds on what it is possible to do with a given channel. While the central results are chiefly of interest to communication engineers, some of the concepts have been adopted and found useful in such fields as psychology and linguistics.'

Information is interpreted in its broadest sense to include the messages occurring in any of the standard communication mediums such as telegraphy, radio or television, the signals involved in electronic computing machines, servomechanism systems and other data-processing devices, and even the signals appearing in the nerve networks of animals and man. The signals or messages need not be meaningful in any ordinary sense. This theory. then, is quite different from classical communication engineering theory, which deals with the devices employed but not with that which is communicated.

Central Problems of Communication Theory.— The type of communication system that has been most extensively investigated is shown in fig. 1. It consists of the following:

1. An information source which produces the raw information or "message" to be transmitted.
2. A transmitter which transforms or encodes this information into a form suitable for the channel. This transformed message is called the signal.
3. The channel on which the encoded information or signal is transmitted to the receiving point. During transmission the signal may be changed or distorted. In radio, for example, there often is static, and in television transmission so-called "snow." These disturbing effects are known generally as noise, and are indicated schematically in fig. 1 by the noise source.
4. The receiver, which decodes or translates the received signal back into the original message or an approximation of it.
5. The destination or intended recipient of the information.

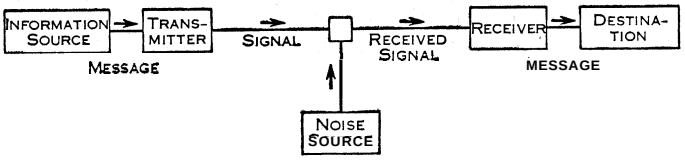


FIG. 1.— DIAGRAM OF GENERAL COMMUNICATION SYSTEM

It will be seen that this system is sufficiently general to include a wide variety of communication problems if the various elements are suitably interpreted. In radio, for example, the information source may be a person speaking into a microphone. The message is then the sound that he produces, and the transmitter is the microphone and associated electronic equipment which changes this sound into an electromagnetic wave, the signal. The channel is the space between the transmitting and receiving antennas, and any static or noise disturbing the signal corresponds to the noise source in the schematic diagram. The home radio is the receiver in this system and its sound output the recovered message. The destination is a person listening to the message.

A basic idea in communication theory is that information can be treated very much like a physical quantity such as mass or energy. A homely analogy may be drawn between the system in fig. 1 and a transportation system; for example, we can imagine an information source to be like a lumber mill producing lumber at a certain point. The channel in fig. 1 might correspond to a conveyor system for transporting the lumber to a second point. In such a situation there are two important quantities: the rate R (in cubic feet per second) at which lumber is produced at the mill, and the capacity C (in cubic feet per second) of the conveyor. These two quanti-

ties determine whether or not the conveyor system will be adequate for the lumber mill. If the rate of production R is greater than the conveyor capacity C, it will certainly be impossible to transport the full output of the mill; there will not be sufficient space available. If R is less than or equal to C, it may or may not be possible, depending on whether the lumber can be packed efficiently in the conveyor. Suppose, however, that we allow ourselves a sawmill at the source. This corresponds in our analogy to the encoder or transmitter. Then the lumber can be cut up into small pieces in such a way as to fill out the available capacity of the conveyor with 100% efficiency. Naturally in this case we should provide a carpenter shop at the receiving point to fasten the pieces back together in their original form before passing them on to the consumer.

If this analogy is sound, we should be able to set up a measure R in suitable units telling the rate at which information is produced by a given information source, and a second measure C which determines the capacity of a channel for transmitting information. Furthermore, the analogy would suggest that by a suitable coding or modulation system, the information can be transmitted over the channel if and only if the rate of production R is not greater than the capacity C. A key result of information theory is that it is indeed possible to set up measures R and C having this property.

Measurement of Information. — Before we can consider how information is to be measured it is necessary to clarify the precise meaning of "information" from the point of view of the communication engineer. Often the messages to be transmitted have meaning: they describe or relate to real or conceivable events. However, this is not always the case. In transmitting music, the meaning, if any, is much more subtle than in the case of a verbal message. In some situations the engineer is faced with transmitting a totally meaningless sequence of numbers or letters. In any case, meaning is quite irrelevant to the problem of transmitting the information. It is as difficult to transmit a series of nonsense syllables as it is to transmit straight English text (more so, in fact). The significant aspect of information from the transmission standpoint is the fact that one particular message is chosen from a set of possible messages. What must be transmitted is a specification of the particular message which was chosen by the information source. The original message can be reconstructed at the receiving point only if such an unambiguous specification is transmitted. Thus in information theory, information is thought of as a choice of one message from a set of possible messages. Furthermore, these choices occur with certain probabilities; some messages are more frequent than others.

The simplest type of choice is a choice from two equally likely possibilities; that is, each has a probability $\frac{1}{2}$. This is the situation, for example, when a coin is tossed which is equally likely to come up heads or tails. It is convenient to use the amount of information produced by such a choice as the basic unit and this basic unit is called a binary digit or, more briefly, a "bit." The choice involved with one bit of information can be indicated schematically as in fig. 2A. At point b either the upper or lower line may be chosen with probability $\frac{1}{2}$ for each possibility.

If there are N possibilities, all equally likely, the amount of information is given by $\log_2 N$. The reason for this can be seen from fig. 2B, where there are eight possibilities each with probability $\frac{1}{8}$. The choice can be imagined to occur in three stages, each involving one bit. The first bit corresponds to a choice of either the first four or the second four of the eight possibilities, the second bit corresponds to the first or second pair of the four chosen, and the final bit determines the first or second member of the pair. It will be seen that the number of bits required is $\log_2 N$, in this case $\log_2 8 = 3$.

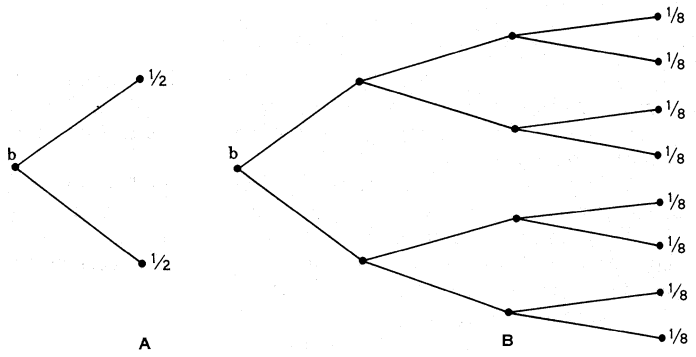


FIG. 2.—A CHOICE FROM (A) TWO POSSIBILITIES (B) EIGHT POSSIBILITIES (*see* TEXT)

If the probabilities are not equal, the formula is more complicated. When the choices have probabilities $p_1, p_2, \ldots, p_n$, the amount of information H is given by:

$$H = -(p_1 \log_2 p_1 + p_2 \log_2 p_2 + \ldots + p_n \log_2 p_n).$$

This formula for amount of information gives values ranging from zero — when one of the two events is certain to occur (*i.e.*, has a probability of 1) and all others are certain not to occur (probability 0) — to a maximum value of $\log_2 N$ when all events are equally probable (probability $\frac{1}{N}$). These situations correspond intuitively to the minimum information produced by a particular event (when it is already certain what will occur) and the greatest information or the greatest prior uncertainty of the event.

The parlor game "Twenty Questions" illustrates some of these ideas. In this game, one person thinks of an object and the other players attempt to determine what it is by asking not more than 20 questions that can be answered "yes" or "no." According to information theory each question can, by its answer, yield anywhere from no information to $\log_2 2$ or one bit of information, depending upon whether the probabilities of "yes" and "no" answers are very unequal or approximately equal. To obtain the greatest amount of information, the players should ask questions that subdivide the set of possible objects, as nearly as possible, into two equally likely groups. For example, if they have established by previous questions that the object is a town in the United States, a good question would be, "Is it east of the Mississippi?" This divides the possible towns into two roughly equal sets. The next question then might be, "Is it north of the Mason-Dixon line?" If it were possible to choose questions which always had the effect of subdividing into two equal groups, it would be possible to isolate, in 20 questions, one object from approximately 1,000,000 possibilities. This corresponds to 20 bits.

The formula for the amount of information is identical in form with equations representing entropy in statistical mechanics, and suggests that there may be deep-lying connections between thermodynamics and information theory. Some scientists believe that a proper statement of the second law of thermodynamics requires a term relating to information. These connections with physics, however, do not have to be considered in the engineering and other applications of information theory.

Most information sources produce a message which consists not of a single choice but of a sequence of choices; for example, the letters of printed text or the elementary words or sounds of speech. The writing of English sentences can be thought of as a process of choice: choosing a first word from possible first words with various probabilities; then choosing a second, with probabilities depending on the first; and so on. This kind of statistical process is called a stochastic process, and information sources are thought of, in information theory, as stochastic processes. A more general formula for H can be given which determines the rate at which information is produced by a stochastic process or an information source.

Printed English is a type of information source that has been studied considerably. By playing a kind of "Twenty Questions" game, suitably modified, with subjects trying to guess the next letter in an English sentence, it can be shown that the information rate of written English is not more than about one bit per letter. This is a result of the very unequal frequencies of occurrence of different letters (for example, E is very common in English while Z, Q and X are very infrequent), of pairs of letters (TH is very common and QZ very rare), and the existence of frequently re-

curring words, phrases and so on. This body of statistical data relating to a language is called the statistical structure of the language. If all 26 letters and the space in English had equal frequencies of occurrence (*i.e.*, each had probability $\frac{1}{27}$) and the occurrence of each letter of text was independent of previous letters, the information rate would be $\log_2 27$, or about 4.76 bits per letter. Since only one bit actually is produced, English is said to be about 80% redundant.

The redundancy of English is also exhibited by the fact that a great many letters can be deleted from a sentence without making it impossible for a reader to fill the gaps and determine the original meaning. For example, in the following sentence the vowels have been deleted:

MST PPL HV LTTL DFFCLTY N RDNG THS SNTNC.

As might easily be deduced, redundancy in a language plays an important role in the science of cryptography.

Encoding Information. — An important feature of the measure of information, H, is that it determines the saving in transmission time that is possible, by proper encoding, due to the statistics of the message source. To illustrate this, consider a model language in which there are only four letters — A, B, C and D. Suppose these letters have the probabilities $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ and $\frac{1}{8}$. In a long text in this language, A will occur one-half the time, B one-quarter of the time, and C and D each one-eighth of the time. Suppose this language is to be encoded into binary digits, 0 or 1, as for example in a pulse system with two types of pulse. The most direct code is the following:

$$A = 00;\ B = 01;\ C = 10;\ D = 11.$$

This code requires two binary digits per letter of message. By proper use of the statistics, a better code can be constructed as follows:

$$A = 0;\ B = 10;\ C = 110;\ D = 111.$$

It is readily verified that the original message can be recovered from its encoded form. Furthermore, the number of binary digits used is smaller on the average. It will be, in fact,

$$\tfrac{1}{2}(1) + \tfrac{1}{4}(2) + \tfrac{1}{8}(3) + \tfrac{1}{8}(3) = 1\tfrac{3}{4},$$

where the first term is due to the letter A, which occurs half the time and is one binary digit long, and similarly for the others. It may be found by a simple calculation that $1\frac{3}{4}$ is just the value of H, calculated for the probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{8}$.

The result verified for this special case holds generally — if the information rate of the message is H bits per letter, it is possible to encode it into binary digits using, on the average, only H binary digits per letter of text. There is no method of encoding which uses less than this amount.

This important result in information theory gives a direct meaning to the quantity H which measures the information rate for a source or a language. It says, in fact, that H can be interpreted as the equivalent number of binary digits when the language or source is encoded in 0 and 1 in the most efficient way. For instance, if the estimate of one bit per letter, mentioned above as the rate for printed English, is correct, then it is possible to encode printed English into binary digits using, on the average; one for each letter of text; and, furthermore, no encoding method would average less than this.

Capacity of a Channel. — Now consider the problem of defining the capacity C of a channel for transmitting information. Since the rate of production for an information source has been measured in bits per second, we would naturally like to measure C in the same units. The question then becomes, what is the maximum number of binary digits per second that can be transmitted over a given channel? In some cases the answer is simple. With a teletype channel there are 32 possible symbols. Each symbol therefore represents 5 bits, provided the possible symbols are used with equal probability. If we can send n symbols per second, and the noise level is not high enough to introduce any errors during transmission, we can send $5n$ bits per second.

The problem of calculating the capacity of a channel is usually more complex than this example because of disturbing noise. As an example, suppose there are two possible kinds of pulse that can be transmitted in a system, a 0 pulse and a 1 pulse. Suppose further that when 0 is transmitted it is received as 0 nine-tenths of the time, but one-tenth of the time noise causes it to be received as 1. Conversely, suppose a transmitted 1 is received as 1 nine-tenths of the time but distorted into a 0 pulse one-tenth of the time. This type of channel is called a binary symmetric channel. It and other noisy channels have definite capacities that can be calculated by appropriate formulas. In this particular case, the capacity is about 0.53 bits per pulse.

The meaning of the capacity of such a noisy channel may be roughly described as follows: It is possible to construct codes that will transmit a series of binary digits at a rate equal to the capacity. This can be done in such a way that they can be decoded at the receiving point with a very small probability of error. These codes are called error-correcting codes, and are so constructed that the type of transmission errors likely to occur in the channel can be corrected at the receiving point. Finally, it is not possible to transmit at a higher rate than the channel capacity and retain this error-correcting property.

The functioning of error-correcting codes can be likened to the ability of a person to correct a reasonable number of typographical errors in a manuscript because of his knowledge of the structure and context of the language. Much of the work in information theory centres around the theory and construction of such error-correcting codes.

Band-limited Channels. — A frequently occurring restriction on communication channels is that the signals must lie within a certain band of frequencies W cycles per second wide. A result known as the sampling theorem states that a signal of this type can be specified by giving its values at a series of equally spaced sampling points $1/2W$ seconds apart. Thus it may be said that such a function has $2W$ degrees of freedom, or dimensions, per second. If there were no noise whatever on such a channel it would be possible to distinguish an infinite number of different amplitude levels for each sample. Consequently, in principle, an infinite number of binary digits per second could be transmitted, and the capacity C would be infinite. In practice, there is always some noise, but even so if no limitations are placed on the transmitter power P, the capacity will be infinite, since at each sample point an unlimited number of different amplitude levels may be distinguished. Only when noise is present and the transmitter power is limited in some way does the capacity C become finite. This capacity depends on the statistical structure of the noise as well as the nature of the power limitation.

The simplest type of noise is resistance noise, produced in an electrical resistor by thermal effects. This type of noise is completely specified by giving its average power N.

The simplest limitation on transmitter power is the assumption that the average power delivered by the transmitter is not greater than P. If a channel is defined by these three parameters W, P and N, the capacity C can be shown to be

$$C = W\log_2 \frac{P+N}{N} \text{ (bits per second).}$$

The implication of this formula is that it is possible, by properly choosing the signal functions, to transmit $W\log_2 \frac{P+N}{N}$ binary digits per second and to recover them at the receiving point *with as small a frequency of errors as desired.* It is not possible to transmit binary digits at any higher rate with an arbitrarily small frequency of errors.

Encoding systems in current use, pulse-code modulation and pulse-position modulation, use about four times the power predicted by the ideal formula. Unfortunately, as one attempts to approach more closely this ideal, the transmitter and receiver required become more complicated and the delays increase.

The relation

$$C = W\log\left(1 + \frac{P}{N}\right)$$

can be regarded as an exchange relation between the bandwidth W

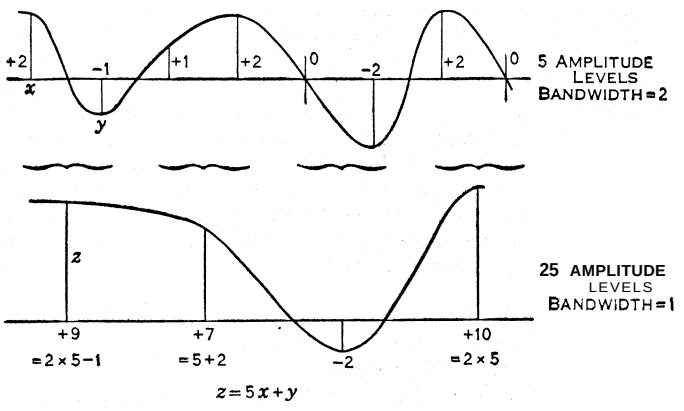


FIG. 3.— THEEXCHANGE OF BANDWIDTH FOR SIGNAL-TO-NOISE RATIO

and the signal-to-noise ratio P/N. Keeping the channel capacity fixed, the bandwidth can be decreased provided the signal-to-noise ratio is sufficiently increased. Conversely an increase in bandwidth allows a lower signal-to-noise ratio in the channel.

One method of exchanging bandwidth for signal-to-noise ratio is shown in fig. 3. The upper curve represents a signal function whose bandwidth is such that it can be specified by giving the samples shown. Each sample has five amplitude levels. The lower curve is obtained by combining pairs of samples from the first curve as shown. If the pair of samples from the upper curve have amplitudes x and y, a single amplitude z for the lower curve is computed from the formula

$$z = 5x + y.$$

The five possible values of x combined with the five possible values of y produce 25 possible values of z which must be distinguished. However, the samples now occur only half as frequently; consequently the band is reduced by half, at the cost of increasing the signal-to-noise ratio. Operating this in reverse doubles the band but reduces the required signal-to-noise ratio.

To summarize, there are three essentially different ways in which bandwidth can be reduced in a system such as television or speech transmission. The first is the straightforward exchange of bandwidth for signal-to-noise ratio just discussed. The second method is utilization of the statistical correlations existing in the message. This capitalizes on particular properties of the information source feeding the channel. Finally, particular properties of the ultimate destination of the messages can be used. Thus in speech transmission the ear is relatively insensitive to phase distortion. Consequently, phase information is not as important as amplitude information, and need not be sent so accurately, resulting in a saving of bandwidth or of power. In general, the exploitation of particular "sensitivities" or "blindness" in the destination requires a proper matching of the channel to the destination.

Filtering and Prediction Problem.— Another type of problem that has been studied extensively in the field of information theory is that of determining the best devices for eliminating noise from a signal and predicting the future value of the signal. These are known as the filtering and prediction problems. The two problems may also occur in combination if it is desired to predict the future value of a noisy signal. Possible applications of the filtering problem occur in the detection of various types of communication signals which have been corrupted by noise or in the smoothing of data subject to observational error. The prediction problem, with or without filtering, may arise, for example, in weather or economic forecasting or in the control of gun directors, where it is desired to predict the future position of a moving target.

The most successful work in this general field has been carried out under the following two assumptions. First, the best prediction or filtering is interpreted to be that which minimizes the mean-square error between the computed value and the true value. Second, the devices performing these operations are assumed to perform linear operations on the signals which they filter or predict. Under these conditions, substantially complete solutions have been found specifying the characteristics of the predicting or filtering device in terms of the power spectra of the signal and of the noise.

Cryptography, Linguistics and Other Applications.— Some applications have been made in the fields of cryptography and linguistics. It is possible to formulate a theory of cryptography or secrecy systems in terms of the concepts occurring in information theory. When this is done, it appears that the information rate R of a language is intimately related to the possibility of solving cryptograms in that language. The smaller this rate, the easier such a solution becomes and the less material is necessary to render such a solution unique. Indeed, within limits, the theory becomes quantitative and predictive, giving means of calculating how much material must be intercepted in a given language and with a given cipher in order to ensure the existence of a unique solution.

A study has been made of the distribution of lengths and frequency of occurrence of the different words in a language such as English. It has been found, for example, that the relative frequency of the nth most frequent word may be expressed quite closely by a formula of the type $P(n+m)^{-b}$, with suitable constants for P, m and b. Experimental data of this type can be explained as consequences of the assumption that a language gradually evolves under continued use into an efficient communication code. *(See* CRYPTOLOGY; LINGUISTICS.)

Psychologists have discovered interesting relationships between the amount of information in a stimulus and reaction time to the stimulus. For example, an experiment can be set up in which there are four lights and four associated push buttons. The lights go on in a random order and the subject is required to press the corresponding button as quickly as possible after a light goes on. It develops that the average time required for this reaction increases linearly with an increase in the amount of information conveyed by the lights. This experimental result holds true under a wide variety of changes in the experiment: the number of lights, the probabilities of different lights, and even varying correlations between successive lights.

These results suggest that under certain conditions the human being, in manipulating information, may adopt codes and methods akin to those used in information theory.

BIBLIOGRAPHY.—C. E. Shannon and W. Weaver, *The Mathematical Theory of Communication* (1949); *W.* Jackson (ed.), *Communication Theory* (1953); *A.* Feinstein, *Foundations of Information Theory* (1958); *N.* Wiener, *Extrapolation, Interpolation, and Smoothing of Stationary Time Series* (1949); C. E. Shannon, "Communication Theory of Secrecy Systems," Bell System Technical *Journal* (Oct. 1949); *Bibliography on Communication Theory,* Union Internationale des Telecommunications (1953). (CE. E. S.)

INFORMER, the term applied to a person who prosecutes in any of the courts of law those who break any law or penal statute, without any direct injury having been done to himself. Such a person is called a common informer when he furnishes evidence on criminal trials or prosecutes for breaches of penal laws solely for the purpose of obtaining the penalty recovered, or a share of it. An action by a common informer is termed a *popular* or *qui tam* action, because it is brought by a person *qui tam pro domino rege quam pro se ipso sequitur.* A suit by an informer must be brought within a year of the offense, unless a specific time is prescribed by the statute. The term informer is also used of an accomplice in crime who turns what is called "king's evidence," or "state's evidence" in the United States *(see* ACCOMPLICE). In Scotland, informer is the term applied to the party who, in criminal proceedings, sets the lord advocate in motion. *See* also DELATOR.

INGE, WILLIAM **RALPH** (1860–1954), English theologian and dean of St. Paul's, was born June 6, 1860, at Crayke, Yorks., the son of William Inge, sometime provost of Worcester college, Oxford, and was educated at Eton, and at King's college, Cambridge. From 1884 to 1888 he was an assistant master at Eton, and during the last two years of that time was fellow of King's college, Cambridge. From 1889 to 1904 he was fellow of Hertford college, Oxford. In 1907 was made Lady Margaret professor of divinity at Cambridge, and in 1911 he became dean of

St. Paul's. His sermons attracted attention because of their criticism of modern life and their pessimistic tone, which earned him the sobriquet "the gloomy dean." Inge died Feb. 26, 1954, at Wallingford, Eng.

Among Inge's numerous theological and devotional works may be mentioned *Christian Mysticism* (Bampton lectures; 1899); *Types of Christian Saintliness* (1915); *Philosophy of Plotinus* (Gifford lectures; 2 vol., 1918); *Outspoken Essays* (1919, 2nd series 1922); *Personal Religion and the Life of Devotion* (1924); *The Platonic Tradition in English Religious Thought* (Hulsean lecture; 1926); and *Christian Ethics and Modern Problems* (1930).

INGEBORG (INGEBURGE, INGELBURGE, INGELBORG, ISEMBURGE, Danish INGIBJÖRG) (*c.* 1176–1237 or 1238), queen of France, was the sister of Canute VI. king of Denmark. She married in 1193 Philip II Augustus, king of France, but on the day after his marriage the king took a sudden aversion to her. The French council of Compiègne acceded (Nov. 5, 1193) to his demand for a declaration of nullity, but the popes Celestine III and Innocent III successively took up the defense of Ingeborg. Philip, having married Agnes of Meran in June 1196, was excommunicated; and, as he remained obdurate, the kingdom mas placed under an interdict. Agnes was finally put aside, but Ingeborg was shut up in the chbteau of Étampes until, in 1213, Philip, hoping perhaps to justify by his wife's claims his pretensions to England, acknowledged her again as queen of France. She survived him more than 14 years, highly respected by all.

INGELOW, JEAN (1820–1897), English poet and novelist, was born at Boston, Lincs., on March 17, 1820, and died in London on July 20, 1897. Jean Ingelow, who was the daughter of a Boston banker, is famous for one poem, "High Tide on the Coast of Lincolnshire"; many of her ballads and songs were set to music in the '70s and had a great vogue. Her works include *Poems* (1863); *The Story of Doom and other Poems* (1867); *Poems* (1885); several novels, of which *Sarah de Berenger* (1880) is perhaps the best known; and a number of excellent children's books, including *Mopsa the Fairy* (1869).

INGEMANN, BERNHARD SEVERIN (1789–1862), Danish poet and novelist, was born at Torkildstrup. Falster, on May 28, 1789. He was educated at the grammar school at Slagelse, and entered the University of Copenhagen in 1806. All his early and unpublished writings were destroyed when the English burned the town. In 1811 he published his first volume of poems, and in 1812 his second, followed in 1813 by a book of lyrics entitled *Procne* and in 1814 the verse romance. *The Black Knights.* In 1815 he published two tragedies, *Masaniello and Blanca,* followed by *The Voice in the Desert, The Shepherd of Tolosa,* and other romantic plays. In 1818 he went to Rome, where he wrote *The Liberation of Tasso.* In 1820 he began to display his real power in a volume of delightful tales. His last comedy. *Magnetism in the Barber's Shop,* appeared in 1821. In 1822 the poet was nominated lector in Danish language and literature at Sorö college, and in 1846 director. *Valdentar the Great and his Men,* an historical epic, appeared in 1824. The next few years were occupied with his best and most durable work, his four great national and historical novels of *Valdemar Seier* (1826); *Erik Menved's Childhood* (1828); *King Erik* (1833); and *Prince Otto of Denmark* (1835). He then returned to epic poetry in *Queen Margaret* (1836) and in a cycle of romances, *Holger Danske* (1837). His last publication was *The Apple of Gold* (1856). Ingemann died on Feb. 24, 1862.

INGENHOUSZ (INGEN-HOUSZ), **JAN** (1730–1799), Dutch physician and chemist, was born at Breda on Dec. 8, 1730 and educated at the University of Louvain, obtaining the degree of M.D. in 1752. Two years later he entered the University of Leyden to study natural history and continued his studies in Paris and Edinburgh. He travelled extensively in Europe, practising medicine and pursuing his scientific studies and published some works in which he displayed unusual insight and originality of thought. In 1772 he became physician to the empress Maria Theresa and a member of the Aulic council at Vienna. He finally settled in London, where he published in 1779 his remarkable small book *Experiments Upon Vegetables, Discovering Their Great Power of Purifying the Common Air in the Sun-shine,* etc. (Ger. trans., 1780; Fr. trans., 1787–89), introducing the concept of the balance between the animal and the vegetable world which became the foundation of the whole modern conception of the economy of living things. The appreciation of the importance of the work of Ingenhousz, and the fact that the power of plants to absorb carbon dioxide and give off oxygen is the most significant activity in nature, came much later with the development of plant physiology. Ingenhousz was also a talented engineer, and the invention of an electrophorus and the plate electric machine is attributed to him.

His other publications include *An Essay on the Food of Plants and the Renovation of Soil* (1796, Ger. trans., 1798); *Nouvelles expériences et observations sur divers objets de physique,* 2 vol. (1785–89); *Vermischte Schriften physisch-medicintschen Inhalts* (1782, 1784) and *Anfangsgründe der Electricitiit* (1781).

See J. Wiesner, *Jan Ingen-Housz, sein Leben und sein Wirkrn als Naturforscher und Arzt* (1905); C. Singer, *The Story of Living Things* (1931) and *Nieuw Nederl. Biogr. Woordenboek,* vol. vi (1924).

INGERMANLAND (Russian: *Ingermanlandia, Ingria,* formerly: *Izhora;* Finnish: *Ingerinmaa),* is the region on the Gulf of Finland between the lakes Ladoga and Peipus. Its terrain is flat except for the slight hill formations along the Luga and Oredezh rivers. The city of Leningrad is situated in this region.

INGERSOLL, ROBERT GREEN (1833–1899), U.S. orator, politician and lawyer, who popularized the higher criticism of the Bible, a humanistic philosophy, and a scientific rationalism which qualified him as the "bull dog" for Charles Darwin in the United States, was born in Dresden, N.Y., Aug. 11, 1833. The self-educated son of a peripatetic Congregational minister, he had little formal education. Admitted to the Illinois bar in 1854, Ingersoll subsequently enjoyed a lucrative law practice in Peoria, Washington, D.C., and New York city. His Civil War service as a colonel of Illinois volunteer cavalry was terminated in 1862 when he was captured and paroled by Confederate General Nathan Bedford Forrest. As an orthodox Republican he was attorney general of Illinois, 1867–69, the "big voice" of the party in the presidential campaigns of 1876 and 1880 (he gave James G. Blaine the soubriquet "The Plumed Knight"), and leading counsel for Republican defendants in the Star Route Scandal of 1882. In spite of his contributions to the party as a speaker, his unorthodox religious views deterred Republican administrations from appointing him to the cabinet or diplomatic posts which he desired. Nationally known as a lecturer, he was in great demand and received as much as $3,500 for a single evening's performance. He died at Dobbs Ferry, N.Y., July 21, 1899. His principal lectures and speeches—which bear such titles as *Some Mistakes of Moses* and *Why I Am An Agnostic*—*are* found in *The Works of Robert G. Ingersoll,* edited by Clinton P. Farrell, 12 volumes (1902).

See C. *H.* Cramer, *Royal Bob,* a biography (1952). (C. H. CR.)

INGERSOLL, ROBERT HAWLEY (1859–1928), U.S. merchant and manufacturer, was born at Delta, Eaton, Mich. Dec. 26, 1859. He spent his youth on his father's farm and had a very limited formal education. At the age of 20 he went to New York city and, with his savings of $1,600, established a business manufacturing and selling rubber stamps. With his two brothers he expanded it to include a wide variety of novelty products including the dollar Ingersoll watch. This became known as "the watch that made the dollar famous," about 70,000,000 being sold by 1919. He lost control of the firm in 1921 but in 1924, in a new venture, successfully introduced a dollar razor strop. Ingersoll died in Denver, Colo., Sept. 4, 1928. (H. J. SG.)

INGERSOLL, ROYAL EASON (1883–), U.S. naval officer, was born in Washington. D.C., June 20. 1883, son of Rear Adm. Royal Rodney Ingersoll. He graduated fourth among 114 in 1905 at the Naval academy. He became a rear admiral in 1938, a vice-admiral in Jan. 1942 and an admiral in July of that year. As commander in chief of the Atlantic fleet from Jan. 1942 to Nov. 1944 he had the responsibility of conducting antisubmarine warfare, escorting convoys and transporting both troops and supplies to Europe and north Africa. In Nov. 1944 he became deputy

commander in chief U.S. fleet and commander of the western sea frontier, in which post he continued until Dec. 1945. He retired on Aug. 1, 1946. (J. B. HN.)

INGLEWOOD, an industrial and residential city in west-central Los Xngeles county, Calif., U.S., a part of the Los Angeles metropolitan area and site of the Los Angeles International airport. Inglewood's industry includes aircraft manufacturing, metal products, pottery production and oil refining. An additional feature is the large race track, Hollywood Park.

The first settlers to enter the area were attracted by the *Aguaje de la Centinela* ("Sentinel Springs"). In 1822 Antonio Avila was given permission by the Mexican government to keep stock around the springs. The Avila family continued to hold the springs area until 1855, when the grant was confirmed by the California state government after a three-year land-claim survey. In 1887 it was acquired by the Centinela-Inglewood Land company, made up of seven Los Angeles real estate investors. Surveyors laid out the townsite during August and September. A railroad connecting Inglewood with Los Angeles was completed the next spring. By that time several small businesses and a hotel were already in operation. Inglewood was incorporated as a California city in 1908 and gained a freeholder charter in 1927. Its greatest proportional growth came between 1920 and 1925. The 1960 census showed a population of 63,390. (J. M. Wo.)

INGLIS, SIR CHARLES EDWARD (1875–1952), British professor of engineering distinguished as a teacher and for his researches into bridge vibrations, was born at Worcester on July 31, 1875. His early researches concerned mechanical vibrations, but in 1913 he published an important paper on the stresses in a plate due to the presence of cracks. He investigated railway bridge vibration from 1923 to 1934. During World War I he designed an easily transportable bridge, bearing his name, which was adopted by the British army and much used in 1917–18. In 1919 Inglis was appointed professor of mechanical sciences and head of the department of engineering, Cambridge university, in succession to Bertrand Hopkinson. On his retirement in 1943 the department had become one of the most important engineering schools in the world. He died in Suffolk, April 19. 1952. (J. F. BR.)

INGLIS, SIR JOHN EARDLEY WILMOT (1814–1862), British major general, son of John Inglis, third bishop of Nova Scotia, was born in Nova Scotia on Nov. 15, 1814. In 1833 he joined the 32nd foot, in which all his regimental service was passed. He saw active service in Canada (1837) and in the Punjab (1848–49), being in command at the storming of Multan and at the battle of Gujrat. In 1857, on the outbreak of the Indian mutiny, he was in command of his regiment at Lucknow. Sir Henry Lawrence being mortally wounded during the siege of the residency, Inglis continued the defense for 87 days against an overwhelming force. He was promoted to major general, made K.C.B. and, in 1860, given command of the British troops in the Ionian Islands. He died at Hamburg, Sept. 27, 1862.

INGOLD, CHRISTOPHER KELK (1893–), English organic chemist, born Oct. 28, 1893, at Ilford, Eng., was educated at Cniversity college, Southampton, and the Imperial College of Science and Technology, London, where he received a Doctor of Science degree in 1922. After lecturing at the Imperial college. Ingold became professor at Leeds, 1924–1930, University college of London university, 1930–37, and director of the chemical laboratories at University college in 1937. Ingold excelled in studies of resonance, mesomerism, electronic interpretations, clarification of constitution of organic substances and their reactions. developments of steric hindrance and use of deuterium in research. He received many honours and awards, including the royal medal of the Royal society (1952) for investigations of the mechanism and factors affecting organic reactions. He was Baker lecturer at Cornell university, Ithaca, N.Y., in 1950. and published *Structure and Mechanism in Organic Chemistry* (1953), authoritative for stereochemistry and reaction mechanics. (V. BW.)

INGOLSTADT, a town of Germany, in the *Land* of Bavaria, on the left bank of the Danube at its confluence with the Schutter, 52 mi. N. of Munich, at the junction of the main lines of railway, Munich, Bamberg and Regensburg-Augsburg. Pop. (1950) 40,523. Ingolstadt, known as *Aureatum* or *Chrysopolis,* was a royal villa in the beginning of the 9th century, and received its charter of civic incorporation before 1255, and later became the capital of a dukedom which merged with that of Bavaria-Munich. The fortifications were erected in 1539. In 1800 the French, under General Moreau, took the town, and dismantled the fortifications. They were rebuilt on a much larger scale under King Louis I, and after 1870 Ingolstadt ranked as an important fortress. The principal buildings are the old palace of the dukes of Bavaria-Ingolstadt; the remains of the earliest Jesuits' college in Germany, founded in 1555; the former university buildings, now a school; and the large Gothic Frauenkirche, founded in 1425, with two massive towers, containing the tomb of Dr. Eck, Luther's opponent. In 1472 a university was founded in the town by the Bavarian duke, Louis the Rich, which at the end of the 16th century was attended by 4,000 students. In 1800 it was removed to Landshut, whence it was transferred to Munich in 1826. The industries are metal founding and the manufacture of locomotives and machinery. The town suffered some damage during World War II.

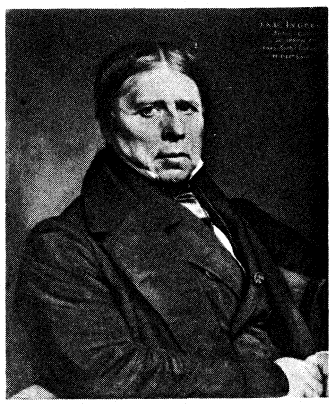
INGRAM, JOHN KELLS (1823–1907), Irish scholar and economist who made a reputation in the fields of literature, philosophy and science, as well as political economy was born in County Donegal, Ireland, on July 7, 1823, and educated at Newry school and Trinity college. Dublin. Elected fellow of his college in 1846, he became successively professor of oratory and English literature (1852–66), regius prufessor of Greek (1866). and librarian (1879). Remarkable for his versatility, he contributed a historical and biographical article on economics to the 9th edition of the *Encyclopedia Britannica* which was translated into many European languages. He died in Dublin on May 1, 1907. His principal works are *Greek and Latin Etymology in England; The Outlines of the History* of *Religion* (1900); *Human Nature and Morals According to A. Comte* (1901); *Practical Morals* (1904); and *Sonnets and Other Poems* (1900).

INGRAM, JONAS HOWARD (1886–1952), **U.S.** naval officer who during World War II supervised the convoy of thousands of U.S. troops to the European theatre, was born in Jeffersonville, Ind., Oct. 15, 1886. He entered the Naval academy in 1903 and graduated in 1907. He became a rear admiral on Jan. 10, 1941, vice-admiral on Feb. 2, 1942, and admiral on Nov. 15, 1944. In 1941 he commanded a cruiser division in the Atlantic, and afterward he became commander 4th fleet and commander South Atlantic force with headquarters in Brazil. He was most successful in his dealings with the South American nations and with Brazilian naval units serving under his command. His fleet was very efficient in antisubmarine warfare. On Nov. 15, 1944, he became commander in chief U.S. Atlantic fleet, and continued in this post until Sept. 1946. He retired April 1, 1947, and died at San Diego, Calif., Sept. 10, 1952. (J. B. HN.)

INGRES, JEAN AUGUSTE DOMINIQUE (1780–1867), French painter, the leader of the classical tradition in French 19th-century painting, was born at Montauban in Gascony on Aug. 29, 1780. His father was an impecunious ornamental sculptor, painter and drawing master who encouraged his eldest child from the very early moment that the boy's gifts for drawing and music became apparent. In 1791 Ingres first attended classes at the academy at Toulouse. The personalities of none of his early teachers left their mark, though Ingres' lifelong love of Raphael dates from his boyhood. In Aug. 1797 he went to Paris and entered the atelier of J. L. David. moving two years later to the Ecole des Beaux-Arts. After no more than a few weeks there he won the torso prize; and in 1800 he was equal second in the Prix de Rome, which he won outright the following year with a painting in the style of David's "Sabine Women," "The Envoys From Agamemnon Before Achilles" (École des Beaux-Arts, Paris).

Unsettled political and economic conditions led to the postponement of the award, and Ingres had to wait until the autumn of 1806 before he could leave for Rome. In the meantime he was given important official portrait commissions, and was provided with a studio in the old Capucine convent, now state-owned, where A. Gros, A. L. Girodet and Ingres' student friends François Granet

and Lorenzo Bartolini worked. "The Envoys From Agamemnon" was warmly praised by John Flaxman, whose influence may be seen in several of Ingres' early works, among them the sketch "Venus Wounded by Diomedes" (c. 1803, Hirsch collection, Basel) and "Jupiter and Thetis" (1811, Aix-en-Provence). Flaxman was at this time famed throughout Europe as a vase painter for Josiah Wedgwood and as an illustrator of Homer, and his friezelike compositions and bold use of unshaded line were regarded as quintessentially classical qualities by Ingres and his friends. They found Flaxman's style more convincing than the new "Greek" manner of their master David.



ALINARI

"SELF PORTRAIT– BY J. A. D. INGRES. IN THE UFFIZI GALLERY. FLORENCE

Ingres borrowed freely from Flaxman's illustrations and from contemporary engravings of Greek sculpture and vase designs. He was deliberately building up a repertory of forms that he continued to use in classical compositions throughout his life Perhaps aware of the poverty of his imagination, Ingres made a virtue out of copying.

Apart from the classical figure compositions the young Ingres was also painting portraits Several were shonn at the Salon of 1806, where they were met with incomprehension and ridicule. Ingres' portrait style was indeed an unusual one, owing much to Raphael. In self-portraits and portraits of friends, the sitters are strongly individualized and given a mysterious, almost tormented air—the touch of romanticism often found in Ingres. But in commissioned works, like the three Rivikre portraits (Louvre, Paris) or Mme. Aymon (Rouen), the artist does not attempt to express the character of his sitters, though their bourgeois origins are plain.

Ingres is not concerned with naturalism of any sort, but with the creation of an abstract design in which the forms of the natural norld are shaped into an eloquent surface pattern. His remarkable natural feeling for line allows him to describe form by contour alone.

In the most revolutionary portraits, like that of Mme. Rivikre, an arabesquelike pattern of lines dominates the picture, and Ingres seems to have abolished space, reducing body, clothes and cushions to a single unified plane. Natural forms are given an unreal near-geometrical smoothness, and are then held in perfect equilibrium by the linear pattern of the picture. Colour is always subservient to line, though Ingres has a strong feeling for texture and delights in rendering rich stuffs. These same qualities may be found in the great series of female nudes which begins in 1807 with the Bonnat and Valpinçon "Baigneuses" ("Bathers," Bayonne and Louvre) and reaches its climax in "Le Bain Turc" ("The Turkish Bath," Louvre).

The "Baigneuses" were painted in Rome; Ingres had finally left Paris in 1806 and did not return when his scholarship expired in 1810. He stayed in Rome, earning a living from the portraits and portrait drawings in pencil, now so admired. which to Ingres were a form of drudgery that prevented his working on the large history pieces he wished to paint. Ingres was planning both classical (Homeric) and historical (Raphaelesque) compositions: two distinct manners that persist in his work. The first large Homeric composition, "Jupiter and Thetis." met only with disapproval when sent back to Paris in 1811. Because he disliked all Italian painting after Raphael, Ingres was accused of archaizing tendencies.

In 1814 and 1819 Ingres again sent work to the Paris Salon, including some pictures in the new "troubadour" style—scenes of medieval history depicted in quasi-realistic manner (events in the lives of Henri IV, of Aretino, of Raphael; and a series of great lovers). He was still much criticized. In 1820 he moved from Rome to Florence; his altarpiece, "Christ Giving the Keys to Peter" (Louvre). had won some favour, and he mas now at work on another religious picture, "The Vow of Louis XIII," commissioned for Montauban cathedral. Ingres returned to France in 1824 to show this at the Salon. It met with universal approbation, appealing to classicist, romantic and troubadour taste alike. A rnost ambitious design, it represents the culmination of Ingres' Raphaelesque manner.

After 18 years' absence in Italy, Ingres became a Parisian celebrity overnight. He was given the cross of the Legion of Honour by Charles X, elected to the French Academy, and asked to paint "The Martyrdom of St. Symphorian" for Autun cathedral and "The Apotheosis of Homer" for the ceiling of the ne museum in the Louvre. He opened a studio and quickly had more than 100 students. The Louvre picture was completed by 1827. It celebrated an early enthusiasm of Ingres', one that also inspired the "Homer Deified" on which he was working at the time of his death. In the "Apotheosis" Ingres' Raphaelesque and Homeric manners are combined. The second commission, for Autun, gave Ingres much difficulty and when exhibited at the Salon of 1834 it was adversely criticized. Greatly upset, Ingres vowed never to show at the Salon again. He stopped painting for a time and left Paris to become director of the French academy in Rome.

He returned to Paris in 1840 and the last 26 years of his life were comparatively uneventful. The most considerable project was a decorative scheme for the chbteau of Dampierre, which occupied Ingres from 1843 until 1850 when work was abandoned. "The Golden Age," unfinished and ruined as it is, marks the revival of mural painting in France which culminates in the work of T. Chassériau and Puvis de Chavannes.

Ingres also continued to paint portraits, religious pictures, nudes and figure compositions, of which "Le Bain Turc" (Louvre), completed 1863, is the most important. Into it he introduced, almost without change, the figure of the "Valpinçon Baigneuse" which he had painted in 1808. Ingres was never against imitation or copying, and replicas by his own hand abound. In 1846 and 1855 retrospective exhibitions of his works were arranged. Ingres died in Paris on Jan. 14, 1867.

Charles Baudelaire, although as the champion of Eugène Delacroix he cannot be regarded as unbiased, laid the foundations of later estimations of Ingres. He perceived that Ingres was a draftsman of genius, who, seeing colour as no more than an inessential prettifying ornament, ruthlessly subordinates it to line. He noticed Ingres' lack of creative imagination, and the way in which he develops little, but switches from style to style. The entire production of Ingres' long output is implicit in the impressionable early years; and, as Baudelaire says, *comme il n'a* pas *progressé, il* ne vieillera pas ("because he has not progressed, he will not age").

Though affected by romanticism, the David-trained Ingres was a classical artist. His classicism made him abstract from the natural world for the sake of pictorial composition. This and his powers of draftsmanship help to explain why he has never lacked admirers, and why Degas, Gauguin, Matisse and Picasso were all profoundly influenced by his work. Many of Ingres' major works are now in the Louvre museum; he bequeathed the contents of his studio, including 4,000 drawings and 30 paintings, to his native town of Montauban.

BIBLIOGRAPHY.—H. Delaborde, *Ingres* (1870); *H.* Lapauze, *Ingres* (1911); *G.* Wildenstein, *Ingres* (1954); N. Schlenhoff, *Ingres—ses* sources *littéraires* (1956). (A. Bs.)

INGRESS, entrance as opposed to exit or egress; in astronomy, the apparent entrance of a smaller body upon the disk of a larger one, as it passes between the latter and the observer; in this sense it is applied especially to the beginning of a transit of a satellite of Jupiter over the disk of the planet.

INHERITANCE. The expression inheritance in its broad sense comprises the devolution of property on death, whether real property (land) or personal property, whether effected by will or by operation of law upon intestacy. In its technical sense the expression is derived from Latin *heres,* an heir.

United States.—U.S. law borrowed its rules of descent of real estate considerably more from the civil lam than the common law.

"The 118 novel of Justinian has a striking resemblance to American law in giving the succession of estates to all legitimate children without distinction and disregarding all considerations of primogeniture. There is one particular in which the American law differs from that of Justinian, that while generally in the United States lineal descendants if they stand in an equal degree from the common ancestor share equally per *capita;* under the Roman law regard was had to the right of representation, each lineal branch of descendants taking only the portion which their parent would have taken had he been living, and the division being per stirpes and not per capita. But in some of the state's the rule of the Roman law in this respect has been adopted and retained." When such lineal descendants stand in unequal degrees of consanguinity the inheritance is per stirpes and not per capita (In re Prote, 1907; 104 N.Y. Supplement 581). This became the rule in practically all 'the states.

The entire subject of descent, substantially, became statutory. The principal changes were in uniformity of rules as between real and personal property and a more substantial provision for the wife. An important feature at common law—"the blood of the ancestor"—lost its importance.

But as in no two states are the rules of descent identical, the only safe guides are the statutes and decisions of the particular state in which the property to be inherited is situated. In most states the rules for the descent of real and personal property are the same, but in several states they continue to differ. The law of primogeniture as understood in England is abolished throughout the U.S., and male and female relatives inherit equally.

The distinction between relatives of the whole and half blood is not ordinarily in force. In a few states it is abolished by statute. In several others those of full blood are preferred.

The English rule that natural children not subsequently legitimated have no inheritable blood has been greatly modified. In several states inheritable blood exists between a natural child and its mother. In some states a subsequent marriage removes the bar as does recognition by the father in some states. In Arizona an illegitimate heir may inherit from and through both parents. Common-law dowers have been largely regulated by statutes which give certain rights to the surviving wife in lieu thereof—usually more favourable to her than her common-law dower. In several states she takes a third interest in fee in land alienated by her husband in his lifetime without joining her in the deed—usually one-third; in Kansas one-half interest in fee.

Curtesy has likewise been very generally abolished and certain statutory rights given to a surviving husband instead. In the states which came in through the Spanish or French titles, dower and curtesy had no place.

In default of issue and subject to the share of the spouse, the parents usually take, and failing parents, collaterals take. A usual form of statute gives the wife one-half where there is but one child; if there be more than one child, the wife takes a child's share.

Degrees of kindred in the United States generally are computed according to the civil law; *i.e.,* by adding together the number of degrees between each of the two persons whose relationship is to be ascertained and the common ancestor. Thus, relationship between two brothers is in the second degree; between uncle and nephew in the third degree; between cousins, in the fourth; etc. In a few states such degrees are computed according to the common law; *i.e.,* by counting from the common ancestor to the more remote descendant of the two from him—thus, brothers would be related in the first degree; uncle and nephew in the second; etc. In most states representation among collaterals is restricted—in some to the descendants of brothers and sisters, in others to their children only.

In eight states (California, Louisiana, Texas, Arizona, Idaho, Nevada, New Mexico and Washington) the law of "community property" of husband and wife prevails. This is derived from the French and Spanish law existing in the territories out of which those states were formed as the result of the Spanish and French occupation. The foundation idea is an equal division at the death of either party of all property acquired during their marriage except by gift, devise or descent. In general the husband has the control and management thereof during the marriage, and the survivor has the administration of the moiety of the one deceased.

(F. R.; X.)

England.— The heir in English law was the person on whom the real property of a deceased person devolved by operation of law. Until 1926 such descent was regulated by the rules and canons of descent. All existing modes, rules and canons of descent were abolished by section 4j of the Administration of Estates act, 1925, which went into operation in 1926. Before 1926 the devolution of personal property upon an intestacy depended upon a complex body of law which was likewise superseded by the provisions of the Administration of Estates act, 1925.

The act contains a composite body of law governing the devolution of both real and personal property. It provides that on the death of a person intestate as to any real or personal estate, such estate shall be held by personal representatives appointed by the court upon trust for sale. The personal representatives have the duty of realizing the estate and applying the proceeds first to satisfy the liabilities of the deceased and then to distribute the residue when realized to the next of kin of the deceased as defined by and in the manner provided by the act. The first person to be considered is a surviving spouse. Subject to the interests of the surviving spouse the residuary estate is held upon the statutory trusts for any issue of the deceased. If the intestate leaves no issue the residuary estate is to be held on trust for the father and mother of the deceased, and if there are neither issue nor parents upon trust for the brothers and sisters of the whole blood; failing whom for brothers and sisters of the half blood. Then come grandparents, then uncles and aunts. If there are none of the aforementioned relatives the surviving spouse takes the whole of the estate absolutely. If no person can be found within the above categories the residuary estate passes to the crown. (See INTESTACY.)

For the inheritance of property by will, see WILL.

In many of the commonwealth countries and British colonial territories the English law of inheritance has been greatly modified by legislation.

Scotland.— Inheritance is that which descends to the heir of the owner on his death intestate. On the death of the person his property. so far as it is not regulated by deed and subject to certain prior claims. devolves on his heir or heirs according to rules of intestate succession.

The rules are the same for both heritage (land) and movable estate. The estate devolves in the first instance, subject to the rights of a surviving spouse, upon the descendants of the deceased, first children, failing them grandchildren and so on. If there are no descendants the estate devolves on relations in the collateral line, that is, brothers and sisters of the deceased, and failing these it passes to the ascendants, the father and his collateral relations, whom failing it passes to the grandfather and his collaterals and so on.

There are, however, important differences between succession in heritage and succession in movable property. In heritage, for instance, males are preferred to females in the same degree and the rule of primogeniture obtains. In movable estate all who are related in the same degree to the deceased share in the estate irrespective of age or sex.

By the Legitimacy act an illegitimate child or, if he is dead, his issue are entitled, if the mother dies intestate and without legitimate issue, to the same interest in her estate as would be the case if the child had been legitimate; and the mother takes the same interest in the intestate estate of her illegitimate child as would have fallen to her if he were legitimate and she were the only surviving parent.

The position of the father, after the brothers and sisters of the deceased, will be noticed as an important point of difference from the English axioms; so also is the total exclusion of the mother and the maternal line. Half blood is either consanguinean, as between children by the same father, or uterine, as between children having the same mother. The half blood uterine is excluded altogether. Half blood consanguinean succeeds thus: if the issue is by

a former marriage, the youngest brother (being nearest to the deceased of the consanguinean) succeeds first; if by a later marriage than that from which the deceased has sprung, the eldest succeeds first.

See also INTESTACY; **WILL.** (P. **E. L.**)

ECONOMIC ASPECTS

There are no concepts of inheritance which can be shown to be "natural," as may well be seen by comparing the ideas prevailing in different countries at the same time, or in the same country at different times. Absolute rights of inheritance and, bequest are mutually exclusive. In general, by an absolute right of bequest is meant the freedom to leave one's possessions exactly as one pleases, whereas an absolute right of inheritance is an inalienable right to possess what someone has left. An Englishman or an American, finding that his parents have left their wealth to some stranger, may be pardoned for emphasizing the moral rights of inheritance. A Frenchman, finding that a substantial part of his accumulated fortune must go, whether he likes it or not, to a son who has by his conduct no moral claim upon it, may be excused for advocating the right of bequest. One who has neither wealth to leave nor to receive may be pardoned for questioning a system which perpetuates through the accident of birth the concentration of economic power inherent in wealth status.

Inheritance and Income Inequality.— Inheritance of wealth is one factor among many affecting the pattern of income distribution in a society. Wealth as well as poverty tends to be self-perpetuating, even in countries where consciousness of social classes is not acute and opportunities are many for the advancement of the astute and the ambitious. Progeny of high-income families usually have better educations as well as better opportunities for early placement in promising positions than do those of low-income families. Occupation is a main source of income differences, and family background continues to be an important influence in occupational selection. Even if inheritance in the form of wealth could be eliminated, differences in the investment made in the training of children would be sufficient to perpetuate income inequality.

It is a common error to overemphasize the effect of wealth ownership alone on the pattern of income distribution. According to estimates made by Simon Kuznets in 1953, a redistribution of all property income in the United States on an equal per capita basis would reduce the income inequality between the top 5% of income recipients and the lower 95% by, at most, only one-third. Since wages and salaries are a large part of total incomes, inequality in their distribution assures inequality in the distribution of all incomes, and the inequality from service incomes in large.

Inheritance and Taxation.— Two sets of taxes have grown around the event of death—estate duties and succession or inheritance taxes. An estate tax is levied on a base defined as the net assets of the estate, whereas a succession or inheritance tax is computed on the share obtained by the beneficiary. At proportional rates, the two types of taxes are equivalent; the total tax liability is the same regardless of how finely an estate may be divided. In practice, however, both taxes are ordinarily levied at progressive rates and therefore they are not equivalent. Estate taxes are usually believed to provide more revenue than succession or inheritance taxes. However, their comparative yields depend upon the exemptions and the rate structures imposed.

The estate tax is found in English-speaking countries. The inheritance tax is, with few exceptions, the only death tax device used throughout the rest of the world. Estate and gift taxes are imposed by the federal government of the U.S. The states also employ estate taxes, and a few have both estate and inheritance taxes. The trend in the 1950s was away from the employment of inheritance taxes in the United States, and the estate tax was the only form of death duty in the United Kingdom. (For history, detailed tax provisions, rates, etc., see ESTATE AND INHERITANCE TAXES.)

From the point of view of reducing the concentration of economic power, both estate and inheritance taxes, as ordinarily designed, are rather crude tools at best. If it is public policy to impose obstacles to the perpetuation of fortunes, there is no compelling reason for imposing a tax only once each generation. A more direct and effective method of reducing wealth concentration is annual net worth taxation. Such a tax was introduced in Japan after World War II as a result of the suggestions of the Shoup commission. The tax was based on the value of assets owned minus debts of living persons. Such a tax may be viewed as a substitute for high rates on large incomes under a personal income tax as well as a substitute for a death tax. Even with a high exemption, such as the first $500,000 of net assets, a system of initially low but progressive rates on net worth could substantially reduce the large fortunes over relatively short periods of time. Tax liabilities could be made to exceed income, and for the few very wealthy families, greatly exceed income.

Another substitute for death taxes is an accessions tax (also introduced into Japan). The base of the tax is the cumulative total of gifts, bequests and inheritances received by any one person from all sources during his lifetime. An accessions tax is a form of inheritance tax, and its employment would call for a marked departure from the traditional form of transfer tax in the United States or the United Kingdom. Such a tax comes close to another proposal advocated by Henry Simons (*Personal* Income Taxation) to include gifts, bequests and inheritances in the income of the recipient and to tax such gains like other gains under an individual income tax. The theory behind this proposal is that the income of a person consists of any gain he receives regardless of its source, and thus a gift or an inheritance is income to the recipient and should be treated as such for tax purposes. No insuperable technical obstacles exist to both an annual net worth tax and the inclusion of gifts, bequests or inheritances under the individual income tax if it is public policy to prevent inheritance from perpetuating wealth concentration.

Incentive Problems.— Death taxes have been called "ideal" taxes from an economic point of view because they merely take away a portion of a windfall gain from the recipient, thus having no effectson economic incentives. This theory is defective because it directs attention to the recipient, whereas the incentive effects, if any exist, apply to the predecessor. A simple tax on dying would have no incentive effects, since a person would know that at his death a flat sum would need to be paid and this sum would be independent of any action he or his beneficiaries might take. The incentive effects of an estate tax may be discovered by comparing such a flat-sum tax on dying with a tax of equal revenue based on the size of the net estate at death. Viewed in this way, the extra anticipated tax cost of an extra dollar added to one's estate is the discounted value of the future rate of tax to be imposed on the added dollar. The alternative to adding to one's estate is spending more money on consumption, making gifts (unless gifts are also subject to tax) and, in the case of an active person, retiring from work at an earlier age. Whether or not high marginal rates of a death tax actually induce wealthy people to consume more had not been systematically investigated at mid-20th century. Some presumption exists that wealthy people, by the time they have reached their middle years, will have settled upon their consumption habits, and the prospect of a tax will have little if any influence on their consumption behaviour. Dissipation of estates by gifts does occur. The gift tax in the United States and the requirement in the United Kingdom that gifts made within a specific number of years prior to death be included in the taxable estate were attempts to prevent this method of avoidance. The evidence suggests that people are rather cautious about giving away their wealth prior to death. According to a U.S. treasury study, even those with estates exceeding $5,000,000 made gifts of only about 12% of their total wealth prior to death. Few people of wealth are apparently willing to part finally with their assets on a substantial scale prior to death, suggesting that the desire to own and control property is deeply rooted in human motivation. The same evidence suggested, but did not prove, that the willingness of people to accumulate wealth is not affected in any marked degree by the prospect of taxes levied upon the size of their estates.

The prospect of heavy taxation of net estates or of the shares

of possible beneficiaries may undermine the inducement of older people to continue to work, where they had the opportunity. Many of course have no choice because of poor health or compulsory retirement plans. In other cases, an estate tax (or an inheritance tax) becomes one possible motivation for early retirement. If the rates under an estate tax were 100%, the dissipation of assets by earning less without consuming less mould be almost costless for people of advancing years. Some might retire earlier by living off their accumulated assets. The rate structure of the U.S. federal tax becomes high only for very large estates, and the number of persons affected is, correspondingly, very small. If the exemptions were greatly reduced and the rates advanced on modest estates, the possible negative effect of death taxes on the incentive to work might have more importance.

Inheritance and Investment.—Inheritance has been defended on the grounds that wealth concentration favours investment and any governmental interference with transfers at death slows the pace of progress through new investment. What justification there might have been favouring wealth concentration as a means of achieving mass-production techniques has long been made obsolete by the industrial corporation. There is, however, some substance to the belief that heavy death taxes may retard the rate of new capital formation. Clarity of thought on this point has been severely handicapped by the popular misconception, shared by legislators, that because a death tax is a tax on capital, it must "come out of capital." Actually, the form of a tax gives no information about the source of the funds which the government obtains. It has been observed that a tax on beer does not mean that the tax is paid out of beer. Likewise a tax levied on persons with respect to the size of their assets does not imply that the tax is paid out of capital. In a literal sense, taxes are paid in money, an asset, and in this respect tax payments do not differ from other payments. The issue of substance is the adjustment which people make in their personal consumption and asset-acquisition expenditures under the impact of a tax. Whether a tax reduces private consumption or expenditures on assets depends primarily on the distribution of the burden of the tax among people classified by the size of their wealth or by the size of their incomes. A revenue system which forces low-income groups to pay taxes will, almost regardless of the type of tax. reduce aggregate consumption expenditures because low-income groups spend what money they have mainly for personal consumption items. Likewise, a tax system nhich hits high-income groups heavily mill reduce their expenditures upon assets because a larger portion of their current expenditures goes for investment. Thus heavy death taxes may be expected to curtail the amount of individual thrift. Its effects in this regard are much smaller than those of progressive income taxes for the reason that death taxes yield less revenue.

There is a school of thought which holds that taxes, including death taxes. need not reduce expenditures on new physical assets. In substance, this position rests upon the theory that actual investment is not restricted in any significant degree by inability to acquire the necessary funds. Large corporations make a substantial portion of total new investment. They obtain funds by plowing back earnings and, on a smaller scale, by borroning. The relevant limitations on their expenditures for new facilities are those connected with the marketing of the product, the rate at which engineering and scientific research points to new profitable investments and, most important, expectations concerning future business developments. Accordingly, a government might virtually equalize the distribution of income by tax and subsidy measures without affecting the ability of business to finance new investments. Taxes are relevant to the scale of investment mainly as they affect the demand for products of a corporation rather than as they may affect the demand on the part of private groups for corporate shares of stocks or bonds. Noncorporate investors can finance themselves also without depending upon wealthy lenders by using the facilities of financial organizations including those sponsored by governments.

Thus it may be claimed that the rate of new investment is not affected in any significant degree by heavy taxation of high-income groups, whether the form of such taxes consist of once-a-generation capital levies, annual net worth taxation or highly progressive income taxation. Accordingly, taxes reduce expenditures for new facilities only if they directly discourage investment expenditures, sometimes alleged to be true of corporate net income and excess profits taxes. Death taxes are mainly irrelevant in this regard because corporations are, for obvious reasons, not subject to such taxes, and individuals who may acquire new physical assets are affected only to the extent that loss possibilities, occasioned by forced liquidation in the settlement of an estate, may be anticipated. Such considerations as these remove almost any economic objections to heavy individual progressive taxes because of their effects on capital formation.

The view that ability to obtain cash is not a limiting factor in the creation of new resources was the dominating, though not the exclusive, implication of the views of British economists as well as a large group of U.S. students in the 1950s. The contrary view, commonly labeled "orthodox" (historically, the great thinkers in economics held that saving limits capital formation), had been gaining more support, partly because the experience of post-World War II inflations was interpreted as experimentally verifying the theory that lax financial policies contribute to price inflations, and that stringent policies, where practised, were, in fact, effective in reducing inflationary pressures. Such evidence supported but did not conclusively establish that greater thrift induces a higher rate of investment in industrial countries without resort to inflation.

If the cost of financing does limit investment, estate taxation does so also, not because the tax is levied on "capital" but because it is imposed on people who spend much of their money for assets. The payment of the tax absorbs funds which in part would otherwise have financed the holding of assets, including new physical resources, and thus tends to advance interest rates. Only the most extreme view of the role of finance in investment, however, would support the conclusion that progressive death taxation reduces expenditures for capital formation on a dollar for dollar basis. In the United States the yield of death taxes was too small in the 1950s to have any quantitatively significant effect on the rate of new investment.

BIBLIOGRAPHY.—A. C. Pigou, *A Study in Public Finance,* 3rd ed., pp. 138–146 (Toronto, London, 1947); William Vickrey, *Agenda for Progressive Taxation,* pp. 198–305 (New York, 1947); Henry C. Simons, *Personal Income Taxation,* pp. 125–147 (Chicago, London, 1938); Harley L. Lutz, *Public Finance,* 4th ed., pp. 485–506 (New York, 1947); John Stuart Mill, *Principles of Politzcal Economy,* vol. 1, bk. 2, ch 2 (London, 1848). (E. R. R.; X.)

INHIBITORS: *see* CATALYSIS.

INIA *(Inia geoffrensis)*, the fresh-water dolphin of the Amazon basin. reaching eight feet in length and pink or black and pink in colour. *See* WHALE.

INISFAIL, a poetic name for Ireland. It is derived from *inis* "island" and *Lia-fáil,* the celebrated stone identified in Irish legend with the stone on which the patriarch Jacob slept when he dreamed of the heavenly ladder.

INITIALS, the first letters of names. In English law it has been held that it is sufficient if a person affixes to a document the usual form in which he signs his name, with the intent that it shall be treated as his signature. So, signature by initials is a good signature within the Statute of Frauds *(Phillimore* v. *Barry,* 1818, 1 Camp. 513), and also under the Wills act, 1837 (In *re Blewitt,* 1880, 5 P.D. 116).

See SIGNATURE; AUTOGRAPH.

INITIATION RITES: *see* PASSAGE RITES.

INITIATIVE: *see* **REFERENDUM** AND INITIATIVE.

INJECTOR, an induced current apparatus which by means of a jet of steam feeds water to a boiler. The invention of Henri Giffard, its introduction in 1859 created great interest, because it seemed impossible that a jet of steam from a boiler could force itself and the water back into the boiler. Yet not only was this done, but later researches proved that exhaust steam at atmospheric pressure could be utilized, and it became possible later to deliver against a pressure of 150 lb. per square inch. The Davies and Metcalfe exhaust injector will do this, and with the help of a small supplementary jet of live steam it will feed against a pres-

sure of 250 lb. per square inch. Exhaust steam has no velocity in the atmosphere, but if issued into a vacuum it acquires a very high velocity. Hence, by condensing the steam by contact with the feed water such a vacuum is produced, and the resulting velocity of the steam, imparted to the water, produces sufficient force to carry the latter into the boiler.

See also EJECTOR; STEAM.

INJUNCTION, in English law, the name for a judicial command whereby a party is required to refrain from doing a particular thing according to the exigency of the writ. Formerly it was a remedy peculiar to the court of chancery, but under the modern constitution of the judicature, the injunction was made equally available in all the divisions of the high court of justice and it could no longer be used to prevent an action in any of them from proceeding in the ordinary course. Although an injunction is properly a restraining order, there are instances in which, under the form of a prohibition, a positive order to do something is virtually expressed by what is known as a mandatory injunction. The injunction was used to stay proceedings in other courts "wherever a party by fraud, accident, mistake or otherwise had obtained an advantage in proceeding in a court of ordinary jurisdiction, which must necessarily make that court an instrument of injustice." As the injunction operates personally on the defendant, it may be used to prevent applications to foreign judicatures; but it is not used to prevent applications to parliament or to the legislature of any foreign country unless such applications be in breach of some agreement and relate to matters of private interest. The jurisdiction of the court to prevent breaches of contract has been described as supplemental to its power of compelling specific performance; thus, *e.g.*, in the case of an agreement of a singer to perform at the plaintiff's theatre and at no other, the court, although it could not compel her to sing, could by injunction prevent her from singing elsewhere in breach of her agreement.

An injunction may as a general rule be obtained to prevent acts which are violations of legal rights, except when the same may be adequately remedied by an action for damages at law. Thus the court will interfere by injunction to prevent waste, or the destruction by a limited owner, such as a tenant for life, of things forming part of the inheritance. Injunctions may also be obtained to prevent the continuance of nuisances, public or private, the infringement of patents, copyrights and trade-marks. Trespass might also in certain cases be prevented by injunction. Purely temporary injunctions may be obtained ex parte but others only on notice to the other side. An injunction obtained on interlocutory application during the progress of an action is called an "interim" injunction, which is superseded by the trial. It may be continued either provisionally or permanently. (See PRACTICE AND PROCEDURE.) (X.)

United States.—Despite the administration of law and equity by a single court, as is true of most U.S. states, the remedy by injunction retains its essentially equitable character. Its issuance is governed, in the main, by the accepted precedents of equity. An extension of the injunction on the principle of equitable jurisdiction over nuisances was the use of the remedy to aid in the enforcement of criminal laws. The fact that the proceedings relating to the issuance and enforcement of injunctions are conducted before a judge alone eliminates the inevitable discretion that under the common law system is vested in a jury. Consequently, when the enforcement of a particular law becomes difficult because of the opposition of a particular community as manifested in the tendency of juries to acquit in criminal prosecutions, resort has been made to this head of equity jurisdiction.

Peculiar to the U.S. federalist system is the problem of federal courts' enjoining proceedings in state courts and vice versa. The general principle is that no such injunctions shall issue; but being courts of concurrent jurisdiction either court that first obtains jurisdiction of the subject matters regards itself as entitled to retain that jurisdiction to the exclusion of the other court and employs the injunction in aid of this purpose. The friction that might result from a liberal use of the injunction was foreseen at an early date, and in 1793 congress prohibited the use of the injunction by the federal courts for this purpose save in bankruptcy cases. The federal courts have, however, by a series of judicial decisions established numerous exceptions to this broad statutory provision among which is that noted above and the principle that the injunction will issue in aid of the exclusive jurisdiction of the federal courts. A second ground of irritation concerned the use of the injunction by the federal courts to restrain the enforcement of state statutes on the ground of their constitutionality. An appeal from such action lay to the U.S. supreme court, but during the interim a single federal judge was able to set at naught the entire administrative authority of a state. The incongruity of this result led congress by a series of statutes beginning in 1910 to prohibit the issuance of such injunctions before a court consisting of less than three judges, one of whom should be a circuit judge, and to provide for expediting an appeal therefrom to the supreme court. Limitations have also been imposed upon the power of federal judges to issue ex parte restraining orders pending an application for a temporary injunction. (J. M. LA.)

For injunctions in U.S. labour disputes, see **LABOUR** LAW: United States. See also EQUITY.

INK is a liquid or semifluid medium in which colouring matter is dispersed. The fluid serves as the vehicle for transferring the colouring matter to the paper or other surface from the pen, rubber stamp, type or other mechanism for making the characters.

Writing Inks are solutions of colouring material and other substances in water. The first inks, dating from about 2500 B.C. and used in the early Egyptian and Chinese civilizations, consisted of lampblack ground with a solution of glue or gums. This mixture was moulded into sticks and allowed to dry. The sticks were mixed with water before use. Coloured juices, extracts and suspensions of many plant, animal and mineral substances have been used as inks, including dragon's blood, alizarin, indigo, pokeberries, cochineal and sepia. A soluble iron salt forms a dark-coloured solution with an extract of tannin. Such mixtures have been used as writing ink for many centuries, and are the basis of modern blue-black inks.

General Properties.—Writing ink should leave a neat, legible mark on the paper. If a permanent ink, the marks on paper should remain legible after soaking in water, and after exposure to strong light. The ink mark should not accelerate deterioration of the paper. The ink should dry fairly quickly on paper and not smudge. It should not produce a feather-edged line or penetrate clear through the paper, or offset onto the adjacent sheet. The ink should have good writing qualities, including free and even flow from the pen without flooding or clogging. It should resist drying up and thickening on the feed and point of fountain pens. The liquid should be stable on standing; it should not form scum or sediment or permit the growth of mould or other microorganisms. It should be inert to steel pens, and to the rubber, plastic and other parts of fountain pens. Numerous special materials, in addition to the colour, are added to inks to modify their properties for the purposes outlined above.

Blue-black inks usually contain ferrous sulphate as the iron salt. At one time the tannin for inkmaking was obtained by extracting oak galls with hot water as part of the process. In the United States, however, most inkmakers adopted purified gallic and tannic acids. A small amount of a mineral or organic acid is usually added. Such a solution has a light bluish-black colour, and the writing on paper is faint initially but on standing becomes darker and insoluble in water. The latter property gives the ink its permanent quality. If the record becomes wet, the characters do not wash out but remain legible. Blue dyes are added to blue-black inks to enhance the appearance and to make the writing initially legible. The addition of black dyes produces permanent black inks. The following formula is from Federal Specification for Writing Ink, no. TT–I–563b:

Gallic acid crystals	5.0 g.
Ferrous sulphate crystals	7.5 g.
Tartaric acid	1.0 g.
Soluble blue (Colour Index no. 707)	3.5 g.
Distilled water, to make (25° C.)	1 l

Aqueous extracts of logwood with various metal salts, principally those of chromium, were extensively used as inks for many years, but by mid-20th century were little used in the United States. A small amount of ink which uses colloidal Prussian blue for the colour is produced.

Coloured inks contain soluble dyes as the sole colouring matter. Such inks are for school and home and such business use as does not require a permanent record, because the writing on paper fades in strong light and washes out if immersed in water. However, the writing on paper will last for many years if protected from such deteriorating effects.

Among the classes of dyes which have been used in writing inks are derivatives of triphenylmethane, azine, thiazine, monoazo, disazo and anthraquinone.

Washable inks are dye-base inks which may be washed from washable fabrics more readily than permanent inks if accidentally spilled, A typical washable ink:

Soluble blue (Colour Index no. 707)	5.0 g.
Glycerine	10.0 g.
Thymol	0.5 g.
Water, to make	1 l.

Quick-drying permanent inks consist of certain substantive dyes dissolved in an alkaline solution. The caustic solution wets the paper readily, which results in rapid penetration below the surface. Dyes are chosen which have strong affinity for the cellulose fibres of the paper, so that the writing on the paper cannot be washed out by soaking in water.

India ink is a dispersion of carbon black in water. Numerous substances have been s'uggested for stabilizing the suspension, including various alkaline solutions, shellac dissolved in borax solution, soap, gelatin, glue, gum arabic and dextrin. It is used mainly as drawing ink, though some is used as writing ink.

Technology.—The manufacture of writing ink consists of purifying the water by distillation or deionization, dissolving the ingredients in large tanks, clarifying the resulting solution by decanting, filtering or centrifuging, and packaging.

The packaging is usually done by a series of automatic machines which put the right amount of ink in each bottle, put on caps and screw them down, attach the label and insert each bottle in the individual carton. Such an automatic production line can produce more than 50,000 small bottles per eight-hour day. Economically, the package and the handling, storing and shipping are by far the most important parts of ink manufacture, because they represent a large fraction of the total cost.

Ballpoint Pen Inks; Other Types.—In writing with ballpoint pens the ink is transferred from the reservoir to the paper by a rotating ball, about one millimetre in diameter, held in a socket at the writing tip of the pen. Ballpoint pen inks consist of dyes or pigments, or both, dispersed in oils, resins, etc., and are essentially printing inks or lithographic varnishes. Cellulose fibres are preferentially wetted by most ballpoint pen inks, hence the latter will write on paper which is wet.

Stamp pad inks, for rubber stamps, are solutions of dyes in glycerine or glycol and water.

Inks for various duplicating processes contain a high concentration of colouring matter.

Inks for numbering and cancelling machines, which use metal type, are dispersions of dyes or pigments, or both, in an oil base.

BIBLIOGRAPHY.—Robert S. Casey, "Writing Ink," *Chem. Industries*, 58: 246 (1946); Robert S. Casey, Barbara Bechtel and C. S. Grove, Jr., "Chemistry of Ink Stain Removal from Fabrics," J. *Home Econ.*, 38: 649 (1946); *Federal Standard Stock Catalog*, section iv, part 5, "Federal Specifications for Ink: Writing, Blue-black for Fountain, Dip and Steel Pens, TT-I-563b" (Oct. 21, 1948); C. A. Mitchell, *Inks: Their Composition and Manufacture*, 4th ed. (1937); W. B. Reynolds, "The Development of Quick Drying Writing Inks," *Chem. Eng. News*, 24: 916 (1946); C. E. Waters, "Inks," U. S. Department of Commerce Circular C426 (1940). (R. S. Cy.)

Printing **Ink** consists in general of a pigment dispersed in a vehicle. Many vehicles are used, the principal ones being linseed oil, raw, boiled and heat bodied to different viscosities. Synthetics of the alkyd type! mineral oil (petroleum derivatives) and petroleum fractions, tung oil raw and polymerized, soy oil and dehydrated castor oil are also used. All these oils, by themselves or in combination with each other or in the form of varnish (cooked with synthetic resins) have their uses for the different types of printing.

Ink made with linseed or alkyd varnish is used for the better types of printing. Mineral oil and mineral oil varnish are the components of the black and colours used in newspapers. The alkyd varnishes are used in lithographic inks for tin decorating, outdoor signs, toys, etc., because of their hardness after baking Mineral oil fractions or petroleum solvents in combination with synthetic resins provide the vehicle for heat-set inks, used mainly in the printing of magazines. Dihydric alcohols (glycols) and alcohol-soluble synthetic resins provide the vehicle for the steam-set type ink used mainly in bread wrappers, chewing gum wrappers, milk cartons and any other uses where lack of odour is a desirable feature.

Methyl alcohol and plasticizers, alcohol-soluble synthetic resins and shellac provide the vehicle for aniline inks. This ink, which is liquid, is used in printing cellophane, wrapping paper, paper bags, glassine paper and plastic materials. Naphthas and other coal-tar solvents in which synthetic and natural (fossil) resins are dissolved provide the vehicle for rotogravure ink. This ink, like aniline, is liquid and is used in printing soap cartons, labels, rotogravure supplements and cellophane and in other uses where quick drying is essential.

Diethyl phthalate and glyptal resin provide the vehicle for hot-wax ink. This ink has the property of drying when the printed matter is dipped in hot wax. It is used in the printing of milk bottle caps and hoods, the printed paper going directly through the hot-wax bath. The drying is accomplished by the molten wax taking the diethyl phthalate away from the ink film, leaving the resin to bind the pigment.

Inks are made to fit specifications such as proofness to alkali, alcohol, grease, lactic acid, odour, rub or scratch, water and soap and fastness to light. Here the pigments used play a leading part even though in some cases the vehicle also has to be made to meet the specifications. For instance, tung oil is almost always one of the components of an ink which has to stand a stiff alkali test. Rubber is used to obtain special results such as binding on metal, quick setting on paper, hardness, etc. Only small quantities of these specialty inks are used.

The pigments used in the manufacture of printing ink are many and varied. These include: (1) for yellow, various shades of chrome yellow, benzidine yellow, yellow lake, hansa yellow and cadmium yellow; (2) for red, the lithol toners from light to dark (the sodium being the lightest, the barium medium and the calcium darker), para toners (light and dark), toluidine, phloxine red, cadmium red, rhodamine and others; (3) for blue, iron blues, peacock blue, phthalocyanine blue, reflex blue and tungstated blue; (4) for green, phthalocyanine green, tungstated green and chrome green; (5) for purple, methyl violet, molybdate purple and tungstated purple; (6) for orange, molybdate orange, Persian orange and ortho orange; (7) for opaque whites; titanium dioxide, zinc sulphide, zinc oxide and lithopone; and (8) for transparent whites, calcium carbonate, magnesium carbonate, alumina hydrate, blanc fixe and clay. The transparent whites are used mainly as extenders to weaken the intensity of the straight pigments. All colours are opaque, semiopaque or transparent in nature. Some are not fast to light, alkali, alcohol, water, soap; others are fast to one and not another; and still others are proof against all tests. "Earth colour" pigments such as raw sienna, burnt sienna, raw umber and burnt umber are rarely used; even though they have good light fastness, they are poor working pigments and are very abrasive, tending to wear down printing plates.

Drying.—The drying action of printing ink is achieved by oxidation, penetration, evaporation or coagulation and penetration. Typographic and lithographic inks contain driers such as cobalt, lead and manganese, sometimes only one and sometimes the three.. Each has the property of absorbing oxygen from the air. This action upon the drying oil which is the vehicle is the film-forming chemical action known as drying.

Newspaper inks or any ink printed on a very absorbent uncoated paper usually contains no drier, the drying being accomplished by

penetration of the ink into the fibres of the paper.

Heat-set inks. the type used in magazine printing, utilize evaporation, while steam-set inks utilize coagulation and penetration. Both types are discussed more fully below.

Steam-Set *Inks.*—When moisture in some form comes in contact with a sheet printed with steam-set ink, the latter dries almost instantly. This is caused by the vehicle or varnish in which the pigment is ground; the vehicle is compounded of glycol (dihydric alcohol) and a resin soluble in the glycol. Most of the different glycols are used, including propylene, dipropylene, diethylene, etc. The resin can be a fumaric, maleic, phenolic or zein (a protein found in maize). The combination of the different glycols and resins gives different rates of drying.

The drying principle is that glycols, being hygroscopic, become saturated and throw the resin out of solution, giving the ink surface a dry feeling. If rolled out on a steel or glass plate when the moisture content of the atmosphere is about 45%, an ink made with diethylene glycol will become dry if the moisture in the room is increased. It will become wet again if the moisture is decreased to the original percentage. This, of course, does not follow when the ink is applied to paper, for when the resin is thrown out of solution by moisture, the combination of glycol and moisture has a chance to soak into the sheet, leaving the resin to act as the binder for the pigment.

Relative humidity is of much importance when printing with this ink. If the humidity is too high it will cause the ink to dry on the printing press. Inks are usually made so they will stand from 70% to 80% relative humidity. Where there is humidity control the ink is made accordingly.

Steam-set inks are used mostly in printing corrugated paper containers and bread wrappers, with or without the application of live steam to the printed sheet. In most cases it is not necessary to apply moisture artificially; the ink absorbs enough from the paper and from the air to dry. An important feature of this ink is that it is almost odourless.

Heat-Set Inks.—The latest development in printing ink is the use of the plastic resin polyvinyl chloride. This resin in finely pulverized form is mixed with a plasticizer. The plasticizer can be made up of the following: tricresyl phosphate, dioctyl phthalate, dihexyl phthalate, santicizer. The mixture is modified with diluent to give the proper flow, and a pigment is ground into it.

This ink is perfectly stable at room temperatures but when used on printing presses equipped with heaters or ovens, it turns from a semi-liquid to a hard, tough solid, by the solution of the resin into the plasticizer when subjected to a temperature of 350° F. or more.

This type of ink is used similarly as the "heat-setting" ink that has been in use for a number of years and which consists of pigment ground in a varnish, made with a resin and hydrocarbon solvent. The resin is any of a series which are soluble in a solvent of a very low kauri butanol value (from 23 to 28); the most commonly used are zinc resinate, calcium resinate, limed rosin and some soluble phenolics of the terpene type or a combination of various of these resins. Solvents of high boiling points, from 230° C. to 320° C., are used. Narrow cuts of these solvents are then used in making the varnish according to the speed of the press and the type of form being printed. Most magazines are today printed with ink which is formulated in such manner so that it will dry instantly under the application of heat.

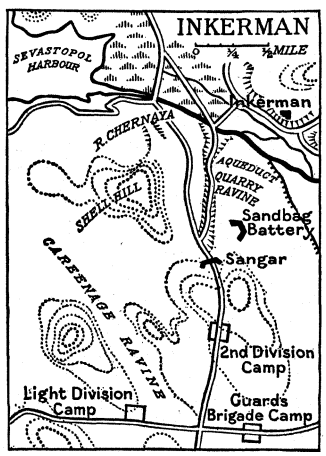
Fast rotary printing presses are equipped with heaters, burners or large steel steam-heated drums which dry this ink by evaporating the solvent. After the printed sheet passes through the burners or over the heated drums it passes over cooling rollers to get it back to almost normal temperatures.

It will be noted by the foregoing that the two types of printing ink have altogether different composition. The drying is affected in one case by the action of the heat melting the plastic and putting it into solution in the plasticizer with the resultant increase in viscosity which turns it from a liquid to a solid compound. In the other case, it merely evaporates the solvent, attaining this way the same purpose. (Jo. P.)

INKBERRY (*Ilex* glabra), a North American shrub of the holly genus (family Aquifoliaceae), known also as evergreen winterberry and Appalachian tea, native to sandy soil from Nova Scotia to Florida and west to Louisiana, mostly near the coast. It is a small shrub, 2 ft. to 6 ft. high, with leathery, evergreen, oblong, usually slightly toothed leaves; small white flowers, solitary or sometimes two or three together, borne on short slender stalks in the axils of the leaves; and small black berries (drupe), about $\frac{1}{5}$ in. in diameter, ripening in autumn. Among other plants called inkberry are the West Indian indigo berry (Randia *aculeata*) and the widely distributed pokeberry (Phytolacca decandra). The Australian or Queensland inkberry is *Mollinedia macrophylla*, a plant of the family Monimiaceae. (See HOLLY; POKEBERRY.)

INKERMAN, BATTLE OF, fought on Nov. 5, 1854, between a portion of the allied British and French army besieging Sevastopol and a Russian army under Prince Alexander Menshikov (see CRIMEAN WAR). This battle derives its name from a ruin on the northern bank of the river Tchernaya near its mouth, but it was fought some distance away, on a nameless ridge (styled Mt. Inkerman after the event) between the Tchernaya and the Careenage ravine, which latter marked the right of the siegeworks directed against Sevastopol itself. Part of this ridge was occupied by the British, while farther to the south a French corps under Gen. P. F. J. Bosquet was posted to cover the rear of the besiegers. The Russians arranged for a combined attack on the ridge by part of Menshikov's army (16,000) and a corps (19,000) that was to issue from Sevastopol. This attack was to have, beside its own field artillery, the support of 54 heavy guns, and the Russian left wing on the Balaklava battleground was to keep Bosquet occupied. If successful, the attack on the ridge was to be the signal for a general attack all along the line. It was apparently intended by Menshikov that the column from the field army should attack the position from the north, and that the Sevastopol column should advance along the west side of the Careenage ravine. But he appointed a commander to take charge of both columns only at the last moment, and the want of a clear understanding as to what was to be done militated against success from the first. Soimonov, with the Sevastopol column, assembling his troops before dawn, led them onto the upland east of Careenage ravine, while the field army column, under Pavlov, crossed the Tchernaya near its mouth, almost at right angles to Soimonov's line of advance.

The British troops on or near the ground were the and division, 3,000, encamped on ,the ridge; Codrington's brigade of the light division, 1,400, on the slopes west of the Careenage ravine; and the guards brigade, 1,350, about $\frac{3}{4}$ mi. in rear of the 2nd division camp. No other forces, French or British, were within 2 mi. except another part of Sir George Brown's light division. A mist overhung the field and the hillsides were slippery with mud. Soimonov, with his whole force deployed in a normal attack formation (three lines of battalion columns covered by a few hundred skirmishers), pushed forward along the ridge (6 A.M.) without waiting for Pavlov or for Dannenberg, the officer appointed to command the whole force. Shell hill, guarded only by a picquet, was seized at once. The heavy guns that had been brought from the fortress were placed in position on this hill, and opened fire (7 A.M.) on the knoll, 1,400 yd. to the south, behind which the 2nd division was encamped. The Russian infantry halted for the guns to prepare the way, and the heavy projectiles both swept the crest of the British knoll and destroyed the camp in rear.



But already Gen. Sir John Pennefather, commanding the division, had pushed forward one body of his infantry after another down the forward slope, near the foot of which they encountered the Russians in great force. On his side, Soimonov had been compelled to break up his regular lines of columns at the narrowest part of the ridge and to push his battalions forward a few at a time. This and the broken character of the ground made the battle even in the beginning a melee. The mist, which had at first allowed the big battalions to approach unobserved, now favoured the weaker side. Soimonov himself, however, formed some 9,000 men, who drove back the British left wing—for the whole of Pennefather's force at the time was no more than 3,600 men. But the right wing, not as yet attacked, either by Soimonov or by Pavlov, held onto its positions on tht forward slope, and a

column of Russian sailors and marines, who had been placed under Soimonov's command and had moved up the Careenage ravine to turn the British left, were caught, just as they emerged onto the plateau in rear of Pennefather's line, between two bodies of British troops hurrying to the scene of action On the front, too, the Russian attack came to a standstill and ebbed, for Soimonov's overcrowded battalions jostled one another and dissolved on the narrow and broken plateau. Soimonov himself was killed, and the disciplined confidence and steady volleys of the defenders dominated the chaotic *élan* of the Russians. Thus 3,300 defenders were able to repulse and even to "expunge from the battlefield" the whole of the Sevastopol column, except that portion of it which drifted away to its left and joined Pavlov. This stage of the battle had lasted about 40 minutes. But, brilliant as was this overture, it is the second stage of the battle that gives it its epic interest.

The first attack made by Pavlov's advanced guard, aided by parts of Soimonov's corps, was relatively slight, but General Dannenberg now arrived on the field and arranged for an assault on the British centre and right, to be delivered by 10,000 men (half his intact forces) chiefly by way of the Quarry ravine, the attack to be prepared by the guns of Shell hill. Pennefather had been reinforced by the guards brigade and a few smaller units. Not the least extraordinary feature of the battle that followed is the part played by a sangar of stones at the head of Quarry ravine and a small battery, called the Sandbag battery, made as a temporary emplacement for two heavy guns a few days before. The guns had done their work and been sent back whence they came. Nevertheless, these two insignificant works, as points to hold and lines to defend on an otherwise featureless battlefield, became the centres of gravity of the battle.

The sangar at first fell into the hands of the Russians, but they were soon ejected, and small British detachments reoccupied and held it, while the various Russian attacks flowed up and past it and ebbed back into the Quarry ravine. Possession of the Sandbag battery was far more fiercely contested. The right wing was defended by about 700 men of the 2nd division, who were reinforced by 1,300 of the guards. The line of defense adjacent to the battery looked downhill for about 300 yd., giving a clear field of fire for the new Enfield rifle the British carried; but a sharp break in the slope beyond that range gave the assailants plenty of "dead ground" on which to form. For a time, therefore, the battle was a series of attacks, delivered with great fierceness by the main body of Pavlov's corps, the repulse of each being followed by the disappearance of the assailants. But the arrival of part of the British 4th division under Sir George Cathcart gave the impulse for a counterattack. Most of the division indeed had to be used to patch up the weaker parts of the line, but Cathcart himself with about 400 men worked his way along the lower and steeper part of the eastern slope so as to take the assailants of the battery in flank.

He had not proceeded far, however, when a body of Russians moving higher up descended upon the small British corps and scattered it, Cathcart himself being killed. Other counterstrokes that his arrival had inspired were at the same time made from different parts of the defensive front, and had the effect of breaking up what was a solid line into a number of disconnected bands, each fighting for its life in the midst of the enemy. The crest of the position was laid open and parts of the Russian right wing seized it. But they were flung back to the lower slopes of the Quarry ravine by the leading French regiment sent by Bosquet. This regiment was quickly followed by others. The last great assault was delivered with more precision, if with less fury, than the others, and had Dannenberg chosen to employ the 9,000 bayonets of his reserve, who stood idle throughout the day, to support the 6,000 half-spent troops who made the attack, it would probably have been successful.

As it was, supported by the guns on Shell hill, the assailants, though no longer more than slightly superior in numbers, carried not only the sangar, but part of the crest line of the allied position. But they were driven back into the Quarry ravine, and, relieving the exhausted British, the French took up the defense along the edge of the ravine, which, though still not without severe fighting, they maintained till the close of the battle. Inkerman, however, was not a drawn battle. The allied field artillery, reinforced by two long 18-pounder guns of the British siege train and assisted by the bold advance of two French horse-artillery batteries which galloped down the forward slope and engaged the Russians at close range, gained the upper hand. Last of all, the dominant guns on Shell hill thus silenced, the resolute advance of a handful of British infantry decided the day, and the Russians retreated. The final shots were fired about 1:30 P.M.

The total British force engaged was 8,500, of whom 2,357 were killed and wounded. The French lost 939 out of about 7,000 who came onto the field, though not all these were engaged. The Russians are said to have lost 11,000 out of about 42,000 present. The percentage (27.7) of loss sustained by the British is sufficient evidence of the intensity of the conflict, and provides a convincing answer to certain writers who have represented the battle as chiefly a French affair. On the other hand, the reproaches addressed by some British writers to Genera1 Bosquet for not promptly supporting the troops at Inkerman with his whole strength are equally unjustifiable, for apparently Sir George Brown and Sir George Cathcart both declined his first offers of support, and he had Prince Petr Gorchakov with at least 20,000 Russians in his own immediate front. He would therefore have risked the failure of his own mission in order to take part in a battle where his intervention was not, so far as he could tell, of vital importance.

When Lord Raglan asked him for support, he gave it willingly and eagerly, sending his troops up at the double and it must be remembered that several British divisions took no part in the action for the same reason that actuated Bosquet. But, in spite of the seemingly inevitable controversies attendant on an "allied" battle, it is now generally admitted that, as a "soldiers' battle," Inkerman is scarcely to be surpassed in modern history.

INLAND REVENUE DUTIES. These duties are described under the headings ESTATE AND INHERITANCE TAXES; INCOME TAX; LAND TAXES; STAMP DUTY; etc. *See* also the relevant sections of the articles GREAT BRITAIN and UNITED STATES.

INLAND WATER TRANSPORT. Transport over navigable waters is essentially regional and can be by means of natural rivers and lakes or by artificially constructed canals. Europe is particularly well favoured with the former and also with adequate rainfall. Before the advent of modern rail and road transport its natural waters were supplemented by a network of navigable waterways based in the west on the Rhine and in the east on the Danube.

Within this network Belgium and the Netherlands were intersected by an intricate system of inland waterways including the Rhine estuary and the Scheldt and Meuse rivers. The U.S.S.R. also had its own internal waterways which were progressively developed under successive five-year plans.

INTERNATIONAL RIVERS

The Congress of Vienna in 1815 declared the Rhine, Danube, Elbe and Oder international rivers, the actual waterways being under state control with operation of vessels thereon left to private enterprise. The act of Mannheim of 1868 codified this maxim in the case of the Rhine. Under it navigation between Basle, Switz.. and the open sea (520 mi.) mas free to vessels of all nations for the transport of goods and persons; no dues based solely on navigation could be levied. A Central Rhine commission was established and functioned until World War I. The principle of freedom of navigation and of equality of treatment of all flags on international waterways was reaffirmed by the Barcelona convention of 1921. Under the treaty of Versailles the Mannheim convention was substantially revised, but before the new regime was fully established Germany withdrew from the commission. It continued to function however up to World War II by maintaining informal contacts with Germany. Membership comprised representatives of the countries through which the river passed. together with Great Britain and Italy.

After the war the commission was re-established with Germany

again a member and the United States participating as an occupying power, and it was functioning effectively in the latter 1950s. Germany was, however, again questioning the encroachment of the revised Mannheim convention on national sovereignty. The commission has no executive powers, and its decisions become binding on governments only when accepted by them.

The Danube, Europe's longest waterway, which for years has been subject to some form of international control, was divided for administrative purposes after World War I into the International Danube commission for the fluvial Danube and the Maritime Danube commission. On the former the riparian states were alone represented and on the latter the United Kingdom and other major powers also sat. The riparian powers mere frequently in dispute, especially Rumania and Yugoslavia over control of the Iron Gates, and only in 1938 was effective control of the lower water established. Before the modifications had been effective for long World War II intervened. After the war political frontiers cut the Danube into three: (1) the west comprising Bavaria and Austria; (2) the middle stretches running through Yugoslavia; and (3) the lower reaches dominated by the Soviet satellites but with Hungary and Czechoslovakia separated from the others by Yugoslavia. Through traffic was at a standstill. In 1948 an abortive attempt was made to constitute a new convention to regulate international navigation on the river, and in 1949 at a second conference Russian proposals confining freedom of navigation to the riparian states was accepted by the Soviet majority, but Great Britain, France and the United States refused to recognize the new regime so established. It lasted until 1952 when a political thaw set in and the C.S.S.R. allowed greater freedom of navigation on the river. In 1953 a new Danube commission was set up of the riparian states of the Soviet bloc and Yugoslavia, and the commission ceased to be used as a political instrument and became again an effective body of technicians. New shipping agreements were signed between the affected states providing for the free and reciprocal use of the river. The German Federal Republic and France were also again free to use the eastern Danube. With the signature of the Austrian state treaty (1955) the U.S.S.R. returned to Austria the shipping and installations seized and traffic again flowed freely. Both the Elbe and Oder remained under military control at mid-century.

MODERN DEVELOPMENTS AND IMPROVEMENT SCHEMES

The years between World Wars I and II witnessed a great development of inland water transport and canal construction in many parts of Europe. (See also WATERWAYS, INLAND.) Inland port accommodation and facilities in Germany were greatly extended between 1919 and 1939, particularly on the larger navigable rivers and canals.

The end of World War II left many of the navigable rivers and inland waterways of Europe much damaged. The navigable channel of the Rhine was completely closed as a result of the destruction of practically all the bridges and the sinking of innumerable vessels. German waterways suffered from Allied bombing, particularly the Weser, Elbe and Oder rivers and the Dortmund-Ems, Weser and Mittelland canal systems. The Danube, which before the war carried raw materials from eastern Europe to the west and manufactured products in the opposite direction, was also left blocked by the retreating German army.

The inundations made by the Dutch caused erosion of banks and other damage. French waterways in the north and east suffered heavily, but Belgium was more fortunate.

Political changes also left their mark. Not one of the prewar international waterway regimes functioned as it did before the war. The Danube and Oder were under entirely new management; and all non-Soviet shipping was blocked at Linz, Aus., by the Russians; the Elbe flows through Czechoslovakia and the German Democratic Republic, of the Soviet bloc, before reaching Hamburg in the German Federal Republic; and the navigable parts of three of Europe's major rivers, formerly considered international. the Vistula, the Niemen and the Dniester, were international no longer. Many canals which linked them had changed hands.

Despite the development of road, rail and air transport in continental Europe, many improvements to existing waterways and new constructions were carried out and more were planned after the end of World War II. These were aided by increasing construction of works for power development which had the advantage of providing opportunities for improving conditions of navigation. Tonnage carried on European inland waterways accordingly greatly increased. The 10,000,000 tons of freight Germany was carrying on its navigable rivers and canals in 1910 rose to 90,000,000 tons by 1938, and in 1954 the German Federal Republic alone carried 109,000,000 tons on its 1,644 mi. of navigable waterways in regular use. The Netherlands in 1954 carried 96,000,000 tons on 2.614 mi. of waterways of which no fewer than 2,182 mi. were canals; France carried 52,000,000 tons on 5,075 mi. and Belgium 51,000,000 tons on 680 mi. The Rhine networkserved admirably the heavy industry of western Europe, carrying large quantities of coal, ores and heavy steel products for which water transport is particularly well suited, as it is also for carrying liquids, such as oil, in bulk.

Great Britain. — For jo years before the development of railways Great Britain enjoyed a canal era, and the main network of its inland waterways, with the exception of the Manchester Ship canal, had been developed by 1830. The chief routes formed a cross, linking the midlands with the Tharnes, the Humber, Mersey and Severn and totalled 904 mi. With railway development and competition the canal companies fell into a precarious state, and many were acquired by the railways and allowed to deteriorate further. Subsequently, apart from a few specific schemes of improvement between World Wars I and II, of which the canalization of the Trent river between Nottingham and Newark and the modernization of the Grand Union canal from London to Birmingham were the chief, little was done to remedy the position up to World War II. Concern at the decay of canals led to persistent demands for comprehensive inquiries of which the most important were undertaken by royal commissions appointed in 1906 and 1930 and by the Chamberlain committee set up by the minister of transport in 1920. Their detailed and sometimes divergent recommendations, which included vesting the canals in public bodies, were not acted upon. During World War II, to relieve the congested and war-damaged railways, some traffic was diverted to them and they were brought under government control. The canal carrier companies also came under temporary government control.

Between 10,000,000 and 11,000,000 tons of freight were carried annually during the war.

By the Transport act of 1947, which came into operation in 1948, responsibility was transferred to the British Transport commissipn, a public corporation which became responsible for the operation of an integrated publicly owned transport system comprising rail, road, inland waterways and docks and harbours. The commission took over 1,138 mi. of waterways operated by independent undertakings, 965 mi. of railway-owned or controlled canals and the 69 mi. of the government-owned Scottish canals, the Caledonian and Crinan, a total of 2,172 mi. The Manchester Ship canal and the associated Bridgewater canal and a few minor undertakings were transferred. The Thames Conservancy board remained a separate entity as did certain navigation authorities having jurisdiction over tidal waters.

The canals thus came under unified control and common ownership with other forms of transport with which their integration, frequently recommended by committees of inquiry, became possible. Management was delegated by the commission to the Docks and Inland Waterways executive whose members were appointed by the minister of transport. In 1954 the executive was replaced by the Docks and Inland Waterways Board of Management whose members were appointed by the commission, to which it was directly responsible. Management was through four divisions, each directed by an area waterways manager, based on the major estuary and port systems of the Severn, Mersey, Humber and Thames. From 1948 to 1953 more than £1,000,000 was spent on arrears of maintenance and £500,000 on additional plant and equipment. Total traffic increased to more than 13,000,000 tons a year, although of the 2,172 mi. acquired, of which 1,129 mi. were river navigation and uide canals, 266 mi. were abandoned and 486 mi. were no longer used by commercial traffic. The commis-

sion operated 1,258 craft and independent carriers about 2,800, with carrying capacities of 44,000 and 185,000 tons, respectively. In 1954 the commission appointed a board of survey to inquire as to whether the maximum economic use was being made of the canals and to make recommendations concerning the future of those no longer commercially economic. It recommended that the commission concentrate on those canals of real value to the transport system and that it be relieved of the remainder. It divided the inland waterways into three categories: those worthy of development and modernization, those that should be retained for navigation but not developed, and those having insufficient prospects to justify retention for that purpose. The commission subsequently announced a program for capital investment of £5,500,000 on the first category. Public opposition to the closure of others and possible loss of amenities led to the appointment by the minister of transport in 1956 of a further committee of inquiry into the future of the inland water ays.

The **Rhine.**—After World War I improvement of the Rhine was delayed by dispute over provisions of the Versailles treaty, but in 1925 the central commission approved Swiss and German improvements and the construction by France of the Great Alsace canal (Grand Canal d'Alsace), to run parallel to the river from the Swiss frontier to Strasbourg and carrying the same freedom of navigation. By 1932 the most difficult and important section between Kembs and Basle, by-passing the Istein rapids, was completed. Switzerland completed the construction of a large port at Basle which resulted by 1952 in more than 40% of Swiss foreign trade passing through the Rhine ports. After World War II Rhine improvements were resumed. The second stage of the Great Alsace canal was completed in 1953, but much construction still remained to be completed in the mid-1950s. Another project was the construction of a canal to connect the upper Rhine with Austria by extending its navigability to Lake Constance. The long-talked-of canalization of the Moselle was held up after World War II by failure of France and Germany to reach agreement.

Rhine-Main-Danube Navigation. — The Ludwig canal, the first step in linking the Rhine and Danube, which connects Bamberg on the Main with Kelheim on the Danube, was built by 1848. In 1922 work started on its enlargement to carry barges of 1,500-ton capacity instead of 120 tons. By World War II the project was only partially completed, and work on the Rhine-Danube connection was still not completed by the mid-1950s. Extensions of about 90 mi. on the Main river near Würzburg and at Neckar had been finished. The Danube was joined at Regensberg, below where it is regulated by a dam with navigation locks at the Kachlet rapids above Passau. This enlarged waterway had a potential capacity greater than that of any other river or canal system in Europe.

Elbe and **Oder.**—Low-water regulation raised barge capacity to 1,000 tons in 1938 on the Elbe. and on the Oder construction of water storage reservoirs ensured free passage of 1.000-ton barges throughout the year. In eastern Germany a 21-mi. canal was opened in 1952 from Paretz to Niederneuendorf which enabled barges to move from the Elbe to the Oder without entering west Berlin. A new link was planned between the Elbe and Doenitz and the Baltic port of Wismar.

Mittelland Canal. — This canal joins the Weser and Elbe rivers. It was begun about 1890 and completed in 1938. It can pass 1,000-ton barges and extends for 300 mi. from the Rhine (western end) to the Oder (eastern end). There is a ship hoist at Magdeburg by which vessels are raised 18 m. from the Elbe river level to the canal level. The completion of this system permitted 1,000-ton barges to proceed from Basle to Konigsberg (Kaliningrad), to pass to the river Vistula. or from Emden to Breslau.

Weser.—The canalization of the upper Weser for 1,000-ton barges was begun in 1935. Improvements before that year had been restricted to low-water river-bed regulation and augmentation of water supply from storage reservoirs. The canalization of the middle section of the river (Minden to Bremen) was begun about 1938. Completion of this project was in abeyance after World War II.

Dortmund-Ems Canal. — The enlargement of this artificial waterway from 700-ton barge capacity to 1,500 tons was begun before 1935. The enlargement of the southern section of this canal was completed for use by 1,000-ton barges from and to the Mittelland canal. Completion of the enlargement of the northern section caused considerable criticism, for without this canal system the north German ports have no natural or other communication with the great inland Rhine ports, and the tendency was to try to divert traffic to them from the Dutch port of Rotterdam by offering favourable rates and tolls.

Belgium. — The Albert canal, 78 mi. long, is the enlargement of an old waterway connecting the Belgian Meuse near Liège with Antwerp. Its reconstruction to pass barges of 2,000-ton capacity was completed in 1939, at a cost of more than $63,000,000. One important objective in the building of the canal was to provide a military barrier to invasion through the Netherlands, although this object was unrealized when invasion came in 1940. Concurrently with the work on the Albert canal, the Belgian government carried out major canalization works on the Meuse to permit 2.000-ton barges to use the river. Plans were made after World War II to enable large Rhine-going lighters to proceed in the northern and eastern districts above Ghent, to near Antwerp, as well as in the Brussels district to Clabecq and to Liège. The Charleroi-Brussels canal was widened to make it accessible to 1,3 jo-ton vessels.

Netherlands. — In the years between World Wars I and II the Netherlands completed the enlargement of many important canals and waterways and began the construction of several new canals. Most of the improvements provided for the navigation of barges of up to 2,000-ton capacity. The waterway from the German Rhine to Rotterdam was improved.

The largest navigation project was the waterway between the Waal at Nijmegen and the Meuse at Maastricht. Designed to pass 2,000-ton barges, it was completed in 1933. Canalization of the Dutch Meuse, the locks on which can take a tug and two barges of 2.000 tons each, was completed in 1935.

In 1932 the Netherlands and Belgium agreed to the revision of the treaty of 1839 to permit the feeding of the Dutch Juliana canal from the Meuse, in return for concessions to Belgium which would enable other canals to be made in that country. Work on the new Amsterdam-Rhine canal was completed in 1952 with the opening of the great Tiel lock. This completed a project first authorized in 1931. The canal cuts shipping time from the German border to Amsterdam from 40 to 20 hr. Subsequently upper Rhine traffic showed a substantial increase. In 1954 the Belgian and Netherlands governments announced plans for a joint project costing more than $100,000,000 for a 37-mi. canal joining Antwerp to the RhBne, a canal from Ghent to the west Scheldt to accommodate ocean-going vessels and a short link connecting the Juliana and Albert canals. The Dutch inland water fleet mas the largest in western Europe, numbering 18,600 vessels aith a carrying capacity of more than 4,000,000 metric tons.

France. — The French government project to make the Rhône navigable between Lyons and the Lake of Geneva made little progress up to 1939, but the scheme was advanced after World War II and the great Génissiat dam. begun in 1937, was completed in 1948. This dam. sitednear Bellegarde, was the largest project of its kind in Europe after Dnieprostroi in the U.S.S.R. The improvement of the RhBne navigation from Lyons to Marseilles, in abeyance since 1940, was also resumed, as was the scheme for improving navigation below Lyons. In March 1952 a plan was announced for building an international canal to connect the navigable headwaters of the Rhine and Rhône. This would provide a 1,300-mi. waterway from the North sea ports to Marseilles. The canal would be 90 to 120 mi., the Rhine waterway being 700 mi. and the RhBne 500 mi. The French inland water fleet was the second largest in Europe, numbering, in 1954, 11,000 vessels with a capacity of 3,750,000 metric tons.

Italy. — The Italian government after World War II began construction of certain canals in connection with the Po and Adige rivers to link Milan with the sea.

Sweden. — The Roads and Waterways administration reported on the peacetime need of the Falsterbo canal, cut across the peninsula of that name during World War II, to pass ships into and out

of the Baltic without going through German mine fields.

U.S.S.R.—The five-year plans of the U.S.S.R. have included vast programs of expansion of inland navigation by the construction of new waterways and the enlargement and improvement of others. Many of the projected works had been completed when Germany invaded the Soviet Union in 1941.

The White Sea-Baltic canal, finally completed in 1935, includes 140 mi. of canals and canalized rivers, the remainder of the navigation being by way of lakes Ladoga and Onega and some smaller lakes. The northern terminal of the canal is at Belomorsk (formerly Soroka), on the southern shore of the White sea.

The Moscow-Volga canal (80 mi.) was opened for navigation in 1937. One hundred and ninety thousand workers were said to have been employed in making it. This canal is icebound for about six months in each year.

The Volga-Don canal (62 mi.), begun in 1938 and opened in 1952, connects the lower Volga with the Don and is a link in the waterway for small vessels from the Baltic to the Black sea.

The Mariinsk canal system formed a link in the waterway connecting Leningrad with Moscow and was begun under the first five-year plan. It includes the Moscova river navigation.

An important later waterway, a short canal in the Volga delta known as the *Volga-Caspian canal,* was to connect the navigable reaches of the river above Astrakhan with the Caspian sea; it was begun in 1939. Xnother, begun in the same year, was the *Dnieper-Niemen waterway,* 31j mi. with 30 locks, designed to link the river Yaselda, a tributary of the Pripet. with the river Shchara, a tributary of the Niemen. This waterway system was planned to connect the Baltic with the Black sea! passing through the provinces of Baranowicze, Pinsk and Belostok.

The Dnieper-Bug canal (126 mi.), completed in 1940, linked the Dnieper, one of the largest rivers in western U.S.S.R., with the western Bug, and provided an outlet to the Black sea for the industrial and agricultural products of western Byelorussia. The Dnieper was also improved for navigation along its whole course. The new river port of Leningrad! on the banks of the Neva. was planned to handle timber exports on a large scale, and included more than seven miles of new quays and wharves.

Most of the canals in the U.S.S.R., newly constructed or enlarged. were designed for the transit of barges of not less than 1,000-ton capacity.

Eastern Europe.— By the mid-1950s a co-ordinated system of waterways was being constructed in eastern Europe. The plan was to construct canals and convert rivers to connect Poland, Czechoslovakia. Hungary and Rumania with the U.S.S.R. Theoretically it should then be possible to travel from Moscow to Warsaw, thence through Silesia to Bratislava and on to Budapest and down the Danube through Bulgaria and Rumania. The system was being built to carry barges of 1.000-ton displacement throughout. The king-pin of the system is the Oder-Danube canal, on which work began in 1939. Total length was expected to be 191 mi., and when it was completed Danube traffic by using it would be in direct contact with the Elbe and thus with Hamburg and the North sea as well as with the Polish and Ukrainian canal network. Associated with it was the improvement by Czechoslovakia of the Danube navigation for 32 mi. below Bratislava and the Hungarian harnessing of the river. In Hungary a canal was planned to connect the Danube with the Tisza, and a 60-mi. gravitation canal was also being dug across the arid Hortobagy plain connecting with the Berettyo, which flows back into the Tisza.

In Rumania the construction of the Danube-Black Sea canal was well advanced. When completed this canal running from the Danube near Cernavoda into the Black sea near Constanta was expected to be 30 mi. long and would shorten the passage up the Danube by 144 mi. Xnother Rumanian project was the construction of a canal from the Danube to Bucharest.

See also WATERWAYS, INLAND; RIVER AND RIVER ENGINEERING; and, articles on individual rivers.

BIBLIOGRAPHY.—*See* works listed in articles mentioned above; also *World Economic Survey,* issued at intervals, up to 1941, by the League of Nations and later by the United Nations; H. G. Moulton, *Waterways versus Railways,* rev. ed. (Boston and New York, 1926); Sir Osborne Mance, *International River and Canal Transport,* Royal Institute of International Affairs (London, 1944). Exhaustive bibliographies were published at intervals up to 1931 by the International Navigation Congress Office (Brussels). The periodicals *Dock and Harbour Authority* (London, monthly), *Journal of the Institute of Transport* (London, monthly) and *Modern Transport* (London, weekly) have occasional articles. (N. G. G.; W. A. F.; E. A. I. D.)

UNITED STATES AND CANADA

The inland waterways system of the United States and Canada consists of canals. rivers and lakes of varying significance from the point of view of inland water transportation.

Korth American canals are relatively unimportant for inland transport. The only ones which need be mentioned are the New York State Barge canal'between the Hudson river near Albany and the cities of Buffalo and Oswego; the Chicago Drainage canal, which forms part of a route between Lake Michigan and the Gulf of Mexico; and canals in the Great Lakes system, which will be referred to in the discussion of that route.

Rivers in the United States and Canada used for inland navigation include the Hudson river from New York city to a point near Albany; the Columbia river in Oregon; and many others. The most important, however, are the Mississippi and St. Lawrence.

The Mississippi and St. Lawrence Rivers.— The Mississippi river, with the Ohio, the Monongahela, the Missouri and other less important tributaries. provides a practicable waterway in the central valley of the United States from Sioux City, Ia., Minneapolis, Minn., and Pittsburgh, Pa.. in the north to New Orleans. La., and the Gulf of Mexico in the south. Through the improved Chicago Drainage canal it connects with Chicago. Ill., and the Great Lakes. From New Orleans to Baton Rouge, La., the Mississippi river is nowhere less than 3j ft. in depth. From Baton Rouge to Chicago, Pittsburgh and Minneapolis the effective depth is nine feet.

Traffic on the Mississippi river and on the Great Lakes constitutes the principal part of inland water transport in the United States and Canada. On the main body of the Mississippi the most important shipments northbound are crude and refined petroleum and residual oils and coal.

Petroleum movements naturally result from the production and refining of petroleum in the great oil districts in Louisiana and adjoining states. The principal shipments southbound consist of petroleum and its products, iron and steel products and grain and grain products. In earlier years a good deal of merchandise was transported, including less-than-bargeload consignments. The latter decreased considerably during World War II.

The St. Lawrence river constitutes an extension of the Great Lakes route from Lake Ontario to Montreal. Que. Below Montreal and especially below Quebec the river broadens into an estuary opening into the Gulf of St. Lawrence. The Ottawa river, flowing eastward from Lake Nipissing in the vicinity of Georgian bay and entering the St. Lawrence above Montreal, is, in effect, part of the St. Lawrence system.

The effective depth of the St. Lawrence above Montreal is 14 ft., a figure which is controlled by the depth in existing locks which have been built by Canada to facilitate navigation in the more difficult portions of the stream. The St. Lawrence seaway, under construction in the 1950s by the U.S. and Canada, was planned to provide navigable depths of at least 27 ft. between Montreal and Lake Ontario.

Great Lakes.—The Great Lakes system consists of five lakes— Ontario. Erie, Huron, Michigan and Superior— stretching westward from the head of the St. Lawrence river to the neighbourhood of Duluth, Minn. Lake Michigan lies in the United States: but the other lakes are on and across the boundary line that separates Canada and the U.S.

Navigation between the lakes is maintained through lock canals at Sault Ste. Marie between Lakes Superior and Huron; through improved channels in the St. Clair river, Lake St. Clair and the Detroit river between Lakes Huron and Erie; and through the Welland Ship canal between Lakes Erie and Ontario. A Canadian canal joins Georgian bay with Lake Ontario. Controlling depths of 21 and 2j ft., respectively. are maintained generally in upbound and downbound channels. except for the Welland Ship canal, which

in the mid-1950s was deepened by Canada to provide depths of at least 27 ft. as part of the St. Lawrence seaway project. A proposal was before the U.S. congress to provide depths of at least 27 ft. in the connecting channels.

Harbour depths ranged, generally, from 21 to 25 ft. in the principal ports, but it was expected that some of these would be deepened consistent with depths in the connecting channels if authorized for further improvement.

On the Great Lakes traffic movements include the shipment of wheat from the grain fields of western Canada and the northern Mississippi valley states to eastern destinations for export or for local consumption and the shipment of iron ore from the mines of the Lake Superior region to steel-producing districts in Indiana, Illinois, Ohio and Pennsylvania. A third major movement is that of coal from eastern mines to ports on Lake Michigan and Lake Superior, from which it is distributed for domestic and industrial use. Net Great Lakes traffic after 1950 exceeded 200,000,000 tons annually.

Question of **Policy.**—The principal question of policy regarding U.S. inland waterways is the relation of existing water transport to land transport in the development of an over-all national transportation policy, a question under continuing study by the President's Water Resources Policy commission (1950), the Presidential Advisory Committee on Transportation Policy and Organization (1955) and the President's Advisory Committee on Water Resources Policy (1955).

BIBLIOGRAPHY.—*Reports* of the President's Water Resources Policy Commission (1950), the Presidential Advisory Committee on Transportation Policy and Organization (1955), the Hoover Commission (1949) and the President's Advisory Committee on Water Resources Policy (1955); the *Annual* Report of the Chief of Engineers (1955); C. H. Chorpening, "Waterway Growth in the U.S.," paper 2643, vol. CT (1952), American Society of Civil Engineers. (S. DT.; X.)

INLAYING, a method of ornamentation by inserting in one material a substance differing therefrom in colour or composition. The art is practised in the fabrication of furniture and artistic objects in all varieties of wood, metal, shell, ivory, coloured and hard stone, and in compound substances. Forms of inlay include:

Niello (*q.v.*), is an ancient and much-practised method of inlaying silver and gold with various metals.

Demascening is the inlaying of gold wire in iron or steel.

Mosaic (*q.v.*) is generally applied to inlay work in hard stone, marble and glass, but the most important class of mosaics—those which consist of innumerable small separate pieces–do not properly come under the head of inlaying.

Pietra dura is a fine variety of inlaid mosaic in which hard and expensive stones—agate, cornelian, amethyst and the like—are used in relief.

Intarsia was originally *a* true inlay of one or more colours of wood upon a darker or lighter ground, and it is from this form of inlaying that marquetry and other wood inlays were developed.

Inlay and Marquetry.—Inlay is more often confined to woodwork, and the art of decorating the surfaces of furniture or wall panelling with small pieces of wood, ivory, tortoise-shell, etc., that are cut into various designs and set into the body of the surface. The term "inlay" is often confused with and sometimes used for the word "marquetry." Marquetry is composed of pieces of very thin wood, or other material of equal thickness, laid down upon a matrix with glue. Thus marquetry is a veneer process, while true inlay is what the term implies—"a laying in" of one material into another material called the "ground." Marquetry is a later development of the ornamental inlays of wood known by the name of Intarsia, which, although a true inlay as opposed to the thin veneer of marquetry, furnishes many examples wherein the process follows that of marquetry. For example in the cathedral of Ferrara, Italy, the backs of the stalls show the perspective lines of some of the subjects traced upon the ground where the marquetry has fallen off, but none of the "sinkings" would be there if the panels had been executed as true inlays instead of veneers.

Process.—The design for a panel is drawn on paper, the lines being pricked through to underlying sheets to make the necessary number of copies, or the pricked sheet is dusted over with a coloured powder which passes through the perforations and marks the design faintly on the paper underneath. The pieces of paper are then cut up and stuck on to several pieces of wood which form the design, one whole print being reserved to paste complete on to the ground or field. Each piece may be cut separately, but they are all bound to fit into the complete pattern when this is cut out of the ground, because all are cut from the same prints. In true inlay the pieces to be inserted are cut out of wood $\frac{1}{8}$ to $\frac{1}{4}$ in. thick. The surface into which these separate designs are to be set is carved out the required depth with wood-carver's tools, and the pieces making the design are driven in.

In marquetry two panels are sometimes made of. the reverse colourings by sawing through the ground and the veneer at the same time. At one time it was quite a common occurrence to produce two pieces of furniture in which one was brass inlaid in the black, and in the other case the pattern was black inlaid in the brass, thus utilizing what would otherwise have been very costly waste material. Although this method of cutting through two or more pieces of wood clamped together, and simply dropping one piece into the opening made by the other, is not generally considered as fine work, many excellent inlayers like Boulle'in the time of Louis XIV., did their inlay work, or marquetry, in just that way. When all the parts have been cut and fitted together face downwards, paper is glued over them to keep them in place, and the ground and the veneer are carefully levelled. The ground is then wetted with glue at a high temperature and the surfaces squeezed between the frames called *"cauls"* until the glue is hard.

History and Development.—Probably the earliest examples of inlay were found in the Venetian work of the 14th century, when wood was inlaid on ivory boxes. Other materials were used at an early date. One of the most beautiful forms of inlay executed by the Italians was with ivory upon walnut wood or black wood. In the 16th century the Italians made inlays of marble in various colours, and in the 17th century a combination of tortoise-shell and metal was not uncommon.

Most of the examples found in England are importations, either from Holland or France. The reputation of the Dutch *marqueteurs* was so great that Colbert engaged two, Pierre Gale and Vordt, for the Gobelins at the beginning of the 17th century. Jean Mac6 of Blois, the first Frenchman known to have practised the art, who was at work in Paris from 1644 (when he was lodged in the Louvre) or earlier, till 1672, as a sculptor and painter, learned marquetry in the Netherlands. His daughter married Pierre Boulle, and the greatest of the family, André Charles Boulle, succeeded to his lodging in the Louvre on his death in 1672. The members of this family are perhaps the best known of the French *marqueteurs.* Their greatest triumphs were gained in the marquetry of metal and tortoise-shell combined with beautifully chiselled ormolu mountings. It is thought by many that Boulle carried the work of inlaying too far. The 18th century commode of late Louis XIV. period, of tortoise-shell, mother-of-pearl and coloured ivories inlaid in brass, an example of which may be seen at South Kensington, is characteristic

The Stuart period produced a good deal of marquetry in England, often pieces of real excellence. Long-case clocks, cabinets, chests of drawers and various other pieces of furniture were subjected to this kind of decoration. A shallower form of marquetry and some solid inlay work were also extensively used in the latter part of the 18th century. With the increase in luxury and display in the 17th and 18th centuries in France and Germany, cabinets and desks became objects upon which extraordinary talent and expenditure were lavished. Perhaps the most beautiful examples of the art in Italy are the panels of choir stalls or sacristy cupboards, though marriage coffers were also often sumptuously decorated in this manner. (F. L. D.)

INMAN, HENRY (1801–1846), **U.S.** painter of portraits, genre and landscape, was born in Utica, N.Y., on Oct. 20, 1801. Apprenticed to the painter John W. Jarvis at the age of 14, he left him after seven years and set up for himself. He was one of the organizers of the National Academy of Design in New York and its first vice-president (from 1826 to 1832). As a portrait painter he was highly successful both in New York and Philadelphia, and

going to England in 1844, he had for sitters the lord chancellor (Cottenham), the poet William Wordsworth, Thomas Chalmers, Lord Macaulay and others. His American sitters included Pres. Martin Van Buren and Chief Justice John Marshall. Inman died in New York city on Jan. 17, 1846.

INN, a right-bank tributary of the Danube. It rises in a small lake under Piz Longhino, in the Swiss canton of the Grisons. After flowing for 55 mi. through the Engadine, it enters Austria at Martinsbruck and continues as a swift mountain stream along the Inn valley as far as Innsbruck where it enters the broader lower Inn valley.

At Rosenheim it leaves the limestone zone of north Tirol and enters the plateau of Upper Bavaria, across which it flows to join the Danube at Passau. Its chief tributary is the Salzach on which stands the town of Salzburg.

See DANUBE.

INNATE IDEAS, ideas supposed to be inborn in the human mind. as contrasted with those received or compiled from experience. The doctrine that at least certain ideas must be innate (*e.g.,* those of God, perfection and infinity), on the ground that no satisfactory empirical origin for them could be conceived, was widely held in the 17th century and had Descartes for its most prominent exponent.

The theory took more than one form, some holding the naïve view that the human mind must from the start of the child's life have an explicit awareness of such ideas, others, more commonly, maintaining innate ideas in some implicit form, either as a capacity for formulating them, which remained dormant until suitable conditions for its actualization occurred in experience, or as a tendency, which again would require favourable conditions for its development.

Descartes professedly adopted the last view. although his writings contain indications of the more nai've version; and, having at first maintained that only some ideas were innate (others being either "adventitious" or "factitious"), he was driven by his metaphysical dualism into concluding that all ideas were innate. The whole doctrine was vigorously and effectively criticized by Locke in the first book of his Essay Concerning Human Understanding, where his main target was innate principles (supposed axioms, both theoretical and practical, of which the mind had inborn knowledge, as they had been implanted in it by nature), with as secondary target the innate ideas mhich were claimed as the terms of the principles. He refuted the arguments for the naïve form of the theory and showed that in its dispositional form the theory ,defeated its own object by making it impossible to distinguish between those ideas which were and those which were not innate.

His refutation was undertaken by way of introduction to his own positive thesis, that all ideas are empirical, the only two sources being. in his own terminology, sensation and reflection. That he did not succeed in his thoroughgoing empiricism, even to his own satisfaction, he recognized in the case of certain key concepts, such as Substance, "which we neither have nor can have by sensation or reflection," and Cause, where he largely anticipated Hume's difficulties.

While Locke seems to have shared some of the assumptions of his opponents (*e.g.,* that if an idea is innate it cannot be wrong), he shoms signs of recognizing, at least in the case of principles, that the philosophically important question was not one of genetic psychology, about origins, but one of logic, about the status and validity of an a priori or necessary proposition. Leibniz, in his criticisms of Locke, carried the matter further; and Kant, completing the distinction that Locke had begun, replaced questions about innate ideas with questions about a priori concepts, which he characterized in terms, not of their origins, but of their necessity as conditions of our experience of an objective world.

(A. D. W.)

INNERLEITHEN, a small burgh of Peeblesshire. Scot.. on the Leithen Water, near its junction with the Tneed, 6 mi. S.E. of Peebles by road. Pop. (1951) 2.361. Area .6 sq.mi. The district is known to have been inhabited by Celtic peoples in JJ B C. Its chief industry is the manufacture of tweeds, hosiery and other woolen goods which, together with the fame of its medicinal springs, brought the burgh into prominence toward the end of the 18th century.

The spa, alleged to be the St. Ronan's well of Sir Walter Scott's novel of that name. has a pump room, well house, etc. The town is flanked on the west by the hill fort of Caerlee and on the east by that of Pirn.

Farther east, close to the village of Walkerburn, is Purvis hill with a remarkable series of terraces or earthen banks, the origin and purpose of mhich are unknown. Traquair house, or palace, on the right bank of the Tweed, is one of the oldest inhabited houses in Scotland, the most ancient portion dating from the 10th century and the main block from 1642.

INNES, JAMES DICKSON (1887–1914), British landscape painter, noted for bold, flat masses of pure colour, was born at Llanelly, Carmarthenshire, Wales. on Feb. 27, 1887. In 1904–05 Innes studied at the Carmarthen art school; then he spent three years at the Slade school, University college, London. Works exhibited in 1907–08 showed him strongly influenced by P. Wilson Steer and W. R. Sickert.

Water colours by J. S. Cotman and J. M. W. Turner and John Constable's paintings were other formative elements, and Innes discovered his aptitude for water-colour landscape. In 1908, inspired by the sun-drenched Pyrenean landscape around Caudebec, Bozouls and Collioure, he adopted a brilliant palette. The next year he visited St. Ives (Cornwall) and Paris, and in 1910–13 he returned often to Collioure and visited Spain. Two expeditions to Wales in 1911–12 with Augustus John further shaped Innes' style. He then painted in oils and became interested in Japanese colour prints. Besides the English roots of Innes' art, parallels with Paul Gauguin and the Fauves can be perceived. Innes' delicate health failed rapidly and, after wintering in Morocco in 1913, he died at Swanley, Kent. on Aug. 22, 1914.

See Lillian Browse (ed.), *James Dickson* Innes, with an introduction by J. Fothergill (1946). (D. L. FR.; X.)

INNESS, GEORGE (1825–1894), U.S. painter of landscapes in the romantic style, was born near Newburgh, N.Y., May 1, 1825. During his boyhood at Newark, N.J., he was interested in drawing but not in school or clerking, whereupon he was allowed a few lessons. There followed work with a map-engraving firm in New York city, an interval of country sketching and a brief study of painting under Régis Gignoux. About 1845 Inness established a studio in New York city and in 1846 exhibited at the National Academy of Design, New York. The next year friends made possible a stay of several months in Italy.

Back in Newark, Inness married his first wife; she died about six months later. In 1850 he married a second time and made a second trip to Europe.

Inness became an associate of the National Academy of Design at 28, but was kept waiting 15 years for full membership. A third trip to Europe (1854) ended his initial period of experiment in subject and struggle against technical tightness. This stay abroad confirmed the already discernible releasing influence of the French Barbizon school led by Théodore Rousseau. It was through the two decades of his middle period (1855–74) that Inness ascended to the height of his powers. The famous and impressive "Peace and Plenty" (1865) remains exceptional in his work for physical dimensions; his more characteristic smaller canvases depict both far-reaching expanses and lesser areas intimately rendered. His increasing control over space relations and scale. drawing and colour was directed to achieving the idyllic and the tranquil; he often brought in storm clouds for the sake of their grays and blues, but he never let them break into tempestuous violence. Yet all the while his temperament continued stormy and passionate. He mas interested in social questions, and argued heatedly for the single tax and for abolitionism, but the deepest effect on him and his art came from his conversion to Swedenborgianism. The beginning of the final period (1875–94) was marked by pictures with great concentration of feeling ("Evening at Medfield") and by others which foretold the later sacrifice of strength to vaporous colour ("Autumn Oaks"). For most of these latter years his home was at Montclair, N.J., and his studio in New

York city, but his notable prosperity permitted frequent trips to distant places. As his nature mysticism intensified, his pictures volatilized into shimmering colour, frequently gorgeous in itself but no longer supported by form construction. During a trip to Scotland he died at Bridge of Allan on Aug. 3, 1894. His painter son, GEORGE INNESS, JR. (1854–1926), remained faithful to the practices of Barbizon and resisted Impressionism in obedience to his father's violently expressed convictions.

See George Inness, Jr., *Life, Art, and Letters of George Inness* (1917); Elizabeth McCausland, *George Inness* (1946). (VL. B.; X.)

INNOCENT (INNOCENTIUS), the name of 13 popes and 1 antipope.

INNOCENT I, SAINT, pope from 402 to 417, was the son, according to St. Jerome, of Pope Anastasius I. During his papacy the siege of Rome by Alaric (408) took place; the pope was, however, absent from Rome on a mission to Honorius at Ravenna at the time of the sack in 410. He maintained and extended the authority of the Roman see as the ultimate resort for the settlement of all disputes; his still extant communications to Victricius of Rouen, Exuperius of Toulouse, Alexander of Antioch and others, as well as his action on the appeal made to him by Chrysostom against Theophilus of Alexandria, are examples of his intervention. In Jan. 417 he made a decision on the Pelagian controversy, confirming the views of the synods of Carthage (for Proconsular Africa) and of Mileve (for Numidia), which had addressed letters to him in 416. He died on March 12, 417, and in the Roman Church is commemorated as a confessor with St. Nazarius, St. Celsus and St. Victor, martyrs, on July 28.

INNOCENT II (Gregorio Papareschi dei Guidoni), pope from 1130 to 1143, was a Roman by birth. His ability, pure life and political connections raised him rapidly to power. Made cardinal deacon of Sant' Angelo in Pescheria by Paschal II, he was employed in various diplomatic missions. Calixtus II appointed him one of the ambassadors who made peace with the empire and drew up the Concordat of Worms (1122); and in 1123, with his later rival Cardinal Peter Pierleoni, he was papal legate in France. On Feb. 13, 1130, Honorius II died, and on that night a minority of the Sacred College elected Papareschi, who took the name of Innocent II. After a hasty consecration he took refuge with a friendly noble from the supporters of Pierleoni, who was elected pope under the name of Anacletus II by a majority of the cardinals. Innocent refused to recognize the choice; by June, however, he was obliged to flee to France.

Much of Innocent's pontificate was spent in vindicating his title. He owed his success chiefly to the tireless energy of St. Bernard of Clairvaux, who at the council of Btampes swayed the French church in his favour (?Sept. 1130). In Jan. 1131, Bernard arranged a meeting between Innocent and King Henry I of England at Chartres. A similar lead was given to the German church by St. Norbert at the synod of Wiirzburg (Oct. 1130). In March 1131 Innocent met the German king Lothair at Liège and induced him to undertake a campaign against Anacletus. The German army invaded Italy in Aug. 1132 and, early in the following summer, occupied all Rome except the Leonine City, which was held by the Anacletans. Lothair was crowned emperor at the Lateran in June 1133, and Innocent gave him the territories of the Countess Matilda of Tuscany as a fief but refused to surrender the right of investiture. Left to himself Innocent again had to flee, this time to Pisa. There he called a council which condemned Anacletus. A second expedition (1136–37) of Lothair expelled Roger of Sicily (to whom Anacletus had given the title of king in return for his support) from southern Italy. but a quarrel with Innocent prevented the emperor's attacking Rome. At this crisis, in Jan. 1138, Anacletus died, and a successor elected by his faction, as Victor IV, resigned after two months. The Lateran council of 1139 restored peace to the church, excommunicating Roger of Sicily; but an expedition undertaken against Roger ended in Innocent's being taken prisoner and obliged to recognize him. The pope supported Bernard of Clairvaux in his prosecution of Peter Abelard and Arnold of Brescia, whom he condemned as heretics.

The remaining years of Innocent's life were taken up by a quarrel with the Roman commune, which had set up an independent senate, and by one with King Louis VII of France, about an appointment. France was threatened with the interdict, but before matters came to a head Innocent died on Sept 24, 1143.

BIBLIOGRAPHY.—A, Fliche and V Martin, *Histoire de l'Eglise*, vol ix, pt. 1, Du *premier concile du Latran à l'avènement d'Innocent III* (Paris, 1946); F. Gregorovius, *History of the City of Rome in the Middle Ages*, Eng trans, vol iv, part 2 (London, 1896); Watkin Williams, *St. Bernard of Clairvaux* (Manchester, 1935, 1953).

INNOCENT III (Lando da Sezza), antipope for a few months in 1179–80, sprang from a noble Lombard family. Opponents of Alexander III elected him pope on Sept. 29, 1179. Alexander, however, bribed his partisans to give him up and imprisoned him in the cloister of La Cava in Jan. 1180.

INNOCENT III (Lotario de' Conti di Segni). pope from 1198 to 1216, son of Trasimund, count of Segni. and of Claricia, a Roman lady of the noble family of Scotti. was born at Anagni about 1160. At the University of Paris he laid the foundations of his profound knowledge of scholastic theology: at Bologna he studied canon and civil law under the famous canonist Uguccione da Pisa. On his return to Rome he became a canon of St. Peter's; he was made subdeacon of the Roman Church by Gregory VIII; and in 1190 his uncle, Pope Clement III, created him cardinal deacon of Santi Sergio e Baccho. The election of Celestine III in the following year withdrew Lotario for a while from the active work of the Curia, the new pope belonging to the family of the Orsini, who were at feud with the Scotti. Lotario, however, employed his leisure in writing several works. of which the most widely known were the two treatises *De contemptu mundi sive de miseria humanae conditionis* and *De sacro altaris mysterio libri sex*, both of which show a heavy debt to the work of Hugh of St. Victor. Yet Lotario was destined to be above all things a man of action, and Innocent III is remembered less as a theologian than as a canonist and a great ruler of the church.

On Jan 8, 1198, Celestine III died, and on the same day Lotario, though not even a priest, was unanimously elected pope by the assembled cardinals. He took the name of Innocent III. Ordained priest on Feb. 21, he was consecrated bishop next day.

Innocent's view of papal authority was expounded in the sermon preached at his consecration, for which he chose the significant text "I have set thee this day over nations and over kingdoms" (Jer. i, 10). As he wrote to the Tuscan rectors, in Christian society the *sacerdotium* stood to the *regnum* as did the sun to the moon. Likewise to the patriarch of Constantinople he wrote: "The Lord left to Peter the governance not of the Church only but of the whole world." Again, in his letter to King John of England he said: "The King of Kings . . . so established the kingship and the priesthood in the Church, that the kingship should be priestly, and the priesthood royal, as is evident from the epistle of Peter and the law of Moses, setting one over all. whom He appointed His vicar on earth." Other popes before Innocent—notably Gregory VII—had maintained the doctrine that the pope had an eminent dominion over secular princes; but it was reserved for Innocent to make it a reality.

In Italy Innocent addressed himself to restoring the temporal authority of the Holy See. This had been almost eclipsed by the power of the emperor Henry VI in the peninsula; but Henry's early death (Sept. 1197) had left Germany divided between rival claimants for the crown and had been followed by a violent anti-German reaction throughout Italy, uhich received Innocent's full encouragement. In these circumstances it was easy for the pope to exact homage from the imperial prefect in Rome and to oust the German *ministeriales* whom the emperor had installed in Italy: Spoleto and Ancona threw off the German yoke; the Tuscan league gathered strength under Innocent's direction; papal rectors once more governed the patrimony of St. Peter; and finally Henry's widow Constance, in despair, acknowledged the pope as overlord of the Sicilian kingdom and, on her death (Nov. 27, 1198), appointed him guardian of her infant son Frederick.

Innocent's triumph over the civic republic at Rome was less easy. A feud between the Poli and Innocent's own brother, Richard, led to an outbreak of violence, and the pope had to withdraw to Palestrina (Praeneste) for a period (1203–04) before he finally achieved mastery of his own capital.

Innocent was determined to prevent a revival of imperial power in Italy. and events in Germany worked in his favour. The rival claimants, Philip of Swabia and Otto of Brunswick. both appealed to his intervention. Early in 1201, Innocent made known the famous *Deliberatio,* in which, after examining the rights of both candidates, he anarded the empire to Otto. But the award was conditional: Otto had to bind himself by the Oath of Neuss (June 8) to respect the papal temporalities in Italy. In 1210, when Otto broke his Pond and invaded Apulia. Innocent declared his deposition and transferred his support to the Hohenstaufen Frederick of Sicily. But Frederick also had to accept Innocent's terms: Sicily was never to be united to the German crown. Otto's defeat by the French at Bouvines (1214) left the pope's new protégé undisputed master of Germany. *(See* GERMANY: *History.)*

As Innocent explained to Berthold V of Zahringen in the bull *Venerabilem* (1202), his intervention in the imperial schism was the act not of a temporal sovereign hut of a spiritual judge. Nevertheless, the temporal dominion of the papacy was extended under Innocent as a growing number of states entered the feudal vassalage of the Holy See:-peter II of Aragon had to surrender his kingdom and receive it back as a papal fief (1204) ; Sancho of Portugal was compelled to pay the tribute promised to Rome by his father; Kaloyan (Joanitsa), tsar of Bulgaria, rendered homage to the pope in order to obtain recognition; and John of England did likewise in 1213 in order to ward off a French invasion. In Sicily. Innocent exercised his rights as feudal suzerain to the full.

Political activities occupied only a part of Innocent's energy. The causes nearest his heart were the organization of a crusade for the relief of the Holy Land, the extirpation of heresy and the reform of the church. Having worked to organize the fourth crusade. he at first severely censured its diversion to Constantinople in 1203 *(see* CRUSADES).

But an event which seemed to put an end to the schism of Eastern and Western Church came to wear a different aspect. Innocent was the first pope to nominate a Latin patriarch of Constantinople. and he expressed the hope that henceforth the church would be "one fold under one shepherd." Moreover, by a bull of Oct. 12. 1204, Innocent permitted crusaders to fulfil their vows by assisting the Knights of the Sword in the conquest of Livonia for the church. By the end of his pontificate the Christianization of Livonia was complete and that of Estonia in progress. Innocent kept the new provinces under his hand by placing the bishoprics of Estonia and Riga in direct dependence'on Rome.

Innocent has been much criticized for invoking a crusade against the Albigensian heretics in 1208. The Cistercian mission to Languedoc had failed, and 50 years of preaching and persuasion had been in vain. Innocent only resorted to a crusade after his legate, Peter of Castelnau, had been murdered with the complicity, as it was believed, of the count of Toulouse. In the eyes of contemporaries it was Raymund of Toulouse, not the pope, who had first drawn the sword.

Innocent's pontificate did nothing to arrest the administrative centralization of the church which had been such a striking development of the previous century. The papal chancery and camera mere reorganized. Minute rules were formulated for the conduct of business and tests devised by the pope for the authentication of documents. This new system in the chancery is reflected in the papal registers, which survive from Innocent's pontificate onward in an unbroken series. The pope's own legal skill strengthened his claim to be "universal Ordinary," and appeals to Rome evoked an endless stream of decretals on all conceivable minutiae of diocesan administration. An attempt was made to bring together his more important judgments in the third and fourth books of the *Quinque compilationes,* and these were incorporated into the official *Corpus juris canonici* under Gregory IX. Not the least important of Innocent's contributions to ecclesiastical law was his legislation on marriage, which reduced the forbidden degrees of consanguinity from seven to four.

Another aspect of this centralizing tendency was the application of the doctrine of the pope's *plenitudo potestatis* to the disposal of benefices: it was under Innocent that the system of provisors began, whereby the pope conferred benefices directly, overriding the rights of the normal patrons, a system that was later to lead to serious abuse. On the other hand: Innocent was inflexible in upholding the canonical election of bishops. for only thus could the standards of the episcopate be maintained. Over this issue he fell foul of King John of England. who sought to impose his own nominee on the vacant see of Canterbury instead of the candidate elected by the chapter. Innocent settled the dispute by nominating to the chapter the English cardinal Stephen Langton (*q.v.*) over the heads of both candidates. John's resistance was broken by an interdict which lay on England from 1208 until 1213 and finally by the threat of deposition.

Innocent's plan for the reform of the church was embodied in the canons of the fourth Lateran council, which he summoned for 1215. This, the greatest of the mediaeval councils, was attended by 412 bishops, by about 800 abbots and priors and by the ambassadors of kings and princes. While several of its canons reenacted those of the third Lateran council of 1179, many new acts had a far-reaching effect on the development of Latin Christianity. Thus a new impetus was given to synodal activity in the dioceses, a steady effort was made to improve the education of the diocesan clergy, and the obligations of the laity were emphasized by the 21st canon, *Utriusque sexus,* which made annual confession obligatory. (See LATERAN COUNCILS.) If the council did not achieve all that Innocent hoped, its canons are a worthy epitaph to the breadth of vision and nobility of purpose of a great pope. It was perhaps the finest hour of the mediaeval papacy.

In the midst of organizing another crusade, Innocent was struck down by a fever and died at Pemgia on July 16, 1216. He was still only 55 years of age.

BIBLIOGRAPHY.—The classical work is still that of A. Luchaire, *Innocent III,* 6 vol. (Paris, 1904–08). *See* also *A.* Fliche and V. Martin, *Histoire de l'Eglise,* vol. x, *La Chrétienté romaine* (Paris, 1950) ; H. L. Mann, *Lives of the Popes,* vol. xi and xii (London, 1915) ; E. F. Jacob, "Innocent III" in *Cambridge Medieval History,* vol. vi (Cambridge, 1929, 1936) ; E. L. Binns, *Innocent 111* (London! 1931) ; and, on Innocent's relations with England, F. M. Powicke, *Stephen Langton* (Oxford, New York, 1928). Innocent's correspondence is in J. P. Migne, *Patrologia Latina,* vol. ccxiv-ccxvii, his theological works *ihid.,* vol. ccxvii. *See* further C. R. Cheney and W. H. Semple (eds.), *Selected Letters of Pope Innocent 111 Concerning England* (London, 1953). For the Lateran council *see* C. J. von Hefele and H. Leclercq, *Histoire des Conciles,* vol. v, 2 (Paris. 1913).

INNOCENT IV (Sinibaldo Fieschi), pope from 1243 to 1254, belonged to the noble Genoese family of the counts of Lavagna. Born at Genoa, he was educated under the care of his uncle Opizzo, bishop of Parma. After taking orders at Parma, when he was made canon of the cathedral. he studied jurisprudence at Bologna. His first recorded appearance in political affairs mas in 1218–19, when he was associated with Cardinal Ugolino (later Gregory IX) in negotiating a peace between Genoa and Pisa. Pope Honorius III gave him a benefice in Parma in 1223 and established him at the Curia as *auditor contradictarum literarum* in 1226; and Gregory IX promoted him to be vice-chancellor of the Roman Church in July 1227 and made him cardinal priest of San Lorenzo in Lucina in September. He was papal *rector* (governor) of the March of Ancona from 1235 to 1240. On June 25, 1243, he was elected pope by the cardinals assembled at Anagni.

When Innocent was raised t o the Holy See, the emperor Frederick II lay under excommunication. Frederick hoped great things from the elevation of a member of a family favourable to the imperial cause; but it was soon clear that Innocent intended to pursue the traditions of his predecessors. Embassies and courtesies were, indeed, interchanged, and on March 31, 1244, a treaty was signed at Rome, whereby the emperor undertook to satisfy the pope's claims in return for his own absolution from the ban. Neither side, however, was prepared to begin to carry out the agreement, and Innocent began to feel unsafe in Rome, where the imperial partisans had the ascendancy. He left Rome in June, arranged to meet the emperor but fled by night on horseback, pursued by the emperor's cavalry, from Sutri to Civitavecchia, whence he took ship for Genoa and proceeded to Lyons, at that time a merely nominal dependency of the empire. Thence, close

to French soil and confident in the sympathy of Louis IX, he issued a summons to a general council, before which he cited Frederick to appear. The council, which opened on June 28. 1245, was attended by about 1jo bishops, most of the German and all the Hungarian bishops being absent. Though Frederick was defended by the jurist Thaddeus of Suessa, the judgment was a foregone conclusion; in the session of July 17, Innocent renewed sentence of excommunication against the emperor and declared him deposed.

Frederick retorted with a circular letter, appealing to the opinion of all Christian princes, and threatened reprisals on clergy who obeyed the papal sentence. But Innocent pursued the war relentlessly. The Mendicant orders mere mobilized to preach against the emperor The German electors were invited to elect a new king and, under the lead of the Rhenish archbishops who had already deserted Frederick. chose Henry Raspe. landgrave of Thuringia, in May 1246. But the *rex clericorum* died in Feb. 1247, and William II. count of Holland, was elected to succeed him in October. Those who fought against Frederick were granted crusading indulgences, and the papal legate took all vacant German benefices into the pope's hand and disposed them on papal partisans. The turning point mas Frederick's failure of the siege of Parma in 1248. The conflict was still unsettled when Frederick died, at Fiorentino in the Regno, on Dec. 13. 12 jo.

Innocent left Lyons for Italy in April 1251. He continued the struggle with Frederick's son and successor. Conrad IV, who in 1252 descended into the Regno, reduced the rebellious cities and claimed the imperial crown. Innocent now offered the crown of Sicily in turn to Richard of Cornwall, Charles of Anjou and Henry III of England. the last of whom accepted the doubtful gift for his son Edmund. After Conrad's capture of Naples. Innocent feared that Rome itself might fall into the hands of the German king. But Conrad died on May 21. 1254, leaving his infant son Conradin under the pope's guardianship. Innocent posed as the champion of the infant king He held, indeed, to his bargain with Henry III and exercistd his rights over the Sicilian kingdom by nominating his own relations to its 'most important offices. Finally. when Manfred. who by Frederick's will had been charged with the government of the two Sicilies, felt obliged to acknowledge the pope's suzerainty. Innocent threw off the mask, ignored Conradin's claims and. in October, announced the annexation of Sicily and Calabria to the States of the Church. He entered Naples on Oct. 27; but meanwhile Manfred had fled and had raised a considerable force; the news of his initial successes reached Innocent as he lay sick and hastened his end. He died on Dec. 7. 1254.

Deep legalistic in outlook. Innocent went beyond his predecessors in claiming for the papacy a direct temporal sovereignty over all earthly kingdoms. Innocent III had been more cautious, preferring to base his political interventions on the spiritual authority of the pope in the matter of sin *(ratione peccati).* But for Innocent IV, the church was not merely the judge of temporal sovereigns but the necessary author of their power. In the church itself, the prestige of the papacy began to suffer as spiritual resources were diverted to political ends. Under the strain of war, papal fiscality became increasingly oppressive. In particular, Innocent's exploitation of the system of papal provisions to benefices aroused a growing body of complaint. Robert Grosseteste, bishop of Lincoln, nho led the English delegation to Lyons, denounced the abuse before the pope's face, and a strong protest was made by Louis IX of France. The abuse had become so great that Innocent's successor was obliged to revoke large numbers of mandates of provision on the ground that in some churches the number of '.expectants" awaiting provision exceeded the total number of benefices in existence.

Innocent IV was a canon lawyer of some eminence. His small work *De exceptionibus* was probably written before he became pope; but the *Apparatus in quinque libros decretalium,* which displays practical sense and a mastery of the materials, was written at Lyons immediately after the council. His *Apologeticus,* a defense of the papal claims against the empire. was lost. Innocent was also a notable patron of learning; he encouraged Alexander of Hales to write his *Summa universae theologiae,* did much for the universities, notably Paris, and founded *studia generalia* at Rome and Piacenza.

BIBLIOGRAPHY —Innocent's registers were edited by E. Berger, *Les Registres d'Innocent IV* (Paris, 1884–87). *See* A. Fliche and V. Martin, *Histoire de l'Eglise,* vol. x, *La Chrétienté romaine,* with bibliography (Paris, 1950); H. L. Mann, *Lives of the Popes,* vol xiv (London, 191j); F Podestà, *Papa Innocenzo* IV (Milan, 1928); A L. Smith, *Church and State in the Middle Ages* (Oxford, 1913). For the Council of Lyons *see* C. J. von Hefele and H. Leclercq, *Histoire des conciles,* vol. v, 2 (Paris, 1913).

INNOCENT V (Pierre de Champagny or de Tarentaise), pope from Jan. 21 to June 22, 1276. was born about 1225 in a dependency of the county of Savoy and entered the Dominican order at an early age. He studied theology at Paris, probably under Albertus Magnus, and incepted as a master in 1259 From 1260 to 1267 and again from 1269 to 1272, he was provincial of his order in France. He was made archbishop of Lyons in 1272 and cardinal bishop of Ostia and Velletri. and grand penitentiary in 1273; and. partly through the influence of Charles of Anjou, was elected to succeed Gregory X. As pope he established peace between the republics of Lucca and Pisa and confirmed Charles of Anjou in his officeof imperial vicar of Tuscany. He was seeking to carry out the Lyons agreement with the Eastern Church when he died.

Before he became pope, he had prepared. in conjunction with Albertus Magnus and Thomas Aquinas, a rule of studies for his order, which was accepted in June 1259; and he was the author of several works in philosophy, theology and canon law. He is sometimes referred to as *famosissimus doctor.*

INNOCENT VI (Etienne Aubert), pope from Dec. 18. 1352, to Sept. 12, 1362 was born at Monts in Limousin. He became professor of civil law at Toulouse and subsequently chief judge of the city. Having taken orders he was raised in 1338 to the see of Noyon and translated in 1340 to Clermont. He was made cardinal priest of SS Giovanni e Paolo in 1342 and cardinal bishop of Ostia and Velletri, grand penitentiary and administrator of the bishopric of Avignon ten years later.

As pope, Innocent revoked the reservations and commendations of his predecessor Clement VI and prohibited pluralities. urged upon the higher clergy the duty of residence in their sees, and diminished the luxury of the papal court. Largely through the influence of Petrarch. whom he called to Avignon, he released Cola di Rienzo. who had been sent a prisoner in Aug. 1352 from Prague to Avignon, and used the latter to assist Cardinal Albornoz, vicar-general of the States of the Church, in tranquillizing Italy and restoring the papal power at Rome.

Innocent established good relations with the German king Charles IV. whom he caused to be crowned emperor at Rome in 1 The following year Charles published the famous Golden Bull (*q.v.*), which prescribed a method for the election of the German kings and passed over in silence the claims of the papacy to approve the election. Contrary to statements sometimes made, Innocent raised no objection to the bull. He had other matters in hand. In 1360 he arranged the treaty of Brétigny between France and England, a success which redounded on his head, for the peace released roving armies of mercenaries. One of these "free companies" occupied Pont-Saint-Esprit and threatened Avignon. In the end Innocent was constrained to buy them off. In the last years of his pontificate he was busied with preparations for a crusade and with negotiations for the reunion of Christendom.

See G. Mollat, *Les Papes d'Avignon,* 9th ed. (Paris, 1949), which contains an exhaustive bibliography

INNOCENT VII (Cosimo de' Migliorati), pope from Oct. 17, 1404, to Nov. 6, 1406, was born at Sulmona in 1336. He was made papal vice-chamberlain and archbishop of Ravenna by Urban VI and cardinal priest of Sta. Croce in Gerusalemme, bishop of Bologna and papal legate to England by Boniface IS. He was unanimously chosen to succeed Boniface. The election was opposed at Rome by a considerable party but peace was maintained by the aid of Ladislaus of Naples, in return for nhich Innocent agreed not to come to terms with the antipope Benedict XIII, except on condition that he should recognize the claims

of Ladislaus to Naples. Innocent issued at the close of 1404 a summons for a general council to heal the schism, but the council never assembled. as the Romans rose in arms to secure an extension of their liberties and finally, maddened by the murder of some of their leaders by the pope's nephew Ludovico de' Migliorati, compelled Innocent to take refuge at Viterbo (Aug. 6, 1405). Later, recognizing the pope's innocence of the outrage, they made their submission to him in Jan. 1406. He returned to Rome in March, and, by a bull of Sept. 1, restored the city's decayed university. He died on Nov. 6, 1406.

See N. Valois, *La France et le grand schisme d'Occident* (Paris, 1896–1902).

INNOCENT VIII (Giovanni Battista Cibb), pope from Aug. 29, 1484, to July 25, 1492, successor of Sixtus IV. was born at Genoa (1432), the son of Arano Cibb, who under Calixtus III had been a senator of Rome. Through the favour of Cardinal Calandrini, half-brother of Nicholas V, he obtained from Paul II the bishopric of Savona. Sixtus IV translated him to the see of Molfetta and created him cardinal priest of Sta. Balbina in 1473 and of Sta. Cecilia subsequently.

Innocent VIII was not a successful pope. His summons to a crusade against Islam went unheard, and he ended by making a treaty with the sultan Bayezid II (1489), agreeing, in return for an annual payment of 40,000 ducats and the gift of the Holy Lance, to detain the sultan's fugitive brother Jem in confinement in the L'atican. Innocent's manoeuvres in Italian politics were equally unscrupulous and unsuccessful. He deposed Ferdinand (Ferrante) king of Naples in 1489 for failure to pay arrears of tribute. But the papal arms were worsted. and Innocent had to abandon his project of incorporating Naples into the ecclesiastical state. He is remembered as the persecutor of Pico della Mirandola. The capture of Granada from the Moors (Jan. 2, 1492) gave a borrowed lustre to his pontificate. Innocent died on July 2j. 1492. A man of lax private morals, he was a weak and unworthy pope. He left the papal camera empty and States of the Church in anarchy.

See A. Fliche and V. Martin, *Histoire de l'Eglise,* vol. xv, *R.* Aubenas and R. Ricard, *L'Eglise et la Renaissance* (Paris, 1951); L. Pastor, *History of the Popes,* vol. v, Eng. trans. (London, 1898); M. Creighton, *History of the Papacy,* vol. iv (London, 1901). (T. CR.; C. H. LE.)

INNOCENT IX (Giovanni Antonio Facchinetti), pope from Oct. to Dec. 1591, was born in 1519. After taking part in the council of Trent. he became nuncio at Venice and was employed on important duties at Rome by Gregory XIII. who made him a cardinal in 1583. Under the invalid Gregory XIV he assumed almost the entire direction of affairs. He was a supporter of the Catholic League in France and of the policy of Philip II of Spain, and it was with the latter's support that he succeeded Gregory on Oct. 29, 1591. He died on Dec. 30 of the same year.

INNOCENT X (Giambattista Pamfilij, pope from 1644 to 1655, was born in Rome on May 7, 1574. He was made auditor of the Rota by Clement VIII. nuncio at Naples by Gregory XV and legate apostolic to Spain and cardinal by Urban VIII. He was elected pope on Sept. 1j. 1644. through the support of those cardinals who had opposed his predecessor Urban VIII's domestic administration and diplomatic policy, both of which he proceeded to reverse. The most emphatic and significant demonstration of this change is to be seen in Innocent's condemnation of the peace of Westphalia (1648), for which papal mediators had worked under Urban; and in the fact that practically no notice was taken of his protest by either side. In support of a pro-Habsburg policy, cardinals favoured by Spain were promoted and recognition of the independence of Portugal. then at war with Spain, was refused. In Rome, the Barberini (relatives of Urban and protégés of Cardinal Mazarin) were attacked and their property confiscated. Much of the initiative in these events was taken not by Innocent but by his sister-in-law, the notorious Olimpia Maidalchini, by whose advice he was almost completely dominated. While her diplomatic policy had the praiseworthy aim of keeping the papacy aloof from international entanglements. her greed for money led her to adopt devices which destroyed the very prestige upon which such a policy depended for its success. In doctrine. Innocent intervened in the quarrel between the Jesuits and the Jansenists and, in the bull Cum *occasione* (1653), condemned five propositions concerning the nature of divine grace said to be in Cornelius Jansen's *Augustinus.* The quarrel thereupon entered a new phase, in which it was contended that papal infallibility did not extend to matters of fact and that the propositions were not in fact implicit in the Augustinus, so that the teaching of Jansen had not been condemned by the bull. On all scores, therefore, papal prestige had seriously declined by the time that Innocent died, on Jan. 7, 165j.

See J. Ciampi, *Innocenzo X Pamfili, et la sua corte* (Rome, 1878), a standard work; also H. Coville, *Études sur Mazarin et ses démêlés avec le pape Innocent X* (Paris, 1914).

INNOCENT XI (Benedetto Odescalchi), pope from 1676 to 1689, was born on May 19, 1611, at Como, where he was educated by the Jesuits. He studied law in Rome and Naples, entered the Curia under Urban VIII and became successively protonotary, president of the apostolic chamber, governor of Macerata and commissary of Ancona. Innocent X made him a cardinal (1645), legate to Ferrara and, in 1650, bishop of Novara. He was elected pope on Sept. 21, 1676, against the opposition of Louis XIV of France. On grounds of moral character he was the outstanding pope of the 17th century, being entirely free from nepotism and invariably refusing to diverge for reasons of expediency from the policy that he considered right. He averted bankruptcy by abolishing sinecures and introducing economies. As a result he was able to finance the war against the Turks and, in particular, to subsidize John Sobieski (King John III of Poland) and the emperor in the campaign which led to the relief of Vienna in 1683.

Innocent XI had to face, in Louis XIV, a man with entirely opposite principles. Their quarrel began when two French bishops resisted an edict of 1673 which extended the *régale* (*i.e.*, the king's right to administer both the temporalities and the spiritualities of vacant sees). Innocent upheld their objection, refused the offer of a compromise and, when Louis replied by having a French synod issue the famous declaration of Gallican liberties (see GALLICANISM) in 1682, refused to confirm the promotion of any of the clergy who had taken part in it.

The deadlock that resulted was made worse in 1687, when Innocent took action against the abuse of ambassadorial privileges by the French representative in Rome. Something approaching a schism threatened, and the deadlock was still unresolved when Innocent died. In addition, Innocent opposed Louis's candidate for the archbishopric and electorate of Cologne (1688) and would not help his plans for James II of England.

In doctrinal matters, Innocent had some sympathy with the Jansenists. On the occasion of an appeal to him by the Jesuit Tirso Gonzalez, whose rigorist theories were being suppressed by his superiors, Innocent showed his disapproval of the lax probabilism taught by many Jesuit casuists (1680); and in 1687 he had Gonzalez made general of the Jesuits. On the other hand, he was personally favourable to the Quietist Miguel de Molinos, most of whose propositions he condemned in 1687.

Any general appreciation of Innocent XI's pontificate must take into account the problems created by the ambitions of Louis XIV at a time when the church was passing through a period of doctrinal discord. Innocent's greatest contribution was perhaps his domestic reform, both moral and administrative. His integrity was unquestioned. He died on Aug. 12, 1689, and was beatified by Pius XII on Oct. 7, 1956.

BIBLIOGRAPHY.—The best modem life is M. Immich, *Papst Innocenz XI, 1676–1689* (Berlin, 1900). For his correspondence *see* G. Colombo, *Notizie biografiche e lettere di Papa Innocenzo XI* (1878); and F de Bojani, *Innocent XI: sa correspondance avec ses nonces* (Rome, 1910–12) For affairs with France *see* E. Michaud, *Louis XIV et Innocent XI,* 4 vol. (Paris, 1882–83); and J. Orcibal, *Louis XIV contre Innocent XI* (Paris, 1949).

INNOCENT XII (Antonio Pignatelli), pope from 1691 to 1700, was born in Neapolitan territory on March 13, 1615; was educated at the Jesuit college in Rome; entered upon his official career at the age of 20; and became successively vice-legate of Urbino, governor of Viterbo and nuncio to Tuscanp, to Poland and to Austria He was made cardinal in 1681 by Innocent XI. whose pontificate he took as a model for his own, which began on July 12, 1691. Nepotism was officially condemned in a bull of 1692 and justice was administered in the papal states without regard for

the status of the persons involved. The deadlock with France was broken in 1693 when both the French bishops of the synod of 1682 and Louis himself wrote letters disavowing the declaration of Gallican liberties of 1682 and Innocent agreed to the extension of the *régale* enacted in 1673 *(see* above. *Innocent XI)* Typically, Louis first assured himself that his repudiation was invalid, since a letter could not annul an edict registered by the *parlement*. In doctrinal matters, Innocent allowed the uneasy peace between Jansenists and Jesuits to continue; condemned the archbishop Fénelon's *Maximes des saints* at Louis XIV's instigation in 1699; but refused to condemn Celestino Sfondrati's book on predestination, which Jacques Benigne Bossuet had denounced as Quietistic in 1697 but nhich was still "under consideration" when Innocent died. on Sept. 27, 1700.

INNOCENT XIII (Michelangelo Conti), pope from 1721 to 1724, the son of the duke of Poli. and a member of a family that had produced several popes. among them Innocent III, was born at Poli on May 13, 1655. He served as nuncio in Switzerland and Portugal and was made cardinal and bishop of Osimo and Viterho by Clement XI. He was elected pope, after a long conclave, on May 8, 1721, as a result of the exclusion by the emperor of the candidature of Cardinal Fabrizio Paolucci One of his first acts was to invest the emperor Charles VI with Naples (1722); he protested in vain against the imperial investiture of Don Carlos with Parma and Piacenza He recognized the Stewart pretender "James III" and promised him subsidies conditional upon the re-establishment of Roman Catholicism in England. Moved by deep-seated distrust of the Jesuits and by their continued practice of "accommodation" (whereby missionaries might modify Christian usage to attract converts) despite Clement XI's express prohibition. Innocent forbade their society to receive new members in China and nas said to have meditated its suppression. This encouraged the French Jansenist bishops to press for the revocation of the bull *Unigenitus;* but the pope commanded its unreserved acceptance. Innocent died on March 7, 1724. (I. F. B.)

INNOCENTS' DAY or CHILDERMAS, a festival celebrated in the Latin Church on Dec 28 and in the Greek Church on Dec. 29 (O S.) in memory of the massacre of the children by Herod. The church early regarded these little ones as the first martyrs. It is uncertain when the day was first kept as a saint's day. At first it seems to have been absorbed into the celebration of the Epiphany, but by the 5th century it was kept as a separate festival In Rome it was a day of fasting and mourning

The boy-bishop (q v.), whose tenure of office lasted till Childermas. had his last exercise of authority then. the day being one of the series of days which were known as the Feast of Fools. Parents temporarily abdicated authority, and in nunneries and monasteries the youngest nun and monk nere for the 24 hours allowed to masquerade as abbess and abbot. These mockeries of religion were condemned by the Council of Basel (1431). The day is still observed as a feast day and merrymaking for children in Catholic countries, and particularly as an occasion for practical joking.

The society of Lincoln's Inn specially celebrated Childermas, annually electing a "king of the Cockneys."

Innocents' day was accounted unlucky, and Louis XI prohibited all state business on the day. The coronation of Edward IV, fixed for a Sunday. was postponed till the Monday when it was found that the Sunday fell on Dec 28

In rural England it was deemed unlucky to do housework put on new clothes or pare the nails. At various places in Gloucestershire. Somerset and Worcestershire muffled peals were rung. In Northampton the festival was called "Dyzemas day," and there was a proverb "What is begun on Dyzemas will never be finished."

The Irish called the day *Lu Crouste na bliana,* "the cross day of the year." or *Diar dasin darg,* "blood Thursday," and many legends attach to it.

In mediaeval England the children were reminded of the mournfulness of the day by being whipped in bed on Innocents' morning. This custom survived to the 17th century.

INNS AND INNKEEPERS. An inn is a hostelry. hotel or public house kept for reward, for the lodging and entertainment of travellers or of any who need temporary accommodation. The name is also given, in a specialized sense. to the institutions set apart for the study and practice of the law. *(See* INNS OF COURT AND CHANCERY.)

English Law.—The term inn includes any house of public entertainment where beds and food are furnished to all persons paying for them, although the prices charged may, of course, vary between one inn and another, according to the character of the accommodation and services provided. The name used—hotel, public house, temperance hotel or whatever it may be—is immaterial. but a lodging house or boarding house is not an inn. because there is a distinction at law between a guest and a boarder—the latter of whom makes a contract to stay for a certain period, the landlord being as free to accept or reject him as is any other party to a contract.

The law enforces on the innkeeper, on the other hand, the provision of certain services for the benefit of travellers. An innkeeper has no right to select his guests or refuse shelter at any hour of the day or night, provided he has vacant accommodation and the traveller is not obviously objectionable; nor can he refuse to serve food at reasonable hours if he has it available. (See R. v. *Higgins* 1948 1 K.B. 165 and *Constantine* v. *Imperial Hotels Ltd.* 1944 K.B. 693.)

By the common law of England an innkeeper is responsible for the personal property of a traveller so long as the relationship of landlord and guest continues between the parties unless the goods are destroyed by the act of God or the queen's enemies. No special contract is necessary in order to create this obligation, which was reaffirmed by the house of lords in *Shacklock* v. *Ethorpe Ltd.* (1939 3 A.E.R. 373). The innkeeper's liability is not founded upon the law of negligence. he is responsible to his guests. except in so far as they may fail to take the ordinary care which a prudent person would take. This rule is qualified by the limitation stated by Lord Justice Asquith in *Williams* v. *Linnitt* (1951 1 K.B. 565 at 580), namely, that "The absolute liability of the innkeeper for the safety of the plaintiff's goods only attaches where such goods are *infra hospitium,* namely, within the inn buildings themselves or within precincts so intimately related to those buildings as to be treated for this purpose as forming part of them." The question of what is *infra hospitium* mas also raised in *Watson* v. *People's Refreshment Houses Ltd.* (1952 1 K.B. 318). On the other hand, where a question is raised of a guest's being injured through the condition of the property the duty of the innkeeper has been held to be to make the premises reasonably safe, not as safe as reasonable care and skill can make them. *(Bell* v. *Travco Hotels* 1953 1 A.E.R. 638).

The common law liability of an innkeeper (except for horses, harness and carriages, which term includes motorcars) for the safe custody of the goods of a guest is limited by the Innkeepers' Liability act, 1863, which provides that an innkeeper shall not be liable to a greater amount than £30 for loss of goods unless the loss is caused by the neglect or default of himself or his servants. This limitation of liability only applies if the words of the first section of the act are exhibited prominently in the hall or entrance to the inn. The law gives the innkeeper a lien over his guest's goods for the amount of the bill, but this lien only attaches to goods brought to the inn by the guest and housed by the innkeeper. (See *Marsh* v *Commissioner of Police* 1943 K.R. 99).

By the Innkeepers act, 1878, goods held under such a lien may be sold after six weeks on the expiry of one month from the publication of advertisements in one London and one local newspaper.

(W. T. Ws.)

Scotland.—In Scotland the law is in most respects the same as in England but injury due to the queen's enemies or to the act of God does not render the innkeeper liable He is moreover bound to receive and house the goods of a traveller, other than personal effects, provided they are not very exceptional or dangerous.

(A. D. *G.)*

The United States.—In the United States the common law follows that of England. and laws of the various states of the union have diminished the liability of the innkeeper in much the same manner as in England.

INNSBRUCK, the capital of the Austrian Bundesland of Tirol, is a beautiful town situated at a height of 1,880 ft. in a wide plain formed by the Inn and its right-bank tributary, the Sill, and mainly on the peninsula between these streams. Surrounded by lofty mountains that seem to overhang the town, it occupies a site strategically and commercially important at the junction of the highway from Germany proper to Italy over the Brenner pass with the great thoroughfare from western Europe to Vienna, Aus., and the east over the Arlberg pass. As the name implies, this is a famous crossing place of the Inn guarded in Roman time by the station of Veldidena, which was succeeded by the Premonstratensian abbey of Wilten.

The town is first recorded by its present name in 1187, and in 1233–3 j it was fortified. About 1420 the archduke Frederick IV built a new castle there, and the town replaced Meran as the capital of Tirol

Innsbruck's history has been generally uneventful, and it always manifested a strong loyalty to the ruling house of Austria, particularly during the revolution of 1848. With Austria, it was annexed to Germany in 1938. In 1945 it became the headquarters of the French zone of occupation.

Within the town there is a striking contrast between old and new. The narrow arcaded streets of the old town, with fine old frescoed houses of the 17th and 18th centuries, give place to the regularly built blocks and open spaces of the more modern accretions, yet without disturbing the sense of unity. One of the finest of the older buildings is the Franciscan or Court church (1553–63), mainly in Italian Renaissance style. Within was preserved the remarkable cenotaph of the emperor Maximilian I (d. 1519), count of the Tirol from 1490 onward, a gigantic marble sarcophagus with 28 bronze statues of his ancestors and favourite heroes and 24 marble reliefs depicting scenes from his life. The church contains also a number of other tombs of notable historic figures.

The university of Innsbruck, formally founded in 1677, suspended during 1782–92 and 1810–26, was refounded in 1826 and makes the town a centre of intellectual life. Well staffed and equipped with fine buildings and a library of about 400,000 volumes, the university influence spreads far beyond the borders of Tirol and Austria. Before the Anschluss of 1938, more than 1,500 students attended its courses, 39% coming from Tirol, 27% from other parts of Austria and 34% from foreign countries including 2% from the Cnited States. After World War II, more than 4,200 students were enrolled. The building for internal medicine and anatomy, which was damaged during the war, was later remodelled. There is also a well-stocked museum, the Ferdinandeum, with rich collections, some illustrative of the Tirolean life.

Other interesting and historic buildings and monuments combine with the surrounding scenic and climatic attractions to make Innsbruck a centre for tourists, whereby its functions as the regional capital and market are strengthened. In the 20th century thousands of visitors were catered for annually, their needs forming the basis of a large trade in foodstuffs and other necessities of daily life. Improved facilities for travel swelled this tourist traffic, a fact that was reflected in the growth of the town after 1900, when its population numbered 26,866. By the census of March 1923 it was 56,365, and the census of 1939 reported 80.084, mainly German-speaking Roman Catholics. The population was 103.503 according to the census of 1961. See also TIROL.

See H. Bobek, *Innsbruck, eine Gebirgsstadt, ihr Lebensraum und ihre Erscheinung* (Stuttgart, *1928).*

INNS OF COURT AND CHANCERY. The four inns of court seated in London — Lincoln's inn, Gray's inn, the Inner Temple and the Middle Temple — have frequently been referred to as "colleges in a university of law," and in their general structure, system of government and functions this analogy holds good. In Coke's *Reports* they are described as "the most famous Universitie for profession of law only" and they are referred to by Fortescue, Coke and Selden as universities for the study of the law on the same footing as the universities of Oxford and Cambridge. Just as the universities are responsible for the preparation of students for a degree and for their discipline, so the inns of court are responsible for the education and discipline of their students; and their respective governing bodies, the benches, exercise the exclusive right of admitting persons to practise by a formal call to the bar.

They are voluntary societies, unchartered, unincorporated and unendowed Hence their early history is very obscure and the date of their respective foundations cannot be precisely determined, for they did not own land, but only leased it, and records of such transactions are much more difficult to trace than dealings with a fee simple. Since the inns were not endowed by any benefactor, there was no foundation charter, and no statutes, to be preciously preserved.

Since the inns were primarily concerned in the middle ages with legal education, attempts have been made to connect them with the early educational establishments of London. No doubt the city was well furnished with schools where the rudiments of Latin, grammar, logic, etc., were taught, possibly with those odd tags of law which often appeared as illustrative material in the course of rhetoric. But this is not sufficient to account for the rise of the inns of court, which were devoted to the technical study of English, not Roman, law and which seem to have been concerned from the first with students well beyond the schoolboy stage.

There is nothing to suggest that while the common law was still young, its administrators had any systematic education in English law; it was learned in the course of service, the first rudiments possibly as private clerk to some official. These conditions persisted well into the 13th century. By about 1256 Henry de Bracton's massive book on the laws and customs of England and the bulk of the plea rolls both show that the common law was extensive and intricate, conducted by numerous skilled men in courts which had considerable establishments.

This law had little in common with Roman and canon law; whence it followed that there was no question of the universities teaching English law. Moreover, there arose a class of men, literate but lay, who took an interest in law. They dominated, and created, the legal profession, and faced and solved the problem of English legal education. The inns of court were the answer they supplied.

This emergence of the literate layman is clear from the appearance (contemporary with Bracton's last years) of treatises on English law in French instead of Latin. From them and other sources it seems clear that already English law was being taught. Many were studying — the surviving manuscripts of these manuals are numerous — and the teachers were able enough to write quite good little books.

The students listened to arguments in court, and discussed law among themselves. That does not mean that there was any permanent inn; the students may well have made their own private arrangements both for teaching and lodging.

The general educational history of the city of London does not seem to show any genuine relevance to all this. It is usual to mention the writ of 1234 whereby Henry III ordered that "no regent of law schools in the said city shall teach laws (leges) there henceforth." This language suggests teaching of academic standards, and leges without further qualification must mean Roman law. F. W. Maitland's suggestion that the schools in question were perhaps the schools of St. Paul's cathedral is attractive, were it not for the fact that one would not expect the civic authorities to exercise jurisdiction over them.

Whatever its meaning, the writ of 1234 cannot be taken as having anything to do with the teaching of English law, whether at inns of court or elsewhere.

By about 1260 laymen were taking up law studies, and didactic manuals were written in the vernacular French for them; law students attended arguments in court and discussed points of law among themselves, from which it is a fair inference that the students not only met in court but almost certainly congregated out of court.

It could be assumed that the students were well-to-do — in 1305 the chief justice suspected that a knotty case before him had been manufactured by some apprentice who bought the land in order to see how it would fare in court. Finally, by about 1300, law-

yers of various sorts were numerous and needed regulation. The city made orders for practitioners before the London courts in 1280, and in 1292 the king commanded his judges to select from different counties 140 apprentices and attorneys and to allow no other to meddle with legal business.

Bearing all this in mind, it is a natural inference that law students should have acted like university students elsewhere, hiring hostels or inns where they could live together. It might even be an established practitioner who leased a house, taking in students and guiding their studies. This system was common in English and foreign universities among such men as could afford to live on such a scale. To assist the poor university student. benefactors often founded colleges (or conferred endowments upon some existing inn or hall) to enable poor scholars to stay. This did not happen in London; law students had the means (sometimes borrowed) to keep themselves at an inn without the aid of collegiate endonments It is not surprising that the inns were at first liable to move as leases expired or more suitable premises were found, and in time leases would be given (or renewed) for long terms; in the Tudor period the growth of the trust enabled the inns to acquire the ownership of their quarters.

Aspirants to practice in the superior courts were only a small proportion of all those needing a legal education. There was a keen demand for stewards and legal advisers to landowners everywhere, conducting general business and keeping manorial courts. These men needed the rudiments, but not the refinements, of the common law, and they too came from the class of literate laymen. There was likewise the large class of attorneys, and a growing class of bookkeepers and correspondence clerks. Some part of their knowledge could be got from *dictatores,* professional teachers of letter writing; more still by joining an inn of chancery.

Chancery clerks (being then clergy in at least minor orders) had long lived as part of the household of the chancellor. but in the 14th century they had become too numerous, and the household broke up as groups of clerks either combined to take inns or married. Many seem to have taken in students for training and, since the penning of writs and other legal documents was a prominent part of their work, a good grounding in law could be obtained in an inn of chancery. By the end of the 14th century these inns were in danger of being submerged by a flood of attorneys-to-be and of students who used a stage at an inn of chancery as a preparation for entering an inn of court. Eventually each inn of court secured control of one or more inns of chancery and supervised its affairs, appointed readers to teach in it and later often bought its premises, thus becoming its landlord.

By the beginning of the 15th century the four inns of court were established bodies with tradition behind them. They were governed by their benchers, who had previously given at least two courses of lectures (readings), and who presided over mock arguments (moots) in which students argued before them difficult points of law. The standard was high and the teaching thorough. A number of manuscript reports of readings and moots survive.

Since the law was highly technical, proficiency could only be acquired by following the severe studies of the inns, so that in practice the inns had a *de facto* monopoly. This soon became recognized. and when benchers called certain students to the bar of their inn, those students were regarded as qualified apprentices or barristers. The inns steadily remained organizations of students. When the crown conferred the degree of serjeant-at-law upon a few outstanding barristers, they at last ceased to be apprentices and withdrew from their inn to the Serjeants' inn. The judges were always serjeants and so remained in Serjeants' inn. In spite of the severity of their studies, there were in the 15th and 16th centuries many students of the inns who had no legal ambitions but joined them for the purpose of general education (which was by no means neglected there). Since the universities were still strongly ecclesiastical, the inns were much frequented by the sons of wealthy families who had no intention of becoming lawyers.

By the end of the 16th century the inns of court began to exclude attorneys and solicitors and refused to call them to the bar. with the result that attorneys especially fell back upon the inns of chancery, and were finally in a profession distinct from that of the barristers.

The golden age of the inns of court may well have been from the middle of the 15th century (as Sir John Fortescue described it) to the early years of the 16th century. The inns (by the end of that period) had acquired the freehold of their sites and began the building of splendid halls which continued through the reign of Elizabeth I. Their material prosperity was also shown by their magnificent feasts and the entertainment offered to the sovereigns. If a man left an inn to become a serjeant, feasting on the scale of a coronation was expected. The system of legal education was at its best and most vigorous during that period.

Various causes brought about its decline. The great activity of the printing press led students to suppose that they could learn more quickly and more easily from printed books, and so they neglected attendance at readings and moots. Indeed, students performed moots by deputy. If students were reluctant, so were the readers, who were unpaid and lost much time from their practices in preparing and delivering readings, and latterly had to provide very costly feasts; many paid heavy fines to escape the office. The judges, who had assumed vague powers of giving directions to the inns, often tried to compel observance of the old system, but it was clearly on the decline. It broke down completely during the Civil War, and the desperate efforts at the Restoration to revive it were abandoned. Readings ceased in 1677. Only the fees survived, and having paid them, the student was deemed to have fulfilled all his duties.

During the 18th century the cessation of the old system left a void which was slowly filled by new arrangements. There had been no readers to recommend students for call to the bar since 1677, so the four inns finally agreed (in 1762) to call students who had kept a stated number of terms; later it was settled that eating three dinners was equivalent to keeping the whole term. The benchers kept their position as the sole governing body of each inn and stoutly resisted the claim that king's counsel should become benchers as of right. It was also settled that the head of the inn was the bencher holding the office of treasurer, which passed by rotation in order of seniority. Since the Judicature acts of 1873, 1874 and 1875 the grade of serjeant-at-law has been extinct, with the result that judges, no longer being serjeants, can remain members of their inns and in fact are benchers.

The inns of chancery were not fitted to become the professional organ of so large a body as the attorneys and solicitors, if only because these practitioners were not congregated in London. They therefore created their own society, and the inns of chancery one by one were sold.

The common law commissioners of 1854 investigated the inns of court, and, thus stimulated, the inns took steps to resume their educational functions. Readerships were established and eminent lawyers engaged in teaching with a view to examinations conducted by the Council of Legal Education, representing all four inns.

Lincoln's Inn.—The legends connecting this inn with Henry de Lacy, earl of Lincoln (d. 1311), and with John Thavie the armourer (d. 1348) have no historical foundation and rest on misunderstandings. It is certain that Lincoln's inn was lessee of the bishops of Chichester on land west of Chancery lane by 1422. It was also shown by G. J. Turner and E. Williams that it once occupied land on the east side of the same lane which had been accumulated between 1331 and 1348 by Thomas de Lincoln, king's serjeant. It is presumably there that Lincoln's inn first came into existence, being known, as often, by the name of the landlord whose "inn" the lawyers rented.

By 1369 Thomas de Lincoln had conveyed the whole of the freehold to the abbey of Malmesbury. It does not follow that the lawyers were already in possession by 1369, for the house may still have been called by Lincoln's name even after he had disposed of it. But it is quite certain that in 1399 the abbey was receiving rent for "the new inn at London called Lincoln's inn." The bishops of Chichester ceased to reside at their house on the other side of Chancery lane in 1412, and evidently the inn moved across the street between 1412 and 1422 to the present site.

The earliest records of Lincoln's inn, the Black *Books,* commence in 1422. The control of the society was vested in the coun-

cil, which consisted of the masters of the bench. Next in rank came the utter-barristers, those who had been called to the bar, and the inner-barristers or students, so called because at the moots held in the hall of the inn the former sat on the outermost part of the form which represented the bar of the court and the latter sat inside and between them. Formerly attorneys and solicitors also might be members of the inn. It is interesting to note that Sir Thomas More's grandfather was chief butler prior to his call in 1470. The chief butler at this period acted rather as clerk to the council than as butler in the modern sense. He was clearly an educated man. The bishop of Chichester's palace and the chapels of Our Lady and of St. Richard sufficed for the needs of the society for nearly a century. The Bishop's hall was pulled down in 1491 and the present Old hall erected in its place in 1506. When this proved insufficient for the growing membership the present New hall was built in **1843.** The present chapel. constructed by Inigo Jones, was completed in **1623,** Thavie's inn (which had no connection with the armourer) has existed since **1376** as an inn of chancery, and its site was acquired by Lincoln's inn in 1550. It was sold by the benchers in **1769** and thus erased as a legal institution. The other inn of chancery attached to Lincoln's inn, Furnival's inn. dates from about **1406.** Its ancient hall, in Holborn, still exists.

Gray's Inn. — The site of Gray's inn formed part of the manor of Portpoole, which passed in 1294 to the dean and chapter of St. Paul's. who let it to Reginald de Grey, chief justice of Chester and first Lord Grey of Wilton. There is little doubt that the judge lived there with his clerks and other officers of his court and law students. The Greys had for a century been connected as officials with both the court of exchequer and the chancery. Gray's inn continued in the de Grey family till the conveyance of the manor of Portpoole in 1503 to the prior and convent of the charterhouse at Sheen, from whom the benchers held the inn until the dissolution of the monasteries in 1**539** when the rent became due to the crown. In 1733 the benchers acquired the freehold. The existing records of the inn only commence with the year 1569, but Chief Justice Sir Thomas Billing told William Paston in 1454 that he had been a fellow in Gray's inn; that would imply that the inn was in existence about **30** years earlier. The constitution and officers of the inn are similar to those of the other inns. When the records open, governors had ceased to be elected. The control of the inn was vested in the masters of the bench. The office of pensioner was abolished in 1630, but the name survives in the *Pension* Book *of Gray's Inn* and in the old and new pension chambers, where the masters of the bench meet for the discussion and transaction of the business of the society and for relaxation. Of the servants of the inn the chief were in 1**j**70 the steward, the master butler, the priest and the master cook. Whether anything of the old hall of the de Greys remains cannot be determined. It was rebuilt or re-edifyed under the supervision of Nicholas Bacon and Gilbert Gerard in 1**jj6.** It was a particularly fine specimen of Tudor architecture and may be compared with the Middle Temple hall, which it much resembled, although on a smaller scale. In 1941 the hall and much else perished in an air raid, but the screen and heraldic glass had been removed to safety. The oak screen is said to have been presented by Elizabeth I. The chapel was reconstructed or re-edifyed in 161**j** and finally restored in **1893.** The library is first mentioned in 1j55.

The inns of chancery affiliated to Gray's inn were Staple inn and Barnard's inn. The former was an inn of chancery in the reign of Henry V and later became the property of the Actuaries society. Barnard's inn, named after Lionel Barnard who leased it from the dean of Lincoln, became an inn of chancery at least before 1451. The inn was later the property of the Mercer's company.

The Inner and Middle Temples. — As far as the history of the Inner and Outer Temples can be traced, they have always been separate societies. Writing about **1387,** Geoffrey Chaucer describes the "Manciple of a Temple" who had **30** lawyers as his masters, which suggests something like an inn, perhaps more than one, as already existing. The Temple had been the seat in England of the Knights Templars, on whose suppression in 1312 it passed after an interval of some years to the Knights Hospitallers of St. John of Jerusalem The first mention of the Middle Temple as a distinct society occurs in a will dated 1404, and of the Temple as an inn of court in the *Paston Letters*, where, under date Nov. 1440, the Inner Temple is spoken of as a college, as is also subsequently the Middle Temple. The two societies continued as tenants to the Knights Hospitallers of St. John until the dissolution of the order in 1**539;** they then became the lessees of the crown and so remained until **1609,** when James I made a grant by letters patent of the premises in perpetuity to the benchers of the respective societies on a yearly payment by each of £10. a payment bought up in the reign of Charles II. In this grant the two inns are described as "the Inner and the Middle Temple or New Temple." Excepting the church and the priests' hall at the west end of the hall, nothing remained in modern times of the edifices belonging to the Knights Templars, the present buildings having been almost wholly erected since the reign of Queen Elizabeth I or since the Great Fire (1666), in which the major part of the Inner Temple perished. The Temple suffered heavy destruction by air raids during World War II. The church has been in the joint occupation of the Inner and Middle Temple from time immemorial—the former taking the southern and the latter the northern half. The round portion of the church was consecrated in 1**18j,** the nave or choir in 1240. The largest and most complete of the four remaining round churches in England, it is built on the plan of the church of the Holy Sepulchre at Jerusalem. Narrowly escaping the ravages of the fire of **1666,** this beautiful building is a perfect specimen of early Gothic architecture in England. The constitution of both societies is similar to those of the other inns, but the meetings of the benchers are in both styled a "parliament," which is further evidence of their antiquity.

The Inner Temple comprehends a hall, parliament chamber, library and other buildings often rebuilt and extended, the present buildings being completed in 1870. The library owes its existence to William Petyt, keeper of the Tower records in the time of Queen Anne, who was also a benefactor to the library of the Middle Temple. Belonging to the Inner Temple. Clifford's inn was the most important of the inns of chancery and numbered among its members Sir Edward Coke and John Selden. Clement's inn was an inn of chancery before the reign of Edward IV. taking its name from the parish church of St. Clement Danes; it was the inn of William Shakespeare's Master Shallow, and the Shepherd's inn of William Makepiece Thackeray's *Pendennis*.

The Middle Temple possesses in its hall one of the most stately of existing Elizabethan buildings. It was completed in 1572, the richly carved screen at the east end in the style of the Renaissance being erected in 1575. The hall, which was preserved unaltered and survived the air raids of World War II, has been the scene of numerous historic incidents, from the time of Queen Elizabeth I. The library, which contains about **70,000** volumes, dates from **1641.** In civil, canon and international law, as also in divinity and ecclesiastical history, the library is rich; it contains also some curious works on witchcraft and demonology. There was only one inn of chancery connected with the Middle Temple, New inn, the buildings of which were razed. *See* also DOCTORS' COMMONS; LEGAL PROFESSION: *England and Wales*.

The King's Inns, Dublin. — The legal school in Ireland, the King's inns, corresponds closely to the English inns of court and is in many respects in unison with them in its regulations with regard to the admission of students into the society and to the degree of barrister-at-law, as also in the scope of the examinations enforced. Formerly it was necessary to keep a number of terms at one of the inns in London — the stipulation dating as far back as 1542 (**33** Henry VIII, c. 3). Down to **1866** the course of education pursued at the King's inns differed from the English inns of court in that candidates for admission to the legal profession as attorneys and solicitors carried on their studies with those studying for the higher grade of the bar in the same building under a professor specially appointed for this purpose — herein following the usage anciently prevailing in the inns of chancery in London. This arrangement was put an end to by the Attorneys and Solicitors act (Ireland) of **1866.** The origin of the King's inns may be traced to the reign of Edward I, when a legal society designated

Collett's inn was established outside the walls of the city; it was destroyed by an insurrectionary band. In the reign of Edward III, Sir Robert Preston, chief baron of the exchequer, gave up his residence in the city to the legal body, which then took the name of Preston's inn. In 1542 the land and buildings known as Preston's inn were restored to the family of the original donor, and in the same year Henry VIII granted the monastery of Friars Preachers for the use of the professors of the law in Ireland. Thenceforward the legal body was known as the King's inns.

In discipline and professional etiquette the members of the bar in Ireland differ little from their English brethren. The same style of costume is enforced, and the same gradations of rank are observed. The King's inns does not provide chambers for business purposes; there is consequently no aggregation of counsel in certain localities, as is the case in London around the inns of court.

Scotland. — The corporation known as the Faculty of Advocates in Edinburgh corresponds with the inns of court in London and the King's inns in Dublin and, like them, regulates the admission of barristers. (See ADVOCATES, FACULTY OF.)

BIBLIOGRAPHY.—W. Dugdale, *Origines juridiciales,* 2 vol., 3rd ed. (1680), *History and Antiquities of the Four Inns of Court, etc.,* 2nd ed. (1780); W. Downing, *Observations on the Constitution, Customs and Usage of . . . the Middle Temple* (1896); J. Stow, *Survey of London,* ed. by J. Strype, 2 vol., 6th ed. (1754–55); W. Herbert, *Antiquities of the Inns of Court and Chancery* (1804); T. Lane, *The Student's Guide, Being a Concise Account of . . . Lincoln's Inn,* 4th ed. (1823); B. T. Duhigg, *History of the King's Inns . . . in Ireland* (1806); Sir John Fortescue, *De laudibus legum angliae,* ed. and tr. by S. B. Chrimes (1942); R. R. Pearce, *History of the Inns of Court* (1848); *Report* of the Commissioners Appointed to Enquire Into the Inns of Court and Chancery (1855); W. H. Spilsbury, *Lincoln's Inn . . . With an account of the Library,* 2nd ed. (1873); W. R. Douthwaite, *Gray's Inn, Its History and Associations* (1886); F. A. Inderwick and R. A. Roberts (eds.), *A Calendar of Inner Temple Records,* 4 vol. (1896 *et seq.*); W. P. Baildon and J. D. Walker (eds.), *The Records of . . . Lincoln's Inn,* 4 vol. (1897–1902); R. J. Fletcher, *The Pension Book of Grey's Inn,* 2 vol. (1901–10); H. H. L. Bellot, *The Inner and Middle Temple* (1902), *The Temple,* 3rd ed. (1925), *Gray's Inn and Lincoln's Inn* (1925); C. H. Hopwood (ed.), *Middle Temple Records,* 4 vol. (1904–05); E. Williams, *Staple Inn* (1906), *Early Holborn and the Legal Quarter of London,* 2 vol. (1927); A. R. Ingpen, *Master Worsley's Book on the History . . . of the Middle Temple* (1910); J. B. Williamson (ed.), *The Middle Temple Bench Book,* 2nd ed. (1938); J. B. Williamson (comp.), *History of the Temple* (1924); W. Blake Odgers, "Sketch of the History of the Four Inns of Court" in Sir Paul Vinogradoff (ed.), *Essays in Legal History* (1913); Sir William S. Holdsworth, *History of English Law,* vol. ii, 4th ed., vol. vi, 2nd ed., vol. xii (1936–38); H. A. C. Sturgess, *Register of Admissions to the . . . Middle Temple, 1501–1944,* 3 vol. (1949). (T. F. T. P.)

INONU, ISMET: *see* ISMET INÖNÜ.

INOUYE, KAORU, MARQUESS (1835–1915), Japanese statesman, mas born in 1835, a samurai of the Choshu fief. He was a friend of his fellow-clansman Ito (later Prince Ito), and they visited England together in 1863, serving as common sailors during the voyage. At that time all travel abroad was forbidden on pain of death, but the veto did not prove deterrent in the face of a rapidly growing conviction that, as a matter of self-protection, Japan must assimilate the essentials of western civilization. Shortly after the departure of Inouye and Ito, the Choshu fief, having fired upon foreign vessels passing the strait of Shimonoseki, was menaced by war with the Yedo government or with the insulted powers, and Inouye and Ito, on receipt of this news, hastened home hoping to avert the catastrophe.

They repaired to the British legation in Yedo and begged that the allied squadron, then about to sail for Shimonoseki to call Choshu to account, should be delayed that they might have an opportunity of advising the fief to make timely submission. Not only was this request complied with, but a Britsh frigate was detailed to carry the two men to Shimonoseki. and, pending her departure. the British legation assisted them to lie perdu. Their mission proved futile, however, and Inouye was subsequently waylaid by a party of conservative samurai. who left him covered with wounds. This experience did not modify his liberal views, and, by the time of the Restoration in 1867, he had earned a high reputation as a leader of progress and an able statesman.

In theory the 1867 Restoration meant the return of all political power to the emperor. In point of fact, real control over the newly established government came to rest in the hands of a little group of about 85 samurai drawn from the four western clans, or fiefs, known as Tosa, Hizen, Satsuma, and Choshu. The Choshu samurai soon became especially influential. Among the Choshu contingent were Yamagata (later Field Marshal Prince Yamagata) who later became the head of the military bureaucracy and Ito who later became the head of the civilian bureaucracy. Because of his intimate friendship with Ito, Inouye was given a high place in the civil bureaucracy. At various times he held the portfolios of home affairs,agriculture and commerce, foreign affairs and finance. He became noted as an outstanding authority on public finance. In 1885, when the new peerage was created, he was given the title of count. He retired from active politics in 1898 but became an elder statesman whose advice was frequently sought by the imperial court. During the war with Russia he was designated special adviser to the minister of finance and by order of the emperor he attended all important state councils. In 1907 he was raised to the rank of marquess. It is generally agreed that Inouye was one of the five outstanding Japanese statesmen during the Meji era, the others being Princes Ito and Yamagata and Marquesses Matsukata and Okuma. (W. M. McG.)

INOWRACLAW (HOHENSALZA), town of Poland, in the province of Bydgoszcz, 21 mi. S.W. of Thorn (Torum). Pop. (1950) 38,000. It has an agricultural trade. Iron founding and the manufacture of machinery and chemicals are important. In the vicinity are important salt works and a sulphur mine. Inowraclaw is mentioned as early as 1185, and in 1772 it passed to Prussia. It became a part of Poland after World War I, was taken by Germany in World War II and was returned to Poland in 1945.

INQUISITION, THE. The name given to the ecclesiastical jurisdiction dealing both in the middle ages and in later times with the detection and punishment of heretics and all persons guilty of any offense against Catholic orthodoxy. (Lat. *inquisitio,* an inquiry.)

It is incorrect to say that the Inquisition made its appearance in the 13th century complete in all its principles and organs. It was the result of, or rather one step in, a process of evolution, the beginnings of which are to be traced back to the fourth century at least.

Opinions **of the** Fathers. — During the first three centuries of the Church there is no trace of any official persecution, and the earlier Fathers, especially Origen and Lactantius, reject the idea of it. Constantine, by the edict of Milan (313), inaugurated an era of official tolerance, but from the time of Valentinian I and Theodosius I onwards. laws against heretics began to appear, and increased with astonishing regularity and rapidity. Heretics are subjected to exile or confiscation, disqualified from inheriting property, and even, in the case of a few groups of Manichaeans and Donatists, condemned to death; but it should be noticed that these penalties apply only to the outward manifestations of heresy, and not, as in the middle ages, to crimes of conscience. Within the Church, St. Optatus alone *(De schtsmate Donatistarum,* lib. iii cap. iii) approved of this violent repression of the Donatist heresy; St. Augustine only admitted a *temperata severitas,* such as scourging, fines or exile, and at the end of the 4th century the condemnation of the Spanish heretic Priscillian, who was put to death in 38j by order of the emperor Maximus, gave rise to a keen controversy. St. Martin of Tours, St. Ambrose and St. Leo vigorously attacked the Spanish bishops who had obtained the condemnation of Priscillian. St. John Chrysostom considered that a heretic should be deprived of the liberty of speech and that assemblies organized by heretics should be dissolved, but declared that "to put a heretic to death would be to introduce upon earth an inexpiable crime."

The Middle Ages. — From the 6th to the 9th century the heterodox, with the exception of the Manichaean sects in certain places, were hardly subjected to persecution. They were. moreover. rare and generally isolated, for groups of sectaries only began to appear to any extent at the time of the earliest appearances of Catharism. But from the latter part of the 10th century until the beginnings of the 12th there were numerous executions of heretics, either by burning or strangling, in France, Italy,

the Empire and England; and during this period it is not easy to determine what part was taken by the Church and its bishops and doctors in this series of executions. In many cases the people, supported by the crown, were responsible for the death of the heretics; the historians give only the faintest indications of any direct intervention of the clergy, except perhaps for the examination of doctrine. The theory in these matters was at first as uncertain as the practice; in the 11th century one bishop only, Theodwin of Liége (d. 1075), affirms the necessity for the punishment of heretics by the secular arm (1050). His predecessor, Wazo, bishop of Liége (1041–44), had expressly condemned any capital punishment and advised the bishop of Chalons to resort to peaceful conversion. In the 12th century Peter the Cantor[1] protested against the death penalty, admitting at the most imprisonment; and in dealing with the heretics of Cologne, St. Bernard, who cannot be accused of leniency where heterodoxy was concerned, recommended pacific refutation, followed by excommunication or prison, but never the death penalty *(see* BERNARD, ST., OF CLAIRVAUX).

But it must be noticed that from the opening years of the 12th century date the beginnings of a decided evolution in the canon law, continuing up to the time of Innocent III., which substituted for arbitrary decisions according to circumstances an organized and particularized legislation, in which judgment was given *secundum canonicas et legitimas sanctiones,* Anselm of Lucca and the *Panormia* attributed to Ivo of Chartres reproduced word for word under the rubric *De edicto imperatorum in damnationem hoereticorum,* law 5 of the title *De hereticis* of Justinian's code, which pronounces the sentence of death against the Manichaeans; and we should remember that the Cathari, and in general all heretics in the West in the 11th and 12th centuries were considered by contemporary theologians as Manichaeans. Gratian in the *Decretum* proclaims the views of St. Augustine (exile and fines). From the beginning of the 12th century the death penalty for impenitent heretics was frequently demanded in influential quarters. In 1184 Pope Lucius III. and the emperor Frederick Barbarossa agreed on the penalties of exile, confiscation, demolition of their houses, *infamia,* and loss of civil rights. The usage, then, was already quite clear; but the death penalty had not as yet been inflicted. It was probably Peter II. of Aragon who was the first to decree, in 1197, the punishment of death by burning against the heretics who should not have left his kingdom within a given time. But it was Innocent III. who gave the most powerful impetus to the anti-heretical movement in the secular world by his frequent exhortations (beginning in 1198) to the secular princes (letters of March 25, 1199, and Sept. 22, 1207).

Beginnings of the Inquisition. — From the foregoing it is clear that the Inquisition did not arise out of, and at the time of, the crusade against the Albigenses. These executions *en masse* certainly created a definitive precedent for violent repression, but there was still no regular organization: the council of Toulouse, held in Nov. 1229 by the Roman legate after the treaty of peace, attempted to organize one, and constituted itself the tribunal. But the procedure was still uncertain. The emperor Frederick II. defined his jurisprudence more clearly: from 1220 to 1239, supported by Pope Honorius III., and above all by Gregory IX., he established against the heretics of the Empire in general a legislation in which the penalties of death, banishment and confiscation of property were formulated so clearly as to be henceforth incontestable. Gregory IX. felt his influence, and also that of the Dominican Gualo, bishop of Brescia, who had subjected his episcopal town to the full rigour of the imperial laws. The pope no longer hesitated as to the principle or the degree of repression; but introduced new methods of inquiry and judgment: he created out of the material furnished by the mendicant orders, and especially the Dominicans, the monastic inquisition, which was more elastic, more constant in its activities and more numerous than the inquisition by legate, and better disciplined than the episcopal inquisition. In Nov. 1232 the Dominican Alberic went round Lombardy with the title of *Inquisitor kaereticae pravitatis.* In 1231 a similar commission was given to the Dominicans of Friesach and to the terrible Conrad of Marburg, whose zeal in Germany even exceeded the pope's wishes. In 1233 Gregory IX. addressed a letter to the bishops in the south of France, in which he announced his intention of employing the preaching friars for the discovery and repression of heresy. The inquisition was now regularly instituted, but its jurisprudence was elaborated by successive additions or limitations by the force of custom and the detailed prescriptions added by the papal constitutions. The pope's commissioners "in the matter of heresy" at first travelled from place to place. On arriving in a district they addressed its inhabitants, called upon them to confess, if they were heretics, or to denounce those whom they knew to be heretics: a "time of grace" was opened, during which those who freely confessed were dispensed from all penalties, or only given a light penance; while those whose heresy had been openly manifested were exempted from the penalties of death and perpetual imprisonment. But this time could not exceed one month. After that began the inquisition. As soon as their mission was at an end, and heresy was considered to be stamped out, the inquisitors left the country. Later, inquisitorial districts were formed. The seat of the Inquisition in each district was the monastery of the order (Dominican or Franciscan) to which the inquisitors for that part belonged. There was never any special court or prison: the *murus* (prison) was lent to the Inquisition by the ecclesiastical or secular authorities. The maintenance of the prisoners and the duty of providing the prison fell in principle upon the bishops (council of Toulouse, 1229), but they tried to evade it. The kings of France, and in particular Louis VIII., granted subsidies to the inquisitors. For each district the inquisitors were chosen by the provincials of their order, approved or rejected by the pope, and removable by him only. Their discretionary powers were absolute. They conducted their interrogations before two persons (laymen or ecclesiastics) and only pronounced their sentence after consultation with leading men in the district. This was the only protection for the accused. It was in vain that the civil lawyers tried to prove that the secular authorities had a right to see the documents bearing on the case; the Inquisition always succeeded in setting aside these claims. The share taken in the proceedings by the bishops, the accused or their representatives, though admitted in principle, was as a rule merely illusory.

Procedure of the Inquisition. — Bernard Guy (Bernardus Guidonis), Dominican, 1261–1331, one of the earliest and most complete exponents of the theory of the Inquisition, admits distinctly that in its procedure *multa sunt specialia.* The procedure was secret and in the highest degree arbitrary, proceeding *sine strepitu et figura judicii,* its object being to ascertain not so much particular offences as tendencies: the murderers of the inquisitor Peter Martyr (Dominican, d. 1252) were tried, not as assassins, but as guilty of heresy and adversaries of the Inquisition; and on the other hand, external acts of piety and verbal professions of faith were held of no value. Moreover, the Inquisition was not bound by the ordinary rules of procedure in its inquiries: the accused was surprised by a sudden summons, and as a rule imprisoned on suspicion. All the accused were presumed to be guilty, the judge being at the same time the accuser. Absence was naturally considered as contumacy, and only increased the presumption of guilt by seeming to admit it. The accused had the right to demand a written account of the offences attributed to him, but the names of the witnesses were withheld from him (Innocent IV.; bulls *Cum negocium* and *Licet sicut accepimus),* he did not know who had denounced him, nor what weight was attached by the judges to the denunciations against him. The utmost that was allowed him was the unsatisfactory privilege of the *recusationes divinatrices, i.e.,* at his first examination he was asked for the names of any enemies of whom he knew, and the causes of their enmity. Heretics or persons deprived of civil rights (*infames*) were admitted as witnesses in cases of heresy. Women, children or slaves could be witnesses for the prosecution, but not for the defence, and cases are even

[1] Pierre de Beauvoisis (?), choir-master *(grand-chantre)* of the university of Paris (1184), bishop of Tournai (1191), of Paris (1196); died as a Cistercian in 1197. He was beatified.

to be found in which the witnesses were only ten years of age. Langhino Ugolini states that a witness who should retract his hcstile evidence should be punished for false witness, but that his evidence should be retained, and have its full effect on the sentence. No witness might refuse to give evidence, under pain of being considered guilty of heresy. The prosecution went on in the utmost secrecy. The accused swore that he would tell the whole truth, and was bound to denounce all those who were partners of his heresy, or whom he knew or suspected to be heretics. If he confessed, and denounced his accomplices, relatives or friends, he was "reconciled" with the Church, and had to suffer only the humiliating penalties prescribed by the canon law. If further examination proved necessary, it was continued by various methods Bernardus Guidonis enumerates many ways of obtaining confessions, sometimes by means of moral subterfuges, but sometimes by a process of weakening the physical strength. And as a last expedient torture was resorted to. The Church was originally opposed to torture, and the canon law did not admit confessions extorted by that means; but by the bull *Ad extirpanda* (1252) Innocent IV. approved its use for the discovery of heresy, and Urban IV. confirmed this usage, which had its origin in secular legislation (cf. the Veronese Code of 1228, and Sicilian Constitution of Frederick II. in 1231). In 1312 excessive cruelty had to be suppressed by the council of Vienna. The next step was the torture of witnesses, a practice which was left to the discretion of the inquisitors. Moreover, all confessions or depositions extorted in the torture-chamber had subsequently to be "freely" confirmed.

The procedure was of course not litigious; any lawyer defending the accused would have been held guilty of heresy. The inquiry might last a long time, for it was interrupted or resumed according to the discretion of the judges, who disposed matters so as to obtain as many confessions or denunciations as possible. After the different phases of the examination, the accused were divided into two categories: (1) those who had confessed and abjured, (2) those who had not confessed and were convicted of heresy. There was a third class, by no means the least numerous, namely, those who having previously confessed and abjured had relapsed into error. Next came the moment of the sentence: "there was never any case of an acquittal pure and simple" (H. C. Lea). The formula for full and complete acquittal given by Bernardus Guidonis in his Practica, should, he says, never or very rarely be employed. The sentences were solemnly pronounced on a Sunday, in a church or public place, in the presence of the inquisitors, their auxiliaries, the bishops, the secular magistrates and the people. This was the sermo generalis. The accused who had confessed were reconciled, and the penalties were then pronounced; these were, in order of severity, penances, fasting, prayers, pilgrimages, public scourging, the compulsory wearing on the breast or back of crosses of yellow felt sewn on to the clothes or sometimes of tongues of red, letters, etc. The inquisitors eventually acquired the right of inflicting fines at discretion. In 1244 and 1251 Innocent IV. reproved them for their exactions. All these minor penalties could be commuted for payments in money in the same way as absolution from the crusader's vow, and the council of Vienna tried to put an end to these extortions. Beyond these minor penalties came the severer ones of imprisonment for a period of time, perpetual imprisonment and imprisonment of various degrees of severity (*murus* lnrgus, murus *strictus vel strictissimus*). The murus *strictus* consisted in the deepest dungeon, with single or double fetters, and "the bread and water of affliction"; but the severity of the prison régime varied very much. The murus *largus*, especially for a rich prisoner, amounted to a fairly mild imprisonment, but the mortality among those confined in the murus *strictus* became so high that Clement V. ordered an inquiry to be made into the prison régime in Languedoc, in spite of Bernard Guy's protest against the investigation as likely to diminish the prestige of the inquisitors. After the sentences had been pronounced, the obstinate heretics and renegades were for the last time called upon to submit and to confess and abjure. If they consented, they were received as penitents, and condemned on the spot to perpetual imprisonment; if they did not consent, they were handed over to the secular arm. When the heretic was handed over to the secular arm the agents of the secular po er were recommended to punish him debita animadversione, and the form of recommending him to mercy was gone through. In effect, handing over to the secular arm was equivalent to a sentence of death, and of death by fire. Jacob Sprenger, Dominican provincial in Germany (1494) and inquisitor, does not hesitate to speak of the victims quas *incinerari* fecimus ("whom we [the inquisitors] caused to be burnt to ashes"[x]). But we must accept the conclusions of H. C. Lea and Vacandard that comparatively few people suffered at the stake in the mediaeval Inquisition. Between 1308 and 1323, Bernard Guy, who cannot be accused of inactivity, only handed over to the secular arm 42 persons, out of 930 who were convicted of heresy.

Punishment by Confiscation of Goods.—From the point of view of jurisprudence of the Inquisition, the confiscation of the condemned man's property by the ecclesiastical and secular powers is only the accompaniment to the more severe penalties of perpetual imprisonment or death; but from the point of view of its economic history the importance of the confiscation is supreme. The practice originated in the Roman law, and all secular princes had already, in their own interest, recognized it as lawful (Frederick Barbarossa, Decree of Verona; Louis VIII., ordinances of 1226, 1229; Louis IX., ordinance of 1234; Raymond VII. of Toulouse, etc.). In the kingdom of France there was a special official, the *procureur* des encours (confiscation in the matter of heresy), whose duty it was to collect the personal property of the heretics, and to incorporate their landed estates in the royal domain; in Languedoc crying abuses arose, especially under Alphonse of Poitiers. Soon the papacy managed to gain a share of the spoils, even outside the states of the Church, as is shown by the bulls ad *extirpanda* of Innocent IV. and Alexander IV., and henceforward the inquisitors had, in varying proportions, a direct interest in these spoliations. In Spain this division only applied to the property of the clergy and vassals of the Church, but in France, Italy and Germany, the property of all heretics was shared between the lay and ecclesiastical authorities. Venice alone decided that all the receipts of the Holy Office should be handed over in full to the state. Clement V., in his attempted reform and regularization of inquisitorial procedure, endeavoured to reduce the confiscations to a fairly reasonable minimum, and in 1337–38 a series of papal inquiries was held into this financial aspect of the matter. The Assize of Clarendon, the Constitutions of Frederick II. (1232) and of Count Raymond of Toulouse (1234) had also come to a joint decision with the councils on this question. Charles V. of France prevailed upon the papacy to abolish this regulation (1378). Confiscation was, indeed, most profitable to the secular princes, and there is no doubt that the hope of considerable gain was what induced many princes to uphold the inquisitorial administration, especially in the days of the decay of faith. The resistance of the south of France to the Capetian monarchs was to a large extent broken owing to the decimation of the bourgeoisie by the Inquisition and their impoverishment by the extortions of the encours. The same was the case in certain of the Italian republics; while in districts such as the north of France, where heretics were both poor and few, the Inquisition did not easily take root, nor did it prove very profitable. These confiscations, the importance of which in the political and economic history of the middle ages was first shown fully by H. C. Lea, were a constant source of uncertainty in transactions of all kinds; there was, for instance, always a risk in entering into a contract in a place where the existence of heretics was suspected, since any contract entered into with a heretic was void. Nor was there any more security in the transmission of inheritances for posthumous trials were frequent; the Liber *sententiarum inquisitionis* of Bernardus Guidonis (1307–23) records sentences pronounced after death against 89 persons during a period of 15 years. But not only was their property confiscated and their heirs disinherited; they were subject to still further penalties. Frederick II extended to heresy the application of the Roman law disqualifying from holding office, and even included under its operation the children and

grandchildren of the guilty man. Alexander IV. and Boniface VIII. lightened the severity of this law, and removed certain disqualifications, notably in the case of ecclesiastical offices and property.

The sphere of action of the Inquisition was gradually extended by the theologians and casuists until sorcery and magic ranked with doctrinal heresy *(see* Hansen, *Inquisition, Hexenwahn,* u. *Hexenverfolgung,* 1900). With regard to Jews, they might profess their religion and observe its rites without being in a state of heresy; they were only heretic when they attacked the Christian faith or community, made proselytes, or returned to Judaism after being converted. But those who practised usury were "suspected of not holding orthodox doctrine as to theft" (Vacandard), and on this account the Inquisition gained a hold on them (the special case of Spain is described on page 381).

TREATMENT OF HERESY

England. — The Inquisition was primarily the instrument for the repression of all kinds of breaches of orthodoxy. Its work in this capacity we will now outline for each of the great countries of mediaeval Christendom. England, whether before or after the establishment of the Inquisition, had few trials for heresy and, particularist in this as in all her religious activity, judged them according to her own discipline, without asking Rome for laws or special judges. But orthodoxy remained almost unimpaired until the time of Wycliffe. Apparently neither the Catharist, Waldensian nor pantheistic heresies gained any footing in Great Britain. The affair of the Templars in France, which was quite political, was repeated in England: Clement V. having ordered their arrest, Edward II., after much hesitation, gave orders to the sheriffs to execute it and then decided that the *ecclesiastical law* should be applied. The papal inquisitors sent to England met with a bad reception, and the pope was obliged to forbid them to use torture, which was contrary to the laws of the kingdom. It was found impossible to establish the Templars' guilt and only canonical penalties were inflicted on them. The rising of the Lollards having alarmed both the church and the state, the article De *haeretico comburendo* was established by statute in 1401, and gained a melancholy notoriety during the religious struggles of the 16th century; it seems to have been not so much a measure for the safeguarding of dogma as a violent assertion of the secular absolutism. It was not till 1676 that Charles II. caused it to be abrogated, and obtained a decision that in cases of atheism, blasphemy, heresy, schism and other religious offences, the ecclesiastical courts should be confined to the penalties of excommunication, removal from office, degradation and other ecclesiastical means of censure, to the exclusion of the death penalty. Scotland was much later than England in giving up persecution and bloodshed; and so late as 1696 a student of medicine aged eighteen named Aikenhead was accused of heresy and hanged in Edinburgh.

France. — The activities of the monastic Inquisition in France lay chiefly in the south. The repression of the Albigensian heresy went on even when its importance had disappeared. The chronicle of the inquisitor Guilhem Pelhisso (d. 1268) shows us the most tragic episodes of the reign of terror which wasted Languedoc for a century. Guillaume Arnaud, Peter Cella, Bernard of Caux, Jean de St. Pierre, Nicholas of Abbeville, Foulques de St. Georges, were the chief of the inquisitors who played the part of absolute dictators, burning at the stake, attacking both the living and the dead, confiscating their property and land, and enclosing the inhabitants both of the towns and the country in a network of suspicion and denunciation. The secular authorities were of the utmost assistance to them in this task; owing to the confiscations, the crown had too direct an interest in the success of the inquisitorial trial; not to connive at all their abuses. There were frequent attempts at retaliation, directed for the most part against the inquisitors, and isolated attacks were made on Dominicans; but the work of repression culminated under Bernard Guy, and completed the destruction of Catharism, the appearances of which after the middle of the 14th century are rare. Afterwards the efforts of the Inquisition were directed against the Spirituals, who were a branch of the Franciscans, and were remote disciples of Joachim, abbot of Floris (*q.v.*), and whom their rigid rule of absolute poverty led, by a reaction against the cupidity of the ordinary ecclesiastics, to repudiate the papal hierarchy. On Feb. 17, 1317 John XXII. condemned all these irregular followers of St. Francis, and the Inquisition of Languedoc was at once set against them. Four *spirituales* were burnt at Marseilles in 1318, and soon the persecution was extended to the Franciscan *beguins* or *tertiarii,* many being burnt about 1320. The Waldenses (*q.v.*) were more difficult to destroy: originally less dangerous to the church than the Cathari, they resisted longer, and their dispersal in scattered communities aided their long resistance.

In the north of France the workings of the Inquisition were very intermittent; for there were fewer heretics there than in the south, and as they were poorer, there was less zeal on the part of the secular arm to persecute them. At its outset, however, the Inquisition in the north of France was marked by a series of melancholy events: the inquisitor Robert le Bougre, formerly a Catharist, spent six years (1233–39) in going through the Nivernais, Burgundy, Flanders and Champagne, burning at the stake in every place unfortunates whom he condemned without a judgment, supported as he was by the ecclesiastical authorities and by princes such as Theobald of Champagne. The pope was forced to put a check on his zeal, and, after an inquiry, condemned him to imprisonment for life. We know that there were inquisitors settled in fle de France, Orléanais, Touraine, Lorraine and Burgundy during the 12th century, but we know next to nothing of what they did. In the 14th century, the Flemish and German heresies of the Free Spirit made their appearance in France, and some executions resulted. But in the 15th century, with the exception of a few condemnations aimed against the Hussites, the Inquisition acted but feebly.

From the middle of the 14th century onward, the *parlement* had taken upon itself the right of hearing appeals from persons sentenced by the Inquisition. And the University again, by its faculty of theology, escaped the jurisdiction of the Inquisition. These two great bodies at the time of the Reformation took the place of the Inquisition in dealing with heresy.

Italy. — In Italy heresy not infrequently took on a social or political character; it was sometimes almost indistinguishable from the opposition of the Ghibellines or the communalist spirit of independence. Lombardy, besides a number of Cathari, contained a certain number of vaguely-defined sects against whom the efforts of the Apostolic Visitors sent by Innocent III. were not of much effect. From the very earliest days of the Inquisition, John of Vicenza, Roland of Cremona and Rassiero Sacchoni directed their persecutions against Lombardy, and especially against Milan. St. Peter Martyr, who was conspicuous for his violence, was assassinated in 1252. On March 20, 1256 Alexander IV. ordered the provincial of the friar preachers of Lombardy to increase the number of inquisitors in that province from four to eight. At Florence both heresy and Ghibellinism were alike crushed by the severities of Fra Ruggieri, and indulgences were promised to all who should aid in the extinction of heresy in Tuscany. Certain districts revolted against this violence, which threatened to devastate Italy as it had devastated Provence; in 1277 Fra Corrado Pagano was killed on an expedition against the heretics of the Vattelline, and two years after the people of Parma rose against the inquisitors. Besides, this reign of terror only raised to a furious pitch the passionate and independent piety of the Italian peoples. The Inquisition had a hard struggle against the successes of Gerard Legarelli, and especially Dolcino *(see* APOSTOLICI), which only came to an end after a long and difficult trial of the adepts of the Messianist sect of Guglielma, some of whom belonged to the noble families of Lombardy. Zip till the beginning of the 14th century, however, the power of the Inquisition steadily increased, and at this period Zanghino Ugolini appeared as the most skilful exponent of its theory and procedure. About the same time Charles of Anjou introduced the Inquisition into the Two Sicilies, but it could rarely effect anything there; the religious cohesion of the country was weak, and refugees were sure of safe hiding, both Waldenses and Fraticelli being frequently

harboured there.

Venice always preserved its autonomy as regards the repression of heresy; she was perfectly orthodox, but remained independent of Rome; Innocent IV. sent inquisitors there, but the heretics continued actually to be subject to the secular tribunals. In 1288 a compromise was arrived at, and the papal Inquisition was admitted into the republic, but only on condition that it should remain under the secular power; thus there was established a mixed régime which survived till the last days of the Venetian state. In Savoy the Inquisition constantly carried on severe measures against the Waldenses of the Alps. During the 14th and 15th centuries there was an uninterrupted succession of trials.

As regards the papal states, "it was in the nature of things that, by a confusion of the two personages, the pope should consider all opposition to him qua Italian prince as resistance offered to the head of the church, *i.e.*, to the church" (Langlois). The Colonna had a personal animosity against the Gaetani; therefore Boniface VIII., a Gaetano, declared the Colonna to be heretics. Rienzi was accused of heresy for having questioned the temporal sovereignty of the pope at Rome. The Venetians, who in 1309 opposed the annexation of Ferrara by Clement V. to the detriment of the house of Este, were proclaimed heretics and placed under the ban of Christendom. Savonarola was attacked because he interfered with the policy of Alexander VI. at Florence. It was this same desire for the hegemony of Italy which inspired the attitude of the popes throughout the middle ages, causing them to excommunicate, apparently without reason so far as doctrine was concerned, the Visconti of Milan, the Della Scala of Verona, the Manfredi of Faenza, etc., and prompting them to lay under an interdict or preach a crusade against certain rebellious great towns (Clement V. against Venice, John XXII. against Milan).

Germany. — In Germany heresies, especially of a mystical character, were numerous; some of them affected the people, and led to religious and social movements of no little importance. The repression of heresy went on by fits and starts, and the Inquisition was never exercised so regularly in the Germanic as in certain of the Latin countries. At the outset of the 13th century persecutions of the Waldenses and Ortlibarii (followers of Ortlieb of Strassburg, c. 1200) took place at Strasbourg; measures were taken locally, until, in 1231, Gregory IX. issued definite instructions to the German prelates with a view to a regular repression of heresy, and gave to Conrad of Marburg full powers to execute them. In Feb. 1234 the Diet of Frankfort decided, in spite of the pope's injunctions, that the destruction of heresy should be entrusted to the ordinary magistrates. Moreover, owing to the struggle between the Empire and the papacy, the German prelates always limited the prerogatives of the papal Inquisition. Marsilius of Padua, the theoretical exponent of the imperial rights, attributes to the secular judge the right and obligation to punish heresy, the priest's rôle being merely advisory. In 1353 Innocent VI. tried to implant the papal Inquisition in Germany once for all; its success was but short, and Urban V.'s attempt in 1362 succeeded little better, in spite of the fact that Charles IV. (edicts of Lucca, June 1369) gave him the support of the secular power. Towards 1372, however, Gregory XI. succeeded in regularizing the exercise of the powers of the papal inquisitors on German soil; and the latter, notably Kerlinger, Hetstede, etc., set to work to destroy the communities of the Beghards (who had developed with extraordinary rapidity), to burn their books, to close those *beguinages* which were under suspicion, and to check mystical epidemics such as those of the "flagellants," "dancers," etc. But these measures provoked protests from the people, the secular magistrates and even the bishops, so that Gregory XI., perceiving that he was face to face with the popular party, invited the bishops to control the inquiries of his own envoys. At the end of the 15th century the two inquisitions were acting concurrently.

Bohemia. — In Bohemia and the provinces subject to it the Waldenses had found their chosen country, and by the middle of the 13th century their propaganda was very flourishing. In 1245 Innocent IV. ordered the bishops to prosecute them with the aid of the secular arm, and in 1257, at the request of King Premysl Ottokar II., Alexander IV. introduced the Inquisition into Bohemia. But from this date till 1335 inquisitorial missions succeeded one another without effecting any sensible diminution in the material and moral strength of the heresy. The Waldenses had been joined by other sectaries, the Luciferani, and especially the Brethren of the Free Spirit. It was in vain that the bishops of Bohemia and Silesia carried on during the second half of the 14th century an active campaign against heresy; the spirit of criticism which had arisen with regard to the morals, and even to the dogmas of the Church, was already preparing the way for Hussitism.

The Balkan States. — In the regions east of the Adriatic, Catharism, the first communities of which had very probably settled here, was supreme in the time of Innocent III. and Honorius III. The first Dominicans who established themselves in these parts had much to suffer from the aggression of those very heretics whom they had come to convert. Gregory XI., implacable in his persecution of Catharism, preached a crusade against them in 1234, and Bosnia was laid waste by fire and sword. But in spite of these violent measures Catharism only gained strength in the churches of Bulgaria, Rumania, Slavonia and Dalmatia. In 1298 Boniface VIII. tried to organize the Inquisition there, but the project remained fruitless. The attempt was revived in 1323 by John XXII. with doubtful success. The persecutions undertaken in the 14th and 15th centuries merely resulted in binding the Cathari to the invading Turks, with whom they found more tolerance than with the Slav princes converted to Roman orthodoxy.

Spain. — In Spain the papal Inquisition only very slowly gained a footing. Spain had been, in turn or simultaneously, Arian under the Visigoths, Catholic under the Hispano-Romans, Mohammedan by conquest, and under a régime of religious peace Judaism had developed there. After the reconquest its heresies had been of minor importance. At the end of the 12th century Alphonso II. and Peter II. had on principle promulgated cruel edicts against heresy, but the persecution seemed to be dormant. By the bull *Declinante* of May 26, 1232 inquisitors were sent to Aragon by Gregory IX. on the request of Raymond of Penaforte, and by 1237–38 the Inquisition was practically founded. But as early as 1233 King James I. had promulgated an edict against the heretics which quite openly put the Inquisition in a subaltern position, and secularized a great part of its activities. The people, moreover, showed great hostility towards it. In Castile Alphonso the Wise had, by establishing in his Fuero *Real* and his *Siete Partidas* an entirely independent secular legislation with regard to heretics (1255), removed his kingdom from all papal interference. At the opening of the 14th century Castile and Portugal had still no Inquisition. It was not against heresy that the church had to direct its vigilance. A mutual tolerance between the different religions had in fact sprung up, even after the conquest; and for a long time past both the decisions of councils and papal briefs had proclaimed their surprise and indignation at this ominous indifference. Sporadic cases of violent measures against Jews and Mohammedans occurred during the 13th century and increased in frequency and severity during the 14th and 15th centuries. Massacres *en masse* and forced baptisms were carried out, instigated by the clergy. A class of "converted" Mohammedans and Jews arose, and increased after the conquest of the kingdom of Granada and the completion of the conquest by Ferdinand and Isabella, and after the pacification of the kingdoms of Aragon and Valencia by Charles V. The Mahommedans and Jews in these parts were given the choice between conversion and exile. Being of an active nature, and desiring some immediate powers as a recompense for their moral sufferings, the Jewish or Mohammedan *Conversos* soon became rich and powerful. In addition to the hatred of the church, hatred and jealousy arose also among laymen and especially in the rich and noble classes. *Limpieza, i.e.*, purity of blood, and the fact of being an "old Christian" were made the conditions of holding offices. And a combination of secular jealousy, national pride, and religious bigotry led to the foundation of an essentially national Inquisition, directed against local heretics, and founded without the help of the papacy. It was created in 1480 by Ferdinand and Isabella

Sixtus IV. had wished the papal Inquisition to be established after the form of the middle ages; but Ferdinand, in his desire for centralization wished to establish an inquisition which should be entirely Spanish, and entirely royal. Rome resisted, but at last gave way. Sixtus IV., Alexander VI., Innocent VIII., Julius II. and after them all the popes of the 16th century, saw in this secular attempt a great power in favour of orthodoxy, and approved it when established. The Inquisition took advantage of this to claim an almost complete autonomy. The decisions of the Roman Congregation of the Index were only valid for Spain if the Holy Office of Madrid thought good to countersign them; consequently there were some books approved at Rome and proscribed in the peninsula, and some which were forbidden at Rome and approved in the peninsula. The Spanish Holy Office perceived long before Rome the dangers of mysticism, and already persecuted the mystics, especially the *Alumbrados* and afterwards the Molinists, while Rome still favoured them. There was even a financial dispute between the Inquisition and the papacy. The Roman Penitentiary sold exemptions from penalties (involving loss of civil rights), such as prison, the galleys and wearing the *sanbenito,* and dispensations from the crime of *Marrania* (secret Judaism). The inquisitors tried to gain control of this sale, and at a much higher price, and were seconded in this by the kings of Spain, who saw that it was to their own interest. The struggle continued throughout the first half of the 16th century, the Curia finally triumphing, thanks to the energy of Paul III. Since, however, the Inquisition continued to threaten the holders of papal dispensations, most of them found it prudent to demand a definite rehabilitation, in return for payments both to the king and the Inquisition. As a national institution the Inquisition had first of all the advantage of a very strong centralization and very rapid procedure, consisting as it did of an organization of local tribunals (established in all parts of the country) with a supreme council at Madrid, the *Suprema*. The grand inquisitor was *ex officio* president for life of the royal council of the Inquisition.

From the very beginning the papacy strengthened the organization by depriving the Spanish metropolitans, by the bull of Sept. 25, 1487, of the right of receiving appeals from the decisions given jointly by the bishops of the various dioceses, their suffragans and the apostolic inquisitors and by investing the inquisitor-general with this right. And, more than this, Torquemada actually took proceedings against bishops; for example, the accusation of heresy against Don Pedro Aranda, bishop of Calahorra (1498); while the inquisitor Lucero prosecuted the first archbishop of Granada, Don Ferdinando de Talavera. Further, when once the Inquisition was closely allied to the crown, no Spaniard, whether clerk or layman, could escape its power. Even the Jesuits, though not till after 1660, were put under the authority of the Suprema. But the descendants of Moors and Jews, though they were good Christians, or even nobles, were most held in suspicion. A family into which a forced conversion or a mixed marriage had introduced Moorish or Jewish blood was almost entirely deprived of any chance of public office, and was bound, in order to disarm suspicion to furnish agents or spies to the Holy Office.

The Spaniards were very quick to accept the Inquisition to such an extent as to look upon heresy as a national scourge to be destroyed at all costs, and they consequently considered it as a powerful and indispensable agent of public protection. As had happened among the Albigenses, commerce and industry were rapidly paralysed in Spain by this odious régime of suspicion, especially as the *Conversos,* who inherited the industrial and commercial capacity of the Moors and Jews, represented one of the most active elements of the population. Besides, this system of wholesale confiscations might reduce a family to beggary in a single day, so that all transactions were liable to extraordinary risks. It was in vain that the counsellors of Charles V., and on several occasions the Cortes, demanded that the inquisitors and their countless agents should be appointed on a fixed system by the state; the state, and above all the Inquisition, refused to make any such change. The Inquisition preferred to draw its revenues from heresy, and this is not surprising if we think of the economic aspect of the Albigensian Inquisition.

The political aspect of the work and character of the Inquisition had been very diversely estimated, it is a serious error to attribute to it, as has too often been done, extreme ideas of equality, or even to represent it as having favoured centralization and a royal absolutism to the same extent as the Inquisition of the 13th and 14th centuries in Languedoc. "It was a mere coincidence," says H. C. Lea, "that the Inquisition and absolutism developed side by side in Spain." The Suprema did not attack all nobles as nobles; it attacked certain of them as *Conversos,* and the Spanish feudal nobles were sure enough of their *limpieza* to have nothing to fear from it. But it is undeniable that it frequently tended to constitute a state within the state. At the time of their greatest power, the inquisitors paid no taxes, and gave no account of the confiscations effected; they claimed for themselves and their agents the right of bearing arms, and it is well known that their declared adversaries, or even those who blamed them in some respects, were without fail prosecuted for heresy. It was, however, only the Bourbons, who had imbibed Gallican ideas, who by dint of perseverance managed to make the Inquisition subservient to the Crown, and Charles III., "the philosopher king," openly set limits to the privileges of the inquisitors. Napoleon, on his entry into Madrid (Dec. 1808), at once suppressed the Inquisition, and the extraordinary general Cortes on Feb. 12, 1813 declared it to be incompatible with the constitution, in spite of the protests of Rome. Ferdinand VII. restored it (July 21, 1814) on his return from exile, but it was impoverished and almost powerless. It was again abolished as a result of the Liberal revolution of 1820, was restored temporarily in 1823 after the French military intervention under the duc d'Angoulême, and finally disappeared on July 15, 1834, when Queen Christina allied herself with the Liberals It was not, however, till May 8, 1869 that the principle of religious liberty was proclaimed in the peninsula; and even since then it has been limited by the constitution of 1876, which forbids the public celebration of dissident religions (S. Reinach). In 1816 the pope abolished torture in all the tribunals of the Inquisition It is a too frequent practice to represent as peculiar to the Spanish Inquisition modes of procedure in use for a long time in the inquisitorial tribunals of the rest of Europe. There are no special manuals, or *practica,* for the inquisitorial procedure in Spain; but the few distinctive characteristics of this procedure may be mentioned. The Suprema allowed the accused an advocate chosen from among the members or familiars of the Holy Office; this privilege was obviously illusory, for the advocate was chosen and paid by the tribunal, and could only interview the accused in presence of an inquisitor and a secretary. The theological examination was a minute proceeding; the "qualificators of the Holy Office," special functionaries, whose equivalent can, however, easily be found in the mediaeval Inquisition, charged those books or speeches which had incurred "theological censures," with "slight, severe or violent" suspicion. There was no challenging of witnesses. The torture, to the practice of which the Spanish Inquisition certainly added new refinements, was originally very much objected to by the Spaniards, and Alphonso X. prohibited it in Aragon; later, especially in the 15th, 16th and 17th centuries it was applied quite shamelessly. But by the end of the 18th century, according to Llorente, it had not been employed for a long time; the *fiscal,* however, habitually demanded it, and the accused always went in dread of it. The punishment of death by burning was much more often employed by the Spanish than by the mediaeval Inquisition.

With the extension of the Spanish colonial empire the Inquisition spread throughout it almost contemporaneously with the Catholic faith. Ferdinand IV. decreed the establishment of the Inquisition in America, and Jimenes in 1j16 appointed Juan Quevedo, bishop of Cuba, inquisitor-general delegate with discretionary powers. Excesses having been committed by the agents of the Holy Office, Charles V. decreed (Oct. 15, 1538) that only the European colonists should be subject to the jurisdiction of the Inquisition; but Philip II. increased the powers of the inquisitors' delegate and, in 1541 established on a permanent basis three new provinces of the Inquisition at Lima, Mexico and Cartagena The first *auto-da-fe'* took place at Mexico in 1574, the year in which Hernando Cortez died. The Inquisition of Portugal was no less

careful to ensure the orthodoxy of the Portuguese colonies. An Inquisition of the East Indies was established at Goa, with jurisdiction over all the dominions of the king of Portugal beyond the Cape of Good Hope. Finally Philip II. even wished to establish an itinerant Inquisition, and at his request the pope created, by a brief of July 21, 1571, the "Inquisition of the galleys," or "of fleets and armies."

During the 16th and 17th centuries the Inquisition in Spain was directed against Protestantism. The inquisitor-general, Fernando de Valdés, archbishop of Seville. asked the pope to condemn the Lutherans to be burnt even if they were not backsliders, or wished to be reconciled, while in 1560 three foreign Protestants, two Englishmen and a Frenchman were burnt in defiance of international law But the Reformation never had enough supporters in Spain to occupy the attention of the Inquisition for long. After the *Marranes* the mystics of all kinds furnished the greatest number of victims. Here again we should not lose sight of the tradition of the mediaeval Inquisition; the mysticism of the Beghards, the Brethren of the Free Spirit and the innumerable pantheist sects had been pitilessly persecuted by the inquisitors of Germany and France during the 14th and 15th centuries The Illuminati *(alumbrados),* who were very much akin to the mediaeval sectaries, and the mystics of Castile and Aragon were ruthlessly examined, judged and executed. Not even the most famous persons could escape the suspicious zeal of the inquisitors Valdés and Melchior Cano. St. Ignatius de Loyola was twice imprisoned at the beginning of his career; St. Theresa was accused of misconduct, and several times denounced; one of her works, *Conceptos del amor divino,* was prohibited by the Inquisition, and she was only saved by the influence of Philip II. Countless numbers of obscure visionaries were accused of Illuminism and perished. Miguel de Molinos, one of the leaders of the Quietist movement, was also arrested and condemned to perpetual imprisonment (1685–87), and during the 18th century, till 1781, several of Molinos' followers were burnt.

The Inquisition also attacked Jansenism, freemasonry (from 1738 onward; *cf.* the bull *In eminenti*) and "philosophism," the learned naturalist José Clavigo y Faxarcho (1730–1806), the mathematician Benito Bails (1730–97), the poet Tomas de Iriarte, the ministers Clavigo Ricla, Aranda and others being prosecuted as "philosophers." Subject also to the tribunal of the Holy Office were bigamists, blasphemers, usurers, sodomites, priests who had married or broken the secrecy of the confessional, laymen who assumed ecclesiastical costume, etc.

Two features of the Spanish Inquisition are especially noteworthy: the prosecutions for "speeches suspected of heresy" and the censure of books. The great scholar Pedro de Lerma, who after fifty years at Paris (where he was dean of the faculty of theology) had returned to Spain as abbot of Compluto, was called upon in 1537 to abjure eleven "Erasmian" propositions, and was forced to return to Paris to die. Juan de Vergara and his brother were summoned before the Inquisition for favouring Erasmus and his writings, and detained several years before they were acquitted. Fray Alonso de Virues, chaplain to Charles V., was imprisoned on an absurd charge of depreciating the monastic state, and was only released by the pope at the instance of the emperor. Mateo Pascual, professor of theology at Alcala, who had in a public lecture expressed a doubt as to purgatory, suffered imprisonment and the confiscation of his goods. The censure of books was established in 1502 by Ferdinand and Isabella as a state institution. All books had to pass through the hands of the bishops; in 1521 the Inquisition took upon itself the examination of books suspected of Lutheran heresy. In 1554 Charles V. divided the responsibility for the censorship between the Royal Council, whose duty it was to grant or refuse the *imprimatur* to manuscripts and the Inquisition, which retained the right of prohibiting books which it judged to be pernicious; but after 1527 it also gave the licence to print. In 1547 the Suprema produced an Index of prohibited books, drawn up in 1546 by the university of Louvain; it was completed especially as regards Spanish books, in 1551, and several later editions were published. Moreover, the *revisores* de *libros* might present themselves in the name of the Holy Office in any private library or bookshop and confiscate prohibited books. In 1558 the penalty of death and confiscation of property was decreed against any bookseller or individual who should keep in his possession condemned books. The censure of books was abolished in 1812.

BIBLIOGRAPHY.—A critical bibliography was drawn up by P. Fredericq in the preface to the French translation (1900) of H. C. Lea's important work: *History of the Inquisition in the Middle Ages* (3 vols., 1888). *See* also J. Havet, *L'Hérésie et le bras séculier au moyen âge jusqu'au XIIIe siècle in the Oeuvres complètes,* vol. ii. (1896); Ch. V. Langlois, *L'Inquisition d'après des travaux récents* (1901); Douais, *L'Inquisition* (1907); E. Vacandard, *L'Inquisition* (1907); Douais, *Documents pour servir à l'histoire de l'inquisition dans le Languedoc* (2 vols., 1900); Döllinger, *Beiträge zur Sektengeschichte des Mittelalters* (2 vols., Munich, 1890; vol. 2 is composed of documents); Molinier, *L'Inquisition dans le midi de la France au XIIIe et au XIVe sidcle. Etude sur les sources de son histoire* (1880); P. Fredericq, *Corpus documentorum inquisitionis haereticae pravitatis neerlandicae (1205–1525)* (4 vols., Ghent, 1889–1900); Tanon, *Histoire des tribunaux de l'inquisition en France* (1893); Hansen, *Inquisition, Hexenwahn und Hexenverjolgung* (Munich, 1900); Llorente, *Histoire critique de l'inquisition d'Espagne* (4 vols., 1818); H. C. Lea, *History of the Inquisition of Spain* (5 vols., 1905–08); S. Reinach, articles on Lea's *History of the Inquisition of Spain* in the *Revue critique* (1906–08); A. S. Turberville, *Mediaeval History and the Inquisition* (1920); H. Nickerson, *The Inquisition* (1923). (P. AL.; X.)

INSANITY. Although formerly a part of scientific nomenclature, the word "insanity" is today employed principally as a term of legal significance. So used, it denotes those conditions of mental disorder or defect which modify certain of the legal relations, rights and obligations of afflicted persons. For discussions of mental disorder in its medical and psychological aspects, *see* ABNORMAL PSYCHOLOGY; MENTAL DEFICIENCY; PSYCHIATRY; PSYCHOANALYSIS; PSYCHOLOGY; PSYCHOSIS.

In general, the legal rules which define the rights, privileges and obligations of persons assume the existence of a degree of mental capacity sufficient to enable the person to manage his conduct and affairs in the ordinary contingencies of life. When, by reason of mental disease or defect, such capacity is lacking, however, the law applies special regulations which deny to the insane person some of the rights and privileges enjoyed by other members of the community, and, at the same time, relieve him of certain obligations and responsibilities. These various rules are encountered both in the criminal and civil law. The degree of mental incapacity required to be found and the modes of proof vary from situation to situation. There is, thus, no single legal test of insanity. Reference must always be made to the particular purpose for which the inquiry is made. Even with respect to the same rule, legal authority is sometimes sharply divided.

INSANITY IN THE CRIMINAL LAW

The most dramatic application of the insanity concept, though not necessarily of the greatest practical importance, is that which relieves the afflicted person of criminal responsibility for his conduct. It is important to understand that the legal tests of responsibility are not, and are not intended to be, scientific definitions of mental disorder. Rather, the legal tests are expected to identify those persons whose incapacities, produced by mental disease or defect, are of such character and extent that criminal responsibility should be denied on grounds of social expediency and justice. The inutility and moral incongruity of holding seriously disordered persons to the criminal consequences of their acts have been recognized in the development of the Anglo-American law for at least seven centuries. Responsibility assumes capacity to make elementary moral discriminations and power to adjust behaviour to the commands of the law. One lacking such capacities is conceived as ineligible for the moral condemnation inherent in a criminal conviction. Such persons, also, are not likely to be deterred from the commission of criminal offenses by the threat of penal sanctions.

Early History. — Beginning with the writings of Henry de Bracton in the 13th century, discussion of the legal consequences of mental disorder appear in the work of several early commentators. The 17th-century treatise of Lord Hale, however, contains perhaps the first systematic effort to state a legal test of criminal responsibility in the English law. Hale wrote: ". . . such a person

as labouring under melancholy distempers hath yet ordinarily as great understanding, as ordinarily a child of fourteen years hath, is such a person as may be guilty of treason or felony." This observation was made the basis of the so-called child of 14 years test in later cases.

In *Arnold's Case* (16 How. St. Tr. 695), decided in 1724, Judge Robert Tracy, relying on a suggestion of Bracton, announced a formulation sometimes referred to as the "wild beast test." Not every kind of "frantic humour," said Judge Tracy, exempts a man from punishment; "it must be a man that is totally deprived of his understanding and memory, and doth not know what he is doing, no more than an infant. than a brute, or a wild beast, ..." In *Hadfield's Case* (27 How. St. Tr. 1282), tried in 1800, Thomas Erskine, the brilliant criminal advocate, induced the court to accept the proposition that "delusion . . . , where there is no frenzy or raving madness. is the true character of insanity."

McNaghten **Rules.**—But it is the rules announced in the famous case of *McNaghten* (10 Cl. and Fin. 200) which constitute unquestionably the most important pronouncement on the subject of criminal responsibility in the Anglo-American law. Though formulated in 1843, the McNaghten rules still provide the basis for the modern lam in most English-speaking jurisdictions. Daniel McNaghten, acting under a delusion that he was being persecuted by Sir Robert Peel, shot and killed Peel's secretary. Edward Drummond, believing him to be Sir Robert. McNaghten was brought to trial on a charge of murder, but was acquitted by a verdict of not guilty on the ground of insanity. The public interest and outcry were of such proportions that the house of lords was induced to employ the unusual procedure of addressing a series of questions to the judges of England on the subject on insanity. The answers to these questions, announced by Lord Chief Justice Nicholas Tindal, constitute the McNaghten rules. It has been suggested that the judges' answers, since submitted in response to hypothetical questions and not in the course of adjudicating an actual case, have no binding legal effect. As a practical matter, however, the rules have been accepted as authoritative in most Anglo-American jurisdictions. A portion of the judges' answer to the second and third questions is most important for the purposes of modern law: ". . . to establish a defence of insanity. it must be clearly proved that. at the time of the committing of the act. the party accused was labouring under such a defect of reason, from disease of mind, as not to know the nature and quality of the act he was doing; or if he did know it, that he did not know he was doing what was mrong." It will be observed that it is the mental condition of the accused at the time of commission of the act which is crucial and that the incapacity must be the result of mental "disease." There have been many widely diverging interpretations of the other important terms of the formulation. Thus, in the United States, "wrong" is frequently understood in the sense of moral wrong, while in Britain mid-20th century cases have held that the accused is not entitled to exculpation if he knew his act was contrary to law.

The McNaghten rules have been the source of sharp and sometimes intemperate controversy for over a century. The range of criticism has been wide and the points made have possessed varying degrees of cogency and relevance. It is said, for example. that the McNaghten rules, by their exclusive reliance on the criterion of knowledge, emphasize unjustifiably the cognitive or intellectual elements of human personality, at the expense of the will and emotions, and, consequently. incorporate an obsolete conception of the nature of mental disorder. Since the rules are founded on conceptions foreign to modern medical science, the psychiatric witness finds it difficult or impossible to translate his learning into the terms of the legal formula, thereby depriving the court and the jury of the full benefit of his expert insight. Also, it is said that the rules require a total incapacity to distinguish wrong from right, although even grossly disordered persons may possess at least rudimentary powers of moral discrimination.

Changes From the McNaghten **Rules.**—Although the attack on the McNaghten rules has received much less than unanimous support, an important segment of opinion has held for many years that drastic changes in the legal tests of criminal responsibility are required. In the United States the adoption of the irresistible impulse test by the federal courts and those of about one-quarter of the states is one important consequence of this dissatisfaction. The irresistible impulse test is accepted in no jurisdiction as a total substitute for the McNaghten rules. Rather, it is intended to supplement the right and wrong test by relieving from criminal responsibility those who may have power to discriminate intellectually between right and wrong but who, because of mental disorder, are unable to act on that knowledge and to control their behaviour. As expressed by a Utah court: "Volitional ability to choose right and avoid wrong is as fundamental in the required guilty intent . . . as is the intellectual power to discern right from wrong and understand the nature and quality of his acts" (78 Utah 580, 6 P. 2d 177).

The irresistible impulse test has also received its share of criticism. and the critics have included both supporters and opponents of the McNaghten rules. Some have urged the difficulties of distinguishing between the irresistible impulse and the impulse which is merely unresisted. More fundamentally, others have complained of the emphasis on "impulse" as erroneously suggesting that volitional disorders are manifested only in sudden or momentary inclinations to commit unlawful acts. Still others have urged that a proper interpretation of the McNaghten rules renders the irresistible impulse test unnecessary, since serious volitional disorders are always accompanied by impairment in the cognitive capacities of the afflicted person.

In recent years the movement to reform the legal tests of criminal responsibility has received increased impetus. A majority of the Royal Commission on Capital Punishment (1949–53) urged the abrogation of the McNaghten rules in England and Wales and the substitution of a test which would submit to the jury simply the question "whether at the time of the act the accused was suffering from disease of the mind (or mental deficiency) to such a degree that he ought not to be held responsible." In the United States the most important recent judicial development was the 1954 decision in Durham v. *U.S.* (214 F. 2d 862) by the U.S. circuit court for the District of Columbia. That decision, applicable only to the District of Columbia and not to the federal courts generally, rejected the McNaghten rules as supplemented by the irresistible impulse test, which had formerly been applied in the jurisdiction. and adopted a new formulation derived from opinions of the New Hampshire court. the only American jurisdiction which had theretofore rejected the McNaghten rules. The Durham test, as it has come to be known, is "simply that an accused is not criminally responsible if his unlawful act was the product of mental disease or mental defect."

The decision was hailed by many in the medical and legal professions as an event of profound importance. It was pointed out that the formulation, by avoiding reference to any particular symptom of mental disorder, eliminates the danger of incorporating into the legal test conceptions of mental disease which are or which may shortly become obsolete. It was also urged that the test provides the psychiatric expert with greater freedom in conveying his scientific evaluation of the accused's condition to judge and jury. It is clear that, in casting aside the McNaghten rules, the court rejected a series of propositions which has constituted for many a symbol of the law's ignorance and obduracy. This is a matter of no small importance. But the Durham formulation suggests problems which may require future attention. Some commentators have pointed to the difficulties in the notion of causation inhering in the phrase "the product of." As Judge Paul Brosman pointed out, it is doubtful "that a criminal act may be committed which is *not,* in some sense, a product of whatever mental abnormality may coexist" (*U.S.* v. *Smith,* 5 U.S.M.C.A. 314, 17 C.M.R. 314). Since the Durham formulation does not state any requirements with reference to the degree of incapacity produced by the mental disorder, and indeed, does not define the concepts "mental disease or defect,"there is considerable question as to the breadth of the exculpation it may at least theoretically authorize.

Trial Practice.— The mode of trying the insanity issue in criminal trials has provoked very nearly as much criticism as the tests of responsibility. The use of the lay jury to decide the issue of

responsibility, the adversary nature of the judicial proceedings, the use of partisan expert witnesses, the elaborate "hypothetical questions" which may be put to the psychiatric witness and other procedural matters have been attacked frequently and with considerable asperity.

While some of the criticism reveals misunderstanding of the purposes and function of legal proceedings in these cases, it cannot be denied that many of the complaints point to weaknesses which can and should be remedied. In the United States, provisions of state constitutions, such as those relating to the right of jury trial, place certain limitations on innovation. Thus, statutes of Washington and Mississippi, which entirely eliminated the defense of insanity from the trial of criminal cases, were held unconstitutional. A California statute has been sustained, however, which requires the insanity issue to be tried in a separate proceeding, after it has been determined in the original trial that the accused committed the criminal acts charged.

Partial Insanity. — Mental disorder may affect criminal liability even though the incapacity of the accused is not of such degree as to relieve him entirely of criminal responsibility. The definitions of certain offenses require proof of particular mental states on the part of the accused. In some jurisdictions, the doctrine of "partial" insanity entitles the defendant to a jury instruction on the issue whether his mental disorder rendered him incapable of entertaining the particular mental state included in the definition of the crime. Thus, in a prosecution for murder in the first degree, the issue would be whether the accused was, by reason of mental disorder or deficiency, rendered incapable of premeditating or deliberating the killing, which is an essential element of the crime. If the jury determines that the accused was incapable of premeditation, it may return a verdict holding him guilty of second-degree murder or some lesser degree of criminal homicide. The U.S. supreme court has refused to reverse a criminal conviction for first-degree murder where the trial judge refused such an instruction (Fisher v. U.S., 328 U.S. 463). But the trend of judicial authority in the United States appears to be toward the contrary result.

Continental European Tests. — Tests of responsibility are included in the criminal legislation of countries whose legal systems are not derived from the English common law. These tests typically give consideration to both cognitive and volitional incapacities. Thus, article 85 of the Italian penal code relieves a person of responsibility when he "is deprived of the capacity of understanding or volition." The factors which most significantly distinguish the continental law of insanity from that of the English-speaking jurisdictions are procedural, not the least important of which derive from the fact that in continental Europe no provision is ordinarily made for the use of lay juries to resolve the issue of criminal responsibility. In some but not all the continental codes, mental disorder, which is insufficient in degree to relieve the accused of responsibility, may be taken into account by the sentencing authority to mitigate punishment.

"Present Insanity." — The significance of mental incapacity in the criminal law is not restricted to the question of the mental condition of the accused when the criminal act was committed. At the common law a person afflicted with what is sometimes called "present insanity" cannot be required to plead to an indictment or stand trial on a criminal charge.

The legal test of "present insanity" is wholly distinct from the tests of criminal responsibility. While the test of "present insanity" has been expressed with some variations in language, "present insanity" consists in essence of that degree of mental disorder which denies the accused understanding of the nature of the proceedings against him or renders him incapable of making or assisting in his own defense. The principle which protects such persons from standing trial has been widely adopted in modern legislation. Indeed, under U.S. constitutional provisions, the principle has been recognized as part of the concept of fair trial and due process of law. The question of "present insanity" may be raised by the defense, the prosecution or the trial judge. It has been held that the judge has not only a privilege to raise the issue, but, when he reasonably suspects the mental capacity of the accused, he is under duty to do so. At common law the issue of "present insanity" was tried before the trial judge, with or without a jury at the judge's discretion. Some of the statutes in the United States preserve the common-law powers of the judge in this matter, others require the summoning of a jury and still others require the trial judge to obtain the assistance of psychiatric specialists in determining the issue. It is important to understand that a finding of "present insanity" only postpones the criminal proceedings until such time as the accused has sufficiently recovered from his incapacities.

One of the important problems in the administration of criminal justice is the detection of mentally disordered persons among those apprehended and brought to trial on criminal charges. Although the right to raise the issue of "present insanity" is clearly established, there is reason to believe that substantial numbers of persons are tried who should not be subjected to criminal proceedings. Even larger numbers of seriously disordered persons are arrested and released from custody who, in their own interests and those of the community, should be confined in mental institutions. In response to these needs, court clinics and other facilities have been established in many localities for the purpose of providing pretrial psychiatric examinations, either on a routine basis or when requested in special circumstances. Most observers agree that such facilities have made a substantial contribution to the effective administration of the criminal law. Perhaps the most interesting statute on this subject is the famous Briggs law of Massachusetts. The law, enacted in 1921, requires the routine examination of all persons charged with certain specified criminal offenses. The examinations are conducted by specialists employed in the state department of mental health. A report of the examination is forwarded to the court and may be introduced in evidence if the accused is brought to trial. The procedure not only assists in the detection of those who are presently insane, but, it is claimed, the tendency of juries to regard the reports as impartial and to give them great weight has done much to eliminate the "battle of the experts" when the issue of criminal responsibility is raised at the trial.

Insanity After Sentence. — There are other situations in which mental disorder has important consequences in the administration of criminal justice. One of these is presented by cases in which a prisoner under sentence of death is found to be incapable, by reason of mental disorder, of understanding the nature and purposes of the punishment about to be inflicted upon him. At common law, the death penalty may not be inflicted in such situations, so long as the mental disorder persists. The reason for the rule, suggested by Lord Coke, is that the execution of a disordered person "cannot be an example to others." Another reason, sometimes advanced, is that the disordered prisoner is incapable of communicating facts to his counsel which might be useful in securing executive clemency. There is a wide variety of statutes in the United States regulating the mode of determining insanity in these cases. Many require a jury trial of the issue. Others authorize the issue to be determined in the courts, with or without juries in the judges' discretion. Still others have eliminated judicial trial of the issue and place its determination, after some species of administrative hearing, in the governor or other executive personnel. Such a state statute has been upheld by the U.S. supreme court (Solesbee v. Balkcom, 339 U.S. 9). Questions may arise, also, as to whether the prisoner has sufficiently recovered his faculties to permit the execution to proceed. Although there is no definitive constitutional ruling on the point, this determination probably must be preceded by a hearing, though not necessarily by a judicial hearing.

Insanity and Acquittal. — A procedural problem of some importance relates to the disposition of defendants who are acquitted on the criminal charge by reason of insanity. If the defendant is still suffering from mental disorder, his interests and those of the community may require that he be confined in a mental institution until his recovery. In the United States this problem has been the subject of a wide range of statutory provisions. The prevailing legislative pattern confers discretion on the trial judge to order the civil commitment of the defendant in such cases, though in many statutes the order of committal can be entered only after the judge has conducted an investigation into the defendant's pres-

ent mental condition. Some of the states require the jury at the criminal trial to consider the defendant's present mental condition. If the jury finds that the accused at the time of acquittal is still afflicted with mental disorder. the trial judge must order the defendant committed to a mental institution. A fen states have so-called "automatic commitment" statutes, which require the immediate confinement of defendants acquitted on grounds of insanity without any further hearing or investigation. These laws. in effect, create a presumption of continuing mental disorder, and have been upheld as constitutional in the state courts. A person who has, in fact, recovered from the mental illness may be released by the hospital authorities, or may challenge the legality of his confinement in the courts, ordinarily in a habeas corpus proceeding in which recovery from the mental disease is alleged. In England, no provision was made for civil commitment of such persons before 1800, and a defendant acquitted on grounds of insanity was permitted to go at large. After that date the trial judge had power to detain the defendant "during His [or Her] Majesty's pleasure." The Trial of Lunatics act, 1883, authorized a new form of verdict—"guilty. but insane"—in cases in which the defendant successfully maintains an insanity defense, and, in effect. directed the automatic commitment of such defendant to the custody of the home secretary. The form of verdict authorized by the 1883 act is inaccurate and illogical; it is, in fact, a verdict of acquittal on the criminal charge, from which an appeal by the prosecution may not be taken. The Royal Commission on Capital Punishment (1949–53), following the recommendations of the earlier Atkin committee, urged an amendment to the law "so that the verdict may again be one of acquittal in language as well as in substance."

INSANITY IN THE CIVIL LAW

Questions relating to the legal consequences of mental disorder are encountered throughout the civil law. These problems may be roughly classified into two broad categories: those relating to the protection and care of the disordered person in the interests of his well-being and the safety of the community, and those relating to the capacity of the insane person to perform certain legal acts and to enter and avoid certain legal relations. As in the criminal law. there is no single legal test of insanity applicable to all situations in which the mental capacity of a person may be in issue

Protection of the Well-being of the Insane and of the Community.— The obligation to afford care and protection for seriously disordered persons has long been recognized by the states. But involuntary commitment to a mental institution subjects the person to loss of liberty. Many of the problems relating to commitment procedures stem from the necessity of reconciling the needs for protective measures and for reasonably adequate procedural safeguards. The degree of mental incapacity justifying civil committal of the disordered person is variously defined in U.S. legislation. The definition of a "mentally ill person" included in the Illinois act is: "any person afflicted with mental disease to such an extent that for his own welfare, or the welfare of others, or of the community. he requires care, treatment, detention and training, and which renders him incapable of caring for and managing his own estate." It was not until 1827 that any state enacted legislation relating specifically to the commitment of mentally disordered persons, and most of the earlier legislation dealt principally with the commitment of the criminally insane. Even 20th-century legislation retains many of the incidents of criminal proceedings both in the language employed and the procedures actually authorized, though the trend is clearly in the direction of lessening the resemblances to criminal actions. During the 1860s many states added the requirement of jury trial in commitment proceedings as a result of certain well-publicized cases, including the famous Packard case in Illinois. involving allegedly improper commitment of sane persons to mental hospitals. At mid-20th century only one state, Texas. retained the mandatory requirement of jury trial, and in about half of the others a jury might be employed at the option of the judge or on demand of the person proceeded against. The dominant legislative pattern places the determination of the issue in the judge, after examination of the person by one, or more frequently, two physicians. In some states; the commitment is ordered by a special or standing commission composed of doctors or lawyers or both. In still others, commitment is almost entirely separated from judicial or administrative proceedings, being authorized on the certification of physicians. Under such statutes a judicial hearing is afforded only if an appeal from the commitment is taken.

In addition to the formal commitment procedures, more than half the states authorize summary commitments, ordinarily on the certificate of a health officer, where, by reason of emergency, immediate hospitalization is deemed necessary. These laws strictly limit the period of time a person may be held, typically between five and ten days. After expiration of the period, the person must be released unless a formal commitment order has been obtained in the interval. Release after formal committal ordinarily follows an administrative finding by hospital authorities that the patient has recovered from his illness. In the mid-1950s several states experimented with so-called "family care" releases, a procedure authorizing the patient to be placed in the care of a private family for an indefinite period of time, under the general supervision of the mental institution. A patient, alleging that he has recovered from his mental disorder, may resort to the courts in an effort to compel his discharge. Habeas corpus proceedings are frequently employed for this purpose.

Another device for the protection of mentally disordered persons is the appointment of a guardian by a court of equity or other court designated by statute. The guardianship may relate either to the person or the property of the insane individual, or both. The test of mental incapacity authorizing the appointment of a guardian is ordinarily said to be whether the person, by reason of mental disorder, lacks capacity to manage his own affairs or to care for his estate. All U.S. jurisdictions have enacted statutes governing, with greater or lesser particularity, the procedure for the appointment of guardians. Most of the statutes authorize the guardianship proceedings to be instituted on petition of a relative or friend of the afflicted person. Some also give this privilege to certain specified public officers, and a few to any inhabitant of the county in which the person resides. Most statutes expressly require that the person be given advance notice of the hearing in order that he may prepare a legal defense. In many states the issue of insanity is determined by the judge, but in others juries must be employed, either in all cases or when demanded by or on behalf of the person alleged to be insane. The older authority takes the view that the property of a ward is vested in the guardian and any conveyance made by the ward is absolutely void. Contrary results have been reached in more recent cases where it was shown that the nard had regained his sanity and that the guardianship had fallen into disuse, although not formally terminated. In any event, the insane person, like the minor, may be held to pay for articles and services necessary to life. if not supplied by the guardian.

Legal Capacity of Insane Persons.—As to persons not under guardianship. the insanity which destroys legal capacity to contract or to convey property must be of such advanced degree as to prevent the person from understanding the nature and effect of the particular transaction. Thus. contractual capacity may exist even though the person is mentally defective or is seriously disordered in the medical sense. Despite language to the contrary in the early cases, it is now generally held that a contract or conveyance made by an insane person is voidable rather than void. This means, among other things. that the insane person may ratify the transaction when he recovers his reason and hold the other contracting party to the bargain, or that, after the death of the insane person, his representatives may ratify the transaction or disaffirm it. Another consequence is that, if the transaction is executed and the bargain is not unfair or unconscionable, the insane person must offer to return the consideration furnished by the other contracting party before he is permitted to rescind. Most states provide by legislation that persons of unsound mind lack capacity to dispose of property by will. The relevant test is nhether the testator is of sufficiently sound mind and memory to understand the nature of his act. to comprehend the character and extent of his estate and to recollect the natural objects of his

bounty. With reference to marriage, a special application of the tests of contractual capacity is made; hence a marriage may be annulled when one of the parties, at the time of the ceremony, was unable to understand the ordinary incidents of the marital relationship. Some state statutes also extend prohibitions of marriage to other classes, such as epileptics and the feeble-minded. Prolonged and incurable insanity, occurring after marriage, is recognized in some states as a ground for divorce.

Insane persons are generally held liable for their torts; *i.e.*, harm they inflict on others. It is apparent that the proposition results in the imposition of civil liability on those who, by reason of mental disorder, may be incapable of avoiding the torts. This rule may be explained, in part, as a historical survival from a period in which tort liability was generally imposed without regard to the fault of the actor. A number of additional reasons have been advanced, none of which appear wholly satisfactory. It is said that since insanity may be feigned, a contrary rule of law might be used improperly by a sane person to escape liability. Also, placing responsibility on the insane person may induce the guardian, or others interested in the person's welfare, to exercise closer supervision of his activities. Finally, public policy requires that, as between two innocent persons, loss should be borne by the one who occasioned it.

In the adjudicated cases, insane persons have been held liable for a wide variety of torts including assault and battery, trespass on land and even alienation of affections. An insane person is liable for negligent harms, and the standard of care is that which is required of a sane person. One exception to the rule of liability relates to certain wrongs requiring proof of a "specific" intent, which a disordered person may be incapable oi forming. These include such torts as deceit, malicious prosecution and defamation.

Finally, mental disorder may have important consequences as it relates to the capacity of insane persons to give testimony in judicial proceedings. The early common-law rule rendered any person of unsound mind totally incompetent as a witness. Although a literal reading of some modern statutes would require the same result, it appears that nowhere is the rule applied in its original rigour. The broad principle generally applied today would exclude a witness only where the disorder substantially impairs the trustworthiness oi the particular testimony. Some oi the cases suggest that a person of unsound mind is competent to testify if it is found that he understands the nature and signlficance of his oath and has sufficient possession of mind and memory to recollect and relate what he saw and heard.

BIBLIOGRAPHY.—Henry Weihofen, *Mental Disorder as a Criminal Defense* (1954) (contains elaborate survey of U.S. cases and statutory materials); S. Sheldon Glueck, *Mental Disorder and the Criminal Law* (1925); Symposium, "Insanity and the Criminal Law," *University of Chicago Law Review*, vol. 22, p. 317 ff. (1955); *Report* of the Royal Commission on Capital Punishment, H.M.S.O. (1953); C. G. Vernier and R. A. Frank, *American Family Laws*, vol. i–v (1938) (includes detailed survey of U.S. statutory provisions relating to civil consequences of insanity); Council of State Governments. *The Mental Health Programs of the Forty-Eight States* (1950); William *A.* White, *Insanity and the Criminal Law* (1923); Manfred S. Guttmacher and Henry Weihofen, *Psychiatry and the Law* (1952). (F. A. A.)

INSCRIPTIONS are documents incised on some hard or permanent material in the form of letters or other conventional signs, for the purpose of conveying some information or preserving a record. (Although inscriptions come from many parts of the world, *e.g.*, India, Mexico. Turkey. China. this article deals only with those from the ancient near east. Greece and Rome. since these have been by far the most thoroughly studied.) Inscriptions are to be distinguished on the one hand from manuscripts. or documents written on papyrus, parchment, paper or other more or less smooth surfaces by means of a brush, reed or pen and some coloured fluid (see PALAEOGRAPHY; PAPYROLOGY), and on the other hand from pictures or reliefs intended to convey information or to record events (see PICTOGRAPHY), though inscriptions were often combined with such pictures or reliefs, especially in primitive times. There are also some classes of documents which are intermediate between inscriptions and manuscripts. such as writing incised with a stylus or sharp-pointed instrument upon tablets covered with a thin coating of wax or scratched upon pottery or other hard materials (ostraka). But as the forms of the letters and the character of the writing in both these cases approximate to what is found in manuscripts, they are usually considered to belong to that class of document; but graffiti, or casual scratching on walls, rocks or fragments of pottery, are sometimes included in the study of inscriptions because they often fill gaps and, in early times at least, did not differ in form or character from ordinary inscriptions. A good example is offered by the names and other records scratched by Greek mercenaries at the time of Psammetichus on the legs of the colossal statues at Abu Simbel in Egypt. As one of the earliest examples of the use of the Greek alphabet, these find their place in the history of inscriptions. On the other hand, casual notes as nell as receipts, accounts, etc., are found scratched upon potsherds or ostraka, which nere merely a cheap substitute for more expensive material such as papyrus; the study of such ostraka cannot be separated from that of manuscripts on papyrus, and really forms a branch of palaeography rather than of epigraphy.

Inscriptions were studied and quoted by authors in ancient times, by orators and by historians — notably Thucydides and Polybius — as records of political. economic and social interest; they also contributed to the history of art, and Polemon had the nickname of *stelokopas* given him for his studies of such documents. His nork is now lost. Some of the great scholars of the Renaissance were interested both in Greek and Roman inscriptions. But the gigantic task of collecting and editing all known ancient inscriptions has been undertaken only since the 19th century.

FORM

Materials and Technique. — Inscriptions were commonly incised on stone or marble, on metal or on wood (though this last material has hardly ever survived except in Egypt) or on terra cotta. In Egypt and Mesopotamia hard stones were frequently used for the purpose, and the inscriptions are therefore well preserved and easy to read. In Greece the favourite material, especially in Athens, was white marble, which takes an admirably clear lettering but is liable to weathering of the surface, if exposed, and to wear, if rebuilt into pavements or similar structures. Many other kinds of stone, both hard and soft, were often used, especially crystalline limestones, which do not easily take a smooth surface and nhich, therefore, are often difficult to decipher, owing to accidental marks or roughness of the material.

The metal most commonly used for inscriptions was bronze; flat tablets of this metal were often made for affixing to the walls of temples and other buildings. Occasionally such tablets were made of silver or gold, and inscriptions were often incised on vessels made of any of these metals. Inscriptions on metal were nearly always incised, not cast. An important class of inscriptions are the legends on coins; these were struck from the die (See NUMISMATICS.) Clay was very extensively used for inscriptions in the near east and in Crete. In this case the symbols were incised or impressed on specially prepared tablets when the clay was soft, and it was subsequently hardened by fire. In Greece many inscriptions on vases were painted before firing (especially when they had reference to the scenes represented), or incised after firing: potsherds (ostraka) were often used as a cheap writing material. Inscriptions were also impressed from a mold upon net clay before firing; this frequently was the case with tiles, amphora handles. etc., objects which often supply valuable information as to the buildings to which they belong or the place from which they took their origin.

The tools used for making inscriptions varied with the material; most of them were chisels of some sort. usually nith a square blade; early inscriptions were sometimes made on hard rock by successive blows with a punch or pointed hammer. Sometimes a circular punch was used for *O* or a letter of which *O* formed a part.

Early inscriptions. which were often amateur work. are frequently very irregularly cut. But in almost all examples of later work the inscriptions were evidently cut by professionals and there are definite styles and methods belonging to various places and periods In Egypt, for instance. the hieroglyphs (q *v.*) mere carefully and delicately cut in early times, but became more careless and conventional in later periods. In Greece the best work was done in the 5th and 4th centuries B.C. in Athens. The letters were all exact and regular in shape, nith no adventitious ornaments, and, especially in the 5th century, were usually aligned

exactly with the letters above and below as well as with those on each side. The result is a beauty and simplicity of effect that has never been surpassed. At that time all the strokes were made of equal thickness, but in the 4th century B.C. and later there arose the custom of holding the chisel obliquely to the surface, thus producing a wedge-shaped stroke. A similar custom in Mesopotamia gave rise to the cuneiform (*q.v.*) system. In Greece this effect appears earlier on metal inscriptions than on stone or marble. In the 3rd century and later it became common to introduce apices, or ornamental ends, to the strokes, a custom which prevails to the present day in ordinary capital letters. The custom of making different strokes and different parts of curves of varying thickness became common in Roman inscriptions, which developed a monumental style of their own, varying from period to period. Inscriptions can often be dated approximately by the style of the cutting as well as by the shapes of the letters; skill in doing this can only be acquired by a careful and minute study of originals and facsimiles.

Inscriptions vary greatly in size according to their intended position, their purpose and the skill of the cutter. Some inscriptions are of great length, the longest—a statement of accounts of the temple at Delos under Athenian administration—being nearly half as long as a book of Thucydides; and many other inscriptions approach this in length.

Symbols and Forms of Writing.—The origin of writing (*q.v.*) and the evolution of the alphabet (*q.v.*) need not be discussed here. For the present purpose it is sufficient to note that most of the known forms of writing originated in some system of picture-writing. Such systems appear independently in different parts of the world—in Egypt, Mesopotamia, Crete, among the Hittites and in China and America. The evidence for all of these is to be found mainly in inscriptions. The development from ideograms (or direct representation of an object or idea) to symbols of phonetic value, and so to syllabaries or alphabets, took place in many different systems to various degrees. The Greeks borrowed the Phoenician system of writing, with certain modifications and improvements. From the Greek was derived the Latin; and from the two, all the later alphabets of European peoples. It is still a matter of dispute whether the Phoenician was derived from the Egyptian.

The pictographic shapes naturally tended to be conventionalized and simplified for convenience of cutting, in accordance with the materials and tools employed. In many cases they developed from a pictorial to a linear form. It is possible that some of these linear forms may not be derived from pictograms at all, but from purely conventional geometrical forms, such as were aidely used at all periods and places as owners' or masons' marks. The tendency of linear forms to become wedge-shaped is most conspicuous in cuneiform, but the same tendency occurred in Greek inscriptions of the 3rd and 2nd centuries B.C., and earlier in inscriptions incised on bronze.

In the north of Europe the Ogham inscriptions are alphabetic, and are apparently an independent invention on arbitrary lines, like the Morse code; but Runes, which were extensively used in the same region, are derived from the Greek or the Latin alphabets.

Certain symbols which are not strictly alphabetic or phonetic in character are also found in inscriptions of most alphabetic systems. The commonest of these are the various systems of numerals that were used in different times and places. It is impossible to give any full description here of these different systems, but a brief account may be given of the principles underlying them. Most of them are based upon a decimal system, doubtless owing to the habit of counting on the fingers. In some cases the symbols are simple and obvious, as in the Cretan script where circles and short horizontal and vertical strokes are used for hundreds, tens and units, each being repeated as often as necessary; and a similar system for the lower denominations was used at Epidaurus in the 4th century B.C. In Athens the usual system was to indicate each denomination by its initial, M for *myrioi* (10,000), X for chilioi (1,000), H for *hecaton* (100), Δ for deca (10), Π for *pente* (5) and I for units. The other Greek system followed that derived from the Phoenicians, using the letters of the alphabet in their conventional order from one to nine, 10 to 90 and 100 to 900; in this arrangement obsolete letters were retained in their original places so as to give the requisite number of 27 symbols. The Roman system of numerals—M, D, C, L, X, V, I (for 1,000, 500, 100, 50, 10, j and 1)—is generally supposed to have arisen from the adaptation of certain symbols in the Greek alphabet.

Apart from numerals, the use of initials in the place of complete words was not common in early times. However. it became very frequent in Roman inscriptions, which sometimes are made up almost entirely of such abbreviations and can only be understood by those familiar with the formulae. Compendia or monograms also occurred in later Greek and Roman times, and became very common and difficult to interpret in early Christian and Byzantine inscriptions.

Some kind of punctuation is often found in inscriptions of all kinds. In Greek inscriptions a vertical line or a dot (or group of dots) sometimes indicates the separation between sentences or words; but words are seldom separated by spaces as in modern printing, so that the text is continuous and no division of words exists. This is particularly the case with Greek inscriptions of the best period. In Roman inscriptions it was usual to separate the words by dots. In certaip inscriptions a cross (+) was used to indicate the beginning of an inscription, especially when its direction was erratic. Christian inscriptions sometimes began with a cross, which doubtless had a symbolic meaning, and a leaf or other device was often placed at the end.

The direction of the writing varies greatly in different places and times. The letters or symbols may be arranged vertically below one another, reading from top to bottom, or horizontally, reading either from right to left or left to right; they may also be arranged in a kind of pattern—in which case their order may be indeterminate, or follow a wandering or curved line, or read left to right and right to left alternately (*boustrophedon*, or as an ox in plowing). Most Semitic alphabets, including Phoenician, read from right to left; and the earliest Greek inscriptions follow the same direction. But the direction from left to right became regular in Greece after the 6th century B.C., and consequently was adopted by the Romans and in all European systems. The individual letters or symbols usually face in the same direction as the writing as a whole.

Position or Place.—When they have a direct relation to the sculptures, reliefs or paintings with which they are associated, inscriptions often form a kind of pattern to fill the background or vacant spaces between the figures. Sometimes, however, and especially in Mesopotamian statues or reliefs, they are cut right across the figures without any regard to the artistic effect. In late Greek or Roman work it was usual to cut any inscription relative to a statue or relief upon the base on which it was mounted, but short inscriptions such as dedications or artists' signatures were often placed in some inconspicuous position upon the work itself. In the case of painted vases the inscriptions relative to the subject represented were usually painted; but dedications and other inscriptions were often incised after the vase had been fired.

In Egypt, inscriptions were often inscribed or painted upon the inner walls of tombs, whether they referred to religious belief or ritual or to the honours and possessions of the deceased. They were intended for his benefit and convenience rather than for the information of others—to perpetuate his familiar surroundings, not to make him live in the memory of his successors. The information which is derived from such inscriptions is invaluable, but such was not the intention with which they were made. On the other hand, inscriptions which were intended to be seen by the public and to perpetuate a record of events or to supply useful information usually occurred in places of common resort, above all in temples and sacred precincts. Sometimes they were cut on convenient rock faces, sometimes upon the walls of temples or other buildings. Most frequently the slabs of marble (stelae), stone, metal or other material upon which the inscriptions were incised were set up in convenient positions to be read in places of public resort. This was the method of publication of all laws,

decrees and official notices, of treaties and contracts, of honours to officials or private citizens, of religious dedications and prescriptions of ritual. Inscribed tombstones were set up over graves, nhich were usually placed along the chief roads leading out of a town; the most familiar example is the sacred way from Athens to Eleusis. Inscriptions commemorative of victories or other great events were erected upon the spot only in exceptional cases; more often such memorials were set up in some great religious centre such as Delphi or Olympia. But boundary stones were necessarily placed on the line which they defined.

Chief Periods and Nationalities. — The study of inscriptions supplies an important contribution to the history of many lands and peoples. In some cases, as in Egypt and Mesopotamia, it forms almost the only source of first-hand written information; in others, as in Greece and Rome, it offers a most valuable supplement and comment to what is otherwise recorded.

Both Egyptian and Mesopotamian inscriptions go back to an extremely early date; it is uncertain which is the earlier but both show, as early as 3000 B.C., a complete, organized system of writing which implies many centuries of development behind it. The Egyptian hieroglyphic script, as used in inscriptions, continued without any essential change of character until Roman times, though various cursive hieratic and demotic types were also in use. On the famous Rosetta stone in the British museum, which first gave the clue to the interpretation of Egyptian writing, hieroglyphic, demotic and Greek versions of the same decree are given side by side. Its date is 19j B.C. The Mesopotamian linear symbols developed, mainly for technical reasons, into a wedge-shaped or cuneiform system which was adopted in modified forms and applied for millennia to different languages: Sumerian, Babylonian, Assyrian, Hurrian, Hittite and Old Persian. An independent hieroglyphic system, which also developed into various linear scripts, appeared in Crete around 2000 B.C. (*see* MINOAN LINEAR SCRIPTS). The Hittite hieroglyphs date from the period of Hittite domination in northern Syria and Asia Minor, from about 1600 to 700 B.C.

The earliest known Phoenician inscriptions date from about the 10th century B.C., and the alphabet remained in use down to the 3rd century B.C. It was modified and adopted by the Greeks at an uncertain date; the earliest Greek inscriptions are generally dated in the 8th century B.C.

In early times each Greek state had its own alphabet; but in the year 403 B.C. (the archonship of Eucleides) the Ionian alphabet, which is the one used now for Greek capital letters, was officially adopted by Athens and soon became universal in Greece. From the various Greek alphabets were derived the different local Italian types. including the Etruscan, with sundry modifications. The Roman alphabet was among these. There are a few very early Roman inscriptions. They did not become common until the 3rd century B.C.; from that time the letters took much the same forms as they preserve to the present day.

The custom of putting inscriptions in Greek and in Latin on buildings and other monuments continued through medieval times and is still customary, classical forms being frequently imitated. The latest dated inscription in the Greek Corpus records the building of a bridge in Sicily in A.D. 1121; the series of Byzantine inscriptions continues practically without interruption to the present day; and Latin retains its use as a universal language in religious, public and private inscriptions.

Methods of Dating. — It is often possible to date an inscription approximately by the style of the lettering. or even by the alphabet used. Thus at Athens the Ionic alphabet was adopted in place of the early Attic alphabet in 403 B.C. But the change was already in process in private inscriptions, Ionic forms are sometimes found earlier, even in official documents. Inscriptions are dated in various ways, mostly by giving the name of a king, magistrate or priest. In the case of kings, they only give an approximate date, unless the year of his reign is given also. But in the case of most independent cities the date is given by the name of an annual magistrate, and thus the year is indicated precisely. At Athens, the name used was that of the Eponymous Archon and, since an almost complete list of these has been drawn up from inscriptions and other sources, this means of dating is quite satisfactory. The custom of dating by Olympiads, which is familiar from later Greek and Roman writers, was rarely used in early Greece, except in connection with athletic victories. Many inscriptions are dated from various local eras, often based upon historical events such as the foundation of a town or festival, the organization of a province or even the visit of an emperor. The number of these eras in later times, especially in Asia Minor, becomes very bewildering. In Attic decrees, and some others, it also was usual to give the day of the month.

In Greek inscriptions of the Roman period, the year of the emperor is defined by the number of his consulate or other indications or titles, as in the corresponding Latin inscriptions. In later times, the dating is commonly by "Indiction," but as this only gives the number of the year within the 15-year period, while leaving that period undefined, such dating is very inconvenient, except for merely temporary use. In the Eastern empire the date from the creation of the world (5509 B.C.) is sometimes given; but the date of the Christian era is hardly ever used.

CONTENT

Purpose of Inscriptions. — Inscriptions may be divided roughly into two main classes: (1) those in which the inscription was subservient to the object on which it mas inscribed or, at any rate, had a direct relation to that object (*e.g.*, the name of the owner or the record of dedication to a god); and (2) those in which the inscription existed for its own sake, or for the sake of the information which it recorded, the object on which it was inscribed being either made for the purpose, as a slab of marble or plate of bronze, or made use of, as in the case of a convenient wall or the surface of a rock or even a potsherd. The walls of buildings are often covered with such inscriptions, especially if they are in a conspicuous or convenient position, and so offer an obvious means of publicity.

For those accustomed to a vast mass of books, newspapers and other printed documents. it is difficult to realize the extensive use and great convenience assigned to inscriptions in ancient times. Not only were public announcements of all sorts, such as should now be made known by advertisements or posters, thus placed before the public, but all kinds of records and enactments — codes of law and political decrees; regulations for all matters, civil and religious; accounts and contracts, public and private; treaties between states; records of public and private benefactions and dedications, and all matters of administration; honours to the living and to the memory of the dead. Many of these were intended to preserve for all time the records which they contained; but others must have been of only temporary interest. It seems, therefore, the more remarkable that they should have been incised on permanent material such as bronze, marble or stone — and incised in the first instance, with a care and perfection of technique nhich have led to their survival to the present day, so as to preserve invaluable evidence as to the life and institutions of the people who made them. Temporary and permanent value are thus often combined in the same inscription. For instance, an Athenian citizen, visiting the Acropolis or the market place, could satisfy himself at first hand as to treaties or decrees of the people, public accounts or state income and expenditure. In the near east and Helladic Greece vast archives of clay tablets were kept in royal palaces and temples.

Relative Inscriptions. — Inscriptions having a direct relation to the object, or representation, on which they are inscribed vary greatly in their contents. Those relating to picture or relief chronicles of the victories or exploits of kings, as in Egypt and Mesopotamia, serve as a record of the events and help to interpret the scenes. Such inscriptions are not common in Greek or Roman work; but frequently, especially in early Greek times and on vases, the names of persons and even of objects are written beside them for the purpose of identification, and sometimes a speech issues from the mouth of a figure. On the carved wooden chest of Cypselus, of about 600 B.C.. hexameter verses were written. curving about among the figures and giving a description of each scene. The bases of statues and reliefs often had inscrip-

tions cut upon them for identification and record, This was particularly the case with honorary statues and tombstones. In other cases, where there is an evident relation between the artistic representation and the inscription, the figures are subordinate and seem merely to illustrate the text, such as a treaty between Athens and Samos with a relief at its head representing the goddesses Athena and Hera clasping hands, as representatives of their respective cities. In other cases the arms or device of a city is carved on an inscription, almost like a seal on a document. In all these cases the figures and the inscription are part of a common design, whether carried out by the same hand or not. But in the case of owners' marks, or names cut on vases or other objects, or of the dedication of such objects, the inscription is not necessarily contemporary; it may indeed be misleading, as in the case, mentioned with disapproval by Cicero, of re-using old Greek statues and placing new dedicatory inscriptions on them in Roman times; for instance, one of the statues of Athenian knights of the 5th century B.C., placed at the entrance of the Acropolis, had a later inscription cut on its base to make it serve as an equestrian statue of Germanicus, probably in 18 A.D. when he visited Athens. In Egypt and Mesopotamia also it is not unusual to find the name of a later king or official cut upon an earlier work.

Independent Inscriptions. — The majority of inscriptions are of independent value and interest, the object on which they are cut being either provided for the purpose or utilized as convenient and suitable. Such inscriptions may be classified as *(a)* religious and (b) political and social. The distinction between the two is not always easy to draw; for in almost all ancient civilizations religion was a part of the established service of the state and was under public control, or at least was closely bound up with political administration. It follows that many inscriptions relating to religious matters take the form of political decrees or state documents, and therefore might, especially as far as form is concerned, be included in either category; but it is usually possible to classify them according to their contents and intention.

Greek Inscriptions

Religious. — Temples. — A temple was often a kind of religious corporation under the control of the state, and its accounts and details of administration were made public at frequent intervals, usually annually, by means of inscriptions, exhibited to public view in its precinct. Many such inscriptions have been found and they supply a great deal of information that can be obtained from no other source. Some great temples, such as that of Apollo on the island of Delos, held great amounts of property, both real and portable, the latter taking the form either of more or less precious offerings dedicated in the temple and its surrounding buildings, or of coined money. The inscriptions accordingly record gifts and acquisitions of landed property, leases and assignments, payments of rent and fines for default, loans and interest and many other business transactions suitable to a great landed proprietor or to a bank. They therefore throw much light upon the social and economic conditions of ancient life, such as are nowhere else recorded. The lists of offerings dedicated in the temple and other buildings almost recreate their appearance. These offerings are described as being on the floor, on the walls, on shelves or in cases; they consisted of vases and other objects suitable for use in the temple service; ornaments and jewels; statuettes, mostly in gold and silver; weapons and tools; coined money; and bullion, mostly melted down from old offerings. The detailed care that was taken to ensure that the full weight of melted objects was preserved, whether made into a new vessel or not, is recorded in other inscriptions. These elaborate inventories were checked and revised by each successive board of administrators, and gave the best possible security against any robbery or peculation. In addition to such general lists, there are also innumerable records of various gifts and acquisitions, whether of land and houses, or of movable property of all sorts. Buildings and repairs, sometimes by the state, sometimes by individuals, whose piety and generosity are suitably honoured, are also recorded. In form, these are often hardly to be distinguished from public works of a secular character, which must be mentioned later.

The inscriptions on or belonging to special dedications are often of great historical interest — there need only be quoted the inscription on the famous snake column from Delphi, with the list of the Greek states which took part in the Persian War, and that relating to the Roman arms dedicated by Pyrrhus of Epirus at Dodona after his victories. Most of the great temples being of immemorial sanctity, it is hardly to be expected that any records of their foundation should be found in inscriptions. But on the other hand there are many accounts of the dedication of new temples, either by states or communities or by private individuals. In almost all such cases it was necessary to obtain sanction for the foundation from the State; thus the inscription often takes the form of a decree of the people authorizing the foundation of the temple, and often giving some privileges to the founder or founders.

Officials. — Inscriptions give much information as to priests and other religious officials. There are, in the first place, lists of priests, some of them covering long periods and even going back to mythical times; there are also lists of the treasurers and administrators, who were usually lay officials appointed for the purpose either by election or by lot. The duties and privileges of priests are recorded in many inscriptions, and vary considerably from place to place. It is recorded, for instance, what portions of a victim at any sacrifice were to be received by the priest. In any important temple this must evidently have been far more than the priest or his family could consume; accordingly, it must have been sold, and so constituted a considerable source of income. Consequently a priesthood was an office well paid and much sought after; and in later Greek times, especially in Asia Minor, priesthoods were frequently sold, under proper guarantees and with due sureties as to the duties being carried out. Sometimes a fee to the priest had to be paid in cash; in some cases a priest or priestess was allowed to take up a collection on certain days. On the other hand, the duties of a priest are often recorded; he had to see to the cleaning and care of the temple and its contents, to provide flowers and garlands for decorations and to supply the regular daily service. Sacrifices on great occasions were usually provided by the state, as also were important repairs; but in some cases a priest undertook these on his own account, and was honoured accordingly — for instance, by being allowed to inscribe his name in the restored temple.

Besides priests, many other officials of various ranks were attached to temples and recorded in inscriptions. Some of these, especially those who were concerned with buildings or constructions, or with the inventories of temple treasures and the accounts of administration, were lay officials appointed by the state. as in the case of political officers. But many others had specialized sacerdotal functions; for instance, in many places there were manteis or prophets, often of special families with hereditary skill in divination; at Eleusis records were found of the hierophant, the torch-bearer and others who took part in the celebration of the mysteries. At Olympia, in later Greek times, was found a remarkable list of officials. viz.: three priests, three libation pourers, two prophets, three custodians (of keys), a flute-player, an interpreter, a priest for the daily sacrifice, a secretary, a wine-pourer, three dancers at libations, a woodman (to supply wood for the sacrifices) and a steward and cook — the last being no sinecure, in view of the numerous sacrificial feasts.

There were also many more menial offices in the service of temples which were carried out by slaves. Such slaves were often presented to the temple or acquired in some other way. There is a whole class of inscriptions, found on many sites, in which the sale of slaves to a temple or to the god of a temple is recorded. It is often difficult to know whether such slaves were intended for the service of a temple, or, on the other hand, such service was either purely formal or was not required at all, the sale to the temple being intended as fictitious, so as to enable a slave to acquire his own freedom and at the same time to secure the protection of the god in his free status.

Ritual. — The ritual appropriate to different divinities and temples varied greatly from place to place, and it was therefore neces-

sary or desirable to set up notices in all public places of worship for the information and guidance of worshipers. The commonest and most essential act of worship was sacrifice; an example of the simplest form of prescription is to be seen in the inscription on the relief from Thasos in the Louvre: "To the Nymphs and to Apollo the leader of the Nymphs, the worshiper may, if he so choose, sacrifice a male and a female victim. It is not permissible to offer a sheep or a pig. No paean is sung. To the Graces it is not permissible to offer a goat or a pig."

It is to be noticed that this order of service contains a prohibition as well as a prescription. Such prohibitions are frequent, and often relate to the need of ceremonial purity in all worshipers entering a sacred precinct. They must, for a certain time, have abstained from certain prescribed means of pollution, varying from place to place. The officials are sometimes ordered to erect notices giving information on this point; for instance, at the precinct of Alectrona at Ialysus, it was prescribed that "no horse, ass mule, nor any other animal with a bushy tail should enter, and that nobody should bring such animals in or wear shoes or any article produced from pigs. There is also a fine for driving in sheep." Other precincts were protected in a more general manner from any invasion or violation. It was prohibited to cut wood or to remove earth and stones or to drive any beasts into some precincts; the right of erecting booths was either restricted or denied altogether. Sometimes more detailed prescriptions are given for the whole organization of a festival; thus at Andania, in Messenia. the arrangements for the celebration of the local Eleusinia—the dress of the participants, the officials and policing—are very fully described. Similarly, in the hall of the Iobacchi, at Athens, the order of proceedings, the officers and the characters in the sacred play and various administrative details are ordered.

When there mas any doubt about a ritual or procedure, divination was often resorted to, and the results of such divination were recorded in inscriptions as a guidance for the future. It was also a common practice to consult Delphi or some other oracle in doubtful or difficult cases; in such cases the exact method of procedure nas sometimes recorded, as well as the response of the oracle. Forms of worship were often prescribed or recorded, especially hymns, which were sometimes inscribed together with their musical notation. The performance of songs or hymns and dances was also a matter of constant reference, especially in connection with lyrical or musical contests; the victorious band or performer often dedicated the prize in honour of the god. A special form of contest was that in dramatic performances, of which many records have survived, both from Athens and from many other parts of the Greek world. The regulation of athletic festivals and the records of victors in their contests also form a numerous class of inscriptions. As regards mysteries, though there are numerous regulations affecting the arrangement of celebrations and the conduct of those participating, there is, as was to be expected, very little concerning the actual performances.

Another interesting phase of Greek religion known mainly from inscriptions is offered by the shrines of healing. The most notable of these was the precinct of Asclepius at Epidaurus. where lists of the cures effected by Apollo and Asclepius have been found on large slabs of inscription, compiled, in all probability, from earlier documents. The cures are of the most varied kinds, ranging from painful diseases or surgical cases to a lost boy and a broken cup. The formula is the same in almost all cases: the consultant comes to Epidaurus, sleeps in the abaton, has dreams or sees visions and comes out whole. In later times, when such faith healing had probably become less efficacious, elaborate prescriptions of diet and hygiene are recorded.

A special form of prayer consisted of curses, which mere often buried in the ground, probably nith the intent to reach the infernal gods. Such curses often give the reason for their being made, usually some injury done to the author of the curse; sometimes they devoted the offender to the infernal gods.

Private Associations.—Another element in Greek religion which is known almost exclusively by means of inscriptions is to be found in the religious associations that existed in many Greek cities, apart from the organization of state religion, though sometimes recognized by it. Each association had its own regulations, which were duly recorded in inscriptions; the associations varied greatly both in purpose and in character. Many of them had a definitely religious purpose, in the worship of certain gods; sometimes an alien community mas given special permission to worship its own god or gods in its own way. Other associations were more social in character and served as clubs, or as burial societies. A remarkable feature about such associations is that the lists of members of many of them include the names of women and of slaves, thus contrasting with the civic basis of established religion in Greece and anticipating a religion in which "there is neither Jew nor Greek, there is neither bond nor free, there is neither male nor female."

Political and Social.--Codes and Regulations.—Ancient writers state that the earliest laws of Athens were inscribed upon tablets of mood. put together in a pyramidal shape. These, owing to their material, have perished; but there are some very early codes of law preserved on stone, notably at Gortyna in Crete. There an inscription of great length is incised on the slabs of a theatre-shaped structure in 12 columns of 50 lines each; it is mainly concerned with the law of inheritance, adoption, etc. Doubtless similar inscriptions were set up in many places in Greece. An interesting series of inscriptions deals with the conditions under which colonists were sent out from various cities, and the measures that were taken to secure their rights as citizens. A bronze tablet records in some detail the arrangements of this sort made when the Locrians established a colony in Naupactus; another inscription relates to the Athenian colonization of Salamis in the 6th century B.C.

Decrees.—A large number of inscriptions are in the form of decrees of various cities and peoples, even when their subject matter suggests that they should be classified under other headings. Almost all legislative and many administrative measures took this form; often a decree prescribed how and where the inscription should be set up. The formulae and preambles of such decrees vary considerably from place to place, and from period to period. Those of Athens are by far the most exactly known, oning to the immense number that have been discovered; and they are so strictly stereotyped that they can be classified with the precision of algebraical formulae and dated, often to within a few years, by this test alone. It was usual to record the year (by the name of the Eponymous Archon), the day of the month and of the prytany (or presiding commission according to tribes), the various secretaries, the presiding officials and the proposer of the decree. It is also stated whether the resolution mas passed by the senate (Boule), by the assembly of the people (Ecclesia), or by both. The circumstances or the reason of the resolution are then given, and finally the decision itself. Some other cities followed Athens in the form of their decrees. with such local variations as were required; others were more independent in their development, and different magistracies or forms of government had various results. In the Hellenistic age and later, the forms of independent government were kept up to a great extent, though little real power remained with the people. On the other hand, it is a common thing to find letters from kings, and later from Roman emperors. inscribed and set up in public places.

Public Accounts.—It was customary to inscribe on stone all records of the receipt. custody and expenditure of public money or treasure, so that any citizen could verify for himself the safety and due control of the state in all financial matters. As in the case of temple accounts, it was usual for each temporary board of officials to render to their successors an account of their stewardship, and of the resources and treasures which they handed over. In all cases of public works the expenditure was ordered by the state. and detailed reports were drann up and inscribed on stone at intervals while the work nas being carried out. In many cases there is a detailed specification of building work which makes it possible to realize not only all the technical details and processes employed. but also the whole plan and structure of a building. A notable instance is the arsenal of Philon. which has been completely reconstructed on paper by architects from the building

specification. In the case of the Erechtheum, there is not only a detailed report on the unfinished state of the building in 409 B.C., but also accounts of expenditure and payments to the workmen employed in finishing it. Similar accounts have been preserved of the building of the Parthenon, spread over 15 years; in the case of both the Parthenon and the Erechtheum, there are included the payments made to those who made the sculptures.

Naval and military expenditure is also very fully accounted for; among other information there are records of the galley slips at the different harbours, and of the ships of the Athenian navy, with their names and condition. In short, there is no department of state economy and financial administration that is not abundantly illustrated by the record of inscriptions.

Tribute Lists.—A set of records of high historical value are the tribute lists, recording the quota paid to Athens by her subject allies during the 5th century B.C. These throw much light on her relations with them at various periods. (See DELIAN LEAGUE.)

Ephebic Inscriptions.—An institution as to which knowledge is mainly derived from inscriptions is the ephebic system at Athens. There are not only records of lists of ephebi and of their guardians and instructors, but also decrees in honour of their services, especially in taking their due part in religious and other ceremonies, and resolutions of the ephebi themselves in honour of their officials. It is possible to trace in the inscriptions, which range over several centuries, the gradual transformation of what was originally a system of physical and military training for Athenian youths from the age of 18 to 20, with outpost and police duties. In later times there were added to the instructors in military exercises, others who gave lectures on what should now be called arts and science subjects; thus in Hellenistic and Rornan times, when youths from all parts of the civilized world flocked to Athens as an intellectual centre, the ephebic system became a kind of cosmopolitan university.

Political *and Commercial* Agreements.—In addition to inscriptions which are concerned with the internal affairs of various cities, there are many others recording treaties or other agreements of an international character between various cities and states. These were incised on bronze or stone and set up in places of public resort in the cities concerned, or in common religious centres such as Olympia and Delphi. The simplest form of treaty is merely an alliance for a certain term of years, usually with some penalty for any breach of the conditions. Often an oath was prescribed, to be taken by representatives on each side; it was also not unusual to appeal to the god in whose temple the treaty was exhibited. In other cases a list of gods by whom the two parties must swear was prescribed. Commercial clauses were sometimes added to treaties of alliance, and commercial treaties are also found, agreeing as to the export and import of merchandise and other things. In later days, especially in the time of the Hellenistic kings, treaties tended to become more complicated and detailed in their provisions.

Another series of records of great historical interest is concerned with arbitration between various states on various questions, mainly concerned with frontiers. In cases of dispute it was not uncommon for the two disputants to appoint a third party as arbitrator. Sometimes this third party was another state, sometimes a specified number of individuals. Thus, in a frontier dispute between Corinth and Epidaurus, 151 citizens of Megara were appointed by name to arbitrate, and when the decision was disputed, 31 from among them revised or confirmed it. In all such cases it was the custom for a full record to be preserved on stone and set up in the places concerned. In this case the initiative in referring the matter to arbitration came from the Achaean league.

Proxenia Decrees.—A very large class of inscriptions deals with the institution of *proxenia*. According to this, a citizen of any state might be appointed proxenos of another state; his duties would then be to offer help and hospitality to any citizen of that other state who might be visiting his city, and to assist him in any dispute or in securing his legal rights. The office has been compared to the modern appointment of consuls, with the essential difference that the proxenos was always a citizen of the state in which he resided, not of that whose citizens and interests he assisted. The decrees upon this matter frequently record the appointment of a proxenos and the conferring on him of certain benefits and privileges in return for his services; they also contain resolutions of thanks from the city served by the proxenos and record honours consequently conferred upon him.

Individual Honours.—This class of inscription is, in form, not unlike the last, except that the honours recorded were given for all sorts of services, private and public, to the state and to individuals. A frequent addition is an invitation to dine in the Prytaneum at Athens. Some were inscribed on the bases of statues set up to the recipient. In early times these inscriptions were usually brief and simple. The bust of Pericles on the Acropolis held nothing but the names of Pericles himself and of the sculptor Cresilas. Later it became usual to give, in some detail, the reasons for the honours awarded; in Hellenistic and Roman times these became more and more detailed and fulsomely laudatory.

Artists' Signatures.—These inscriptions are of special interest for the light they throw upon the history of art. The artist's name was usually carved upon the base or pedestal of a statue. especially in earlier times, and consequently was easily separated from it if the statue was carried off or destroyed. An instance in which both statue and pedestal are preserved is the Victory, signed on its pedestal by Paeonius at Olympia. Occasionally, and more frequently in later times, the artist's signature was carved upon some portion of the statue itself. But in later copies of well-known works it has to be considered whether the name is that of the original artist or of the copyist who reproduced his work.

A special class of artists' signatures is offered by the names signed by Attic vase painters and others upon their vases. These have been made the basis of a minute historical and stylistic study of the work of these painters and unsigned vases also have been grouped with the signed ones, so as to make an exact and detailed record of this branch of Greek artistic production.

Historical Records.—The great majority of these fall into one of the classes already referred to. But there are some instances in which an inscription was set up merely as a record, *e.g.*, a list of athletic or other contest victories. The most famous historical record is the autobiographical account of the deeds and administration of Augustus, which was reproduced and set up in many places; it is generally known as the Monumentum Ancyranum because the most complete copy of it was found at Ancyra. The Marmor Parium at Oxford, found in Paros, is a chronological record of Greek history, probably made for educational purposes and valuable for the traditional dates it gives of events from the earliest times.

Tombs.—This is by far the most numerous class of inscriptions, both Greek and Latin. In early Athens often no record was left beyond the name of the deceased, the name of his father and his deme. Sometimes a word or two of conventional praise was added, such as "a good and wise man." Occasionally the circumstances of death were alluded to, especially if it took place in battle or at sea. Such epitaphs were frequently in metrical form, usually either hexameters or elegiacs. Many of them have been collected and they form an interesting addition to the Greek anthology. In later times it became usual to give more elaborate praise of the deceased; but this was hardly ever so detailed as on more modern tombstones. The age and other facts about the deceased mere occasionally given on Greek tombstones, but not nearly so often as on Latin ones, which offer valuable statistical information in this respect.

LATIN INSCRIPTIONS

Latin inscriptions may be classified on much the same lines as Greek; but certain broad distinctions may be drawn at the outset. They are generally more standardized as to form and as to content, not only in Rome and Italy, but also throughout the provinces of the Roman empire. One of the chief difficulties in deciphering Latin inscriptions lies in the extensive use of initials and abbreviations. These are of great number and variety, and while some of them can be easily interpreted as belonging to well-known formulae, others offer considerable difficulty, espe-

cially to the inexperienced student. A mere list of such initials and abbreviations occupies 68 pages in R. Cagnat's *Cours d'epigraphie latine*. Often the same initial may have many different meanings according to the context. Some common formulae such as V.S.L.M. (votum solvit *libens* merito, "according to justice he discharges his vow willingly"), or H.M.H.N.S. (*hoc monumentum* keredem *non sequetur*, "this monument is not to pass to the heir") offer little difficulty, but there are many which are not so obvious and leave room for conjecture. Often the only way to determine the meaning is to search through a list of initials, such as those given by Cagnat, until a formula is found which fits the context.

Most of mhat has been said about Greek inscriptions applies to Roman also. The commonest materials in this case also are stone, marble and bronze; but a more extensive use is made of stamped bricks and tiles, which are often of historical value as identifying and dating a building or other construction. The same applies to leaden water pipes which frequently bear dates and names of officials. Terra-cotta lamps also frequently have their makers' names and other information stamped upon them. Arms, and especially shields. sometimes bear the name and corps of their ox-ners. Leaden disks were also used to serve the same purpose as modern identification disks. Inscriptions are also found on sling bullets — Roman as well as Greek; there are also numerous classes of tesserae, or tickets of admission to theatres or other shons.

As regards the contents of inscriptions, there must evidently be a considerable difference between the records of a number of independent city states and an empire including almost all the civilized world; but municipalities maintained many of their independent traditions in Roman times. and consequently their inscriptions often follow the old formulas.

The classification of Roman inscriptions may, therefore, follow the same lines as the Greek, except that certain categories are absent and that some others, not found in Greek, are of considerable importance.

Religious.—*Temple* Dedications. — These are very numerous; and the custom of placing the name of the dedicator in a conspicuous place on the building was prevalent, especially in the case of dedications by emperors or officials, or by public bodies. Restoration or repair was often recorded in the same manner. In the case of small objects the dedication is usually simple in form; it usually contains the name of the god or other recipient and of the donor, and a common formula is D.D. (dedit, *donavit*, "he gave," "he has given"). often with additions such as L.M. (*libens* merito, "willingly according to justice"). Such dedications are often the result of a vow, and V.S. (*votum solvit*, "he discharges his vow") is therefore often added. Bequests made under the wills of rich citizens are frequently recorded by inscriptions; these might either be for religious or for social purposes.

Officials.—A priesthood was frequently a political office and consequently is mentioned along with political honours in the list of a man's distinctions. The priesthoods that a man had held are usually mentioned first in inscriptions. before his civil offices and distinctions. Religious offices, as well as civil, mere restricted to certain classes. the highest to those of senatorial rank, the next to those of equestrian status; many minor offices, both in Rome and in the provinces, are enumerated in their due order.

Regulations. — Among the most interesting of these is the ancient song and accompanying dance performed by the priests known as the Arval brothers. This is, however, not in the form of a ritual prescription, but a detailed record of the due performance of the rite. An important class of documents is the series of calendars that have been found in Rome and in various Italian towns. These gave notice of religious festivals and anniversaries, and also of the days available for various purposes. The bronze tablets from Iguvium contain extensive ritual instructions in the Umbrian dialect for a cult association known as the Atiedian brethren.

Colleges. — The various colleges for religious purposes were very numerous. Many of them, both in Rome and Italy and in provincial municipalities, were of the nature of priesthoods. Some were regarded as offices of high distinction and were open only to men of senatorial rank; among these were the Augurs, the Fetiales, the Salii and, in imperial times, the Sodales Divorum Augustorum. The records of these colleges sometimes give no information beyond the names of members. but these are often of considerable interest. Haruspices and Luperci were of equestrian rank.

Political and Social. — Codes and Regzrlations — Information as to these is not drawn mainly from inscriptions and, therefore, they need not be considered here. On the other hand, the word *lex* (law) is usually applied to all decrees of the senate or other bodies. whether of legislative or of administrative character. It is best, therefore, to consider all together under the heading of public decrees.

Laws and Decrees.—A certain number of these dating from republican times are of considerable interest. One of the earliest relates to the prohibition of bacchanalian orgies in Italy; it takes the form of a message from the magistrates, stating the authority on which they acted. Lans all follow a fixed formula, according to the body which passed them. First there is a statement that the legislative body was consulted by the appropriate magistrate in due form; then follows the text of the law; and finally the sanction, the statement that the law was passed. In decrees of the senate the formula differs somewhat. They begin with a preamble giving the names of the consulting magistrates, the place and conditions of the meeting; then comes the subject submitted for decision. ending with the formula Q.D E.R.F.P. (quid de ea re fieri *placeret*, "what does the senate determine to be done concerning this matter?"); then comes the decision of the senate, opening with D.E.R.I.C. (de ea re ita *censuerunt*, "concerning this matter they have resolved thus"). C is added at the end, to indicate that the decree mas passed. In imperial times the emperor sometimes addressed a speech to the senate, advising them to pass certain resolutions: or, especially in later times, he would give orders or instructions directly, either on his own initiative or in response to questions or references. The number and variety of such orders is such that no classification of them can be given here.

One of the most famous is the edict of Diocletian, fixing the prices of all commodities. Copies of this in Greek as well as in Latin have been found in various parts of the Roman empire.

Building Records. — A very large number of inscriptions record the building or repair of public buildings by private individuals. by Roman or provincial magistrates and by emperors. In addition to the dedication of temples, inscriptions recording the construction of aqueducts, roads, especially on milestones. baths, basilicas, porticos and many other works of public utility are found. In early inscriptions often nothing nas given but the name of the person who built or restored the edifice and a statement that he had done so. But later it was usual to give more detail as to the motive of the building, the name of the emperor or a magistrate giving the date. the authority for the building and the names and distinctions of the builders; then follows a description of the building, the source of the expenditure (e g., S.P.-*sua pecunia*, "his money") and finally the appropriate verb for the work done, whether building, restoring, enlarging or otherwise improving. Other details are sometimes added, such as the name of the man under whose direction the work was done.

Military Documents.—These vary greatly in content, and are among the most important documents concerning the administration of the Roman empire. "They are numerous and of all sorts — tombstones of every degree, lists of soldiers' burial clubs. certificates of discharge from service, schedules of time-expired men, dedications of altars, records of building or of engineering works accomplished. The facts directly commemorated are rarely important." But when the information from hundreds of such inscriptions is collected together, "you can trace the whole policy of the imperial Government in the matter of recruiting, to what extent and till what date legionaries were raised in Italy; what contingents for various branches of the service were drawn from the provinces, and which provinces provided most: how far provincials garrisoned their own countries, and which of them,

like the British recruits, were sent as a measure of precaution to serve elsewhere; or, finally, at what epoch the empire grew weak enough to require the enlistment of barbarians from beyond its frontiers." (F. Haverfield, Authority and Archaeology, p. 314.)

Treaties and Agreements.—There were many treaties between Rome and other states in republican times; but as a rule, knowledge of these does not derive from inscriptions, which are very rare in this earlier period. In imperial times, to which most Latin inscriptions belong, international relations were subject to the universal domination of Rome, and consequently the documents relating to them are concerned with reference to the central authority, and often take the form of orders from the emperor.

Proxeny.—This custom belonged to Greece. What most nearly corresponded to it in Roman times was the adoption by a city or a state of some distinguished Roman as its patron. The relation was then recorded, usually on a bronze tablet placed in some conspicuous position in the town concerned. The patron probably also kept a copy in his house, or had a portable tablet which would ensure his recognition and reception.

Individual *Honours.*—Honorary inscriptions were extremely common in all parts of the Roman world. Sometimes they were placed on the bases of statues, sometimes in documents set up to record some particular benefaction or the construction of some public work. The offices held by and the distinctions conferred upon the person commemorated are enumerated in a regularly established order (*cursus honorum,* "order of honours"), either beginning with the lower and proceeding step by step to the higher, or in reverse order with the highest first. Religious and priestly offices are usually mentioned before civil and political ones. These might be exercised either in Rome itself, or in the various municipalities of the empire.

There was also a distinction drawn between offices that might be held only by persons of senatorial rank, those that were assigned to persons of equestrian rank and those of a less distinguished kind. It follows that when only a portion of an inscription has been found, it is often possible to restore the whole in accordance with the accepted order.

Artists' Signatures.—When these are attached to statues it is sometimes doubtful whether the name is that of the man who actually made the statue or of the master whose work it reproduces. Thus there are two well-known copies of a statue of Hercules by Lysippus, of which one is said to be the work of Lysippus and the other states that it was made by Glycon. Another kind of artist's or artificer's signature that was commoner in Roman times is to be found in the signatures of potters upon lamps and various kinds of vessels; they are usually impressed on the mold and stand out in relief on the terra cotta or other material. These are of interest for the information they give as to the commercial spread of various kinds of handicrafts and the conditions under which they were manufactured.

Historical Records.—Many of these inscriptions might well be assigned to one of the categories already considered. But there are some which were made expressly to commemorate an important event or to preserve a record. Among the most interesting is the inscription of the Columna Rostrata in Rome, which records the great naval victory of Duilius over the Carthaginians; this, however, is not the original, but a later and somewhat modified version. A document of high importance is a summary of the life and achievements of Augustus, already mentioned, known as the Monumentum Ancyranum. The various sets of Fasti constituted a record of the names of consuls and other magistrates or high officials, and also of the triumphs accorded to conquering generals.

Tombs.—These are probably the most numerous of all classes of inscriptions. Though many of them are of no great individual interest, they convey, when taken collectively, much valuable information as to the distribution and transference of population, as to trades and professions, as to health and longevity and as to many other conditions of ancient life. The most interesting early series is that on the tombs of the Scipios at Rome, recording, mostly in Saturnian metre, the exploits and distinctions of the various members of that family.

About the end of the republic and the beginning of the empire, it became customary to head a tombstone with the letters D.M. or D.M.S. (dis *manibus sacrum,* "sacred to the shades of the gods"), thus consecrating the tomb to the deceased as having become members of the body of ghosts or spirits of the dead. These are followed by the name of the deceased, usually with his father's name and his tribe, by his honours and distinctions and sometimes by a record of his age. The inscription often concludes aith H.I. (*hic* iacet, "here lies") or some similar formula, and also. frequently, with a statement of boundaries and a prohibition of violation or further use—for instance, H.M.H.N.S. (*hoc monumentum heredem* non sequetur, "this monument is not to pass to the heir").

The person who erected the monument and his relation to the deceased are often stated; or if a man has prepared the tomb in his lifetime, this also may be stated, V.S.F. (vivus sibi fecit, "while living he made this for himself"). But it is obvious that there is an immense variety in the information that either a man himself or his friends might wish to record.

Milestones and Boundaries.—Milestones (*miliaria*) have already been referred to, and may be regarded as records of the building of roads. Boundary stones (termini) are frequently found, both of public and private property. A well-known instance is offered by those set up by the commissioners called "III. viri A.I.A." (*agris iudicandis* adsignandis, "for assigning boundaries of farms") in the time of the Gracchi.

See also OGHAM SCRIPT; RUNES.

BIBLIOGRAPHY.—*Ancient Near East:* J. B. Pritchard (ed.), *Ancient Near Eastern Texts Relating to the Old Testament,* 2nd ed. (1955), translations of inscriptional material; S. N. Kramer, *From the Tablets of Sumer* (1956); E. Chiera, *They Wrote on Clay* (1947); J. Friedrich, *Extinct Languages* (1957), on the decipherment of inscriptions, *Kleinasiatiache Sprachdenkmäler* (1932), inscriptions from Asia Minor.

Greece: A. J. Evans, *Scripta Minoa,* vol. i and ii (1952); E. L. Bennett, *The Pylos Tablets* (1955), *The Mycenae Tablets* (1958); M. Ventris and J. Chadwick, *Docunzents in Mycenaean Greek* (1956); *Inscriptiones Graecae;* E. S. Roberts, *An Introduction to Greek Epigraphy,* 2 vols. (1887–1905); M. N. Tod (ed.), *A Selection of Greek Historical Inscriptions,* 2nd ed. (1948); C. D. Buck, *The Greek Dialects* (1955), collection of epigraphic texts; G. Klaffenbach, *Griechische Epigraphik* (1957); A. G. Woodhead, *The Study of Greek Inscriptions* (1959).

Italy: Corpus inscriptionum Latinarum; E. Diehl, *Inscriptiones Latinae Christianae veteres* (1925–31); J. E. Sandys, *Latin Epigraphy,* 2nd ed. (1927); R. Cagnat, *Cours d'épigraphie latine,* 3rd ed. (1898); J. Whatmough, *Prae-Italic Dialects of Italy,* vol. ii and iii (1933); E. Vetter, *Handbuch der italischen Dialekte* (1953), collection of inscriptions in Oscan, Umbrian and other dialects of ancient Italy; J. W. Poultney, *The Bronze Tables of Iguvium* (1959); M. Pallottino, *Testimonia linguae Etruscae* (1954), collection of Etruscan inscriptions.

Gaulish Inscriptions: J. Whatmough, *Dialects of Ancient Gaul* (1949–51).

Germanic Runes: W. Krause, *Was man in Runen ritzte* (1935); *Runeninschriften im älteren Futhark* (1937); H. Arntz, *Handbuch der Runetzkunde* (1935); *Die einheimischen Runendenkmäler des Fertlandes* (1939). (E. GR.; J. PL.)

INSECT, a class (Insecta) of animals usually defined as those members of the phylum Arthropoda in which the body is divided into three parts: head, with mouth parts and sense organs; thorax, with locomotor organs, legs and wings; and abdomen, with the digestive, reproductive and excretory organs. As insects usually possess six legs, they have at times been termed the class Hexapoda (see fig. 1).

To the casual observer they comprise the pests, from bedbugs, houseflies and clothes moths to the gardener's potato beetles and plant lice; the aggressive attackers, such as the biting flies, ants, bees and wasps; and such conspicuous beauties as the butterflies that idle the summer away on flowers. Few observers comprehend the great variety and number of individual insects. The majority of even adult insects are in size below that which attracts the human eye. Many are microscopically minute. For every adult, visible or not, there are a hundred or more young even less visible. In numbers of species, in the vast numbers of individuals and in the social organization of many of the higher forms, they are eminently successful. They have been a great group of such numbers since the middle Coal age, 300,-

000,000 years before man appeared.

Variety in Insects.—No other class of animals even approaches the class Insecta in the great variety of species. Within many species the individual has two or three forms. The butterfly has emerged from a chrysalis; the chrysalis is preceded by a caterpillar. All three forms are butterfly. The housefly has been a pupa in a brown capsule in the ground; the capsule and its contents just previously were a maggot crawling in filth. Insects are known with 21 forms (Phylloxera quercus).

All living and many dead organisms appear to be fed upon by insects. They are adapted to every land and fresh water habitat where food is available. Many live in brackish water up to one-tenth the density of sea water, a few in sea water and some fly larvae can live in pools of crude petroleum where they eat other insects that fall in. Knowledge of one sex may give little clue as to the appearance of the other sex. In some, the female is a mere inactive bag of eggs, while the male (Strepsiptera; figs. 115, 117) is winged and one of the most active insects known. Some insects feed only in the larval stage (Ephemeroptera; figs. 23-26) and go without food as adults. Some insects (queen ants) live 16 years as adults, some mayflies only 20 minutes.

The insects that advertise their presence to the other sex by flashing lights, and some larvae well lighted to no apparent purpose, are as unexpected as are the many forms which imitate other insects in colour and form and thus avoid trouble, or which make sneak attacks in the guise of something harmless.

Behaviour is equally diverse, from the almost inanimate parasitic forms where the larva lies in the nutrient blood stream of its host and feeds by absorption, to dragonflies which pursue victims in the air and dytiscid beetles that out-swim prey in the water.

Insects have gone much farther. On their line of evolution they have developed care of the young, a family life, where the mother lives to defend or feed her young and from this the insect society, where in many tropical areas cities of termites and ants may reach populations of millions of inhabitants. These are true co-operative societies with some in a more advanced stage of co-operative behaviour (more truly a society) than is the human society. Among ants many farm mushrooms or oversee herds of other insects for a living, or do little themselves but have slave ants work for them.

Numbers of Insects.—Entomologists have described more than 625,000 kinds of insects, and estimates of the total of living forms vary from 2,000,000 to 4,000,000. These are kinds or species and are not estimates of individuals. No scientist familiar with insects has attempted to estimate individual numbers beyond areas of a few acres or a few square miles in extent. Figures soon get beyond the grasp of the mind. Large populations and great numbers of kinds are related to small size, a high rate of reproduction and numerous small, suitable food supplies.

Because of small size, insects retain a distinct advantage in being able to develop from egg to adult in a minimum of time as compared with other animals of equal brain capacity. Only minimal volume of tissue has to be developed to produce an adult. The minimal volume of tissue can be produced on a very small amount of food. This speed of reproduction on a per capita small amount of food permits great populations of insects within even small areas. A commonly used method in teaching entomology is to count all insects in and on a square yard of rich moist soil. Including the young and adults of all forms from microscopic young Collembola to all large adults, 500 are easily found and 2,000 are not unusual. This is roughly 4,000,000 insects which live normal insectean lives in comfort on one moist acre. The untrained observer could tramp through such an area and would notice only an occasional butterfly, bumblebee or large beetle, supergiants among insects. Only a few thousand species touch man's living seriously enough to rate retaliatory measures—those that attack his crops, herds and products, and those which carry disease. However, when they do appear as enemies of man, they can build up populations with speed and attack in incredible numbers. In spring the few houseflies which winter over are rare insects. In August their descendents occur in great numbers. Thus man moves about in a world of insects but is virtually unconscious of their vast numbers.

Insects and Man.—Insects injure nearly every organic material possessed or produced by man, and even puncture lead-covered telephone cables which wood-boring beetles mistake for hard, dead tree limbs. The millions of dollars poured into research by the Allied armies and navies, in the protection of the armed forces of World War II gave the world the first broad view of the immediate human danger from disease-carrying insects. The armed forces for the first time in human history were given planned protection by the very best scientific control that could be devised, protection against typhus, typhoid, plague, malaria, jungle typhus and various other deadly and prostrating diseases transmitted by insects and their immediate relatives the ticks and mites. A survey (C. L. Metcalf and W. P. Flint, Fundamentals of Insect *Life*, 1932) of the annual account of the United States against insect damage to crops, products, livestock and health amounted to $1,606,164,000. Our present knowledge gained by war research on army and navy health would increase this figure many million dollars. Because of the inadequacy of surveys of this kind the estimate must be far below the total actual damage, perhaps 50%. We do not know what a forest tree, a field crop or livestock might be like entirely free from such damage. Greenhouse flowers as compared with field-grown flowers give some suggestions. The remarkable crops on newly irrigated areas before insect pests have been introduced are also suggestive.

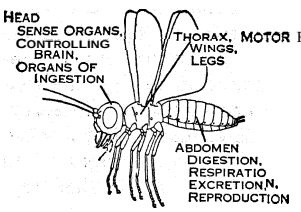


FIG. 1.—DIAGRAM OF BASIC BODY PLAN OF THE INSECT

Speed and Diversity of Insect Evolution.—The subclass Vertebrata of the Chordata has an age of 480,000,000 or more years, the Insecta, 250,000,000 years. (A. S. Romer, Vert. Paleontology, 2nd. ed., 1945). But in numbers of species the insects are more than ten times as great. The advantage in the evolutionary speed of insects is due largely to the great numbers produced as against the low reproduction rate in the vertebrates. Evolution is based largely on mutations, but also on recombinations, chromosomal abberations, and on gene fluctuation in relation to environment. Mutations generally occur in the order of once in 10,000 births. Insects usually lay from a few hundred to a thousand eggs per female in each generation. Generations are short, sometimes several a year. The vertebrate female reproduces very slowly and generations are usually several years long. A special mutable germ plasm for the insects need not be invoked.

The small size of the insect plus diversity of small environments are probably involved in diversity of forms in insects. A new form of insect can not survive without a reciprocal environment into which it can fit. Because of small size, many more such environments (microenvironments) per acre or per square mile are available to new insect forms than to the large vertebrate forms. Two acres are required for one horse or cow. Eight million insects can live on an equal area.

Flight is a great factor in insectean success in that it permits the insect quick and easy access to the numerous small environments and particularly to scattered food supplies.

Another factor enters into the diversity of insects, the phenomenon of metamorphosis which finally divides the insect into two insect forms—larva and adult—each of which, somewhat conditioned by the attachment to the other, can evolve in certain directions peculiar to each. In some insects four lines of evolution in one species are recognizable; (1) larva of male, (2) adult of male, (3) larva of female and (4) adult of female (see scale insects in section Order XV. Hemiptera). Evolution has dealt lavishly with the insects.

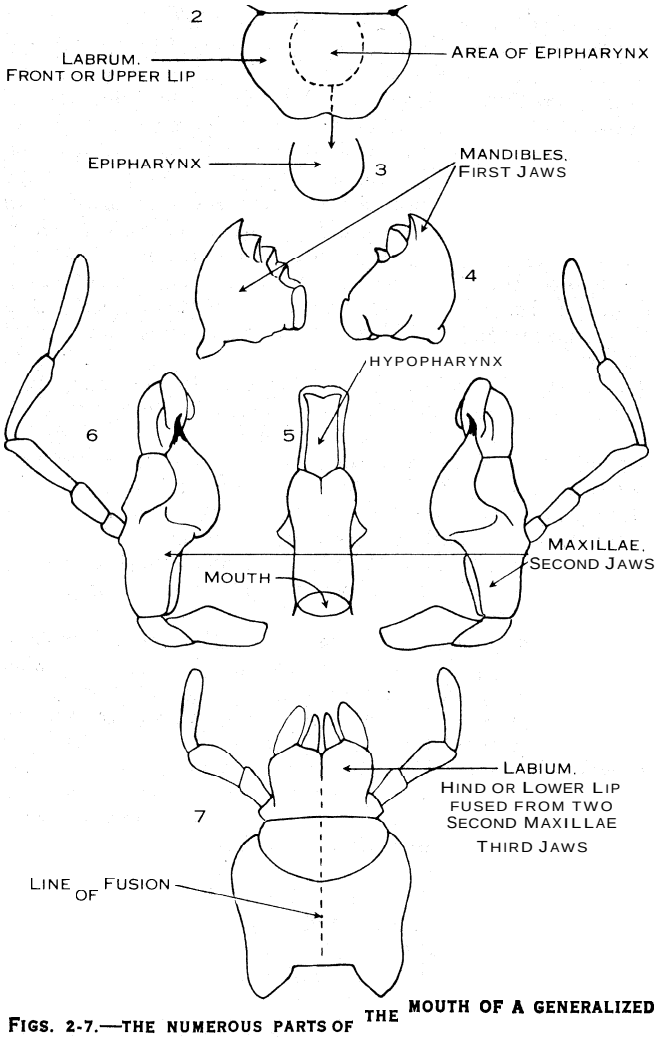
Insect Evolution Guided by Limitations Imposed by the Exoskeleton (C. H. Kennedy, "Exoskeleton a Factor in Limit-

ing and Directing Evolution of Insects," *Jour. Morph.* and Physiol., 48 [1927]).—Being arthropods, insects have an external skeleton (exoskeleton), a basic feature of that phylum as contrasted with the internal skeleton (endoskeleton) of the phylum Chordata (vertebrates and allies). For movement in a stiff exoskeleton, the appendages (mouth-parts, antennae and legs) are jointed, while the body itself is segmented, with movable joints at the neck and in the abdomen (fig. 1). In the evolution of the world of insect species, the hard covering skeleton has been in some ways an advantage and in other ways a handicap. As an impermeable covering it has prevented desiccation in dry environments and so has permitted the aquatic crustaceanlike ancestors of insects to invade dry land and their descendants, the insects, to penetrate even hot, dry deserts. But the disadvantages of an exoskeleton are great because, in growth, it has to be shed regularly. This series of rebirths, 4 to 20 or more in number, is a series of critical events. Even the linings of the breathing tubes (tracheae), which penetrate to every muscle and internal organ, have to be pulled out through the spiracles (respiratory openings). The critical danger is the loss of body shape. The insect, without a hardened exoskeleton while shedding, is a soft white object which has to retain its form through inflation with blood and air until the succeeding skeleton hardens. To secrete the new skeleton, which is a liquid plastic (chitin) that hardens to shape, the whole body wall is a continuous gland—one of the most delicate tissues known. The slight inflation pressure possible against such delicate tissues restricts all insects to small size. An animal of even the size of a dog or cow, if it had to shed an exoskeleton for further growth, would have to lie down as its soft legs could not support it, and could not arise until the skeleton had hardened. If it did have this arthropod process of growth, it would harden on the ground and the animal would arise plano-convex in shape, or, if enough pressure had been developed to retain symmetry, the pressure must have ruptured the delicate, glandular body wall. The body wall at time of shedding (ecdysis) is not only glandular, to secrete the new skeleton, but also frail from the fast growth. Thus the basic arthropod design of body wall, by physical law, limits insects to small size. Few weigh as much as a tenth of an ounce. The few giant Crustacea shed while floating in water. Insects are essentially land animals.

Locomotion, Sense Organs and a Steering Brain.— Through arthropod-pattern, insects have locomotion and with it, the concurrent steering behaviour which locomotion makes necessary. Sedentary and drifting animals (sponges, polyps, some molluscs) without locomotion never develop complex behaviour. The insects move about by undulation (larvae), by walking and, in higher forms, by flying. Locomotion is dangerous except where evolution has provided a guiding nervous system which contacts the environment through perfected sense organs and directs locomotion from dangers, and to profits. The insects have locomotion and the accompanying highly developed guiding sense organs and brain, but lack size and, with lack of size, the possibility of a large elaborately developed brain. In large animals (Aves, Mammalia) the large brain gives elaborate instinctive behaviour and, in later evolution, thought and reason. The insect brain is microscopic in size. It lacks the many storage cells for memory and the many cross fibres which in large brains permit the comparison of memories which forms the basis of plastic behaviour. However, the elaborate instinctive behaviour of such higher insects as the ants, bees and wasps indicates that the minute brain is most intricately and elaborately organized. It appears to be the most elaborately organized bit of matter of its minute size in the world. Thus insects have rigid instinctive behaviour, as compared with the plastic behaviour based on memory of experience and its sequential education as found in animals (birds and mammals) of large brains.

The Structural Design.—The insect's anatomical design can be traced from marine annelid worms with a segmented chitinous exoskeleton but without jointed appendages. They crawled and swam by undulation. From this design was evolved the trilobite-like form by the addition of jointed appendages along the side of the body. Annelids and worms had a variable number of body segments; but in the next stage, the crustacean, the body is divided definitely into 19 or 21 segments, depending on whether 4 or 6 are allotted to the head. Exceptions occur in the trilobites and millepedes (sens *lat.*). Insects of the order Collembola have only six segments in the abdomen.

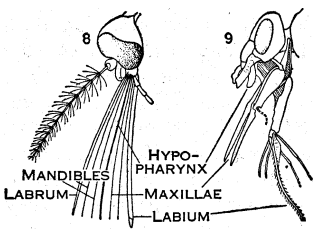
The Value of the Arthropod Structural Design lies largely in the fact that the mouth-parts and locomotor organs



FIGS. 2-7.—THE NUMEROUS PARTS OF THE MOUTH OF A GENERALIZED BITING INSECT, THE COCKROACH

are in series of pairs. The mouth-parts (figs. 2–7) have three pairs of jaws: the biting mandibles, the holding maxillae, with the third pair or second maxillae fused into a lower lip or labium (fig. 7). Added to these are an anterior lip, the labrum and internally a hypopharynx and an epipharynx, nine parts. The insect has six legs where most active animals have two or four. It is a redundancy of parts until the possibilities of evolution are considered, then it appears as a mine of material on which evolution can act. Animal evolution has its difficulties one of which is a radical change of function in a single essential organ while that organ continues to operate. It may account for some of the slowness of evolution in the vertebrates and the comparative paucity of forms in that group as compared with the vast number of forms in the insects. In the insects the many specialized organs, mouth-parts and locomotor organs mainly, have been evolved through change in a part of a previously homogeneous series. In the bee, (fig. 9), the maxillae and labium have become a very effective nectar-gathering tongue of three parts, while the first pair of jaws, the mandibles, have not changed function except toward greater strength. In the beetles (Coleoptera) the forewings have become perfect waterproof covers for the delicate hindwings which have kept the function of flight. In the praying mantis the forelegs have become prey-grasping

organs, while the four remaining legs continue as walking organs. In the grasshopper the hindlegs change into vaulting organs for instantaneous movement, while the other two pairs retain their function of slow walking and of perching. Students of evolution term this process as differentiation in a series. The structural design with parts in series permits evolution to change structures and add new habits with the greatest of evolutionary ease. The insect continues with its previous habits plus the advantages of the new structure and new habits or under evolutionary pressure to save energies, loses the outmoded parts by degeneration and depends nholly on the newly evolved more advantageous organs. The many things insects can do with the extra pair of legs (only four are needed for support) and with the extra two pairs of jaws make a long list.



FIGS. 8-9

Mouth-parts of the female mosquito evolved from biting mouth-parts, used in piercing and sucking blood (from Snodgrass). (9) Mouth-parts of a eucerid bee used for biting, digging and lapping

On this jointed body design are evolved all types of insects. It is rich in possibilities. The addition of wings has made greater speed possible, an advantage in mating and in finding the scattered microhabitats suitable to each species, and speed has necessitated better sense organs and more elaborate behaviour. On ecdysis (the shedding of the skeleton and periodic growth) is evolved metamorphosis.

Metamorphosis is a sudden change in form during ontogeny, *i.e.*, the development of the individual. In insects it is obviously involved with ecdysis and is probably a physiological mechanism very similar to, or a part of, the mechanism of rapid growth at such periods. Only too little study has been given the mechanism of ecdysis and its co-mechanism metamorphosis. It occurs in three forms, with many variants of each: early metamorphosis, as in the Prometabola (Ephemeroptera); incomplete metamorphosis, as in the Hemimetabola; and complete metamorphosis, as in the Holometabola. Metamorphosis in insects revolves around the nature of the development of wings in ontogeny where wing development is different in each of the great groups. Any striking metamorphosis does not occur in the earliest insects, the Ametabola, which have never possessed wings, or in lice which have lost their wings.

CLASSIFICATION BY THE FORMS OF METAMORPHOSIS

The names for the forms of metamorphosis and their classification are a perennial argument among entomologists. The present system is logical etymologically and embodies the ideas of leaders who have worked over the whole field of classification. Eventually the palaeontologists and physiologists will give a satisfactory classification. Subclass names for insects based on metamorphosis, or the lack of it, are of two derivations, (1) structural, usually with the subclass name ending in the Greek *pterygota* (=bearers of wings), or, (2) functional, with a subclass name ending in the Greek *metabola* (=change). As metamorphosis is a change or function, though almost immediately expressed in structure or form, for direct discussions of metamorphosis, as in this review, terms compounded on *metabola* are preferred. The structural series of terms is equally valid.

Metamorphosis started in the earliest winged insects, the Palaeodictyoptera of the Coal age, as a restriction of functional wings to late life stages. Late larval stages (fig. 10) in that order may have had functional gliding wings. While eventually many organs went through metamorphosis, the process is usually defined by the stages of the evolution of the metamorphosis of the easily observed wings.

Ametabola (=no change) is the subclass name applied to the group of orders of insects which do not have metamorphosis. These are the Collembola, Protura and Thysanura[1], where immature forms have the shape of the adult. There are no wings in present species and have been none in their ancestry (metamorphosis occurs only in winged insects). These are the most primitive forms of insects known, though not yet identified positively among early fossils.

The Protura (fig. 20) are an anomalous group in that the basic design of the body changes after hatching. The adult proturan has 12 full abdominal segments, but it hatches with 9 (segs. 1–8, plus seg. 12). Later segments 9, 10 and 11 are interpolated between segments 8 and 12. It might be termed metamorphosis in the broad zoological sense, but it is not a part of the mechanism of insect metamorphosis which later was initiated as a restriction of wings to late instars (see *Prometabola*, below) and then evolved to the development of a highly differentiated pupa in the highest Holometabola (p. 404). The proturan change in form resembles the lengthening of the body in species of the arthropod class Chilopoda, the centipedes, which also acquire segments after birth.

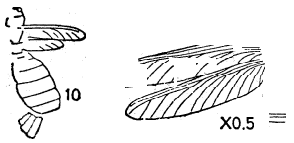
Leach *(Brewster Edinburgh Encyclopedia,* vol. 9 [1815]) proposed the term Arnetabolia (now Ametabola[2]), a functional term for the Thysanura including the Collembola and the lice. The Protura were discovered later by F. Silvestri in 1907. Lang *(Lehrbuch der vergleichende Anatomie,* 1889) proposed the name Apterygota (=not carriers of wings) a structural term to displace the awkward term Apterygogenea of Brauer ("Systematische-Zoologioche Studien," *Sitz. math. Naturw., Akad. Wiss.,* Wien, 91 [1885]). Brauer's research, the first from an evolutionary standpoint, is the basis of all present classifications by forms of metamorphosis.

Prometabola (Greek, pro- in the sense of early) was proposed by Heymons ("Die verschiedenen Formen der Insecten Metamorphose," *Ergebnisse* u. *Fortschr. Zool.,* 1:137–188 [1909]) for Ephemeroptera (mayflies) (figs. 23–26), which insects pass through four stages, egg, nymph (aquatic), subimago (a sexually immature form with wings) and imago (adult, sexually mature with wings). Wings develop in the nymph as external wing pads. Metamorphosis takes place between the nymph and the subimago, which by zoological definition is a larval or immature form.

The mayflies thus have functional wings in a last larval instar (subimago) as well as in the adult (imago). The development of functional wings has not yet reached complete suppression up to the imago as in all later insects. This may be a hangover from the earliest winged insects, the Palaeodictyoptera (figs. 10, 11).

A structural term such as Propterygota, parallel with Prometabola, does not appear available in the literature. Its use is suggested.

Metamorphosis began in the first winged insects, the Palaeodictyoptera, known only as fossils from the lower Upper Carboniferous age on into the Permian. Evidence suggests that some of these may have had functional wings in late larval stages, *i.e.*, immature sexually, as well as in the adult (Handlirsch, 1908, 1925). The Ephemeroptera are now classed as an order closely related to the Palaeodictyoptera with a similar venation (R. J. Tillyard, 1922, 1923). The Prometabola then include the Ephemeroptera by venation and metamorphosis and may include some fossil orders when there is a better knowledge of fossil history.



FIGS. 10-11

Fossil larva *Stenodictya* (10); and fossil adult of *lobata* (11), a palaeodictyopterous or earliest winged insect, showing gliding wings on a late larval (10) stage (from Handlirsch)

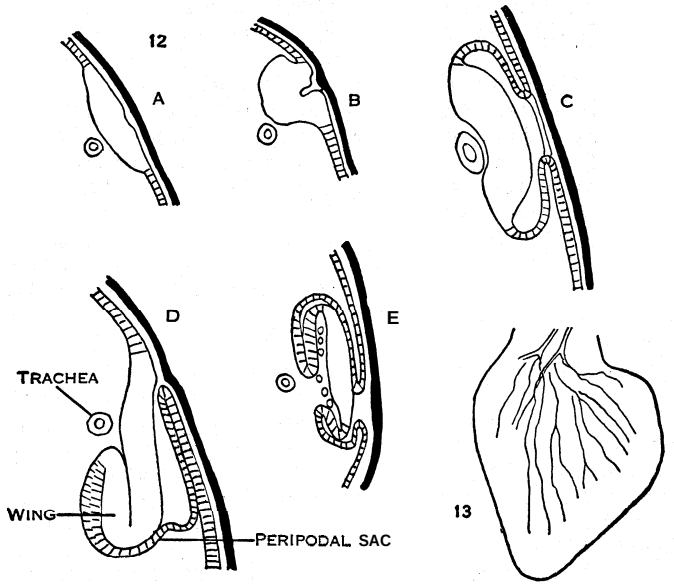
Hemimetabola (=half change) is the subclass proposed by H. C. C. Burmeister (*Handbuch der Entomologie* for a congeries of orders the majority of which had no pupal stage, and thus when winged had "incomplete" metamorphosis. For various reasons he included the Thysanura, Ephemeroptera, the Neuroptera, *sens lat.* and the Trichoptera, the latter two with

[1] For serial arrangement of Ametabolic orders this review follows A. D. Imms, *Trans. Soc Brit Ent*, 3 5, fig 2 (1936); and H. E. Ewing, *Ann. Ent. Soc. Amer.*, 33:513, fig. 5 (1940)

[2] J H Comstock, *Manual of Entomology* (1898), shorteoed Ametabolia to Ametabola and used it for Ephemeroptera plus Hemimetabola (*lc*).

pupa and complete metamorphosis. R. J. Tillyard (1926), who studied classification as profoundly as any 20th century author, accepted the term with the exclusion of the Thysanura, Neuroptera, sens *lat.* and the Trichoptera. Except for the removal of the Ephemeroptera to the Prometabola of Heymons, the present discussion of this subclass follows Tillyard. Hemiinetabola then includes the Odonata, the Plecoptera, Orthoptera, Isoptera, Dermaptera, Embioptera, Zoraptera, Corrodentia, Mallophaga, Anoplura (variously placed) and the hemipteroid series, Thysanoptera and Hemiptera.

The term Hemimetabola (=half change) is functional. The widely used term from the view of structure is Exopterygota of David Sharp ("Classification of the Insecta Hexapoda," Proc. *4th* Internat. Congress of *Zool.,* 4:246–249 [1898]), in reference to the external development of the wings in the wing pads. Tillyard (1926) proposed Ectopterygota, "pure Greek," for Exopterygota which he thought hybrid, Latin plus Greek, but the latter is still in use and appears to be properly compounded.



FIGS. 12-13

Diagrams of cross sections of the developing internal wing pad of an Insect (Lepidoptera) with complete metamorphosis: (A) in early stage of the caterpillar; (B) later stage; (C) peripodal or wing-pad sac forming; (D and E) wing-pad (prepupal stage) with peripodal sac shrinking and soon to free wing-pad (from Mercer). (13) Wing-pad of caterpillar dissected out of the internal peripodal sac (from Mercer)

In this series of orders metamorphosis occurs between the last immature (nymphal) stage and the adult stage (imago). There is no subimago and no true pupa with wings developed internally. In the Hemimetabola wingless genera and wingless orders, Mallophaga, Anoplura, have virtually no metamorphosis as the adult without wings has the nymphal form. Ample anatomical evidence shows that such are descended from winged insects. The nymph is usually an active long-legged campodeiform type (body form of Campodea, order Thysanura, figs. 21, 22), in most orders, with the details of body structure those of the adult. In some of the orders, Isoptera, Thysanoptera and some Homoptera, the last nymphal stage is a quiescent one but has wing pads developed externally and is not a true pupa (figs. 14–17, 72, "pupa" of thrips). (Compare next, "pupa," Holometabola.)

The widely followed use in America of the term Hemimetabola by J. H. Comstock (1918) for the aquatic orders, Ephemeroptera, Odonata, Plecoptera, falls before the recent discoveries in fossil insects as discussed by Tillyard and F. M. Carpenter. They show that the Ephemeroptera have a palaeodictyopterous venation. Tillyard and Carpenter show that the Odonata retain in the wings the primitive vein MA, lost in all other recent orders except Ephemeroptera and perhaps in the Plecoptera, still in doubt. The Odonata have no winged subimago stage and, except for vein MA, fall in the Hemimetabola, as the preseht review follows metamorphosis as more pertinent than structure. The Odonata then are an early branch from the very base of winged insects while the Plecoptera have structures which make them aquatic orthopteroid insects, such as the great development of the anal area of the hind-wing, uhile E. M. Walker (1931) has shown the low placement of antennae as in Grylloblatta. The three orders could not have originated from a common aquatic stem. Each is an independent aquatic adaptation in the most important feature of aquatic adaptation, the gills. In the Ephemeroptera (fig. 24), they are paired on abdominal appendage bases (R. E. Snodgrass, *Morphology* of the Insect Abdomen, Part 1:77, Smithsonian Inst. [1931]); in the Odonata the gills are rectal in Anisoptera, with caudal plate gills in some Zygoptera (fig. 30), and in others paired abdominal gills on the sternites (P. P. Calvert, 1911). In both Anisoptera and Zygoptera breathing is by rectum in early instars, and by rectum in Zygoptera when external gills are lost. In the Plecoptera, when present, they are thoracic and cephalic or anal (Leuctra and *Megaleptoperla,* New Zealand). The emphasis placed by Comstock on the term naiad for the aquatic nymphs in these orders as a character of a group of orders has a suggestion of ecology. Classification on metamorphosis is based on phylogeny and ontogeny. Thus the three orders are not a consistent group structurally (*i.e.,* in gills) and can not have a common inheritance of function (metamorphosis). They are not a close phylogenetic group in metamorphosis, and not at all in venation.

Holometabola (complete change), a name proposed by Burmeister, 1839, Handbuch der Entomologie, includes those insects which have a resting stage (prepupa and pupa) between the larva and adult (butterfly) (figs. 138–140). The wings are developed internally in sacs (peripodal sacs) (figs. 12, 13), in the prepupal stage, which is also the last larval stage, and are everted from the sacs to external position on the pupa. The pupal skin splits off, the adult emerges, which frees the crumpled wings in the external wing pads of the pupa to expand into adult wings. Metamorphosis is not between two stages. as in the Prometabola and the Hemimetabola, but makes two changes between the last three instars, between prepupal stage and pupa and between pupa and adult. The larvae are different also from the nymphs of the preceding group, as they have no external wing pads and may be campodeiform (lower Coleoptera, fig. 82); eruciform (fig. 139, Lepidoptera and lower Hymenoptera); maggots (fig. 147, muscoid Diptera); and grubs (figs. 97, 98, lower Coleoptera, Micromalthidae, and higher Coleoptera, fig. 101, and higher Hymenoptera, with many variants).

The structural term for the Holometabola is Endopterygota, of David Sharp ("Classification of the Insecta Hexapoda," Proc. *4th* Internat. Congress of *Zool.,* 4:246–249 [1898]), in reference to the development of the wing pads within the larva. By the nature of the larvae and the adult structure, the orders fall into three groups: (1) the coleopteroid series, Coleoptera and Strepsiptera; (2) the neuropteroid series, Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Diptera and Siphonaptera; and (3) the hymenopteroid series, Hymenoptera. The Hymenoptera were later classed as Neuropteroidea by Tillyard; in Panneuroptera by G. C. Crampton.

The beginning of the coleopterous series is lost in Permian or earlier times. Even then it was a well-defined group. Modern remnant groups, Cupesidae, Micromalthidae, the suborder Adephaga and perhaps the Lymexylidae, show two types of larvae, legged campodeiform (Adephaga) and legless larvae (Micromalthidae). Larval legs in the campodeiform larvae are usually slender and weak, which suggests a possible redevelopment from short legs in an earlier eruciform larva, a boring type. In general, campodeiform larvae occur in the free-living Adephaga, the Carabidae (ground beetles) and relatives, in the lower Polyphaga, Staphylinoidea (rove beetles) and relatives, and tend to be displaced by legless boring types in the higher families, the Curculionoidea (weevils). The weevils have evolved into the degeneracies of parasitism on plants. Another great branch ending in the Meloidea have evolved into degeneracies of parasitism on animals (insects). The Scarabaeoidea (scarabs) are probably the tip of another great branch, as some have achieved family (semisocial) life. Next to the Hymenoptera, the Coleoptera are most instructive in the several great evolutionary series. (See A. G.

Böving and F. C. Craighead, *Larvae of Coleoptera* [1931] and C. W. Leng, *Catalogue of the Coleoptera of America . . .* [1920]).

The neuropteroid series of orders shows a similar reduction of locomotion and concurrent reduction in larval legs as the evolution of metamorphosis progresses to the highest forms such as the maggot of the highest Diptera. Metamorphosis is under an evolutionary guidance or pressure which arrives at similar structural and functional results over two or more independent paths. In the Seuroptera, Rlecoptera, Trichoptera and Lepidoptera the larva is campodeiform in the first three orders and is eruciform in the Lepidoptera. In the Diptera it is legless from lowest to highest forms. In free living forms some elongate active larvae may develop false legs, as in the Lepidoptera, and even in dipterous legless larvae, those of the Ephydridae.

The order Hymenoptera of the Holometabola shows evolution of the larva from an eruciform type (caterpillarlike) through various legless parasitic types to the final legless grub of the highest social forms in the ants, bees and wasps.

The origins of these great modern groups with the highest form of metamorphosis is yet unsettled. The coleopteroid series has structural characters which suggest an orthopteroid origin near the base of that group. The neuropteroid series is equally old by fossil record but shows fewer orthopteroid characters. The Hymenoptera were thought by Tillyard (1926), on the discovery of a wing of *Protokymen,* to have been descended from a Permian group he termed the Protohymenoptera; but more complete fossils have shown this to be a Megascopteron, a mayfly-like insect (F. M. Carpenter, 1930). Comstock (*Wings of Insects,* 1918) associated the primitive Hymenoptera with primitive Diptera on wing characters. The fact that three groups have evolved similar types of metamorphosis with a pupal stage, an exceedingly complex mechanism of metamorphosis, allows one of two explanations: (1) that the three are descended from a common ancestry which had a pupal stage or (2) that within the limits of the basic arthropod structure and physiology, and the similar limits in subsequent winged insects, metamorphosis can only evolve in one direction, touard a pupal stage and a helpless larva. This raises the question why it has not done so in the great orders composing the Hemimetabola. In fact, it has paralleled this evolution in the production of a pupalike stage but with wing pads developed externally in the Isoptera, Thysanoptera, male Coccids and elsewhere. Even the primitive Odonata have a week of inaction in the last larval stage before the emergence of the adult.

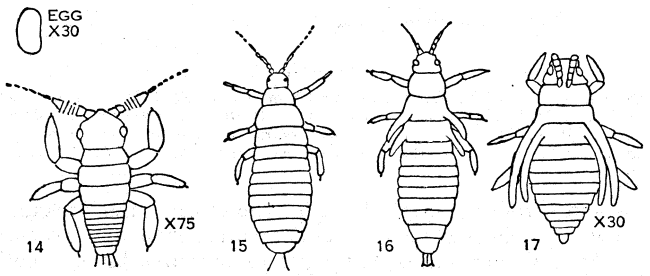
The Meaning of Metamorphosis.— This outstanding physiological phenomenon, one of the strangest developments in animal life, runs all through the evolution of the winged insects. Its beginning was associated with the evolution of wings. In the restriction of the wings to the reproductive adult it preserved them for that very active stage where they can be of most benefit to the species. Because of small size the insects use small environments, temporary wet spots as with mosquitoes, individual scattered plants of the host species, individual hosts for parasitic insects, to locate which wide and capable locomotion is most advantageous. In insects, wings are fragile and irreplaceable. Thus the problem of the development and protection of the wings is the basic or central palingenetic thread about which all other phases of metamorphosis have been evolved. The use of wings is locomotion at its best, and bound up with locomotion the evolution of brain and habits, and so becomes the necessitous central advantage in metamorphosis. Its forms define the great groups based on type of metamorphosis, except where wings are lost in parasitism and social life.

The inhibition of wing development in the larva, and the sudden release of that development at a late ecdysis, is the first evidence of a physiological mechanism of metamorphosis. However it operates, it was established as a feature of the period of sudden growth at ecdyses. Having once been established physiologically, its further development in many other directions became a matter of mutation, evolution and the fitting of the wingless larva and winged adult, two discrete or even antithetic entities in evolution of metamorphosis, to the many diverse waiting microenvironments. Once established, metamorphosis itself evolved on its own.

With this saving of the wings for uses more advantageous in the adult, with fully developed sense organs, came in a second advantage: the larva no longer burned up precious energy in locomotion but could devote more energies to eating and groning. Larval growth processes were separated from adult reproduction activities. Neither function was reduced physiologically by the operation of the other. A winged insect without the adolescence in the growth of the endoskeletoned vertebrate could waste no precious energies sowing. "wild oats." The winged insect goes to sleep at the end of larval life and wakes up at the end of pupation into reproductive maturity. Adolescence is not needed. for education of the minute brain and is discarded.

Having separated the tno somewhat antagonistic phases of individual development, growth and reproduction, in the lower Hemimetabola of incomplete metamorphosis, the already established mechanism of metamorphosis in an independent line. the Holometabola, evolved into the next step, the reduction of the development of the adult body structures to one period of differentiation, the prepupal and pupal stages, the period of differentiation of new parts. This is complete metamorphosis with the life history divided into (1) a period of growth (larva), (a) a period of differentiation (prepupa and pupa), (3) a period of reproduction (imago). This was not an evolution out of the advanced Hemimetabola. Fossil evidence indicates it was out of lower Hemimetabola, or an even lower group, and more or less in point of geological time a parallel evolution.

While complete metamorphosis was evolving, two other phases of metamorphosis were evolving which accentuate its appearance of change at the pupal stage.



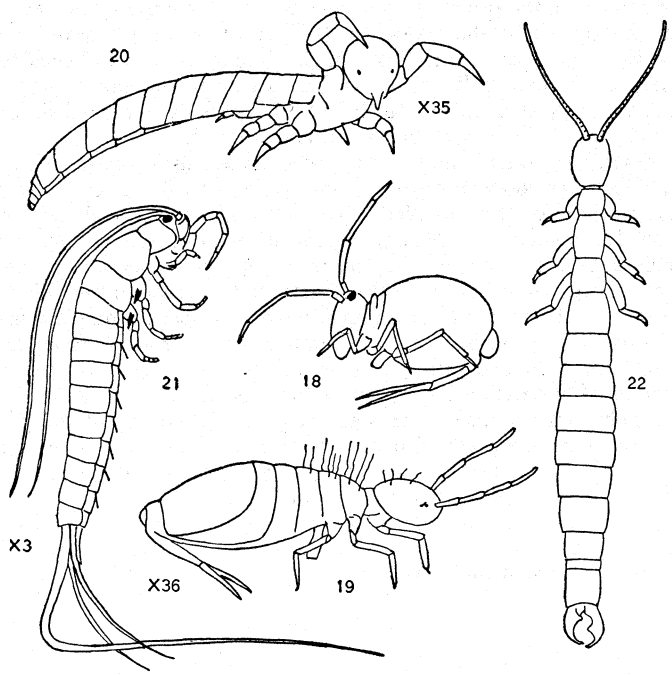
FIGS. 14-17

Egg and immature stages of the bean thrips (adult, see fig. 72): (14, 15) first and second larval stages; (16) third larval or prepupal stage which does not feed; (17) fourth immature or "pupal stage." Not a true pupa as in insects with complete metamorphosis because the wing pads are developed externally in the "prepupa" (16) (from Bailey)

As metamorphic change increases, the larva appears to hatch from the egg at earlier stages in its embryonic development. It tends to carry the embryonic form of hatching time through the larval stages to pupation. The Neuroptera, Mecoptera, Trichoptera and Lepidoptera of the Holometabola hatch as legged larvae. They hatch so in the lower Coleoptera and Hymenoptera, but in the highest forms of these they hatch before legs develop in the embryo. In the latter two orders the larvae of the higher forms are legless and vermiform. In the Diptera all larvae hatch at this very early stage. All dipterous larvae are legless. This increasing retrogression in the larva as holometamorphosis evolves was first pointed out as a matter of hatching in earlier embryonic stages by A. Berlese (1913). (*See* A. D. Imms, *Recent Advances* in *Entomology,* and ed. [1937] for a review.) The opposed theory is that the larva, after the evolution of metamorphosis, has had its larval evolution detached from the evolution of the adult and proceeds to degenerate in the abundant and better food supplies used among the highest insects. It is an aberrant form of parasite degeneration. Legs and sense organs are no longer needed by larvae living in or on more good food than they can consume. This degeneration is very apparent in larvae of parasitic Hymenoptera where they merely lie in the blood stream of the insect host, where the larvae of the social forms are fed by nurses, and in the weevils (Coleoptera) where the larva merely eats its way

through cambium, nuts or fruits. Imms (1937, pp. 51–64) suggests that both types of retrogression may fit into the picture of larval degeneracy.

The second accent to complete metamorphosis, apparent rather than a phase of metamorphosis itself, is the fact that the adult continues the evolution of form after complete metamorphosis has been established. It evolves farther toward many specializa-



FIGS. 18-22

Collembola: **(18)** *Papirius unicolor* (from Jackson); **(19)** Entomobrya *laguna*, California (from Bacon); (20) Protura: Acerentomon *doderoi* (from Berlesi); **(21)** Thysanura: *Nesomachilis maoricus*, New Zealand (from Tillyard); **(22)** Evalljapyx *propinquus*, California (from Bacon)

tions away from the original active type of early Hemimetabola. It is in the Holometabola that more often evolution produces such diverse types out of the series of primitive biting mouthparts, out of the series of three pairs of legs, and from the series of two pairs of nearly similar wings (pointed out in the section, *The* Value *of the Arthropod Structural Design*, above).

Secondary Adaptive Features. — So far only the basic features of metamorphosis, those which define the Prometabola, Hemimetabola and the Holometabola, have been reviewed. In every group, but most often in the Holometabola, larvae in special small groups within the greater classification show special adaptations to special larval habitats. These are larval organs and larval habits that are not carried over into adult organs and adult behaviour, but which disappear at the time of metamorphosis or earlier as in parasitic larvae. Some examples which have been compared in the classification of metamorphic processes are the independent development of larval gills in the aquatic larvae of Ephemeroptera, Odonata and Plecoptera. In each case the gills are on a different part of the body and evolved independently. The larval silk glands which produce the silk cocoon protecting the pupa are larval mouth organs in the Lepidoptera, Hymenoptera, etc., but are Malphigian glands emptying through the anus in the Neuroptera and some Coleoptera. The parasitic larvae of the great number of families of parasitic Hymenoptera show endless larval specializations.

Thus metamorphosis, along with the saving of the locomotor wings, separates the periods of growth, differentiation, and reproduction from each other by separation of the life history into larva, pupa and adult, so that each period can speed up with the least physiological interference of the other two processes. This is metamorphosis in the Holometabola.

This view that metamorphosis in its final holometabolic form separates the life history into a growth stage (larva), a oeriod of differentiation (pupa) and one of reproduction (imago), appears to have been minimized by recent writers studying limited phases of the subject. It was proposed by Fritz Müller (1864), was enlarged upon by P. Deegener (1909) and accepted by David Sharp (1895). After the first reduction of the wings to late stages, these trends to separation of physiological processes develop independently in each group of orders and even independently within each of the four large orders.

This separation of the three great physiological processes of life prevents each from hindering the others. Life itself is speeded up. Early forms of insect life went through 12 to 40 instars (growth periods), consuming time from several months to a year or more. Very modern insects have the number of instars reduced to about five or six, and in many higher flies and bees a generation may take from a few days (the housefly) to three or four weeks (the honeybee worker). This means elastic adaptation of populations to temporary food supplies, such as the quick build-up of workers in a hive during flowering seasons. It means also more generations with the accompanying mutations and thus the speeding up of evolution itself.

Value of Metamorphosis. — The most striking evidence of the value of metamorphosis is the increasing number of species from the Ametabola to the Holometabola. With each step up, from the Ametabola with no metamorphosis to the Holometabola with final complete metamorphosis (with exception of the Prometabola), the number of species described has increased enormously. They are:

Ametabola	1,420
Prometabola	1,270
Hemimetabola	83,650
Holometabola	537,960
Total described	624,300

With the evolution of the larva in the Holometabola into a wormlike form, we find the great series of parasitic families, where the insect as a larva can be wholly endoparasitic and in the imago retain all the benefits of wings and sense organs. In the most masterful of all insects, the social wasps. bees and ants, we find the same wormlike larva filed in pidgeon-holes, in wasp and bee combs, or corded in piles in ant nests, and fed and cared for in rotation, where reproduction is completely production-lined. Nearly the same ants are found as fossils in the Baltic amber, where the production line was probably in operation 50,000,000 years before it was thought of in America, in Detroit. Complete metamorphosis makes it possible.

This suggests, results from the evolution of metamorphosis which parallel the very greatly increased output of the production line in the automobile factory. The thought can be referred further to the auto plant design. The latter is a saving of energies. Metamorphosis becomes an energy-saving device in separating growth, differentiation and reproduction. After having been evolved up to this level, it steps forward again by making use of the growing larva in internal parasitism and again using the larva to the benefit of social organization as a convenient production-line form. Production-line methods in the hymenopterous society are probably of almost as much value as the co-operative behaviour usually thought of as spelling success. The two go together. Energy values have become so necessitous in the insect society that it burns out labour. The worker bee. at the height of the midsummer honey-flow, works every daylight hour and lives only two or three weeks. One of the English bumblebees works all night, as well as all day, on warm June moonlight nights The bald-faced hornet in America works in warm weather from early dawn, to the human eye, until after dark by the same meter of light. The social wasps, social bees and ants work on cool days when the sun passes under a cloud, when most other flower-loving insects disappear. The production-line behaviour mechanism takes all the energy the workers can deliver.

The Insect as an Evolving Energy-Transforming Mechanism. — The insect is the tip of a line of evolution of protoplasm. Protoplasm is an energy-transforming mechanism. The animal takes in food and oxygen. They unite, releasing the energy in the

food. The energy and by-products give growth and supply material and the greater part of the energy of all the living processes. Apparently evolution constantly improves the animal mechanism. Better energy-transforming mechanisms displace (survival of the fittest) poorer ones.

Insects start out as "selfish" individualists with heavy losses in battling the environment. Then the "selfish" behaviour of the individualist gives way to a second level in the evolution of behaviour. The female loses "selfish behaviour" which is displaced by mother care of her young (see ANT, BEE, WASP). Mother care is a great advance in that it helps the insect in its weak young stage to master the environment vicariously through its mother's strong adult organs and more complex adult behaviour. Mother care is the great second level in the evolution of animal behaviour (*q.v.*). Finally a third level is reached in evolution of the insect where the offspring, usually females, assist the mother. Co-operation has appeared and we have the family-society, characteristic of most social insects (*q.v.*). (See TERMITE; WASP; BEE; ANT.) This is the third and final level of insect evolution.

The production-lined insect society, with its exhausted working class, emphasizes the evolving energy values in the whole evolution of insects (see later section on The Ants).

The insect society has evolved out of mother care for the young (family life). In its highest form (wasps, bees and ants) it is a society of females with the elimination of the maie except for fertilization (see later section on The Ants: The Problem of the Male). In the highest form, the honeybee, even all traces of the family are eliminated (see HYMENOPTERA). The social organism is an energy-transforming mechanism which demands all from the co-operative working class which have become slaves to the social mechanism, slaves to exhaustion and death. In the honeybee, the queen mother degenerates to mere egg production. The slavelike workers rule and operate the society. The queen saves her energies by dodging work and lives several years. The worker-slaves of the system burn their energies out by hard labour and live a few weeks only in the highest co-operative societies.

CLASSIFICATION

By decision of the Committee on Zoological Nomenclature of the International Congress of Zoology, technical classification of the insects starts with that given by the Systema naturae of Carolus Linnaeus in 1758. Linnaeus proposed the class Insects and divided it into seven orders based on the presence or absence and nature of the wings. F. Brauer (1885) gave the present general arrangement of orders based largely on metamorphosis. Entomologists have revised this classification until at present the highly technical lists of orders run to 30 or 40, much of which revision has been based on the extensive publications of Anton Handlirsch of Vienna on fossil insects which, for the first time, gave entomologists a good picture of the evolution of the group and the relationships of modern orders to each other. One classification uses 55 orders (G. C. Crampton, Entomologist, 61:82, 1928). The simplified classification usually used for convenience in textbooks and general work contains 23 to 25 orders.

INSECTA

SUBCLASS I: AMETABOLA

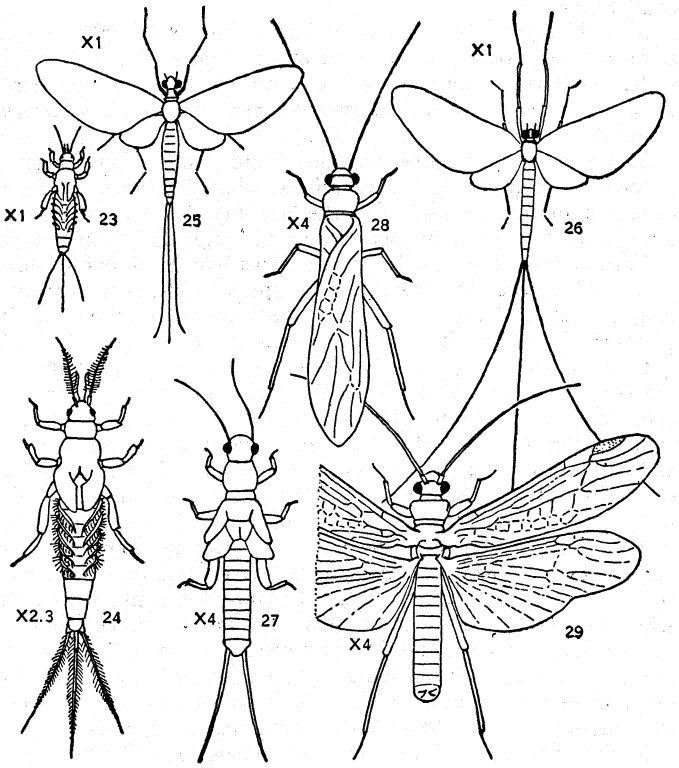
Primitively wingless insects with no true metamorphosis: abdominal appendages present other than gonopophyses (sexual appendages) and cerci.

Order I. Collembola (Figs. 18, 19).—Springtails; 1,100 species in 5 families. Very small, soil insects, with four-jointed antennae; abdomen of 6 segments. Because at no time in the embryo are there more than six segments, the question arises whether these should be classed as true insects. The first segment of the abdomen has a ventral tube with a glandular sucker-like tip considered an adhesive organ, segment four or five usually has a forked springing organ, while on segment three is a hook that holds the spring in place when not jumping. Hence the name Springtail (see footnote 1, above).

Pseudosinella has an egg stage of five days and goes through six instars in ten days. Hence Collembola can build up an enormous soil population following a heavy rain, or in western America following one deep irrigation, where on the surface of an irrigating trough they may appear as a black soot for hundreds of feet. This is an outstanding example of the myriads of microscopic insects usually unnoticed in moist soil.

Order II. Protura (Fig. 20).—Sixty-two species in three families. Minute insects without antennae; with eyelike spots (pseudoculi) which may be vestigial antennae; abdomen of 12 segments, no cerci; mouth-parts piercing, fore-legs held above head like antennae and probably used as tactile organs.

These insects on hatching have nine segments in the abdomen; three are added, by interpolation between the last and next to the last, during larval growth. (See Classification by the Forms of Metamorphosis: Ametabola, above.) The three pairs of small appendages on segments one to three of the abdomen, and the development of abdominal segments by interpolation, are characteristic of chilopodlike forms. Protura are found in humus-filled moist soil.



FIGS. 23-29

Ephemeroptera: *Ephemera* sp.; (23, 24) nymph showing external wing-pads and lateral abdominal gills; (25) subimago, the winged "larval" stage; (26) imago or adult; (27-29) Plecoptera: Nemoura *vallicularia*, a species without the usual thoracic gills in the nymph (from Wu)

Order III. Thysanura (Figs. 21, 22).—Bristletails; 270 species in 6 families. Small insects with many-jointed antennae and biting mouth-parts. Abdomen of ten segments with vestiges of abdominal legs on six or more segments, and prominent cerci.

Because of their external mouth-parts, long antennae, cerci and general shape of body, the Thysanura have usually been considered closely related to the wingless ancestors of the winged insects. While associated with the soil, many are found, for the first time in insects, in very dry places—dry stumps, dry rocky ridges and, as household pests, occupying dry closets and warm areas about stoves and hearths. In insect evolution it is the first order to show a definite adaptation to dry conditions. The number of instars is indefinite, each lasting from four to eight days, and may reach more than 40 instars (Thermobia). The female in Thermobia reproduces at half of her full growth at about one-fourth of the 40 or so instars (H. L. Sweetman, 1938). In later life one lot of eggs is laid during each instar, and the female may

double in size after the first deposition of eggs.

With Thermobia the male in mating deposits a spermatophore in front of the female. She moves forward and attaches it to her sexual organs and then, turning her head, eats it. It is not known by what route the sperms reach the eggs (see Order *V. Odonata;* bedbug, Suborder *Heteroptera* and Order *XVIII. Strepsiptera*).

In technical literature Thysanura are split into two suborders, Ectognatha and Entognatha, or into two orders, Thysanura and Diplura.

Subclass II: Prometabola

Winged insects with functional wings in a subimaginal (immature) stage as well as wings in the imago. Nymph aquatic in the one recent order Ephemeroptera.

Order IV. Ephemeroptera (Figs. 23–26).—May flies; 1,270 species in 5 families. Small to medium sized, soft-bodied insects, inconspicuous setiform antennae, large eyes; vestigial mouth-parts; one or two pairs of many-veined, fanlike wings, hind pair reduced or wanting; slender legs, tarsi one to five segmented; very long filiform segmented cerci and usually a similar median caudal filament.

Nymph aquatic, with pairs of lateral abdominal gills, but in some species extra gills on head or on thorax. External wing-pads, and biting mouth-parts with which it feeds on fragments of plant tissue, algae and diatoms; 27 instars in Baetis *posticatus* of America.

Subimago, an immature stage not found in other living insects, follows the nymph. It has functional wings but does not feed: as it is immature sexually, it is the last stage larva (in zoological sense). It may be homologous with the pupa in Holometabola.

In the larger may flies the aquatic larva lives from one to three years. It does all the feeding for the species. The subimago lives long enough to expand its wings (*Potamanthus*) or over night (Ephemera). The adults live long enough to mate and oviposit.

In the emergence of *Potamanthus* the active nymph swims to the surface of the water. its back splits and from it arises the subimago, which immediately sheds its skin, releasing the final imago which continues the flight but almost immediately mates and scatters its eggs on the water, all within a half hour of the emergence of the subimago of the nymph at the surface of the water. This is one of the shortest known adult lives among insects. In most may flies the process covers 24 hours. In this order the relationships of the species to the environment are carried nearly 100% by the nymph. The larva, the active food gathering stage of the insect, shows many special adaptations to swift waters, to quiet ponds and, in many species, to burrowing through the bottom mud. The imago is reduced to mating and egg laying, and in some species, with males unknown, mating has been lost and eggs hatch without fertilization (parthenogensis).

In the parthenogenetic species the female loses the behaviour of mating and has her activity reduced to mere emergence from the water and a short flight while dropping her eggs. This is one of the most abbreviated behaviour patterns known in adult winged insects. It shows an equally reduced brain activity. The female in such species is one of the most reduced, if not the most reduced, mentally of any insect except the female in the more degenerate families of the order Strepsiptera (order XVIII, below). Evolution in this archaic insect, one of the first structural patterns with wings, has not yet seized upon the opportunities opened up for the development of brain and behaviour to accompany this new and better mechanism of locomotion. It has survived on the vast food supplies opened to it by an aquatic nymph.

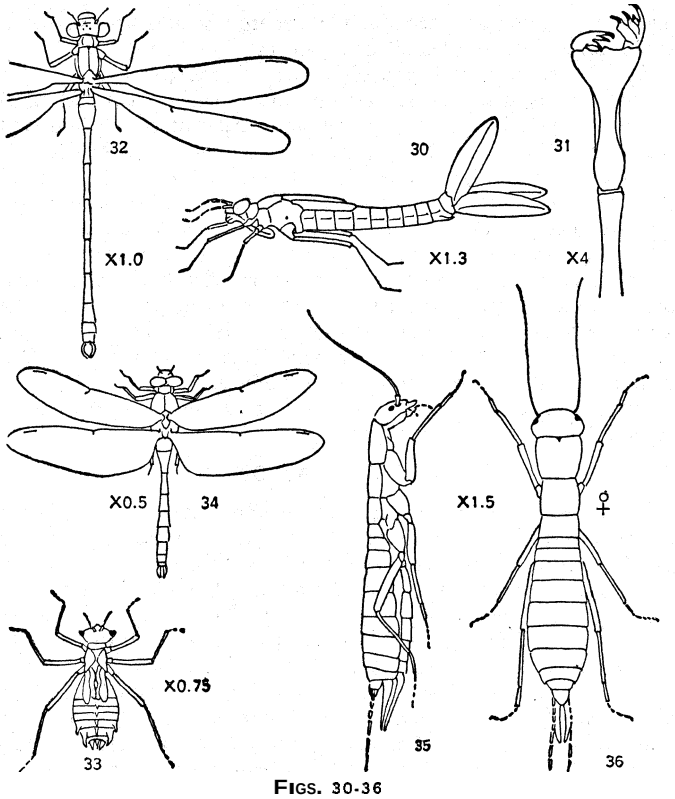
In this order the restriction of wings to a late developmental stage saves them for reproduction, a more critical function of locomotion than that of feeding. It is the first appearance in insect evolution of the physiological mechanism of metamorphosis (*q.v.*). The may flies are one of the most beneficial groups of insects as they, in their vast numbers, transform aquatic vegetation into fish food.

Subclass III: Hemimetabola

Winged insects, but including many secondarily wingless through parasitism or other life habits where wings would be an incumbrance; wings restricted to imago. Larva a nymph usually resembling the adult in form and habits. No true pupa, as wing-pads are developed externally. but in some groups a quiescent "nymphal" period preceding adult. Metamorphosis is incomplete. Both nymph and imago gain their own livelihood, with adult life and larval life nearly equal in length, that of the adult somewhat shorter through greater activity; exceptions in social and over-wintering forms.

Order V. **Odonata** (Figs. 30–34).—Dragonflies; 4,500 species in 17 or more families. Large insects with long slender bodies, very large eyes and vestigial antennae. Two pairs of equal, membranous, net-veined, narrow wings. Biting mouth-parts; tarsi three-jointed, cerci small, one-jointed, males with a secondary copulatory organ on abdominal segment two, suborder Anisoptera (figs. 33, 34), or on two and three, suborder Zygoptera (figs. 30–32).

Nymphs usually aquatic, breathing basically by rectum but in later stages of the nymph of the suborder Zygoptera by abdominal gills: labium a long, hinged prey-grasping organ (fig. 31).



Figs. 30-36

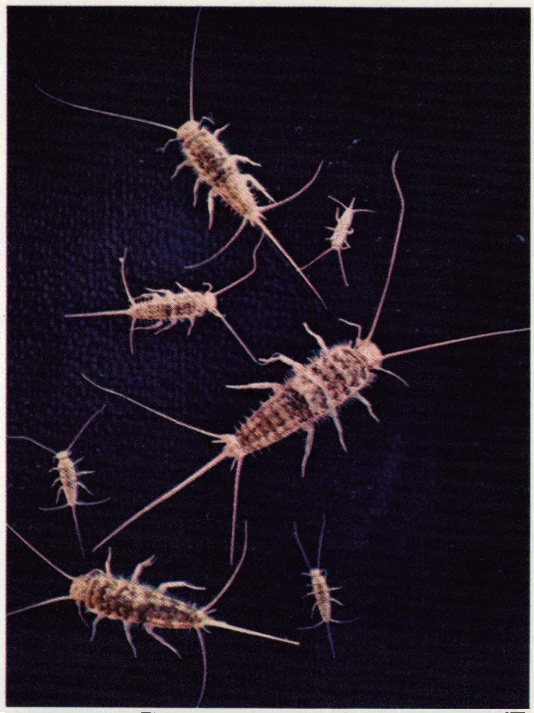
Odonata, suborder Zygoptera. Archilestes *californica:* (30) nymph with three caudal gills; (31) prehensile lip of nymph, the labial palps evolved into raptorial jaws; (32) imago; (33-34) Odonata, suborder Anisoptera. Somatochlora *metallica*, Europe; (33) nymph which breathes by drawing water into large gill-filled rectum (from Cabot); (34) imago (from Jacobson and Bianchi); (35, 36) Orthoptera: *Grylloblatta campodeiformis*, British Columbia (from Walker). See figs. 37-40 for other Orthoptera

Because of the preservation of the vein MA in dragonfly wings, they have split off from all other winged insects at the very bottom of the evolution of such (see Dragonfly).

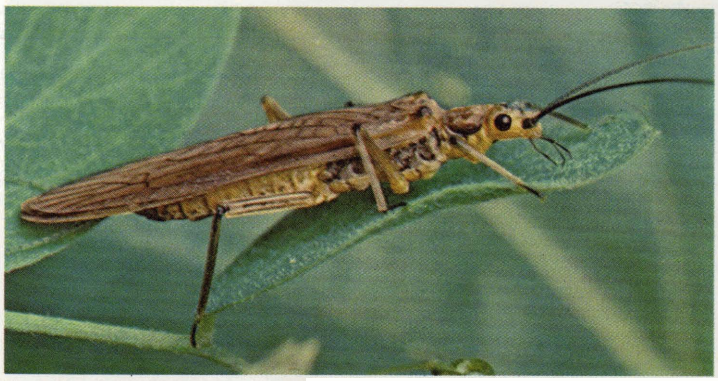
The Odonata are the earliest of the existing orders in which the evolution of the brain and behaviour has progressed to equal the evolution of the wings, the new and vastly better locomotor organs. The more primitive existing Odonata, such as *Tachopteryx thoreyi* of Mesozoic evolutional level, are stupid to the point of alighting on the collector when he is in pursuit of them as compared with the alert modern Libellulidae which arose in the Cenozoic.

The aquatic larvae are active, with good eyesight, and hunt active prey; but a few (Petaluridae, Gomphidae) burrow for prey, while some (Pseudostigmatinidae) live in tropical rain forests in mud collected at the bases of leaves. Dragonfly adults

Dragonfly, order Odonata. Dragonflies are found throughout the world, nearly everywhere there is fresh water. This species was photographed in central Africa



Firebrats, order Thysanura. Wingless insects, in some species eyeless; firebrats are household pests



Stone fly, order Plecoptera. Medium-sized to large insect with well-developed eyes and wings. The nymphs are aquatic

May fly, order Ephemeroptera. Another flying insect found near bodies of fresh water where eggs are laid and nymphs mature

Termites, order Isoptera. Portrait of three of the castes of a *Reticulitermes* species: winged individuals are kings and queens, large yellow-headed individuals are soldiers, others are workers

REPRESENTATIVES OF INSECT ORDERS

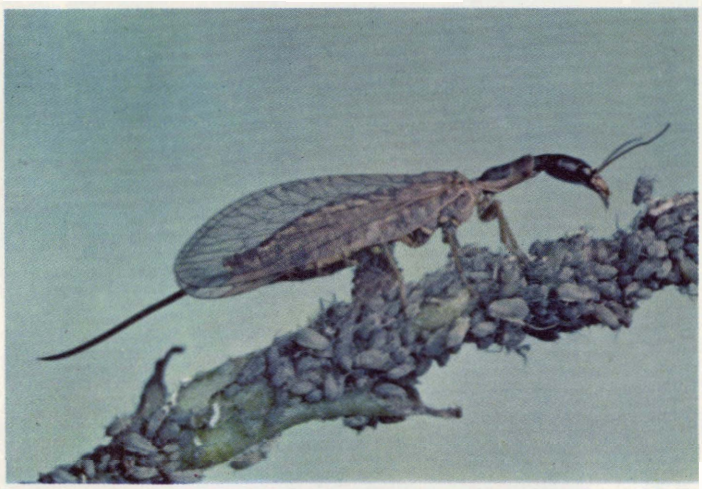
PHOTOGRAPHS, (TOP LEFT, CENTRE LEFT, BOTTOM LEFT, BOTTOM RIGHT) E. S. ROSS, (TOP RIGHT) ROMAN VISHNIAC—PUBLIX

INSECT

Brown lacewing, order Neuroptera. Soft-bodied insect with extremely elaborate venation of its large wings. Larvae are beneficial to man as aphid eaters

Earwig, order Dermaptera. A hard-bodied insect characterized by a pair of "forceps" (cerci) at the end of its abdomen

Paraphagadochir trachelia, a web spinner, order Embioptera. A social insect that lines its subterranean tunnels with silk produced from glands in its front tarsi (leg segments)



Snake fly, order Raphidiodea (considered by some a superfamily of Neuroptera). Photograph shows the long, slender ovipositor of a female as she rests on a plant stem covered with aphids

Stylops, order Strepsiptera. Twisted wing flies, a small, parasitic order. This unusual photograph shows a male in the act of feoundating a female that lives within the abdomen of a boo (note wings at top centre) that is feeding on a flower

REPRESENTATIVES OF INSECT ORDERS

PHOTOGRAPHS, E. S. ROSS

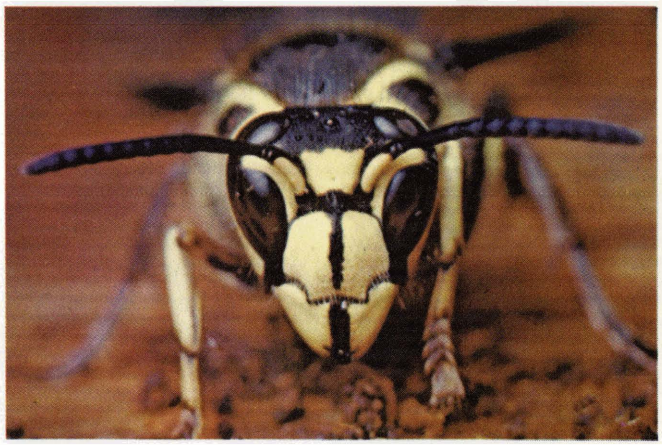
Horsefly, ***Tabanus*** species, order DIptera. Colour patterns of the compound eyes are used **in identifying species** of ***Tabanus.*** Houseflies and **mosquitoes are also** members of **this order**

A velvet ant, a **mutillid** wasp, the female of which is wingless and **antlike, order** Hymenoptera. This is the great order of social insects, including bees and ants. Velvet ants are parasites on other insects

Bush katydid, ***Microcentrum rhombifolium*, order Orthoptera.** The **leaflike colour, shape** and **pattern** of venrtlon **serve to camouflage** the katydid from predators

Long-horned meadow grasshopper, ***Orchelimum*** species, another member of the Orthoptera, related to the katydids and crickets

Cockroach, order **Blattaria** (considered by some a family *of* Orthoptera). **Flattened,** quick-running **scavengers,** some **species** have **become** household **pests.** Most are tropioal, such as **this** onr from Peru



Close-up of the head of a queen bald-faced hornet ***(Vespula maculata),*** order **Hymenoptera.** This wasp is related to the common yellow jacket

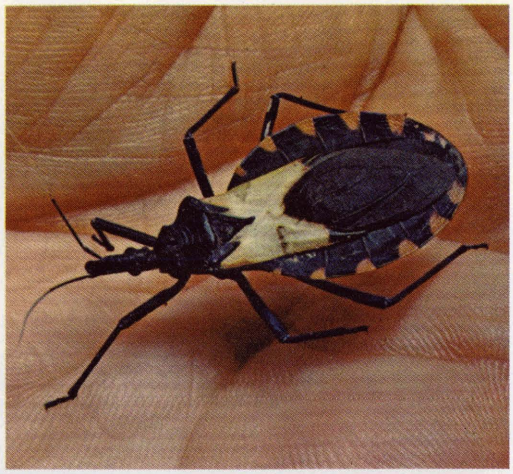
REPRESENTATIVES OF INSECT ORDERS

PHOTOGRAPHS, (TOP LEFT, TOP RIGHT, CENTRE LEFT, BOTTOM LEFT) JOHN H. GERARD, (CENTRE RIGHT. BOTTOM RIGHT) E. S. ROSS

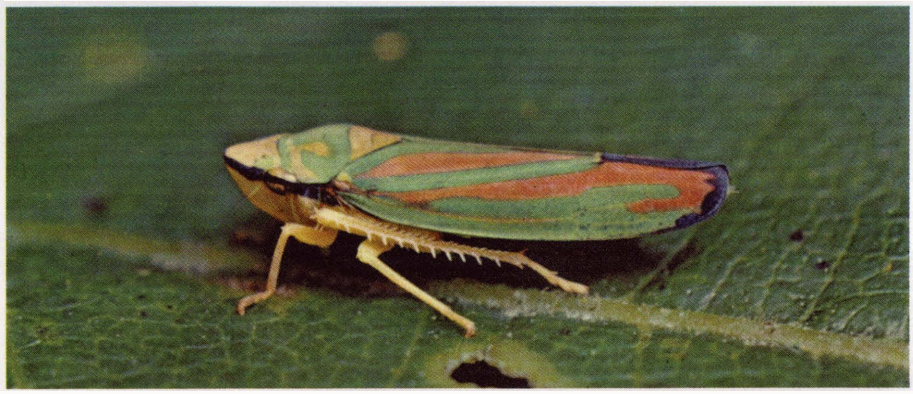
INSECT

Nymphs of the milkweed bug, a member of the chinch bug family, Lygaeidae, pests that attack many cereal crops and grains

Stink bug, family Pentatomidae, protected by its nauseous d o u r and taste



Triatoma **species,** a **reduviid** or **assassin** bug. **This** one is a household invader and a disease carrier **that bites** man



Leafhopper, a plant-sucking insect of the family Cicadeliidae. Many species are destructive to the trees, shrubs and flowers upon which they feed

Cicada, *Tibicen* species, the familiar song-producing insect of the summer. The skin case left after its final molt may often be seen attached to the bark of a tree

Another reduviid bug shown emerging from its **final** molt to **its** adult stage

A shield-backed bug (family **Scutellaridae)** of central Africa. A **plant-**eating insect related to the stink bugs

HEMIPTERA: THE TRUE BUGS AND THEIR RELATIVES

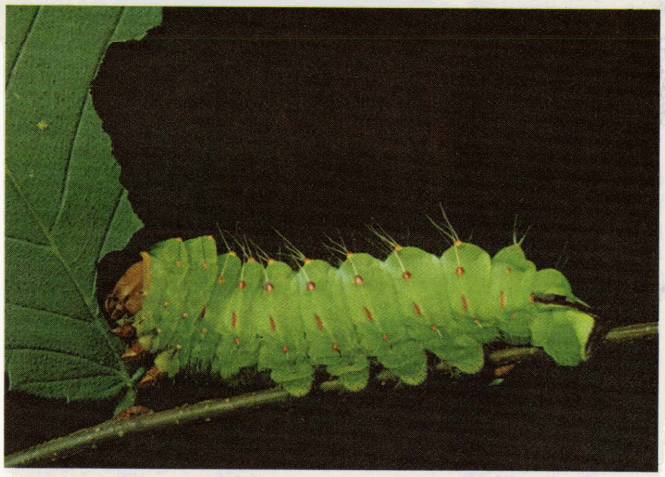
PHOTOGRAPHS, (TOP LEFT) JOHN H. GERARD, (TOP CENTRE) ROMAN VISHNIAC—PUBLIX, (TOP RIGHT, CENTRE RIGHT— 2, BOTTOM RIGHT) E. S. ROSS, (BOTTOM LEFT) D. DWIGHT DAVIS

Caterpillar of the Cynthia moth. See picture and caption, page 611

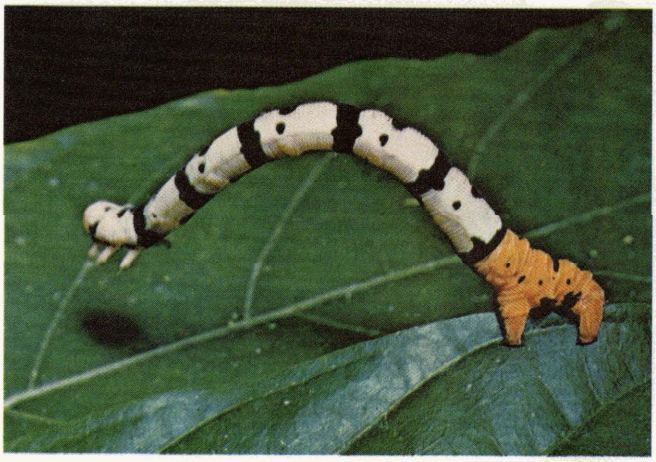
Larva *of Charaxes* species (family **Nymphalidae**), a large **African butterfly**

Cynthia moth, *Samia cynthia*, **family Saturniidae, resting** on **a flower just** after emerging from **its cocoon.** The **wings have** not yet fully opened

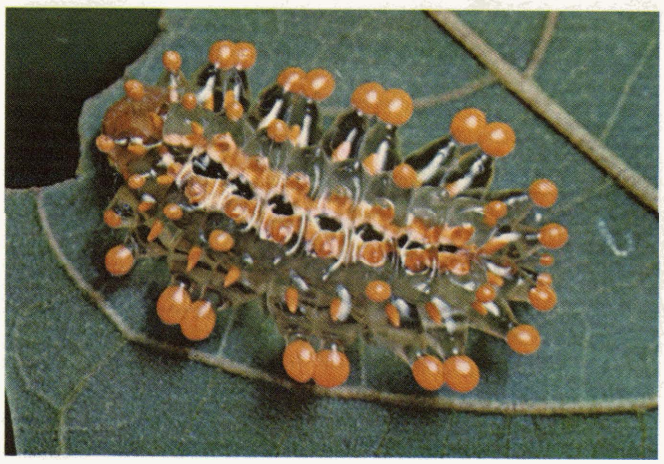
Red caterpillar of Peru. The hairs on **this** larva are **poisonous**



Caterpillar of the polyphemus moth *(Antheraea polyphemus)*



Measuring worm of the Congo. This is the larval stage of one of the geometrid moths, second largest family of the **Lepidoptera**



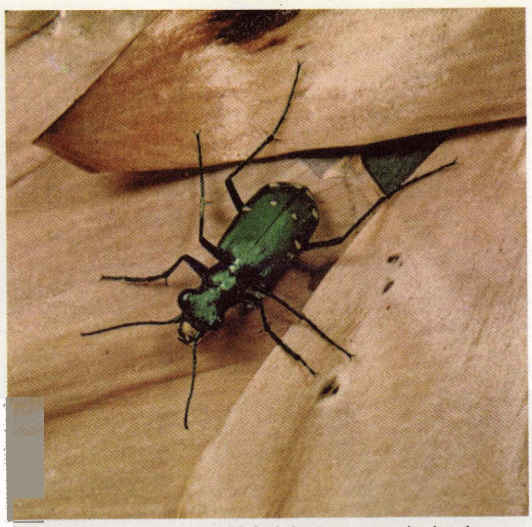
Exotic larva of a Peruvian lepidopteran

LEPIDOPTERA: BUTTERFLIES AND MOTHS

PHOTOGRAPHS. (TOP LEFT, CENTRE RIGHT) JOHN H. GERARD; (TOP RIGHT) ROMAN VISHNIAC—PUBLIX, (OTHERS) E. S. ROSS

INSECT

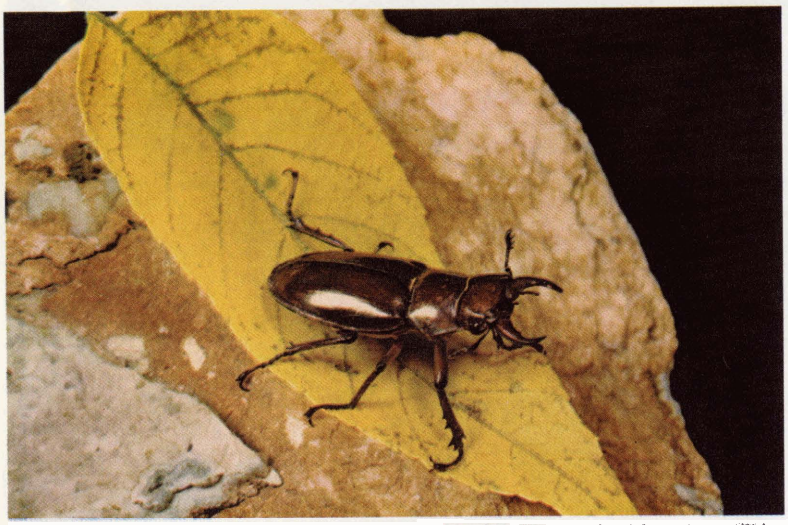
The ivory-marked beetle (*Eburea quadrigeminata*), a long-horned wood-boring beetle (family Cerambycidae)



Six-spotted tiger beetle (*Cicindela sexguttata*) showing metallic coloration that is typical of many cicindelids

Tumblebugs (*Canthon laevis*) rolling a ball of dung. After a site has been selected, eggs are laid in the ball of dung and it is buried

Eyed elater (*Alaus oculatus*), a click beetle (family Elateridae)



Stag beetle (*Pseudolucanus capreolus*), ♂ male showing the greatly enlarged mandibles that resemble the antlers of a stag

Striped blister beetle (*Epicauta vittata*) shown on a tomato, one of the crop plants on which it feeds

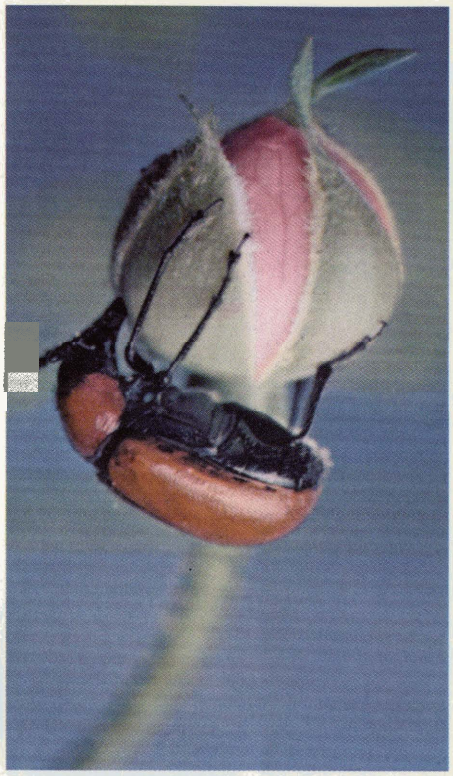
COLEOPTERA: BEETLES

PHOTOGRAPHS, JOHN H. GERARD

Western spotted cucumber beetle (*Diabrotica undecimpunctata*), a pest which destroys cucumbers by eating and by acting as a disease carrier

White grub, the larva of the June beetle or June bug, ***Phyllophaga*** species

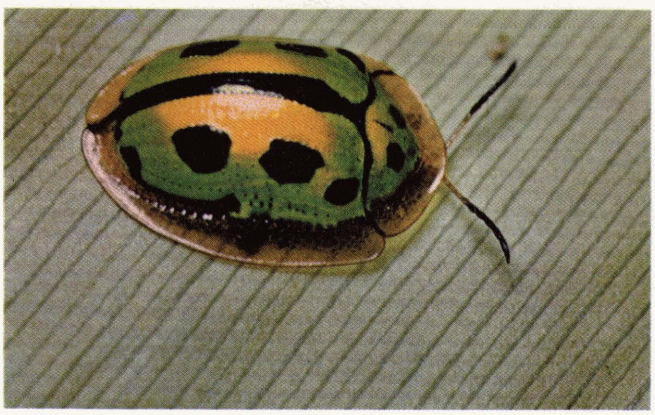
Colorado potato beetle (*Leptinotarsa decemlineata*), a serious crop pest



Fuller rose weevil (*Pantomorus godmani*), a flightless snout beetle of the western U.S., that attacks fruit trees as well as roses

The round-headed apple borer, ***Saperda candida*** (family Cerambyoidae), shown above its **emergence** hole in a **branch**

Another **cerambycid** beetle, the cottonwood borer (***Plectrodera scalator***), photographed on a tiger lily



A Peruvian **cassid** or tortoise beetle, family **Chrysomelidae.** The brilliant metallic colours of **these** beetles disappear when they die

A around beetle ***Galerita bicolor,*** a North American member of the large **family** Carabidae

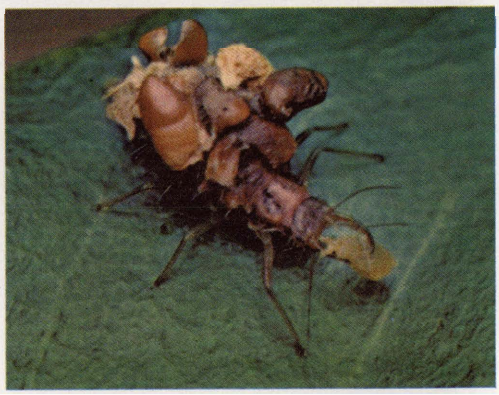
COLEOPTERA: BEETLES

PHOTOGRAPHS (TOP LEFT, TOP CENTRE LOWER, TOP RIGHT, BOTTOM LEFT) E. S. ROSS, (TOP CENTRE UPPER, CENTRE LEFT, BOTTOM RIGHT) D. DWIGHT DAVIS, (CENTRE RIGHT) JOHN H. GERARD

INSECT

Aggregation of monaroh butterflies ***(Danaus plexippus)*** resting during a migratory **flight.** The monaroh follows a regular seasonal migration and return flight

Bee fly (family **Bombyliidae) hovering** as it **drops its eggs** into the entrance of the burrow of a ground **nesting bee**



Larva of a **green lacewing, family** Chrysopidae, **carrying** "trash"—the remains of **victims—on its back** as it forages

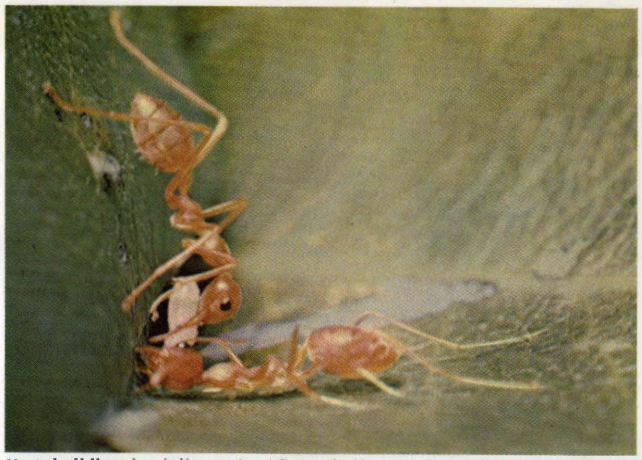
A rare **example** of nonhuman use of a "tool": a **sphecid wasp** tamping dirt into its burrow by means of a tiny stone **held** in its mandibles

A oriokrt singing in front of the **entrance** to **its** nest. The sound is made by **raising** the wings up over the **back** and rubbing them together

Female mantis **assuming** a frightening pose to ward off attack on her **eggs, the white mass** on which she is standing

INSECT HABITS

PHOTOGRAPHS, (TO? LEFT) D. DWIGHT DAVIS, (OTHERS) E. S. ROSS



Nest building by tailor ants (*Oecophylla species*) of Angola. Ant at left is holding a larva and squeezing it. As larva secretes silk, second ant uses it to weave leaves together. See below

Group of tailor ants pulling leaves together in preparation for permanent attachment by sewing with larval silk

Formica ants tending aphids. The smaller insects are "milked" by ants to$ a sweet "honeydew" they seorete. In return, the ants carry the aphids to choice feeding grounds and may take them into their awn nests during the winter

Completed nest of the tailor ant (*see* pictures above) showing leaves gathered together and sewn around the twig of a tree. Nests may be made mer- than 100 ft. above the ground in tropical trees

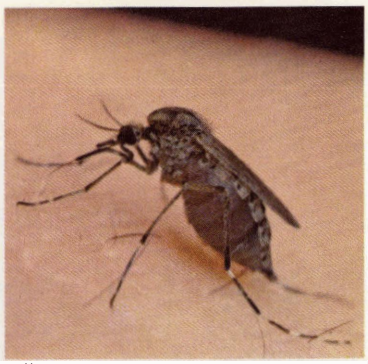
TWO HIGHLY ORGANIZED ACTIVITIES OF THE ANTS

PHOTOGRAPHS, E. S. ROSS

INSECT

Aphids (at right) sucking the juices from a plant while an aphid (on left), the larva of a golden-eyed lacewing, attacks an aphid

Hawk wasp stinging a large spider. The wasp carries the paralyzed spider to a burrow and deposits eggs on it



Aëdes mosquito feeding on man. Note abdomen swollen with blood. Only the females are bloodsuckers

Damselfly (order Odonata) eating an insect held in its mandibles while mites (red spots) bite the damselfly. Mites are arachnids, members of the same phylum (Arthropoda) as insects

Blues (lycaenid butterflies) drinking at a mud hole. Note extended proboscises

Robber fly (family Asilidae) feeding upon a grasshopper. Prey is held by the strong legs of the fly while it uses its beak to puncture the integument of its victim

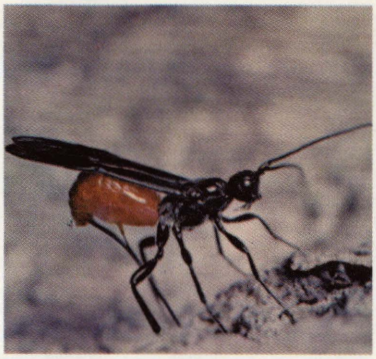
Aulicus, a checkered beetle (family Cleridae), feeding upon an insect larva

INSECTS FEEDING

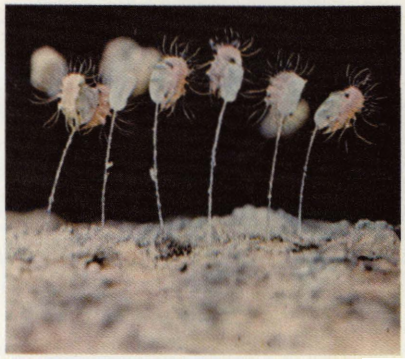
PHOTOGRAPHS, (TOP LEFT) ROMAN VISHNIAC—PUBLIX, (TOP CENTRE) JOHN H. GERARD, (OTHERS) E. S. ROSS

INSECT

Cicada, *Tibicen* species, just emerged from its nymphal **shell, completing a metamorphosis that lasts as** long **as** 17 years in some **species**



Braconid, a parasitic wasp, laying eggs. Note long ovipositor **extended** from abdomen



Lacewing larva (family Chrysopidae) **hatching** from eggs. Each egg **is** borne on the **end of a** hairlike stalk formed of a hardened seoretion

Arctiid eggs hatching on a **leaf. Grown** larvae **are the familiar "woolly bear" caterpillars** that become nocturnal moths

Newly-hatched stink bugs (family Pentatomidae) and their empty egg cases on a leaf

Aphids being born **alive** by **parthenogenetic reproduction** of **wingless females.** Note individual emerging from mother at right

Short-horned grasshoppers or locusts **(Acrididae)** mating. Eggs are laid in the **soil in** large masses enclosed in a capsule

Praying mantis ***(Stagmomantis carolina)*** with egg mass. Egg laying takes place in autumn, the eggs hatch early the following summer. Each capsule contains about 200 eggs

REPRODUCTION AND METAMORPHOSIS

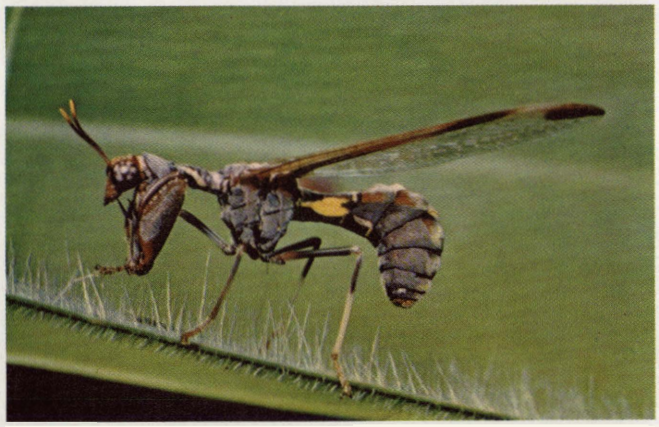
PHOTOGRAPHS, (TOP LEFT. BOTTOM RIGHT) JOHN H. GERARD, (OTHERS) E. S. ROSS

INSECT

Parasitic fly of central Africa with the body shape and markings of a bee, features that serve to protect it from the bees which it parasitizes

Cryptic pygmy locust (family Tetrigidae), a tiny insect that resembles the bark of a tree

Nymph of orchid mantis (*Hymenopus* coronatus). The form and coloration of the nymph serve to conceal it from its prey. The adult of this species bears little resemblance to the nymph



A mantidfly or mantispid (related to lacewings) with wings and abdomen like those of a wasp, and enlarged front legs like those of a mantis

Larva of the spicebush swallowtail butterfly (*Papilio troilus*). Large eyelike spots are merely protective coloration

A walking stick, *Diapheroma* femorata, a phasmid, related to the rnantids, coloured and shaped like a twig. These insects also assume positions that further enhance their disguise

PROTECTIVE COLORATION AND MIMICRY

PHOTOGRAPHS (TOP LEFT, TOP RIGHT CENTRE RIGHT) E. S. ROSS. (CENTRE LEFT) J. R. HENDRICKSON FROM D DWIGHT DAVIS, (BOTTOM RIGHT) D. DWIGHT DAVIS, (BOTTOM LEFT) JOHN H. GERARD

are agile on the wing, with probably the best vision of all insects, and catch gnats and mosquitoes. Hence the common name "mosquito hawk": an order with very agile locomotion, unusual vision and the accompanying agile behaviour. The beat of the long wings is slow, due to primitive slow muscles, which are long for power, giving the thorax housing them a backward slant termed skewness of the thorax. The sense of smell is greatly reduced.

Order VI. Orthoptera (Figs. 35–40).—*Grylloblatta,* cockroaches, grasshoppers, katydids, crickets, mantids and phasmids, 21,000 species in 7 families. Forewings leathery, hind-wings membranous with a large posterior lobe folded up fan-wise; mouth-parts for biting; cerci present.

The nymph resembles the winged adult, with usually five to nine instars.

Eggs are frequently laid in packets or oofheca formed from secretions of abdominal glands. For the first time mother care of the young begins to appear in a few groups. The majority have a life of at least one year and some even longer. With this increasing length of life of the adult, the mother has opportunity to contact her young. Family life in insects usually appears where the species is gregarious, with old and young living together in a crevice or enclosed space, as in the log-inhabiting roach *Cryptocercus* (L. R. Cleveland, 1934).

Family life is also associated with life on the ground. The surface of the ground is the most intense animal environment known. A ground insect never knows whether it will meet friend or enemy around the corner, behind a tuft of grass or hidden in the ground. Man himself had a slow simian mind until he adopted walking on the ground among tigers, wolves and such. Only the quick-witted or otherwise protected insect survives in a ground environment. This means that surviving ground insects in general have a more complex and intelligent behaviour than flying insects, tree insects or subterranean insects. In Orthoptera the ground-inhabiting roaches develop a family life in occasional species. Crickets and grasshoppers, when disturbed, vault to safety. Such radial locomotion in a group is antisocial. Survival in such species is by a behaviour of disassociation. Also many live only six months, so that generations do not overlap where a mother can associate with her offspring. Walking sticks are nearly all tree insects, with the young usually hatching on the ground from eggs dropped from a tree, which disassociates mother and offspring. Further, walking sticks depending on the camouflage of their shape, are exceedingly slow, and possess the stupidity that is associated with the lessened locomotion. Mantids, where the female usually eats the male after mating, are carnivorous with a savage behaviour, a type which seldom evolves into mother love. Thus, except for a few ground-inhabiting cockroaches, the behaviour of most Orthoptera is very simple. They are at the evolutional level where in a few species for the first time behaviour has become complex enough to show reversal from primeval "selfish" behaviour to mother care.

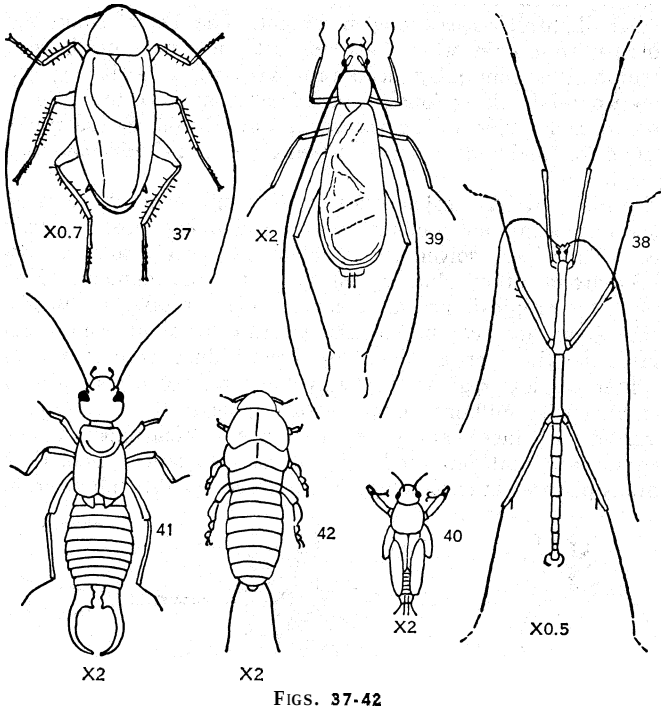
In technical publications the Orthoptera are usually split into five orders, adding Grylloblattodea, Phasmida, Blattaria and Mantodea.

Order VII. Plecoptera (Figs. 27–29).—Stone flies, 1,260 species in 8 families. Roachlike insects, but more slender, with long antennae; wings membranous, folded in repose, the hind-wings with a large posterior area folded roughly fan-wise as in many Orthoptera. Mouth-parts for biting but generally degenerate; a few records of having chewed flower buds. Tarsi three-jointed, cerci often elongate.

Nymphs aquatic with biting mouth-parts. The smallest forms without gills, but usually with tufted gills on the thorax and jaws, and in a few species, with gills about the anus. The nymphs of the more primitive species herbivorous, slow; of the higher species carnivorous and more active. This is another but minor beneficial group that transforms aquatic vegetation into fish food.

A group with probable orthropteroid relationship, but with no immediate relationship to Odonata and Ephemeroptera, and with behaviour little above that of may flies. The adult lives several days but without food.

Order VIII. Dermaptera (Figs. 41, 42).—Earwigs, 1,050 species in 7 families. Small to medium-sized insects. Usually elongate with the body terminating in a pair of large forceps. Usually heavily chitinized, hard. Filiform antennae, good eyes, biting mouth-parts. Fore-wings are short hard covers for the much-folded, fanlike hind-wings.



FIGS. 37-42

Orthoptera (also figs. 35, 36): (37) *Periplaneta americana*, cockroach (from Marlatt); (38) *Diapheromera femorata*, walking stick; (39) *Oecanthus nigricornis*, tree cricket (from Fulton); (40) *Tridactylus apicalis*, pigmy cricket (from Morse); (41, 42) Dermaptera, earwigs; (41) *Forficula auricularis*, European earwig (from Tümpel); (42) *Hemimerus talpoides*, a louselike external parasite of African rats (from G. H. Carpenter)

Nymphs resemble adults, but in some species the cerci (forceps) are long threadlike filaments.

Earwigs are gregarious ground insects, usually omnivorous. The eggs are laid in a cluster and guarded by the mother until hatched, when the young wander away. This is the second and independent development of family life in insects. It arises in species that live on the ground—the most dangerous environment—and congregate under logs, stones and other safe spots with the mother living to see her young.

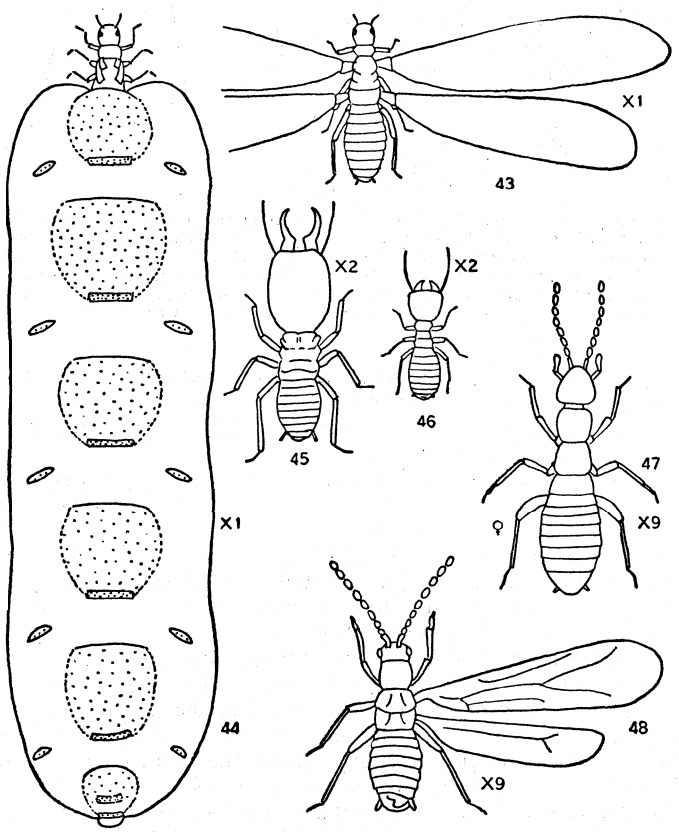
Two species of *Hemimerus* are wingless, have two filamentous cerci instead of forceps, and are external parasites on African rats. Two species of the related *Arixenia* of the East Indies live with bats. These forms are truly viviparous. The eggs hatch and the young mature partially within the mother's oviducts. where they are nourished by a placentalike organ which connects the abdomen of the embryo to the ovarian tissues of the mother (see *Order XV. Hemiptera, Suborder Heteroptera*, below: Polyctinidae, viviparity with placenta on neck of embryo). Largely because of the great differences between the semisocial habits of true earwigs and the external parasitism of *Hemimerus,* almost as wide apart as habits can be in insects. these have at times been given an order of their own, Diploglossata, of four species. the smallest proposed order of insects.

Order IX. Isoptera (Figs. 43–46).—Termites, white ants, over 2,000 species in 5 families. Social insects usually with four long feeble wings in the males and females. numerous wingless workers derived from both sexes. In some species neuter, soldier. nurse and other castes; reproductive males and queens dark; nonreproductive castes usually white and soft.

The primitive Australian species *Mastotermes darwinensis,* which lays eggs in an ootheca as do roaches, shows by structure, intestinal protozoan fauna and habits, that the termites are an

order of social roaches with modifications (far reaching degeneracies usually) in structure and behaviour for a social life. Because the female lacks a special sperm receptacle, the male lives with her and fertilizes her from time to time. Most termites eat wood, which in many forms is digested for them by a fauna of special ciliate protozoa living in the gut. The diet of wood lacks proteins, to obtain which termites eat their own dead, re-eat faecal matter containing dead protozoa and, in a few species, grow wood-inhabiting fungi. There is also much regurgitation of food to each other among the socii, trophallaxis, or the trading of food for food and for services (see Order XXV. Hymenoptera: Bees, below).

Termites live in sealed nests, which cut them off from the numerous behaviour problems which free-living insects have to face. They have solved the problem of difficult contacts with the environment by shutting off the outer environment. However, some tropical species forage for plant products. Because of the wood diet, they become dangerous pests about wood structures. In the wet tropics they help reduce forests to soil. In drier tropical regions they may build mound nests up to 20 feet high with millions of inhabitants. The earth of the mound is mixed with faecal and other substances, which makes its surface so hard that few predators can gain entrance. One of the famous pictures in entomology is a railroad cut through a termite



FIGS. 43-48

Isoptera, termites or white ants; Termes *natalensis*, Africa: (43) winged virgin queen (male closely similar); (44) aged queen, dealiated (wings off) and abdomen distended with eggs, immobile; (45) soldier; (46) worker (from Hegh); (47, 48) Zoraptera, rare, semisocial termitelike insects; Zorotypus *hubbardi*, U.S.; (47) female; (48) male (from Caudell)

nest at Katanga, Belgian Congo (Y. Sjöstedt, Revue *Zool. afric.*, 2:354–391, Bruxelles, 1913). Once a year in temperate species the termite nest is opened by the workers and the winged queens and males have a colonizing flight. Those which survive start new nests. In such flights they are easy prey to numerous birds, lizards and insectivorous mammals. The queen in some of the tropical species becomes enlarged to three or four inches (fig. 44) and is thought to live six or more years and to lay as many as 1,000,000 or more eggs. The population of a small nest of *Nasutitermes* when counted totalled 3,600,000.

Such enormous aggregations of a single species thoroughly protected from outside enemies become extremely desirable living places for numerous other insects, termitophiles (lovers of termites), thousands of species of which live with the termites themselves as parasites, as predators, but more often as symbiont~.Many of these are glandular and secrete substances which are eaten by the termites in return for housing and food. (See later sections on Hymenoptera: Bees, Trophallaxis.)

These great social complexes are built on mother behaviour, for the life of the mother is long enough to associate her with the young where the association has been more or less compulsory from living in cracks and crevices and where there has been built up a great caste of workers. These, both male and female, by some twist of heredity, have inherited mother behaviour but do not have mother reproductive ability. Rigid inherited mother instinct, stepped up by trophallaxis, compels them to care for the young (see later sections on Hymenoptera: Social Wasps, Bees and Ants). Social behaviour of the termites began in their ancestors, the roaches. This is the third development of social behaviour.

Order X. Zoraptera (Figs. 47, 48).—An order of minute insects of wide distribution but of one family, Zorotypidae, and one genus Zorotypus of 12 species. Some species have wings with two to four veins, others are wingless; biting mouth-parts; simple antennae, two-segmented tarsi, cerci short.

They occur in small colonies frequently near termite nests. They appear to be social, perhaps with castes, but there are only fragmentary notes on habits. By some they are thought to be related to termites, by others related to the book lice and psocids; very rare.

Order XI. Embioptera (EMBIIDINA, Figs. 51, 52).—One hundred species in eight families. Small slender campodeiform insects with biting mouth-parts, filamentous antennae, moderate eyes. Wings occur only in males of certain species.

Peculiar in having silk glands on first tarsal segment of forelegs in all instars of both sexes (the male dolichopodid fly thus spins web); in having femur of hind-legs large, housing enlarged depressor muscles for hind tibiae which probably give them their ability to run backward as well as forward. Some species are parthenogenetic (true eggs, but developed without fertilization).

Embiids are semisocial in that adults and young live in silk tunnels under stones, in grass tufts, under bark and similar places. The silken tunnels are spun from the glands in the forefeet, and help keep the nest atmosphere moist and entangle enemies. The species are inhabitants of the warm temperate zones and the tropics. Food mostly dead plant matter; little is known of colony habits. This is the fourth development of social behaviour.

Order XII. Corrodentia (Figs. 49, 50).—Psocids and book lice, 875 species in 15 families. Minute to small insects. Body short, compact; head large, prothorax necklike, eyes large, beaded antennae which may be short or long; no cerci.

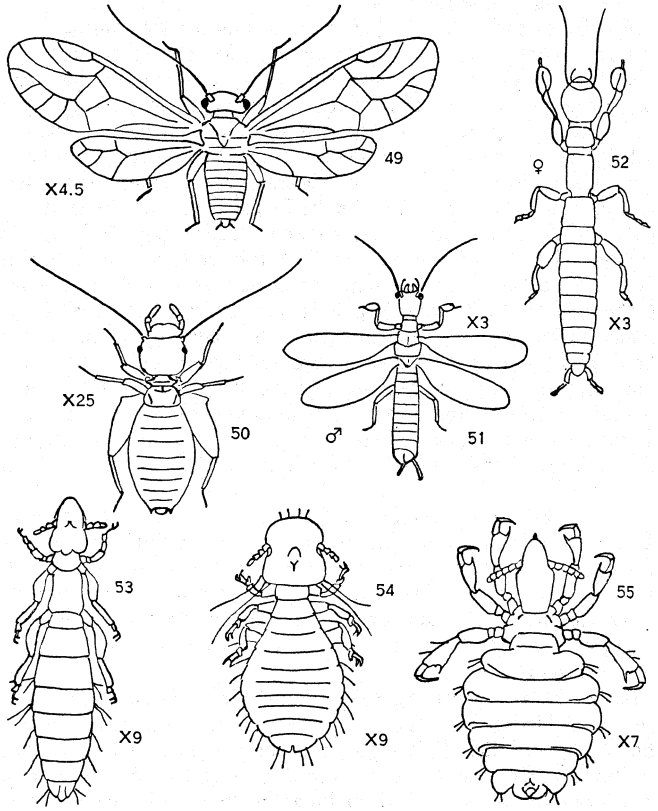
Corrodentia fed on dead plant and animal matter. They are ground and bark insects, frequently gregarious and in many species the young are associated with parents though none are known to be social. They have a simple behaviour, as do many insects which succumb to living on dead matter, which is usually abundant and of course does not have to be out-witted by superior intelligence. The bark-inhabiting psocids may be the progenitors of the Mallophaga, the biting bird lice (see next order). Book lice (fig. 50) are pests in libraries, where they eat paste and glue.

Order XIII. Mallophaga (Figs. 53, 54).—The biting lice of birds, with a few on mammals; 2,500 species in 9 families; of the shape and size of psocids and book lice, but usually tough-bodied against the pecking and biting of the host. Wingless; antennae and eyes reduced; biting mouth-parts; body with long smooth hairs reducing friction in crawling through feathers and hairs; legs short; claws, if present, adapted to grasp feathers or hairs.

No metamorphosis, as there are no wings. The species spread by contact between hosts as both birds and mammals have mating, and frequent family contacts.

This order is usually associated with the Corrodentia on the theory that psocids as bark insects crawled onto perching birds for warmth and were able to subsist on feathers, epidermal scales and dried blood about wounds. As ectoparasites, louse locomotion degenerates and with it the sense organs and any complex behaviour. Insects parasitic as adults do not later develop family or social behaviour. (See *Order* XXV. *Hymenoptera* where larvae become parasitic, the adults remain free-living and finally both become social.)

Order XIV. Thysanoptera (Figs. 14–17, 72).—Thrips. Minute, slender insects, mouth-parts of needles for piercing and sucking: 2,500 species in 17 or more families. Slender antennae, narrow hair-fringed wings; tarsi one- or two-jointed, with bladderlike organ on tip; no cerci.



FIGS. 49-55

Corrodentia (Psocoptera or Copeognatha), psocids, and book lice: (49) Psocus *fasciatus*, psocid, England (from McLachlan,); (50) *Lipocelis divinitoria*, book icuse (from Howard and Marlatt); (51, 52) Embioptera (Embiidina, Embiaria), web spinners, semisocial, a small tropical group, *Embia* major, Himalayas: (51) male; (52) female (from Imms); (53, 54) Mallophaga, biting bird lice: (53) *Liperurus squalidus*, duck louse; (54) *Goniocotes* compar, pigeon louse (from Osborn); (55) Anoplura, sucking or mammalian lice: Hematopinus *suis*, hog louse (from Osborn)

Metamorphosis with a pupalike stage. Thrips are strange insects of obscure relationships, but usually associated with the Homoptera and Heteroptera (hemipteroid orders) on account of the piercing mouth-parts.

One to seven generations a year. Nymphs with four instars, the third and fourth with wing-pads and do not feed (figs. 4–7). In some forms instar three is inactive in a cell in the ground and is called a "prepupa." Its antennae are free. and body movement is possible when disturbed. Instar four has antennae folded back over head and is more quiescent, called the "pupa." The "pupa" is not a true pupa because its wing-pads have been developed externally in the prepupa. (See earlier discussion under *Classification by the Forms of Metamorphosis: Holometabola*.)

The wings (fig. 72) are very narrow with one or two parallel veins. The wing surface is extended to three or four times the original area by wide fringes of hairs. by which the weight of the wing is reduced in such minute insects. Minute insects of other orders have similar wing structure, as in the minute moths termed Microlepidoptera, in minute wasps (Hymenoptera) parasitic on insect eggs and in very minute beetles, Trichopterygidae, Sphaeridae and Ptiliidae. It is convergent evolution in independent lines, common in insects, where the best mechanical design is produced that can be evolved from the insect material and basic design available.

Some thrips are carnivorous blood suckers, some herbivorous sap feeders. While they may become very abundant, they show no tendency of family or social behaviour. Insects with piercing and sucking mouth-parts have a basic behaviour of attack not easily modified to the tender care of young. Also the smaller forms have a very simple behaviour. Some are pests on pear blossoms, on onions and tobacco.

Order XV. Hemiptera (Figs. 56–71, 73–So).—Insects with needlelike mouth-parts which suck sap and blood; commonly called bugs. This great group falls into two such distinct subgroups that they are frequently treated as two distinct orders. The present tendency is to unite them. A similar situation occurs in the Odonata but there union is closer because of an intermediate mostly fossil suborder. This review treats the two hemipteroid suborders, Homoptera and Heteroptera, individually because of the great distinction of habits; the first feeds on plants wholly, the second on animals, except for a few families of sap feeders.

Suborder Homoptera (Figs. 56–71).—Cicadas, tree hoppers, leaf hoppers, aphids, scale insects; 34 families. Insects with piercing mouth-parts, living almost altogether on plant juices. Head small, because small muscles can operate the piercing needles of the mouth-parts. Wings membranous, with fore- and hind-wings similar and held sloping, roof-shaped, over body. Size large (cicadas) to minute (scale insects and aphids).

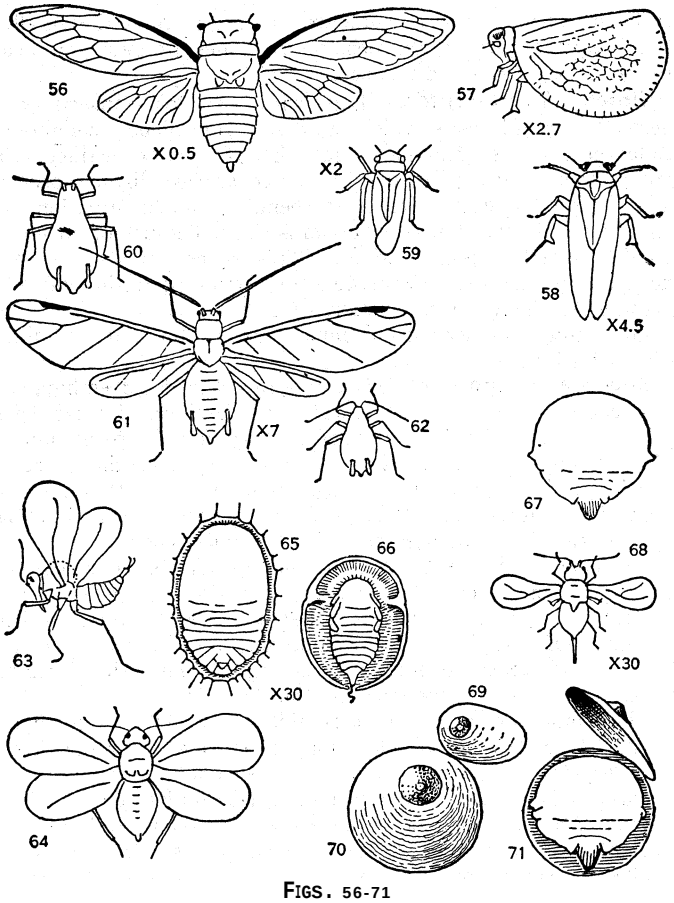
Behaviour is simple, but the life history may be very complex in the higher species (Phylloxera) parasitic on plants. The Homoptera form a very large order and are the least studied of any. Of the hemipteroid suborders, the Homoptera are simpler and appeared earlier in geological time, the Permian period. Heteroptera appeared in the Triassic.

The Homoptera appear to lack ability to imbibe or to digest animal blood. An anticoagulant may be lacking, or proper digestive enzymes, or proper excretion of poisonous animal proteid products. Those considered primitive (Cicadidae, fig. 56, Fulgoridae. Membracidae, etc.) are large, but show tendencies to obligate feeding on one or a few host plants. This tendency evolves to the more highly specialized minute forms (Aleurodidae, Coccidae, Aphidae), many of which are wholly confined to one plant species for food and which show some of the highest phases of parasite degeneracy of sense organs and locomotion found among insects. Conversely, the life history, as in many parasites. may become very complex. Complex life histories, an adaptive development in parasitism, reach their peak for insects in the higher Homoptera. In the life cycle of the plant louse, *Phylloxera quercus* of Europe. as many as 21 forms occur. The earlier and simpler phase of insect parasitism on particular plants with degeneracy of sense organs and locomotion has a parallel in the higher Coleoptera with degeneracies in the families of weevils.

Rfetamorphosis is incomplete, with a nymph which also has piercing mouth-parts. The number of instars. including adult, decrease from the cicada (fig. 56) with nine to the scale insects (figs. 67–71) where the male has four and the female three. The male scale insect passes through a quiescent "pupal stage" but one in which the wing-pads have been developed externally as in the "pupa" of thrips. The female (figs. 67, 70, 71), an immobile scale in the higher forms of Coccidae with only three instars, and never reaching winged adult form. .thus produces viable eggs in a late nymphal form In the aphids (figs. 60–62) metamorphosis is incomplete, but is involved uith the production, in nymphlike wingless forms (figs. 60, 62), of eggs which, without fertilization (parthenogenetically). develop within the mother who gives birth to active nymphs. At such periods in this life cycle all may be females, which in a few days after birth reproduce in the same manner. This is a production-line reproduction that can build up an enormous population in a few

days. It is only equalled by queen termites, queen bees and queen ants. Because of this, aphid pests require speed in control.

The scale insects as pests are almost as difficult to control as aphids. Many secrete a waxy "scale" cover (figs. 70–71) impervious to water. Some of their products have commercial value. The body of the cochineal scale on cactus has furnished the food-colouring dye carmine. Various other dyes are derived



FIGS. 56-71

Hemiptera, suborder Homoptera, cicadas, fulgorids, cicadellids, aphids, white flies, scale insects: (56) *Cicada marginata* (from Davis); (57) *Acantholomia bivittata*, fulgorid (from Dozier); (58) *Perkinsiella saccharicida*, sugar cane leafhopper, fulgorid, Hawaii (from Kirkaldy); (59) *Exitianus obscurinervis*, a ciccadellid, the commonest American pasture leafhopper (from Osborn). (60-62) *Myzus persicae*, peach aphid, three forms of the female, holarctic (from Theobald). (63-66) *Aleyrodes citri*, an aleyrodid, the citrus white fly; (63) male; (64) female; (65) "prepupa"; (66) male "pupa" (from Morrill). (67-71) *Lindingaspis rossi*, auricaria scale; (67) mature female freed from wax scale: (68) male: (69) male scale; (70) female scale; (71) female with wax scale lifted (figs. 67, 68, 70 from Ferris). Male "pupa" of Lindingaspis not shown

from the bodies of scales, while shellac and waxes from the scale-cover of oriental species have furnished the basis of lacquers and varnishes.

Nearly all Homoptera pass in large quantities a sweet diarrhoea called honeydew used as food by Hymenoptera. Ants are particularly dependent on it for sugars. Some ants cultivate and rear aphids and scales ("ant cows") as domestic animals for the honeydew. When bees use it in making honey, government authorities label the product "honeydew honey." It is used in cheap cookies and other 'bakery products. Many leafhoppers and other Homoptera transmit plant diseases which are as destructive as the direct sucking of plant juices.

Suborder Heteroptera (Figs. 73–80).—A group of varied forms, water bugs, plant bugs, bedbugs, stink bugs; 43 families. True bugs are insects with piercing mouth-parts. The form varies, but with small head, short wings—if such are present—held flat over body; the fore-wings thickened at the base as covers which protect the hind-wings. Size usually larger than in the Homoptera. Behaviour and life history simple, but in predatory species behaviourwis much more advanced than in the plant-sucking Homoptera.

Metamorphosis is incomplete, usually with five instars in the nymph, which resembles the adult in both structure and habits.

Some Heteroptera are suckers of blood, while others suck plant juices. In many, digestive enzymes are injected into the prey where they act as a noncoagulant to prevent the delicate beak from being plugged by clotting blood, and where the injected enzymes actually digest the internal parts of the prey. which predigested food is then sucked up. A meal leaves the insect prey an empty sack. A "bite" or sting by a bug is usually painful, since the tissue around the wound is partially digested. Thus bugs are able to use animal proteins, as compared with the plant-feeding Homoptera.

A series of families are aquatic, breathing air by coming to the surface (see fig. 73, water boatman). Authorities usually consider these a primitive group, which may explain the thickened fore-wings as an adaptation which prevents wetting of the flying hind-wings. A parallel evolutionary situation occurs in the lower Coleoptera, where hard fore-wings could have been an adaptation to aquatic life. The order shows much peculiar specialization in family groups. In the bedbugs (fig. 80), parasitic in nests of mammals and birds, the copulatory pouch (organ of Berlese) lies in the ventral wall of the abdomen and has no direct connection with the female's sexual organs. Sperm travel to the eggs through the internal tissues. In the bat bugs, Polyctinidae (fig. 79), also parasitic, the egg develops within the female; the embryo gro s through food supplied by a placental organ connecting the neck of the embryo with the ovarian tissues. In insects one other such organ is found in the Hemimeridae, order Dermaptera (see above), parasitic on African rats. Here the placental organ is attached to the abdomen of the embryo.

Various Hemiptera as blood feeders are carriers of diseases. Hemiptera seldom build up the enormous populations found in the vegetarian Homoptera and other herbivorous insects. All carnivores occupy the apex of a "food-pyramid." Each requires many victims, while each of the victims requires an even more numerous food-pyramid base. (C. S. Elton, Animal Ecology, London, 1935).

Order XVI. Anoplura (Fig. 55).—Sucking lice of mammals and some birds; 280 species in 5 families. Similar in form to the biting bird lice (Mallophaga), but the head small because of the smaller muscles operating the needles of the piercing mouth-parts. All are blood sucking; no wings, hence no metamorphosis.

The sucking lice are a compact group in general structure, but have no connecting forms indicating to what order they might be related. External parasitism with similar degeneracies and general appearance suggest relationship to the Mallophaga, while the piercing mouth-parts suggest relationship to the Hemiptera. However, recent study of the piercing mouth-parts (see Stozanovich, Jr., in *Microent.*, 1945, G. F. Ferris [ed.]) indicates that they are very different from those in the latter order. Being feeders on blood, they transmit various human diseases, such as trench fever and typhus.

SUBCLASS IV: HOLOMETABOLA

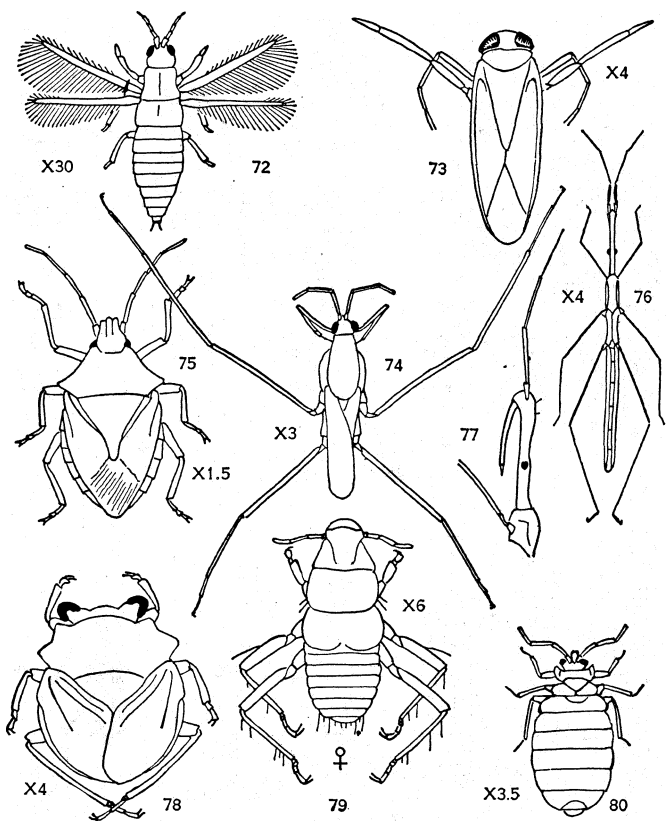
Winged insects, but including many secondarily wingless through parasitism, social life or other life habits where wings would be an encumbrance. Metamorphosis complete, with a true pupa with its wing-pads developed internally (figs. 12, 13) in the last larval instar (prepupal stage). Larvae, from degeneracy of locomotor and sense organs, are unlike imago. Larval life frequently shortened to a few days, adult life lengthened to weeks, months or years. In higher forms, larva usually associated with ample food supply and limited largely to mere eating and growing in size.

Order XVII. Coleoptera (Figs. 81–109).—The beetles; 154 families, 250,000 species. Minute to large insects, usually very hard-shelled, the fore-wings modified into horny elytra which meet

tightly in a straight line down the back; hind-wings, if not lost, membranous and folded beneath them. Prothorax large; mouth-parts for biting; cerci absent.

Larvae of many types, from campodeiform to legless grubs; pupa free. Rfetamorphosis complete, usually in a hard-shelled cell in the ground, occasionally in a silk cocoon spun from the anus.

The beetles in number of species comprise one-half of all described insects. They form the most numerous order of all animals from Protozoa to S'ertebrata. No satisfactory explanation of their unparalleled success as animals has ever been given. In general they do not evolve into high specializations in structure or habits. Modern beetles are very similar to the earliest fossil forms in the Permian, the last Coal age The general evidence suggests that they are evolved from an early orthopteroid type of insect near the cockroaches; that perhaps they have developed complete metamorphosis more or less independently from that evolved in the neuropteroid series of orders. The evidence is conflicting as to which families are the oldest in the order, Boving and Craighead (Larvae of Coleoptera, Brooklyn Ent. Soc., 1931) place the families Cupesidae and Micromalthidae as the oldest of all living Coleoptera. These have cylindrical larvae, some of which in *Micromalthus* (figs. 97–99) are legless (*Cupes*, figs. 94–96). If these are the oldest types the Coleoptera probably have evolved from boring (aquatic?) insects with cylindrical larvae.



Figs 72-80

(72) Thysanoptera, thrips; *Hercothrips fasciatus*, bean thrips, California. See also figs. 14-17 (from Bailey). (73-80) Hemiptera, suborder Heteroptera, true bugs: (73) *Arctocorixa alternata*, water boatman (from Hungerford); (74) *Gerris* buenoi, water strider (from Garman); (75) *Apateticus cynicus*, stink bug (from Htckman in Garman); (76, 77) Hydrometra *martini*, (77) side view of head showing piercing beak (from Garman); (78) *Gelastocoris* barberi, toad bug (from Garman); (73-78 American); (79) *Hesperoctenes impressus*, parasitic on bats, Neotropical (from Ferris); (80) *Cimex lectularius*, bedbug, cosmopolitan (from Marlatt)

The suborder Adephaga, with such families as Cicindelidae, Carabidae and Dytiscidae (figs. 61–84), is rated as the lowest of the larger groups. These are aquatic or shore-loving groups. They have campodeiform larvae, active and predaceous, but the larval legs are generally slender and weak as though redeveloped from previously reduced legs. All remaining beetles are usually grouped in the suborder Polyphaga, nhich contains five or more radiating lines of evolution. These lines arise in forms generally with campodeiform larvae and end in forms with cylindrical or even legless grublike larvae. In some of the higher families, the first stage larva is active and campodeiform, the full-grown larva cylindrical and nearly legless, uhich ontogeny suggests a recapitulation of ancestral forms.

The higher groups tend to evolve into (1) parasitism either on plants, the weevils, Curculionoidea and Platystomoidea, or on animals (other insects) the Meloidea; or (2) social life, the tumblebugs of the Scarabaeoidea and the ambrosia beetles of the Scolytidae. In either parasitism or social life the partially-grown larva does not need legs to find food.

Hypermetamorphosis occurs in the Meloidae (figs. 104–109), *Epicauta vittata* (figs. 104–107), E. *cinerea* (figs. 108, 109), species parasitic on clusters of grasshopper eggs. The meloid egg hatches into a campodeifnrm larva (fig. 104), very active, which runs about and finds a buried cluster of eggs. It burrows into these and changes into the short-legged form (fig. 105), which fattens up into the later form (fig. 106). The next, a full-fed stage (fig. 107), is fat and inactive and is called a prepupa; this sheds its skin turning into the true pupa (fig. 108) from which the adult (fig. 109) emerges. A similar series of forms (hypermetamorphosis) occurs in the family Mantispidae, order Neuroptera, parasitic on spider egg-clusters.

Parasitism on plants occurs all through the higher families of the Coleoptera, especially in the weevils, where many species are obligate or limited to feeding on one species of plant. In the highest forms of this obligateness, the larva, legless and inactive, spends its life feeding in a nut, fruit or similar very nourishing plant part. As in all parasitism, locomotor and sense-organs disappear and other degeneracies appear. In weevils even the adult may lose flying uings and the species may be reduced to one of females only, that do not need fertilization by a male.

Beginning social life appears in six families (W. M. Wheeler, Insect Societies, 1928). No social forms appear in the active carnivorous series of families. Here behaviour is too vigorous and abrupt to be easily evolved into the slow and more gentle behaviour necessary in the care of young.

In the Scarabaeidae, in the section of the dung beetles (scarabs) the young are fed on manure of the hoofed mammals (cattle, sheep, etc.). In one species of the tumblebug (*Copris hispanus*) studied by Fabre, the manure is rolled into a marble-sized ball by the parents, a hole is dug, the ball of manure is dropped into the hole, then cut into four parts in each of nhich an egg is laid. The mother remains in the chamber keeping the pellets free from fungus while the larvae develop. She then accompanies the young adults to the surface, where the family breaks up. In other species in this group the male lives with the female, helping her care for the young. In the Passalidae, which bore tunnels in and feed upon rotten wood, both parents live with the young, chew the wood up for food for the young, and both parents and young have sound-producing organs by nhich they call each other. The parents also help the young, at the time of pupation, build a sawdust cocoon. The adults of *Passalus* have pockets of live fungus in the colon. These may help digest the wood as do protozoa in the termite intestine and in that of *Cryptocercus*, the social cockroach. No study has been made of the fungal pockets.

In the highest level of the Coleoptera (the weevils) the larva, being immersed in an abundant food supply, needs little mother care beyond selection of the food medium. However, in the family Platypodidae and in some genera of the Ipidae, food habits have shifted from that of eating general plant tissues in which the tunnels lie, to the cultivation and eating of fungi grown on the wood walls of the tunnels. The fungal food is tended by the mother, as it needs special care in planting and harvesting to prevent fast growth. which sometimes chokes the tunnels and smothers the family. From the nature of the food, these weevils are called ambrosia beetles. The mother carries live fungus from her home burrow to that she makes for her eggs and young. After

establishing fungus beds in the burrow, she gathers the crop and places it before the larvae.

It appears unusual for intelligent behaviour to develop in a group which has shown broad parasitic degeneration, but it is associated with a shift from normal plant food to the growth of fungi by the adult. In insects, evolution of social life is largely the evolution of the behaviour of the adult, coincident with degeneration of behaviour in the young.

Order XVIII. Strepsiptera (Figs. 110–117).—Stylops or twisted-winged insects; 170 species in 6 families; size small to minute; mostly with the female endoparasitic; female as a primary larva, free, active, spiny, long-legged; after boring into host, she becomes an egg-producing sac without eyes, antennae or legs. Her head and thorax fuse into a cephalothorax (probably a pupal stage); at maturity she is enclosed in the larval skin, at the anterior end of which is a brood-passage opening, which is also used by the male in coitus. Sperm pass between female and larval skin case to a series of genital openings on venter of female, as her sexual organs are degenerate. Male with flabellate antennae, eyes wide apart, in some species stalked; fore-wings reduced to a pair of short flaps (pseudohalteres); thorax large; abdomen short.

The male has a pupal stage within last larval skin within host. The female larva changes into a pupa with head and thorax fused, from which form she develops no further. In the most primitive family Mengeidae, the female (fig. 114) has small eyes, antennae, mouth-parts and short legs, and has been found living free under stones. In all higher families she is an endoparasite in the abdomen of host insects, mostly Homoptera and Hymenoptera. Here the cephalothorax protrudes between two abdominal sclerites (fig. 116). She feeds by osmosis.

The Strepsiptera are considered a highly specialized parasitic offshoot from the Coleoptera. The fore-wings of the male (fig. 117) appear to be rudimentary elytra. The six distinct families, and world distribution with hosts in several orders of insects, indicate an old group well considered an order. The life history, habits and structure of larvae somewhat parallel those in the Rhipiphoridae (Coleoptera). In both, the primary larva is active and the later larva becomes an endoparasite.

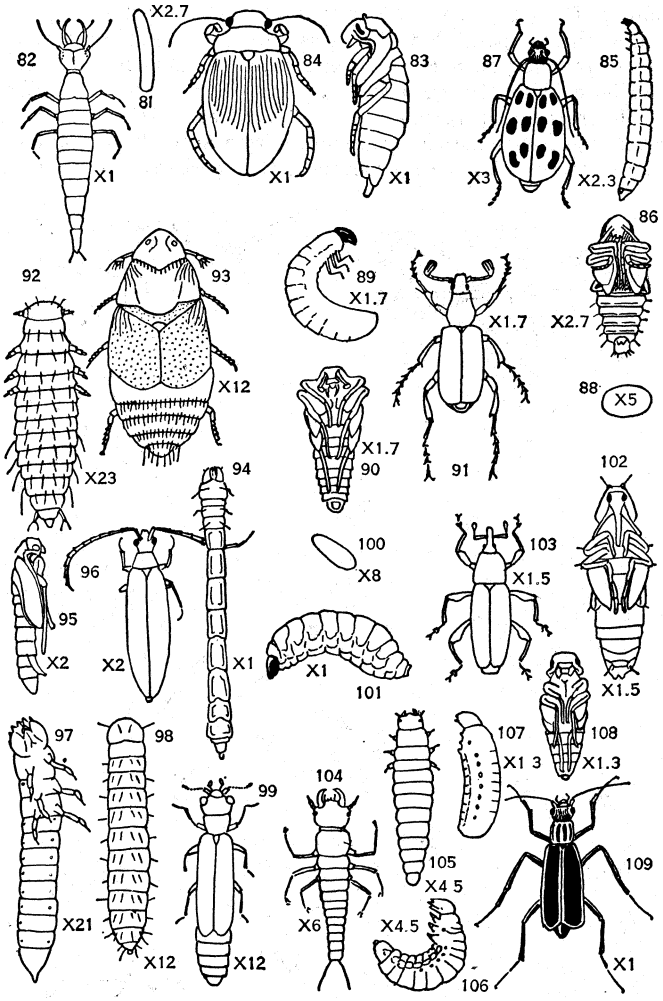
To entomologists the Strepsiptera form one of the most interesting groups of insects. Metamorphosis has reached an almost explosive development. The primary larvae (fig. 111) has legs and is intensely active in search of a host, finding which it bores in, lives by absorption of food (osmosis) through the body wall, becomes legless and quiescent. It pupates in the last two larval skins. The female evolves into a mere sac of eggs (fig. 115), with head and thorax fused into a cephalothorax which is apparently a pupal stage, while the male evolves into one of the most intensely active insects known, in his search for a mate. This life history is one of the more striking examples of how metamorphosis divides a life history into four parts by an interpolated pupal stage: (1) male larva, (2) male adult, (3) female larva, (4) female adult, when each can evolve radially in an independent direction.

Order XIX. Neuroptera (Figs. 118–121).—Fish flies, ant lions, aphis lions, mantispids and many others; 20 or more families, 4,350 species. Small to large soft-bodied insects, with long subequal net-veined wings which are folded rooflike over the body. Venation dense and elaborate in the higher forms. Tarsi five-jointed. Mouth-parts with raptorial jaws, usually modified into tubular blood-sucking organs; no cerci.

Larva various, campodeiform, eruciform, gilled in the aquatic Sisyridae. Metamorphosis complete, hypermetamorphosis in the Mantispidae. A cocoon is spun from silk produced by the normally excretory Malpighian tubules and passed out the anus.

The Neuroptera appeared in the Permian Coal age and are as old as the Coleoptera. The 20 or more families are relic, highly specialized tips of a great Mesozoic order, from which the connecting links between families have become extinct Structure and habits of the living forms are very different from family to family. They show evolution from a fairly simple venation, Sialidae and Coniopterygidae, to some of the most elaborately-veined wings known, in such families as the Myrmeleonidae, Ascalaphidae and Dilaridae. The term lacewings is a common name for many of these.

The majority are voracious wandering predators that stalk their prey. But the larva of the ant lion, Myrmeleonidae, digs a circular pit in sand or dust in which it lies in wait for any insect that slides to the pit bottom. The larva of the spongilla fly (Sisyridae) is parasitic in fresh-water sponges, while that of the Mantispidae is parasitic in egg sacs of spiders where it undergoes a hypermetamorphosis. The lacewings of the Hemerobiidae (figs. 118–121) and Chrysopidae eat aphids and scale insects, making themselves very beneficial insects. Because they are soft and shrink out of shape on pins in collection, few collect Neuroptera, but they are of great interest to students of insect evolution and habits. They are primitive and queer of habit.



FIGS. 81-109

Coleoptera, beetles, comprising one-third of all insects, the largest order of animals in the world. (81-84) *Dytiscus marginalis*, dytiscid diving beetle, European; egg, larva, pupa, imago (from *Korschelt*), notice the primitive campodeiform larva (82); (85-87) *Diabrotica 12-punctata*, chrisomelid, corn rootworm, American (from Riley); (88-91) Macrodactylus *subspinosus*, scarabaeid, rose chafer, egg, larva, pupa, imago (from Riley); (92-93) *Platypsyllus* castoris, platypsyllid. parasitic on the beaver (from Riley); (94-96) Cupes conocolor, cupescid, a very primitive borer in wood (from Snyder); (97-99) *Micromalthus debilis*, micromalthid, legged and legless larvae, a very primitive borer (from Barber); (100-103) *Sphenophorus* obscurus, a weevil, the sugar cane borer, Hawaii. Notice completely legless larva (from Riley); (104-109) Epicauta, 2 spp.: E. *vittata*, blister beetles parasitic on grasshopper eggs. Notice hypermetamorphosis (four types of larva); (104) campodeiform, active first-stage larva; (105, 106) second stage larva which changes from form 105 to form 106; (107) Quiescent prepupal form; (108) E. *cinerea*, pupa; (109) adult. (Figs. 104-109 from Riley)

Order XX. Mecoptera (Figs. 122–126).—Scorpion flies; 7 families, 310 species; small to medium sized, slender predacious insects with biting mouth-parts in an elongated head held vertically; antennae long; eyes large, widely separated: legs

long; four long slender wings, when such are present. Larvae eruciform (caterpillarlike).

The common forms of damp woods, *Panorpa* and *Bittacus,* look like four-winged crane flies (Diptera). The venation of the aings is similar to that of the crane flies, but with more cross veins. The name comes from the great bulb of male genitalia in some genera, appearing as a stinging organ to the ignorant, as on the tail of a scorpion. The caterpillarlike larva is a voracious predator (fig. 124) that wanders among the dead leaves of the forest floor. The adult *Bittacus* hangs from bushes with his long fore-legs and catches passing gnats with his grasping hind feet (fig. 126). This requires remarkable binocular vision to the rear, very unusual in animals. Good binocular vision which judges distance is associated with good eyes wide apart, characteristic of this order.

The order Mecoptera is of special interest to students of the evolution of insects, as by anatomy it appears to be ancestral to the Trichoptera and Lepidoptera and to the Diptera and Siphonaptera, and closely related to the Neuroptera. The five orders have been termed the panorpid complex or mecopteroid orders by Tillyard.

Order **XXI.** Trichoptera (Figs. 127–133).—Caddis flies, case worms: 16 families, 3.600 species. Small to medium mothlike insects, nocturnal or crepuscular; feeble biting mouth-parts, long antennae, large eyes; wings folded over body rooflike, covered with hairs and scales.

Larvae aquatic, living in a silk case to which usually are attached sand grains, sticks or pebbles (figs. 129–133); eruciform and most species with filamentous abdominal gills (fig. 127)

Larvae of the primitive family Rhyacophilidae scramble among the stones in torrents or many build silken tunnels. The larva of the Hydropsychidae build a hammocklike silk net on water falls, which sieves prey out of the running water. The majority build silk tubes or cases which may be free, so the larvae can crawl about by extending head and legs, or are attached solidly to a rock or log in the stream bed. Nearly all cases are variously camouflaged by sand grains, pebbles, sticks or bits of leaves glued to their surface. As the larva grows, it crawls out and builds larger cases. Its taste may change. Some species use one type of case ornament when young and another at an older stage. They pupate in a silk or gelatinous cocoon within the case. The pupa has no gills, but breathes air by spinning a sieve across the opening of the case. The air dissolved in the water running through the case forms a permanent air bubble within the case against the spiracles of the pupa. When ready to emerge, the pupa with its special free jaws gnaws out, the pupal skin splits and the adult flies up from the water. With defective mouth-parts, the adult lives but to mate, oviposit and die.

Caddis flies are general feeders, some herbivores, other omnivores. Except when flying in swarms in a mating dance, they show little associative behaviour. No aquatic insect shows any tendency toward family or social life. and but few even show any tendency to larval or adult aggregations. Exceptions are water striders, Gerridae (Hemiptera), whirly-gig beetles, Gyrinidae and the mating dances of caddis flies, and of some aquatic Diptera. In all these the larvae are aquatic, the adults aerial (except Gerridae of the Heteroptera, where both larva and adult are water-surface forms) which prevents mother care of the young.

Caddis flies rate as beneficial insects. They are one of the few animals which convert the great areas of aquatic vegetation into attractive fish food. They occur in enormous numbers.

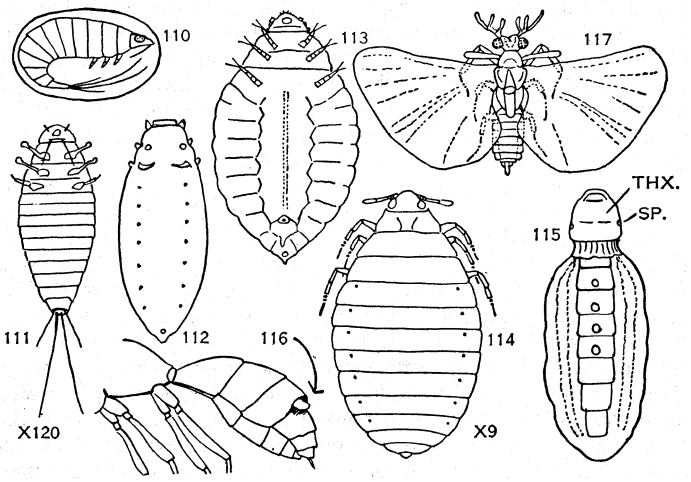
Order **XXII.** Lepidoptera (figs. 134–141).—Moths and butterflies; 190 families, 105,000 species in 1,000 genera; small to large insects with mandibles lacking, the two maxillae with galeae developed into a hollow nectar-sucking proboscis, coiled at rest; wings usually fanlike and covered with overlapping scales.

Larva eruciform, or caterpillar (figs. 134, 136, 139), with none to four pairs of abdominal prolegs; compound eyes reduced to a semicircle of 4–12 ocelli on each side of head; antennae vestigial; mouth-parts for biting; usually herbivorous.

The Lepidoptera divide into two great groups, the moths, Heterocera and the butterflies, Rhopalocera. The butterflies have antennae thickened, clubbed at the tip and sometimes (skippers, Hesperoidea) hooked at tip. The moths have many-jointed antennae, but plumose or not, and never clubbed. Moths are usually crepuscular or nocturnal, though there are many brightly-coloured forms which are diurnal, some of which have the appearance and habits of large butterflies.

The form of life history is monotonously alike through this great order. The caterpillar is herbivorous. except in a few Lycaenidae (butterflies) where it feeds on aphids and other small insects. It is carnivorous in moth larvae in ant nests, in the clothes moth, the wax-moth of bees and a few others. Some are borers in plant stems and wood, while others are aquatic with filamentous gills. The adult usually feeds on sugar as found in the nectar of flowers, in sweet sap, at times in fruit injured first by a bee, wasp or bird. Some of the most gorgeous South American *Morpho* butterflies are baited by faecal matter.

Except in the very primitive Micropterigidae, the pupa is obtected with all appendages glued to its surface, one of the highest forms of pupa in evolution (fig. 140). In the moths the last instar of the caterpillar usually spins a silk cocoon about itself from its temporarily modified salivary glands, which cocoon serves as a protective case while the caterpillar changes into a pupa and while the pupa transforms. In the butterflies there is no silk cocoon. The use of silk is reduced to a pad from which



FIGS. 110-117

Strepsiptera, the twisted-winged insects in reference to the folding of the male's wings, internal parasites of other insects (Fig. 116). (110-114, 117) Eoxenos *laboulbenia*, Menoeidae, the, most primitive family with active adult female (Fig. 114); (110) first stage larva in egg dissected from mother; (111) first stage larva or active triungulin; (112) last stage male larva; (113) last stage female larva; (117) adult male, notice rudiments of forewings. (115, 116) Xenos *pallidus*, female; (116) with cephalothorax projecting from abdomen of the wasp *Polistes* sp.; (115) dissected out, showing the fused, pupalike, cephalothorax. The male copulates with the cephalothorax. The sperm enter the female through the four circular openings on the abdomen. Because of copulation with the neck region of the female it was thought until recently this was the tip of the abdomen. (Figs. 110-114 and 117 from Parker and Smith; 115 from Bohart)

the pupa (chrysalis) hangs with a silken loop about its middle (fig. 140). The oriental silk worm with its moth, *Bombyx mori,* is the only insect fully domesticated by man. It can not live without his care in daily feeding and is not known in a wild form.

In spite of the simple behaviour of larvae and adult, the Lepidoptera show a definite tendency to aggregations: (1) of caterpillars, as in the army worms (Noctuidae), the various tent caterpillars (Lasiocampidae), the fall webworm (Arctiidae) and a few others; (2) aggregations of adults about water holes and moist places, where each species tends to form its own group. However, the food habits of adult and caterpillar are so different the mother could not feed her young. She has lost her main household tools. biting mouth-parts. in place of which she has a perfected sucking proboscis of little home use. Further, the

large awkward nature of the wings prevents the use of a family nesting cavity. Lepidoptera can not retain present body design and evolve on into the top level of insect evolution, social life.

Protective coloration and mimicry in these large and conspicuous insects rates as one of the most argued problems in entomology. Many caterpillars are green, brown or gray, the colour of the host plant. This seems a logical protective coloration. But the adult butterflies in motion-except a few which alight when in danger, fold their wings, and appear as dead leaves with markings like leaf veins—are to the human eye the most conspicuous objects in the landscape.

Order XXIII. Diptera (Figs. 142–149).—Two-winged flies such as gnats, mosquitoes, midges, horseflies, houseflies, sheep tick, bat tick and others; 138 families, 73,000 species. Adult; size that from minute, "no-see-um midges" *(Culicoides)* to crane flies, with wing expanse up to 100 mm. Antennae and eyes large; mouth-parts for sucking and lapping; one pair of wings, on mesothorax; second pair reduced to knobs (halteres) and present when fore-wings are absent. Abdomen long and wings narrow in lower families (suborder Orthorrhapha), wings and body shorter in higher families (suborder Cyclorrhapha).

Larva legless, wormlike in the Orthorrhapha, but *a* maggot with a few specialized exceptions in the Cyclorrhapha, in which suborder it has no well defined head (fig. 147).

Pupa obtected (appendages glued down) in the Orthorrhapha, coarctate in the Cyclorrhapha. In the latter the insect pupates within the last larval skin, which forms a tight hard cover for the true pupa within (fig. 148). The names of the two suborders are based on how the adult escapes from the pupa. In the Orthorrhapha (straight seam) the adult escapes from a straight longitudinal dorsal slit. In the Cyclorrhapha (circular seam) the anterior end of the pupal case opens by a circular seam. This outer shell, the last larval skin, covering the true pupa in the Cyclorrhapha, is termed a puparium (fig. 148).

In the Diptera (*q.v.*) metamorphosis has reached its greatest specializations in body structure other than that of the nervous system, as behaviour remains throughout the order comparatively simple. Metamorphosis has taken over completely. The larva feeds and grows, the prepupa and pupa are for differentiation, and the adult merely eats and reproduces. In the higher forms, mother care goes no further than laying the eggs on an attractive medium. The larvae throughout the order with a few exceptions are thin-skinned wormlike creatures (figs. 143, 147), which have locomotion reduced to wormlike undulation, and with the co-ordinate reduction of sense organs and behaviour which accompanies reduced locomotion. In the higher flies they are maggots and degenerate to a final extreme. They lie in the moist food medium and eat and grow. Many do a few hours labour at the end of larval life when they desert the food medium, crawl to a place favourable for pupation and dig in to safety.

The larval life is almost an aquatic or semiaquatic one throughout the order (always with exceptions). They live in water (mosquitoes) (figs. 142–145), in mud (horseflies), in damp wood (many syrphids), in moist earth (gnats), in the blood of hosts as parasites (tachinid flies), in wounds (screw-worm maggots), in carcasses and faecal matter (muscoid flies). In the highest, a parasitic group, the sheep tick and relatives (Pupipera), the larvae live in the moist tubes of the mother fly (viviparous), where they are nourished on a milk produced by the greatly enlarged accessory glands and are born to pupate immediately, the larvae parasitic in the mother, the mother a blood-sucking parasite of birds and mammals.

The carnivorous larva in the phantom gnats has caudal gills, is transparent in *Chaoborus* and floats in the water with four swim-bladders. The larvae of aquatic forms are beneficial in that nearly all are herbivores and serve to transform microscopic plant life into fish food.

The pupa in some of the lower Diptera (mosquitoes) (fig. 144) is an active wiggler. As with the larva, it breathes by coming to the surface. It swims to the surface, gets a breath of air and sinks. It does the same in the related family of phantom gnats (Chaoboridae).

Metamorphosis in the pupa has reached its most extreme form in the higher Diptera. In the maggot (fig. 147) at the prepupal stage the antennae, eyes and mouth-parts of the pupa are formed from embryonic buds (groups of cells, histoblasts) on the concave inner surface of a cavity opening into the pharynx of the maggot. When partially formed, the sac turns inside out like turning a stocking, whereupon the parts of the head are on the convex outer surface of a head which is the everted sac. No comprehensive study of this curious process throughout the Diptera has been made. Head formation appears to be normal in the Orthorrhapha. The wings and pupal legs are formed in peripodal sacs as in other Holometabola.

The ptilinum is another curious organ formed only in the higher flies. It is a sac within the head of the newly formed adult which can be filled with blood by body pressure and extruded through an opening in the front of the head, an opening which closes in later adulthood. This organ is used to push off the cap of the puparium, to push off the cap of bee and wasp cells in flies parasitic on such, and to push a hole up through the soil after pupation in the ground. The young fly braces itself, extrudes the ptilinum, and shoves a hole into the ground ahead of itself. The ptilinum is withdrawn and the fly crawls forward into the cavity, when the process is repeated. A housefly can dig its way up through seven feet of loose sand by this process.

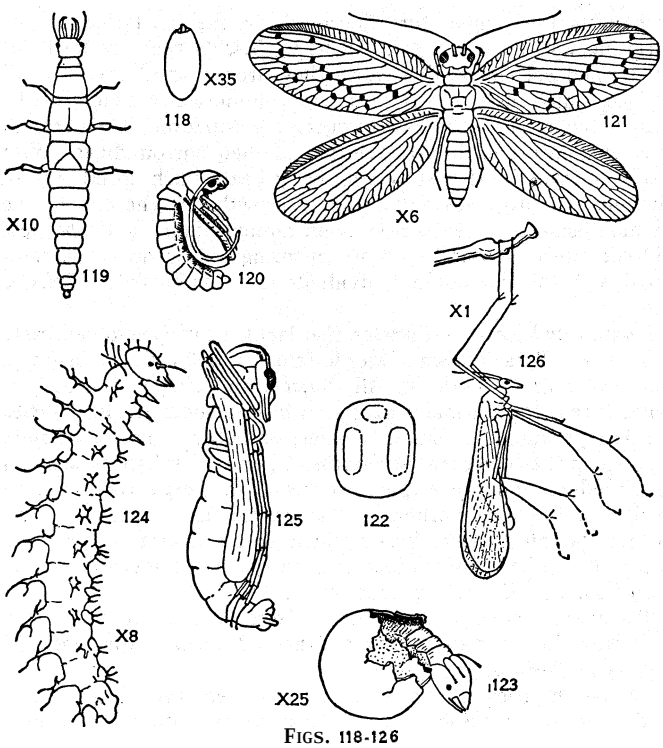
The adult flies of the majority of the higher families are some of the most active insects known, but do not have the endurance on foot or on the wing of that of the wasps, bees and ants. Some estimates give them a reasonable speed of 50 miles an hour. They are seldom taken on the wing by birds and other insects. Evolution has streamlined the body by rounding the head, folding the antennae in a groove down the face, shortening the body and shortening and speeding up the wings. Instead of attaching the front edge of the hind-wings to the trailing edge of the fore-wings to clear air eddies, the hind pair has been discarded, hence the name Diptera (two wings).

Whole families of flies as larvae are parasitic on other insects. The Tachinidae are all so, and are one of the most beneficial groups of insects. They keep down outbreaks of Lepidoptera by attacking the caterpillar. The egg is usually laid on the caterpillar, back of the head. The maggot bores in but leaves its posterior end, which has the spiracles for breathing, sticking out of the host's body, or it may attach the spiracular end to a large tracheae or spiracle of the host while it devours the viscera. In the Apioceridae, which are parasitic on spiders, the female spurts thousands of microeggs over weeds and bushes where spiders may lurk. These hatch minute very active larvae, which may wait for a spider to come by or may crawl to a likely spot. Some finally find and attack the spider in its web. The maggots of other flies (blue bottles, Calliphoridae) help to reduce the carcasses of birds, mammals and dead fish to soil. But the housefly whose maggot is reared in filth, excrement, spreads intestinal diseases when it walks on human food. The many blood-sucking families of flies from mosquitoes (Culicidae) to horseflies (Tabanidae) only add to the discomfort of man and his domestic animals. DDT has given the first easy control of the housefly. The mosquitoes which transmit malaria, yellow fever and other dread diseases make one of the greatest health problems over large areas.

Metamorphosis in the Diptera has almost completely separated the life of the larva from that of the adult, permitting evolution to operate on each form structurally in adaptation to utterly different environments. It is the highest form of metamorphosis we find in insects. The adult has been separated from the larva. In none is there mother care of the young beyond instinctively depositing eggs on the specific larval food medium. The larvae are ground insects in general, but with simple larval behaviour. The extraordinary development of the adult for speed in flight has removed it from the ground and its dangers, so there has been less need for the survival of the quick-witted and the evolution of elaborate behaviour which is a precursor of the elaborate mother care which can evolve on into social life. The Diptera can not become social. They are too simple-minded.

Order **XXIV.** Siphonaptera (Figs. 150–154).—Fleas; 6 families, 900 species, adults minute to small, apterous, laterally compressed insects, blood-sucking, ectoparasitic on mammals and some birds.

Larva wormlike; biting mouth-parts, toothed mandibles; vestigial antennae; eyeless; without legs; they feed on organic debris, usually in the nests or dens of their hosts. Metamorphosis



FIGS. 118-126

(118-121) Neuroptera. Fish flies, lacewings, ant lions, etc. *Hemerobius stigmaterus,* lacewing: egg, larva, pupa, adult (from Smith). (122-126) Mecoptera. Hanging flies, scorpion flies. *Bittacus pilicornis:* (122) freshly laid egg; (123) swollen egg, hatching; (larva, 124, pupa, 125, and imago, 126) the last in usual hanging position ready to grab passing gnats with middle and hind feet (from Setty)

complete and having features resembling that of the lower Diptera (Nematocera).

The fleas are a compact group of species of similar structure, life history and behaviour. They are Holometabola by metamorphosis, and by elimination remain nearest the lower Diptera in larval structure and adult mouth-parts. But the latter do not compare easily with any found even in the Diptera. The pupa (fig. 153), is exarate with free appendages as in lower Holometabola. The larva is legless, and in a coiled position transforms within a silken, disk-shaped cocoon flat on the surface of attachment (fig. 152).

Being blood sucking, they transmit various blood diseases, particularly bubonic plague. This is the basis of the many campaigns against rats and other rodents, the carriers of fleas and plague. The complete life cycle for most species falls within four to ten weeks. The use of the recently introduced DDT will probably be very effective in the temperate zones where freezing kills any fleas out-of-doors, but in tropical areas they can breed in yards the year around.

Order XXV. Hymenoptera.— Sawflies, parasitic wasps, true wasps, bees and ants; 118,000 species. Insects which have two pairs of membranous wings, if not lost in social and parasitic forms; hind wings locked to front wings by hooklets: mouth parts for biting, but in higher forms adapted also to lapping and sucking; antennae and eyes very highly developed (with exceptions). In the lowest forms of sawflies, abdomen with ten segments as in other higher insects; but above the sawflies, abdomen constricted at posterior end of first segment. with that segment fused onto the hind end of thorax. Female with ovipositor modified for sawing, piercing or stinging.

Larva eruciform in sawflies; vermiform, and usually without legs and developed sense organs, in the higher forms. Metamorphosis complete, with a cocoon of silk in most families.

Metamorphosis is less involved and apparently has not developed as high a mechanics of metamorphosis in the Hymenoptera as in the higher Diptera *(see Order XXIII. Diptera:* metamorphosis of the muscid fly head).

"If the Hymenoptera be judged By their intelligent behavior they must be regarded as including the highest members of their class" (A. D. Imms, A *General Textbook of Entomology, E. P.* Dutton & Co., Inc., N.Y. [1925]). They include the great series of parasites on insects, which constantly keep other insects from outbreaks disastrous to man, and many of which have strange special adaptations to parasitic life. They include the many kinds of fossorial (digger) wasps. The females of some of these are the most intelligent individualists in the insect world. But above all they include the great series of social wasps, bees and ants, where family life has evolved into social life, and this has evolved in the honeybee beyond any comparable level in human evolution, to a level where family life has disappeared completely and the whole social structure is a pure co-operative society Judged by the evolution of intelligent behaviour, the social wasps, bees and ants outrank all other insects in evolution. They do not hide from the dangers of the environment as do the termites, but face the environment openly and with intelligence boldly master it. *(See* SOCIAL INSECTS.)

The Sawflies and Parasitic Ichneumons (sens lat.).—The evolution within the Hymenoptera from sawflies to social forms has been one of the evolution of adult locomotion and adult sense organs, with concurrent evolution of the best brain and most elaborate behaviour found in any group of insects. The evolution of locomotion and the evolution of mental ability and behaviour go hand in hand. The sawflies are slow, stupid herbivores who live in and on extensive areas of food (leaves) where they do not need high intelligence to find more. Out of these evolve the great series of families of parasitic wasps, from the large Ichneumonids to the microscopic insect-egg parasites, the Chalcids. The majority are parasitic on insects, usually on larvae and eggs. In parasitism, means must be evolved for the parasite to find the scattered hosts. This is a constant pressure for the perfection of locomotion and sense organs. From the later sawflies on to the ants, the first segment of the abdomen has been transferred to the thorax. The new design improves locomotion in two ways: more room is given in the enlarged thorax for the great flying muscles and an extra pair of spiracles is transferred. giving the thorax of Hymenoptera three pairs instead of one or two, which makes a mechanism that pours air directly into the wing muscles. Sugar, a most energy-producing food, is used heavily by ants, bees and wasps. The lower Ichneumonids have long bodies, frequently dragging a long ovipositor, long legs which impede flight, and fairly long wings all of which mean slow motion. Within the parasitic series, evolution has shortened the wings; and, to give balance, has shortened the body; and, to lessen drag, has shortened the legs and the ovipositor, or has folded the latter against the body in a groove. The antennae have been shortened and folded against the face. This is evolution for speed and endurance on the wing. Speed without good sense organs and mental ability is dangerous to the individual. The preceding diagnosis applies more especially to forms parasitic on insects. Scattered through this long series of parasitic wasps are individual genera and even families in which the larva is herbivorous, such as cynipid gall wasps with simple behaviour, and *Harmolita* (Chalcidae), a pest of grains, where slower and even wingless forms may occur. Herbivorous forms living in great areas of their food do not need precision flight to find the hosts.

Transition from Parasitism to Family Life.—*In* spite of a widely accepted view among zoologists that a parasitic line can not retrace its steps and evolve back into a free life, there evolved out of this group of parasitic forms the great advanced group of the Aculeata or Hymenoptera with the ovipositor modified into a sting. This evolution is apparently based on the highly evolved locomotion, sense organs and habits of the adult which itself is

not parasitic. In the parasitic forms the larva had already degenerated to a point with the minimum of locomotion and sense organs. The habit of the adult of chewing and feeding on the host (malaxation) and a second ability, that of stunning the host with a poisoned ovipositor or evolving sting, may have been the evolutionary bridge which made for a contact of the mother with her young so that care of the young and family life could evolve as it has all through the stinging Hymenoptera. (See W. M. Wheeler, Social Insects, chap. 3 [1928].) From this point on, locomotion of speed and endurance, acute sense organs and intricate, intelligent behaviour of the adult evolved hand in hand. From this point on, by provision of nest and food for the larva, the latter had from the time of emergence from the egg the advantage of the use, vicariously, of adult tools and adult behaviour. Thus physiologically in its relationship to the environment the larva is vicariously an adult from emergence from the egg. This vicarious use of adult organs by larvae from birth is one of the great advances in insect evolution.

A group of a half dozen families such as the Evaniidae, parasitic on cockroaches; the Chrysididae, parasitic on wasps and bees; the Tiphiidae, parasitic on beetle larvae; and the Mutillidae, parasitic on wasps, carry the parasitic habit over from the true parasitic Hymenoptera into the great group of aculeate Hymenoptera. However, parasitism, that other way of living, continues to crop out up to the social parasitism found in wasps, bees and ants.

Digger *Wasps* and Mud Daubers.—Except for shorter hours of work, the amount of intelligent work done by the individualistic mother females of the next great series (the digger wasps), which include many genera in the Vespidae (senslat.) and the Sphecidae (sens lat.), is probably the greatest done by the individual in any order of insects. However, they do not work the long hours found in the day of the social Hymenoptera. In the usual life history, the queens and males emerge from the nest in the fall, mate and the male dies. The fertilized queen hibernates, and in the spring can range for miles in her hunt for a particular type of nesting site, but usually chooses a vacant spot in her home area, as the nests are commonly in close groups. She digs a hole in the ground one or more feet deep. She hunts a particular type of insect or spider, usually a caterpillar, which she paralyzes by a sting near the victim's nervous system, after which she flies away with the doped prey to the nest, alighting within a few steps of its opening, by which she shows a remarkable homing ability—the recognition of a half-inch opening, frequently camouflaged, in an area many acres in extent. Usually she places the victim near the nest, reopens the nest, carries the victim down to the bottom of the tunnel, lays an egg on it and packs dirt over it. She then emerges from the ground and closes the opening. She then seeks another victim. In a branch of this group the mud daubers, instead of digging a hole in the ground, manufacture a hole by building a mud cell in some protected place. The queen digs mud in some wet spot, transports it to the nest site and plasters it on layer by layer, a job of many hours' labour. She provisions it usually with spiders which have been paralyzed, places an egg in the cell and closes it with a mud cap. No two species in this great group have exactly the same sequence of habits, but all are intelligent and complex.

Social Wasps.--Out of these groups have evolved the family-minded papermaking wasps and the bees and ants; the bees from sphecoid ancestry, the social wasps and ants from vespoid forebears. In these the queen lives to take care of the young.

Polistes of the Vespidae. The queen constructs an open comb with the hexagonal cells hanging down. The paper is made of soft wood chewed from fence rails or dead timber. Paper is a nonconductor of heat which, when the nest is filled with brood, holds the latter at a higher temperature than would a mud nest. The mother queen feeds her young on chewed insects and nectar. The first reared are stunted females who from then on help with nest duties. Later in the season, with the increasing household help of these worker females, the food improves in quantity and the females reared have the size and reproductivity of queens, the queens for the succeeding year's nests. In late summer the males appear, fertilize the young queens and die. The aueens hibernate, each to start a new nest in spring.

Vespa, the hornets and yellow jackets. The nest is paper, but is surrounded by two to four layers or walls of paper, with a small guarded entrance. Within are tier on tier of pendant paper comb. As the nest grows, an inner layer of wall is torn off, chewed up and plastered on the outside until the late summer nest will range in size from that of a grapefruit to that of a large pineapple, the great hanging nests of the bald-faced hornet. In such nests the temperature is raised by the insulation of the enclosing wall to above 90°. All living insects generate heat but are termed cold-blooded because they are so small the ratio of surface, which dissipates the heat, to volume which generates the heat, is too greatly in favour of surface dissipation. They remain at a temperature slightly above that of their surroundings. With insulation the Vespa nest retains body heat which speeds up all physiological processes pertaining to growth. At the end of the six months' season (each nest is an annual affair) a Vespa nest will contain a thousand or more offspring of the queen as compared with the few dozen individuals in an uninsulated Polistes nest.

Polistes and *Vespa.—Polistes* also lacks a highly evolved caste of workers. These are small sterile females, but with the instincts and behaviour of mothers. All Polistes and Vespa socii are females except for the males produced in late summer. In Polistes the first produced are small females, probably a matter of food shortage in the cooler spring months. They are probably too small to reproduce and are termed workers. In Vespa these are so small that they are workers in size as well as habits. All work to feed the late summer brood which produces large queens and males. Vespa has evolved into a caste system of society. At the end of summer the nest is abandoned.

The males produced in the fall are from unfertilized eggs. They mate with the summer's young queens and die with the first cold day, as in Polistes.

Bees.—The bees by structure have evolved from digger wasps of the superfamily Sphecoidea. These wasps with a few exceptions use mass provisioning of the young. Enough food, paralyzed insects, spiders, etc., is stored in the larval cell to feed the larva until maturity. The cell is sealed, and in many species the digger wasp female never sees her young. Some primitive bees are close to such conduct but as far as known the queen remains with the nest and she and the young queens use it jointly before the latter mate and scatter. All bees are anthophilous, i *e.*, live on pollen and nectar. The more primitive forms, *Allodape* of Africa, practise mass provisioning. In some species of *Allodape* all young are in one cavity, but each with its own ball of pollen. In later evolution a cell is made for each larva, but mass provisioning is practised in Xylocopa (carpenter bee), Cerattna (little carpenter bee), Megachila (leaf cutter), Prosopis, *Colletes*, etc. However, the mother queen usually remains in the nest until her offspring appear. These may help clean the nest out or may help to provision the later young before they mate and disperse. At this level there is no worker caste of nonreproducing females. These species of lower semisocial bees retain the ancestral wasp habit of mass provisioning but do not feed the young animal protein as do the wasps.

Social Bees.—The truly social bees comprise only a few genera, the best known of which are *Bombus* the bumblebee, *Apis* the honeybee and two tropical genera *Melipona* and *Trigona.*

Bumblebee.—With the bumblebee the nest is usually a one-season affair. The fertilized queen winters over by hibernation. In the spring she finds a mass of fibres, usually on the ground, which most often is a deserted mouse nest. Then follows a short period of two or three weeks when very few queen bumblebees are to be seen. The queen has hollowed out a cavity in the bed of fibre, has built a wax honey pot, filled it with honey and has built near it a mass of pollen wet with honey on which she lays her first batch of eggs. She builds over this a cover of wax secreted by glands on the ventral side of her abdomen. She then sits on this mass of pollen, wax and eggs, keeping it warm with her own body heat until the eggs hatch. The larvae eat their bed of pollen and honey, and more pollen and honey which is brought to them

by the queen. She feeds the larvae by injecting this liquid mixture of pollen and honey through the wax roof of the larval chamber. As the larvae grow larger, she feeds each one individually. On the 11th day after the eggs are laid, in one species carefully observed by F. W. L. Sladen, the larvae each spins a silken cocoon. These stand side by side like barrels on end; the queen keeps them warm by covering them with her body. She faces her honey pot from which she can sip from time to time. From these first cocoons emerge a half dozen or so minor workers, which then appear in the field where they gather honey and pollen for the succeeding brood. In late summer in most species, large virgin queens and males are produced. These mate at the end of the summer, the males die and the fertilized queens hibernate, each to establish its own nest the following spring.

The habits of the bumblebee form one of the most instructive items in the evolution of social life in insects.

1. The nest is an annual affair.

2. It starts in the spring as a family mother-nest with all the work in its early stages done by the mother.

3. Mass provisioning is employed, which is characteristic of the provisioning in the digger wasps and in the lower bee families.

4. It changes to progressive provisioning, with many daily contacts between the mother and the young during the lifetime of the first brood.

5. The early brood of the season are smaller than the later brood; probably do not reproduce, so that a caste system appears in its incipiency. With the co-operative help of the workers, the family becomes a society and the mother becomes the queen of the society.

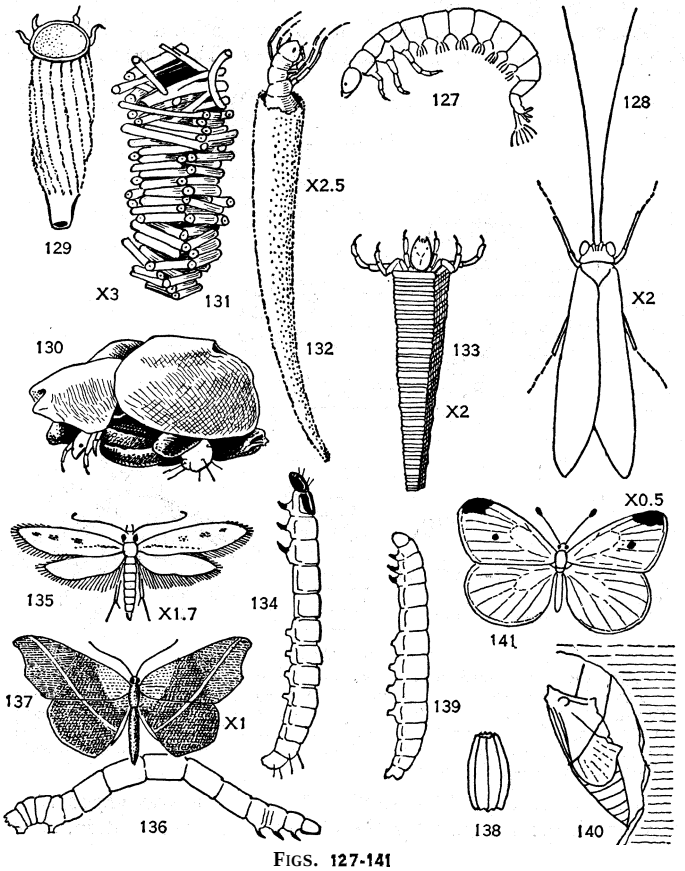
6. A nest reproduces the next spring after the pattern of the reproduction of the nest in the digger wasps and primitive bees, by each over-wintering fertile queen starting her own nest.

Three other items appear which are not specific to the bumblebees. They are found in all social Hymenoptera:

7. Nearly the whole social structure is one of adults using adult behaviour, adult powers of locomotion, adult sense organs and adult social tools, the mouth parts and highly modified legs. The larvae are completely degenerate and have lost all direct contacts with the environment of the nest. In the larvae locomotion has disappeared, sense organs have degenerated to the mere appreciation of food placed before them, so that larval behaviour is reduced to a minimum. However, the contacts of the larvae with the environment are made not by the weak and degenerate mouth parts, and behaviour of larvae, but vicariously by the fully mature contactual organs of the adults, those of the mother and nurse workers. Thus, for all practical purposes, the larva from birth has contact with the environment through the mature organs and mature behaviour of the adult. This is one of the greatest steps forward in the evolution of insects. So longer does a larva have to face a hostile environment with its weak organs and undeveloped behaviour.

8. Up to the level of the bumblebee society, particularly in those forms where the mother does not at any time associate with her young, as in the fossorial (digger) wasps, the care of the mother for the young has been a complex instinctive behaviour. Nothing about the young has attracted the mother, as she does not actually contact them. W. C. Allee would ascribe an aggregating factor to the fossorial wasps and the lower bees which nest sometimes densely in restricted areas, a principle of co-operation exhibited particularly in the defense of the group of nests by any one or all the mothers. The slight co-operation shown in the semisocial bees, where the young queens help clean out the old nests, would be a similar aggregating factor; but with the introduction of progressive provisioning, as in mid-growth of the bumblebee larvae, there enters another aggregating factor, trophallaxis.

9. Trophallaxis is the exchange of foods between members in an insect society. (See W. M. Wheeler, Social Insects, chap. 9 [1928].) Presumably in the bumblebee and the older larvae of the honeybee, and throughout the ants, there are developed glandular secretions (usually connected with the salivary organs in the larvae), and perhaps a regurgitation of digested food, which secretions are delectable to the worker nurse so that when the latter feeds the larva the larva gives the worker a tasty bit of food in return—a personal secretion which operates as a reward for mother love. Trophallaxis is especially developed in the many other insects associated with ants, usually spoken of broadly as myrmecophiles. It appears also in the insects associated with the termites, where they are termed trematophiles. Many of these



FIGS. 127-141

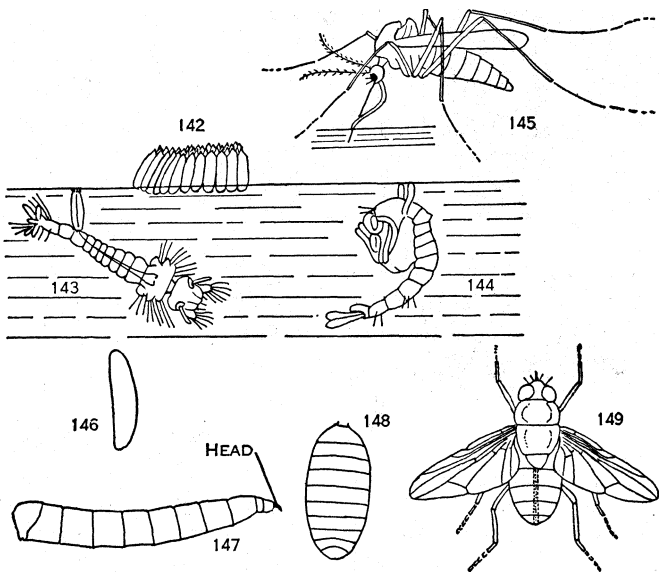
Trichoptera. Caddis flies, caseworms. (127-128) Hydropsyche *simulans:* (127) web-spinning larva; (128) imago; (129) silk case of *Mayatrichia* ayarna; (130) pebble case of Protoptila rnaculata; (131) "log-cabin case" of *Oecetis cinerascens*; (132) sand cornucopia of *Leptocella albida*; (133) chimney case of *Brachycentrus numerosus* (from Lloyd) (Figs. 127-132 from Mohr in Ross). (134-141) Lepidoptera. Moths and butterflies (134, 135) *Tinea pellionella*, clothes moth (from Marlatt); (136, 137) Drepanodes *muriferata*, a measuring worm, Australia (from Tillyard): (138-141) *Pieris* rapae, common cabbage butterfly (from *U.S.* Farm Bull. *1461*). Notice silk loop holding chrysalis (140), the remnant of the cocoon common to moth pupae

have enormous development of various body glands which secrete delectable substances by which they pay for their room and board. Termites also regurgitate partially digested food to friends. Thus the basic behaviour on which such a society exists is extraordinarily complex, is almost wholly adult behaviour up to the evolution of trophallaxis, when even the larvae do something for the adults.

Honeybee.—The society of the honeybee differs from all other insect societies (with the suspected exception of some ants whose habits are imperfectly known) in that the family life of the mother queen starting her own nest and taking care of her first brood has completely disappeared. The honeybee nest reproduces a new colony by the forcing of the mother queen out of the home colony by a young, vigorous queen, her own daughter. The mother takes with her a numerous band of faithful workers. This process is called swarming. and apparently may occur several times in the life of one queen bee, which is several years. Thus we arrive at a society in its final stage of evolution. Family life, the care of the young by the mother, has completely disappeared. The mother queen is reduced to mere egg-laying. The whole complex is a co-operative society of workers and larvae completely and thoroughly social. Students (K. von Frisch) of the honeybee

assure us that the young bees go through a routine of education, and that the honeybees have a simple series of signals, "a bee language," by which scouts inform the hive of the discovery of new areas of nectar and other simple incidents in bee life. The young worker bee functions first as a hive nurse, then as a water gatherer, and finally as a honey and pollen gatherer. The only immature behaviour left is that of trophallaxis, which helps to hold the society together.

The Ants.—The great majority of ants have a social system somewhat similar to that of the bumblebee. The food in different



FIGS. 142-149

Diptera, the two-winged flies. (142-144) *Culex* sp.: (142) floating "raft" of eggs; (143) larva; (144) pupa; (145) Imago, biting female; (146-149) *Haematobia' serrata,* hornfly, blood-sucking pest of cattle: (146) egg; (147) maggot (larva); (148) puparium (shrunken skin of last larval stage, which functions as a protective cover for the true pupa within); (149) adult (from Osborn)

species is almost anything edible. They are the scavengers which pick up all dead insects for the bits of meat they contain. They collect nectar on flowers, but prefer to operate wholesale by gathering the enormous quantities of honeydew, the sweet diarrhoea of the Homoptera. Nests are usually perennial affairs which operate indefinitely with the same queen, some of which have Seen known to live 16 years. In nests with several queens, the life is indefinite until some major catastrophe wipes out the whole colony. In the temperate zones at some time during the warm period of the year, at a time usually specific to each species, males and queens are produced. These have wings, and swarm and mate. Each daughter a potential queen then, after mating, casts off her wings and hunts a suitable place for a nest. By her own mother etiorts she excavates a simple chamber in which she rears her first half dozen minor workers. During that period she lives largely by absorption of her own large wing muscles. She is supposed to lay extra eggs which she chews up and feeds her young. Up to this point she is merely a mother caring full time for her family. The minor workers, on maturity, are wingless, nonreproductive females which take over the further care of the nest and the gathering of food. At this point the mother usually ceases interest in her young and becomes a mere egg-laying female, a queen of a co-operative society fed and cared for by the workers. Many variants of this type occur among ants especially in predatory and parasitic species. New colonies are formed (1) by young queens and (2) by swarming of extra queens with a considerable group of workers. Such ants are *Formica exsectiodes, F. truncicola* and *F. rufa clivia*

The Problem of the Male.—In the protoplasmic organic world the male has developed in both plant and animal kingdoms. In the evolving protoplasmic mechanisms he integrates heterozygous populations and also helps in the production of new better adapted species. He is needed, but in animals at large is useful only once, at mating. In the animal scheme the two sexes appear to have about the same amount of chemical energy in the total lifetime. In the female it is used up in the production of eggs and, in social forms, in the care of the young. The male has an unused excess of energy in the Hymenoptera. He is the nervous fast caste of the ant society. The female possesses a seminal receptacle which, filled once, in mating. lasts during her lifetime. Evolution permits the male to retain his excessive activity, as it is needed to find and fertilize the slower female. Mother care of the young is not inherited by the male ant. After mating he would become an expensive nonpaying guest. Evolution gives him death. (In the termites the female is without a seminal receptacle and has to retain the male throughout life.) The problem of the male is a real one in the animal world. In most birds he inherits mother care of the young and helps in domestic affairs. He contributes as much toward the care of the young as does the female in most instances. In *Homo sapiens* he disposes of his excess energy in art, science, literature, horse racing and war. Evolution in the Hymenoptera lets him die. The ant world is a female mother-world.

Fully social bees are few compared with the ants, all of which are social and live in colonies which continue from year to year. The major differences between ants and bees are:

Ants and Bees.—Ants are generally omnivorous while bees use only pollen and nectar. With live brood in the nest which must be fed regularly and often, the social bees store honey and pollen. The ants store seeds *(Pheidole)* and a few (*Myrmecocystus, Prenolepis*) store honey in repletes, which are workers fed honey until the distended body renders them immobile. In periods of food shortage a worker contacts a replete and is given a meal regurgitated from the replete's honey crop. Because most ants are omnivorous, they can live in areas with few nectar-producing flowers. For sweets they use honeydew, the sweet diarrhoea of sap-sucking homopterous bugs which live in both grasslands and forests. The bees tend to be limited to flowering seasons, and to flowering areas.

Ants walk; even the queen walks after mating; bees fly. In walking, ants can gather food at night and in cool weather, because the slower walking muscles do not need the high temperatures to operate that are needed by high-speed wing muscles of bees.

Ants walk in moisture and low temperature, which is reflected in nursery moisture and temperature. Bees fly at higher temperatures, which is reflected in warm dry nurseries. Ants at little cost of excavation use any kind of a cavity for brood. Wasps and bees at great expense of time and energy build elaborate warm, dry combs. The ant expense comes with constantly carrying brood from one part of the nest to another to keep larvae and cocoons at optimum moisture and temperature levels. The ant nest is a slum in architectural design as compared with the regular combs of wasps and bees. The mediocre design of an ant nest is very plastic, adapted to every advantage or disadvantage in the nest medium, a reflection of the more plastic temperature and behaviour of the ant, who survives on the dangerous ground by his/her more plastic behaviour. Perhaps ants do not see well enough to be interested in regular design as in bee and wasp comb.

Ants walk, which keeps them constantly in the most dangerous of environments, the surface of the ground. This tends to weed out the stupid ones. Survival of the fittest in ants is toward the development of acute senses and a rich behaviour. This is reflected in the greatly varied modes of life found among ants and in the constantly varying care of the brood.

Slowing the speed of ants down to a walk has made them better nurses in that contacts between mother or nurse and the young have to come down to the slow level of the activity of the young. With ants all common nest activity is at the calm social level.

Walking, however, has acted as a minor handicap in that evolution has kept the ant legs slender and trim for walking. They do not evolve into pollen baskets, pollen combs and wax shears, the social tools available to the bees.

Life on the ground has minimized vision and emphasized smell as a sense. In ultimate analysis smell is more specific and a better ground sense than the poor mosaic vision conditioned by a hard exoskeleton. It operates as well in an intricate totally dark nest as out in the light.

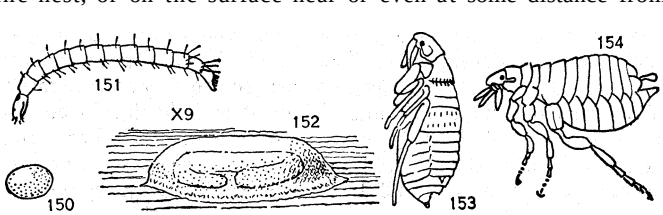
Determination of Castes.—In the higher Hymenoptera the male caste is determined by parthenogenesis, *i.e.*, he comes from an unfertilized egg. Queens and workers come from fertilized eggs and all are females. In the honeybee, queens are from fertilized eggs (as are the workers), but from such eggs placed in a large cell and from a larva given extra food which apiarists term royal jelly. In the honeybee, queens or workers which arise from the same type of egg differ in development because of full feeding with full development in the queen and more limited feeding with stunted stature in the worker caste.

No definite data has ever been advanced that castes in ants are produced in this manner. Finally Neal Weber, 1935, found a tropical ants' nest, *Cephalotes atratus quadridens,* with a mosaic caste in which one side of the body might be worker while the other side would be soldier. This evidence indicated trouble in the chromosomes, in the heredity mechanism. The conclusion was that in C. *atratus quadridens* the soldier caste was determined by the heredity mechanism. Wheeler, 1937, discusses this case with bibliography. *See* also S. F. Light, 1942–43, 1944, S. E. Flanders, 1944, and P. W. Whiting's 1941 review of Wheeler, 1937.

Population Limitations in the ants are mainly: (1) loss of life when the young queen goes abroad to establish a new nest; (2) loss of the whole colony by parasites, disease and the attack of predatory ants and other animals; (3) loss of the whole colony through minor climatic changes, drouth, cold winters and floods, also the growth of forest in new areas which shades out a nest that needs the warmth of the sun to mature brood and (4) the death of the queen in a one-queen nest.

Sanitation.—No great congeries of animals can live together without cleanliness of the habitation. Ants have evolved from parasitic forebears where the larva becomes an internal parasite. Such must not kill the host with poisonous faecal matter until the parasite has used the host as food, to the extent necessary. The larvae of the parasitic Hymenoptera (Ichneumonidae to Chalcidae) eat such pure food, the blood and viscera of the host, that little faecal matter is produced. The stomach is closed during larval life so that faecal matter can not pass into the intestine. At pupation the passage opens and the faecal matter is passed into the cocoon or it is retained as in the honeybee until the first flight from the hive.

Ants are very careful housekeepers. In an abandoned area of the nest, or on the surface near or even at some distance from



FIGS. 150-154

Siphonaptera, fleas. *Ctenocephalus felis*, cat flea: egg, larva which lives in organic dirt in floor cracks, the disk-shaped silk cocoon, pupa and imago which lives on mammals (from Howard and Marlatt)

the nest, they establish a garbage pile. All household refuse and the bodies of the dead are carried to this kitchen midden.

Domestic Animals.—Hundreds of species of insects have been described which apparently can not live except in ant colonies with the care given them by the ants. The relationship of guest to host is usually one of trophallaxis. The guest has some secretion delectable to the ant. The aphids or plant-lice (Homoptera) which pass sweet honeydew are oftenest met with.

In the forms of *Lasius niger,* the common yard ant, aphids are nursed on the roots of plants. In one species of aphid the ants collect the fall eggs of the aphid, store them in the nest piled like cannon balls in a fort, and when they hatch in the spring the young are placed on knot weed roots and later transferred to the more succulent corn roots where such are available. Many aphids that winter as adults and live on roots are wholly dependent on ant care especially in digging long tunnels that follow the roots and permit the exploitation of the aphids and the spread of the latter along the roots. Such ants are fully in *a* pastoral stage of social evolution.

Many small beetles live only in ant nests. Such give off secretions or odours "which ants appear to enjoy as a cat enjoys catnip" (W. M. Wheeler, *Ants,* 1913). Such are fed and otherwise cared for by the ants.

Slavery.—Slave-making ants, species of the *sanguinea* group of *Formica,* and of the genus *Polyergus* are among the common ants of Europe and North America. The sanguineas, as an army, raid a nest of *Formica fusca,* or in America a nest of either F. *fusca* or *pallide fulva,* carry home the larvae which are reared in the sanguinea nest, where they grow up as workers for the slavers. *Polyergus* has evolved into slavery to where mandibular teeth are lost. Slaves have to chew the masters' food and feed them. Many variants of this behaviour pattern occur between other ant species.

Harvesters.—Various ants, the cosmopolitan genus *Pheidole* and the American genus *Pogonomyrmex,* collect seeds usually of grasses, which are eaten and stored against nonharvest seasons. In *Pheidole* are giant-headed lady "soldiers" which hull the seeds rather than fight. In some species the soldier's head is larger than her entire body.

Farmers (Fungus Growers, Leaf Cutters).—In the Americas from Tennessee south to the tropics occur several related genera of the Myrmecine tribe Atti which cut leaves, carry these to their nests, where the leaves are chewed up and worked into subterranean fungus beds. The beds are started by the queen on founding the nest, who brings a mouthful of fungus from her home nest. The Atti live entirely on the fungus crop. The shape and style of the fungus beds is specific for each species.

Sewing with Silk.—The preceding examples of complex instinctive or rigid behaviour are outdone by nest building in the oriental genus *Oecophila,* which gets its name from its home of leaves, which are sewn together with silk thread. The sewing is a triple co-operation: (1) A group of workers line up along the edge of a leaf, hook their tarsal claws in the leaf on which they stand, reach across and with their mandibles pull the edge of a parallel leaf to the edge of the one occupied. (2) Another group goes into the brood chambers and collects a number of full grown larvae whose silk glands are gorged with liquid silk ready to spin cocoons for pupation. (3) The second group carry the larvae to the scene of the work, touch the mouth of each larva to the edge of one leaf then to the other. The silk sticks and dries while the first group holds the leaves. Co-operation is in each of two groups then between the two groups.

The Ant Patrol.—The ants, not numerous in species, patrol the insect world. Every square yard has from one to half dozen colonies with obscure openings overlooked by the human occupants. In the temperate and warm regions of the globe they daily patrol every square foot of soil that can produce vegetation, and carry home probably as much as 90% of all dead insects of the ground's surface and of the standing vegetation. Ants occupy the very peak of insect evolution. They patrol the world.

The Peak of Insect Social Evolution.—Both termites and ants have reached the level of farming which in each case is the cultivation of fungi. Certain wide-spread forms of *Formica sanguinea* live as slavers, perhaps a slightly higher social level, as they rear the young of other animals, those of the related forms of *Formica fusca,* into slavery. But the most wide-spread and commonest insect in the northern hemisphere from Yokohama to London, from New York to San Francisco is *Lasius niger* in its several forms and closely related species whose wide-spread success is based on its behaviour at a pastoral level. It rears and tends great herds of "ant cows" (aphids) for the sweet honeydew they produce. Some of its strains of aphid stock are unknown except in ant nests, except as cared for from egg to aphid old age. Such strains of "ant cattle" are completely domesticated. Such is the top level of insectean social evolution as gauged by

wide-spread success.

But the forms of *Lasius niger* and relatives have never been successfully monographed. They are so similar, so abundant and commonplace, so uninteresting in their cloudy colours, dirty yellows, browns and grays, that ant students pass them by for the obvious rarities. In appearance of mediocre size, of colour, of structure they are merely uninteresting drudges in smelly nests. The brilliant colours, the size and above all the dash and resourceful individualistic behaviour of their distant digger-wasp ancestors has disappeared. All are alike. 411 have sunk in evolution to mediocrity of appearance and behaviour. They work in gangs and succeed as gangsters. Thus in the highest level of insectean social evolution brilliant individualism has vanished. 'If'ide-spread mediocrity has supplanted it—a mediocrity that is successful in co-operative groups. Is this mediocrity the certain fate of protoplasm in its evolution as a steadily improved energy-transforming mechanism? Will the mediocre gang in the final social evolution of other animals eventually supplant brilliant individualism?

The Use of Tools.—The use of the silk-gorged larva as a shuttle or bobbin of silk by the workers of the ant *Oecophylla* (a near relative of *Lasius*) is the only known instance of the use of a separate tool by any ant worker. The other instance among insects is the pebble held in the mouth and used to hammer dirt into a plug to close the door of her burrow as used by the digger wasp *Ammophila,* a habit which recently has been questioned. The basic arthropod design of the foot, as well as the limitation to a minute brain, stops the evolution of the insect society at the threshold of the next great advance in social evolution, the use of detached and later the use of powered tools. The insect foot is closed by one tendon operated by one muscle located in the tibia above. As compared with the five-fingered hand of the mammal it is a defective single finger. The ant can not hold a tool firmly in its front foot.

Ants and many other animals use the mouth-parts as tools. Such are defective as tools in two ways: (1) The manipulator of the mouth tool is limited in range to the length of neck and head. (2) The mouth-parts are so close to the guiding binocular eyes that the distances are so short, and angles of vision are so narrow at the short distances from eye to tool, that the latter can not be precisely directed except at the zero angle of straight ahead.

In ants the range-finder eyes are structurally on the base of the tool itself. They can not in present basic arthropod design be detached from the mouth-part tool without a redesign of foot and mouth-parts. The basic arthropod design of limited minute brain and of tools tied directly to the guiding Binocular vision apparently forever stops the evolution of ant and other insectean societies at the slave-making and pastoral level of social evolution. The fossil ants perfectly preserved in the Baltic amber of 50,000,000 years ago are so nearly identical with present backyard species that experts assume they had then completed the evolution of the pattern of their present social behaviour.

Evolution in insects, however, is continuing at the present, as is shown in field work on the fruit flies by J. T. Patterson and students, by T. Dobzhansky and Warren Spencer; by A. E, Emerson in work on termites; by Richard Goldschmidt on *Lymantria;* and by the work in economic entomology where pests develop immunity to control measures.

BIBLIOGRAPHY.—Articles on insects appear each year in several hundred entomological and other biological journals. A thousand or more separate bulletins, books memcirs and popular treatises are published annually. The iollowing will open the various subjects indicated, and have comprehensive bibliographies.

General textbooks.— *G. H,* Carpenter, *Insects* (1924); W. H. Wellhouse, *How Insects Live* (1926); *D.* Sharp, "Insects," *Cambridge Natural History,* vols. V, vi (1895, 1898); L. F. Henneguy, *Les Insectes* (Paris, 1904); *A.* Berlese, *Gli Insetti* (Milan, 1900–25); C. Schroder, *Handbuch der Entomologie* (Jena, 1912–28); J. H. Comstock, *Introduction to Entomology* (1920); *A.* D. Imms, *General Textbook of Entomology* (N.Y., London, 1925); E. O. Essig, *College Entomology* (1942); *C.* L. Metcalf and W. P. Flint, *Fundamentals of Insect Life* (1932).

The iollowing are more local in coverage: V. L. Kellogg, *North American Insects* (1905); H. M. Lefroy, *Indian Insect Life* (Calcutta, 1909); T. B. Fletcher, *South Indian Insects* (Madras, 1914); R. J. Tillyard, *Insects of Australia and New Zealand* (Sydney, 1926); E. O. Essig, *Insects of Western North America* (1926); A. da Costa Lima, *Insectos do Brasil* (Rio de Janeiro, 1939–43).

Scme comprehensive volumes on special phases of insect life are:

Embryology—O. A. Johannsen and F. H. Butt, *Embryology of Insects and Myriopods* (1941).

Insect Parasitism of Insects.—C. P. Clausen, *Entomophagous Insects* (1940).

Physiology.—V. B. Wigglesworth, *The Principles of Insect Physiology* (London, 1939). Also articles by J. Franklin Yeager.

Anatomy.—R. E. Snodgrass, *Principles* of *Insect Morphology* (1935).

Ecology.—R. H. Chapman. *Animal Ecology* (1931).

General Biology.—A. D. Imms, *Recent Advances in Entomology* (New York and London, 1931, 2nd ed., 1937); E. L. Bouvier, *Habitudes* et *Metamorphoses des Insectes* (Paris, 1921); A. Paillot, *L'Infection chez les Insectes* (Paris, 1933); P. Buchner, *Tier und Pflanze in intrazellularer Symbiose* (Berlin, 1921); H. Osborn, *Meadow and Pasture Insects* (1939); S. A. Graham, *Principles of Forest Entomology* (1929); *W.* S. Patton and A. M. Evans, *Insects, Ticks and Venomous Animals,* 2 vols. (1929); M. Neveu-Lamaire, *Trait6 d'Entomologie Medicale et Veterinaire* (Paris, 1938); Balachowsky et Mesnil, *Les Insectes Nuisibles aux Plantes Cultivées,* 2 vols. (Paris, 1936).

Social Insects.—*H.* St. *J. K.* Donisthorpe, *British Ants* (Plymouth, 1915) and *Guests of British Ants* (Plymouth, 1927); A. Forel, *Le Monde Social des Fourmis du Globe* (Geneva, 1921); W. M. Wheeler, *Ants* (1913), *Social Insects* (1928), *Social Life Among Insects* (1923); T. Rayment, *A Cluster of Bees* (Sydney, 1935); O. E. Plath, *Bumblebees and Their Ways* (1934); *E.* Hegh, *Les Termites* (Bruxelles, 1922); *G.* F. Hill, *Termites from the Australian Region* (Melbourne, 1942); *T.* E. Snyder, *Our Enemy the Termite* (1935); C. A. Kofoid, ed., *Termites and Termite Control* (1934). *See* also books and articles on insect behaviour by A. E. Emerson, Phil Rau and T. C. Schneirla.

(C. H. KY.)

PHYSIOLOGY

Insects are highly organized creatures; they are small in size and mainly terrestrial in habit, those insects which live in water being derived from terrestrial ancestors. They are therefore extremely subject to desiccation; and the success of the insects as a class in the colonization of almost every type of environment, including the hottest and driest portions of the earth's surface, is a result of the many ways in which their physiology is adapted for the conservation of water.

The Egg.—Most insects begin their development within an egg which is covered by a hard shell, the chorion, composed chiefly of a scleroprotein "chorionin." Eggs laid in exposed places are completely waterproof and can withstand exposure in the open for months without drying up. Eggs of other insects, such as locusts, which are laid in the earth, or of some which attach their eggs to leaves or insert them into the stems of plants, are able actively to absorb moisture from their surroundings. Many insects pass the winter in the egg stage. In these, embryonic development is arrested at a certain point and the organism goes into a state of dormancy or "diapause." It is often necessary, as in the silkworm, for the egg to be exposed to a low temperature before development is resumed. When it is fully developed, the young insect may chew its way out of the egg if it has biting mouth-parts, as in the caterpillar; or it may force off an egg cap or cut an opening in the shell by means of "hatching spines" of varying types. The young insect aids itself in this process by swallowing air and when it is free from the shell it distends itself with still more air so that the newly hatched insect is always much larger than the egg from which it has come.

The Integument. — The insect is covered by a "cuticle" which is laid down by a single layer of epidermal cells sometimes called the "hypodermis." The cuticle is a remarkable structure which plays a most important part in the physiology of the insect. It is at once flexible to allow movement of the parts, rigid to serve as a skeleton to which the muscles are attached, and waterproof to protect the insect from desiccation. Its best known constituent is "chitin." Chitin resembles the cellulose of plants, but instead of being composed of chains of glucose molecules it is made up of chains of acetyl-glucosamine residues. It is associated and perhaps chemically combined with protein; in this form it is colourless, tough and elastic, and composes the innermost layer or "endocuticle." In the outer parts of the rigid areas of the cuticle

the protein present is hardened (probably as the result of "tanning" by quinones) to produce a resistant brown or amber coloured material, "sclerotin"; this layer is called the "exocuticle." Outside this there is an extremely thin layer, the "epicuticle," which contains no chitin; this layer is probably complex in structure. but an important constituent of it is a film of waxy material which is responsible for the waterproofing of the cuticle as a whole. Delicate cytoplasmic filaments extend from the epidermal cells, through the substance of the endo- and exocuticle, up to but not penetrating the epicuticle. These are the "pore canals"; they enable the cells to exert their action by the secretion of enzymes, etc., upon the outermost layers of the cuticle. In fact, they ensure that the cuticle remains a living tissue. The entire cuticle is pierced in many places by the ducts of unicellular dermal glands which pour out secretions over the surface. In some insects these glands give rise to a protective cement; in others, to wax or lac. The insect waxes and the shellac of commerce come from this source.

Articulated to the cuticle are hairs of various types, many of which are connected with sensory nerves and constitute sense organs. Or they may be dilated and flattened to form scales, as on the wings of butterflies and moths. Pigmented substances deposited within these scales, or the physical scattering of light caused by the structure of their surface, are responsible for the bright colours of insects. Black or bro n colouring is generally a result of melanin pigments deposited in the substance of the exocuticle.

Growth. — The rigid parts of the cuticle are incapable of stretching or of growth. If the insect is to grow the old cuticle must be shed from time to time, a new and larger cuticle having first been formed beneath. This process is termed moulting or "ecdysis." The epidermis separates from the old skin, the cells divide and arrange themselves in proper form and then lay down the new cuticle. Meanwhile the old endocuticle is digested and the products are absorbed through the new cuticle; the exocuticle is not attacked. In the young stages of insects there are always certain "lines of weakness," usually in the middle of the thorax, where the exocuticle is wanting. When the new cuticle is formed arid digestion of the old is complete, the old skin therefore splits along these lines and the insect can creep out from it. At this stage the new cuticle is still colourless and soft. The insect proceeds to swallow air and distend itself to its full size. It contracts its muscles and so forces the body fluid into the wings causing them to expand. It then sets in motion the oxidative processes within the cuticle which lead to the hardening and darkening of the skin.

The moulting process is initiated by a hormone, which, in some insects at least. is secreted by certain large cells in the brain. In some insects it is the stretching of the body wall which stimulates the secretion of this hormone. In most insects there is a striking change in form, a metamorphosis, at the last moult when the adult stage is reached, and in certain orders (Lepidoptera, Coleoptera, etc.) the final stage is preceded by an inactive pupa. This change in form is likewise controlled by hormones. The *corpus allatum,* a small gland of internal secretion lying close behind the brain, produces a hormone throughout the early stages of growth which prevents the development of adult characters when the insect moults. If this gland is removed from the young caterpillar. for instance, it will turn into a tiny pupa when it moults, and then into a tiny moth.

The phenomenon of diapause or dormancy seen in the egg also appears during the larval or pupal development of insects. All growth may cease and exposure to cold may be necessary before it is resumed. Diapause seems to be caused by an arrest in the secretion of the moulting hormone.

Muscular System and Locomotion. — The movements of insects are brought about by numerous muscles connecting one part of the exoskeleton or cuticle with another. In his classic work Pierre Lyonnet (1762) described **4,061** muscles in the goat moth caterpillar. When the body wall is rigid, as in the grasshopper, the muscles run across the flexible joints from one region of firm cuticle to another. In a soft-bodied insect, such as a caterpillar, the firmness of the body wall is ensured by a general tension or tone in all the muscles which sets up an even pressure upon the body fluids. Many of the movements in such an insect are brought about by the pressure of the blood acting upon points where the muscles have been relaxed.

An insect, such as a beetle or a fly, walking on six legs, supports itself on a tripod, consisting of the anterior and posterior limb on one side and the middle limb on the other, while it carries forward the other three legs. It holds on to rough surfaces by means of claws at the extremity of its tarsi. Many insects are able to hold on to smooth surfaces by means of adhesive organs termed "pulvilli." These bear innumerable hairs with soft flattened extremities. It seems that when these are drawn over a smooth surface they become applied so closely to it that seizure or "adhesion" takes place and the insect is held by surface molecular forces.

When examined physiologically, the muscles of insects do not seem to differ very greatly in their performance from those of vertebrates. Yet it is well known that during flight the wings of insects are vibrated at very high frequencies; the bee will make about 200 wing beats per second, the mosquito nearly 300. It seems likely that these high rates are brought about by the relatively slowly contracting muscles setting up vibrations in the walls of the thorax on to which the wings are articulated.

Nervous System. — The nervous system, like that of vertebrates, consists of elongated cells which convey electrical impulses from one part of the body to another. These cells are termed "neurones"; they consist of a cell body, and an axon filament. The cell bodies of the sensory neurones are located close to the sense organs in the skin, their axon filaments form the sensory nerves which run to the central nervous system. The cell bodies of the motor neurones, the axon filaments of which form the motor nerves running to the muscles, lie within the central nervous system, which likewise contains the cell bodies of the association neurones connecting the various nerve centres together.

The central nervous system consists of a series of ganglia: the supraoesophageal ganglion or brain which receives the nerves from the great sense organs on the head, the eyes and antennae, and is the main centre for the co-ordination of behaviour, the suboesophageal ganglion which innervates the feeding parts, and a series of ganglia supplying nerves to muscles and sense organs of their own segments throughout the thorax and abdomen. To an extent that varies in the different groups of insects, the ganglia become partially fused with one another. None of the ganglia contain centres absolutely vital to the insect: the decapitated insect, deprived of the brain and suboesophageal ganglia can still live and walk; the isolated abdomen can still lay eggs. The individual ganglia can in fact serve as the centres for the simpler reflex actions, such as the withrawal of the leg on pressure. They can even effect the degree of co-ordination necessary for walking. But for the co-ordination of all the complex reactions of the insect to the stimuli it encounters the brain is necessary.

Besides this main nervous system there is also in insects a "peripheral nerve net" containing scattered ganglion cells which net, it has been suggested, is responsible for maintaining the steady contraction or tonus of the muscles. Finally there is a "sympathetic nervous system" which supplies the viscera.

Sense Organs: Vision. — Insects have eyes of two sorts, simple and compound. The simple eyes or ocelli consist of transparent lens-shaped swellings of the cuticle with a retina composed of a few dozen light-sensitive cells immediately below. In many insect larvae the ocelli occur in small groups on either side of the head and they serve for the perception of objects. In adult insects the ocelli occur alongside the compound eyes and are commonly situated in a group of three on the vertex of the head They seem to play no part in vision but possibly serve, like many other sense organs, as "stimulatory organs" which increase the reactivity of the insect to visual stimuli perceived through the compound eyes.

The compound eyes are very elaborate visual organs. They consist of large numbers of facets (some **4,000** in the housefly, 10,000 to 20,000 in the dragonfly) each of which has its own reti-

nal element below. Each facet or "ommatidium" receives a pencil of rays from the object. The whole eye thus projects upon the retina a composite erect image consisting of a mosaic of points of light each contributed by one ommatidium. The fineness of the mosaic and so the acuity of vision, will increase as the number of facets increases. It has been estimated that in the bee, under the best conditions of illumination. the resolving power of the eye is about one-hundredth part as good as that of man.

Insects have a considerable ability to distinguish the forms of objects; bees can be trained to associate black figures of a particular shape on a white ground with the presence of food. But the chief function of the compound eyes is probably to perceive the movement of objects as the stimulating points of light pass from one ommatidium to the next. Insects also perceive colour. The colour sense is particularly well developed in flower-visiting insects like butterflies and bees. Bees can be readily trained to come for food to a particular colour. They also experience the phenomenon of "simultaneous contrast": a gray patch on a blue ground appears yellow to the bee. Many insects can perceive ultra-violet light: moths will fly round a lamp screened by glass transmitting ultra-violet which appears totally black to our eyes.

Sense Organs: Mechanical and Chemical Senses.—At many points on the cuticle of insects there are little hairlike processes connected with a nerve cell beneath. These organs are termed "sensilla." The simplest type is the long hair with an articulated base. These are organs of touch. They occur all over the body but are most evident on the antennae in many insects and on the long tail-like appendages or "cerci" of such insects as the cricket. In the antennae of mosquitoes and on the cerci of crickets these hairs are moved by sound vibrations in the air and thus serve as simple organs of hearing. Other sense organs responding to mechanical stimuli are the "campaniform organs," minute domes set in the cuticle which are stimulated by bending strains in the integument; the "chondotonal sensilla" which have the form of long filaments running from one point to another within the body and which react to changes in mechanical tension; and the peripheral nerve net which probably perceives tension in the joints. Besides the sensory hairs, there are much more highly specialized organs of hearing in certain grasshoppers and crickets, derived from modified chondotonal organs.

The chemical senses of taste and smell are well developed in insects. Organs of taste, which distinguish salt, sweet, sour and bitter qualities, occur chiefly around the mouth parts. But various insects (butterflies and flies) can perceive sweet substances even in very dilute solutions in contact with the tarsi. The organs of smell are usually thin-walled hairs or minute cones situated chiefly on the antennae and palpi, often arising from the floor of a pit. The males of certain moths, which can locate the female by the sense of smell a mile or more away, have bushy antennae covered with these organs. In bees the sense of smell seems curiously like our own; unrelated substances which smell alike to us are also confused by the bee.

Insects can also perceive differences in temperature and humidity. The location of these senses is not always well defined, but in some insects at least they reside in the antennae. Thus the antennae, which assume such diverse forms in different insects, subserve a varied range of senses.

Behaviour.—The physiologist aims at describing behaviour in terms of reflex responses which follow invariably a given stimulus. Many of the reactions of insects to stimuli in the environment can be described in this way, as so-called "forced reactions." But very often these reactions are so much influenced by other stimuli, or by preceding events. that the complex behaviour of insects can not be satisfactorily described in these terms alone; in many descriptions psychological conceptions are made use of, such as conation the innate seeking of some end or goal.

The reactions of an insect are greatly affected by the state of excitation of the nervous system. Any of the sense organs may exert this general stimulatory effect. Insects deprived of the antennae are apt to become very sluggish and difficult to arouse by light or by touching parts of the body If the antenna of one side is removed or the eye on one side covered the insect is liable to circle toward the sound side owing perhaps to the increased muscle tonus in that half of the body. A well-marked response in many insects is "thigmotaxis": if the organs of touch are out of contact with any object the insect becomes active; when contact is regained, as for instance when an earwig or a bedbug crawls into a crevice, it comes to rest and falls into a state of sleep or "akinesis." Separation of the feet from contact with the ground provides an immediate stimulus to flight.

In the orientation of the insect many different physiological mechanisms are utilized. Orientation may.be (1) by "orthokinesis": the insect keeps moving while subjected to unfavourable stimuli, but settles down when it reaches a favourable environment. (2) "Klinokinesis": the insect moves in a straight line in a favourable environment but changes direction frequently in an unfavourable. If the response is violent enough it appears as an immediate "avoiding reaction." (3) "Tropotaxis": the insect compares the intensity of stimulation in two bilaterally symmetrical sense organs, such as eyes or antennae: and inclines toward the favourable side. (4) "Klinotaxis": the insect as it moves about senses first one side and then the other with eyes or antennae and then turns in the direction of the favourable stimulus. Any of the senses that we have discussed, of light, smell, taste, temperature or humidity may be concerned, singly or in combination.

But in addition to these simple reactions the insect sho s a varying capacity for memory, most evident among the ants. bees and wasps, and for the more elementary types of learning; they show complex chains of actions often spoken of as "instinctive behaviour"; and they show, again particularly the bees and wasps, an ability to appreciate time.

Respiration. — The conveyance of oxygen to the tissues and the elimination of the carbon dioxide resulting from oxidation is effected by the respiratory system. As was discovered by Marcello Malpighi (1669) in the silkworm. most insects breathe by means of tracheal tubes, which usually open at the surface of the body through a number of spiracles and conduct air directly to the tissues. The tracheae are invaginations of the cuticle which anastomose and branch among the internal organs. In the larger branches their walls are stiffened and prevented from collapse by a spiral thread. Their finest terminations, which are devoid of this spiral thickening, contain a variable amount of liquid, and are termed "tracheoles." These envelop or even penetrate the tissue cells.

If the spiracles were always open the insect would lose excessive quantities of moisture and would soon die of desiccation. Each is therefore provided with a sphincter and is held closed most of the time, being opened only at intervals as the need for oxygen requires. During activity the spiracles are opened more frequently. In the smaller and less active insects oxygen is conveyed from spiracles to tissues wholly by diffusion. But in larger and more active forms (grasshoppers, bees. flies, etc.) the tracheae are ventilated by alternate contraction and expansion of the body wall. These respiratory movements occur particularly during activity, and in many insects they are made more effective by the expansion of the tracheae at various points to form large thin-walled air sacs. These are ventilated mechanically, but the supply of oxygen through the branches running from them is still dependent on gaseous diffusion. The increased opening of the spiracles and the increased mechanical ventilation during activity are brought about by the accumulating carbon dioxide stimulating respiratory centres in the nervous system.

In aquatic and in parasitic insects there are many remarkable adaptations in the respiratory system. Most of these are concerned with bringing the spiracles, often a single pair of spiracles at one end of the body, into contact with the atmospheric air. But in a few larval insects the tracheal system is closed; it sends a rich meshwork of branches either to the general surface of the body or to special outgrowths ("tracheal gills") on the body surface or, as in dragonfly larvae, within the rectum. These gills enable the insect to obtain its oxygen from that in solution in the water.

The blood of most insects is of little importance in respiration.

In a few larvae (Chironomidae or "blood worms") there is haemoglobin in the blood and under conditions of poor oxygen supply, as when these larvae are living in mud, this pigment acts as a carrier of oxygen.

The Blood and Associated Tissues. — Insects have an open circulation. Throughout most of the body the organs and tissues are bathed directly by the blood or "haemolymph." But this is kept in circulation by a dorsal vessel or heart which pumps it from the hind end of the abdomen and discharges it into the body cavity again in the head. There are also small accessory pumping organs or hearts which ensure the circulation in the wings, legs and antennae.

The blood is a clear colourless or slightly green or yellow fluid which, as we have seen, plays little part in respiration. It contains a few white blood cells or "haemocytes" which act as phagocytes, ingesting microorganisms or debris from disintegrated cells. For the most part these cells do not circulate but adhere to the tissues.

Associated with the circulatory system are other tissues which function in storage of reserves and in intermediary metabolism. The "pericardial cells" occur in little groups along the sides of the heart. Their function seems to be to remove from the blood colloidal material such as unwanted proteins derived from the breakdown of cells. The "fat body" is often the most conspicuous object in the insect abdomen. It serves as a store for fat, glycogen and sometimes for droplets of protein, particularly during hibernation or during the pupal stage, when no food is taken. The "oenocytes" are large clear cells which usually occur in groups below the epidermis. They become active and enlarged during moulting, and probably secrete certain of the constituents that go to form the cuticle.

The light-producing organs of the various beetles (the glow-worm, firefly, etc.) are probably derived from the fat body. They are covered by a layer of translucent cuticle. Within the cells an enzyme "luciferase" causes the oxidation of a substance "luciferin" and almost all the energy liberated appears in the form of light.

Digestion and Nutrition. — Almost every kind of organic material can be used as food by some insect. The feeding mechanisms and the digestive processes of insects are therefore exceedingly diverse. Cockroaches, ants, beetles, caterpillars, chew their food; the blood-sucking bugs and flies pierce the skin and absorb the blood; plant-sucking insects do the same on plants; butterflies can only imbibe nectar. The first and last segments of the gut, the fore-gut and hind-gut, are lined with thin cuticle continuous with that over the body surface. The intervening segment, the mid-gut or stomach has the lining cells freely exposed. Where the insect eats solid food the mid-gut is generally protected by a delicate detached membrane of chitin, the "peritrophic membrane."

The enzymes which digest the food are produced in the salivary glands and in the mid-gut; they vary with the nature of the food, enzymes which digest proteins being most evident when the food contains much protein and so on. The absorption of the products of digestion also takes place in the mid-gut. The hind-gut seems to be chiefly concerned in the absorption of water. At the dilated end of the hind-gut. the rectum. there are groups of enlarged epithelial cells, the so-called "rectal glands." The function of these seems to be to recover as much water as possible from the faeces before they are discharged. They play an important part in the conservation of water.

Insects which feed on substances difficult to digest, such as wood or hair (keratin) commonly have digestive enzymes specially adapted to deal with them. In other insects, such as termites ("white ants"), great quantities of protozoa or other microorganisms are maintained in the gut and serve to digest the food for their hosts.

Besides the energy-providing foods. fats and carbohydrates and the body-building proteins, insects require much the same range of accessory foods or vitamins as do mammals. They find an ample quantity of these when they feed on a mixed diet. But insects which feed solely on blood, or flour, or plant juices, generally harbour symbiotic microorganisms, often within special groups of cells called "mycetomes." These microorganisms provide their hosts with a source of the vitamins that are lacking in their food.

Excretion. — The main excretory organs of insects are the Malpighian tubules. These are blind vessels, varying in number from 2 to 100 or so, lying freely in the body cavity and discharging into the gut at the junction of the mid-gut with the hind-gut. The urine which they produce is mixed with the residue of food from the stomach and the mixture after passing along the hind-gut forms the excreta or faeces. The character of the excreta depends on the type of food eaten. Where this is very watery, as in the plant-sucking insects (plant-lice or aphids and the like), the excreta are wholly fluid; insects such as the mealworm which feed on dry foods discharge a dry powdery excrement from which every trace of water has been removed. In certain insects, notably in caterpillars and in the larvae of such beetles as the mealworm which dry their excrement before discharge, the blind extremities of the Malpighian tubes are closely applied and bound down to the outer wall of the rectum; but the significance of this "cryptonephridial" arrangement is not fully understood.

The chief waste product in the urine is uric acid, which usually appears in solid form as granules or crystalline spheres that become more and more concentrated as the water is reabsorbed. In many insects, besides being discharged in the urine, uric acid accumulates in cells in other parts of the body ("storage excretion"). The stored granules may collect in special "urate cells" scattered through the fat body, in ordinary fat body cells, or in the epidermis, where they account for the chalky colouring of many caterpillars. In other insects, particularly larvae which feed inside the tissues of plants, granules of calcium carbonate may accumulate in quantity in the Malpighian tubules and as "calcospherites" in the cells of the fat body.

The excretions from the Malpighian tubes are sometimes made use of by the insect to strengthen or to colour the silken cocoon spun by the larva before pupation and in a few insects (the ant lion larva and its allies are the best known) a part of the Malpighian tube is actually modified to secrete silk.

Metabolism. — A11 the chemical changes which the constituents of the living body undergo are comprised within the term metabolism. They include the breakdown of the food substances and their building up into all the complex materials needed for growth and reproduction, the breakdown of stored materials to provide energy for movement and the elaboration of all the chemical secretions by the many glands.

From the carbohydrates, the fats and the proteins in the food, insects produce and store the fat and glycogen used for energy production. These are stored mainly in the fat body. During starvation or in hibernation the carbohydrate stores are first consumed, and then the fat. Many insects can subsist for weeks or months upon their stores of fat. Proteins are always necessary for growth and reproduction.

The glands of insects in the skin and elsewhere produce an astonishing range of chemical substances. Some of these such as silk, wax and lac are articles of commerce. Then there are complex venoms, notably in the glands of the stings of bees and wasps; formic acid in certain ant venoms; cantharidin in the beetle called "Spanish fly"; urticating substances in the hairs of caterpillars; stink glands and scent glands and many more. Among the most striking chemical products of insects are their pigments. Some of these such as the yellow carotins, some anthocyanins and flavones, and derivatives of chlorophyll, are derived from their plant food. But many of the most conspicuous, such as the pterine pigments of Pierid butterflies and many other butterfly pigments of an unknown composition seem to be by-products of metabolism which have been utilized in ornament. Production of such pigments may be markedly affected by the surroundings; thus the chrysalides of certain butterflies adapt their coloration to that of the background on which they rest.

The processes of oxidation in the body which accompany the liberation of muscular energy vary enormously in insects with the intensity of their activity. Thus on going from rest to active

flight the oxygen consumption of the bee may increase 48-fold and during flight a bee weighing 100 milligrams may burn sugar at the rate of 3; to 40 milligrams per hour.

Water Metabolism and Temperature. — The most important factors in the environment which influence the physiology of insects are temperature and humidity. The retention of sufficient water in the tissues is a prime necessity of life and we have seen that by having an impermeable cuticle, by keeping the spiracles closed as much as possible and by recovering water from the excreta before they are discharged, insects, in spite of their small size, are able to exist in dry environments.

Insects are greatly affected also by temperature. They are cold blooded or "poikilothermic" animals whose temperature is normally the same as that of their surroundings. But if the surroundings are too cold they are incapable of movement. Certain butterflies at high altitudes can not fly unless the sun is shining and their bodies are warmed by the radiant heat. During flight the contracting muscles produce enough heat to raise the body temperature far above that of the surrounding air. The large hawk moths are unable to take flight until their body temperature has been raised to 32°–36° C. by preliminary fluttering and during flight their temperature may rise above 41° C.

Different insects are able to resist different levels of high temperature; the largest forms can cool themselves to some extent for short periods by the evaporation of water, but few can withstand temperatures much above 50° C. for a period of one hour. There are differences also in their resistance to low temperatures. Insects which pass the winter in the open in cold climates develop in the cold season a condition of "cold hardiness." In this state, in which the total water content of the body is reduced, the insect can be cooled (supercooled) far below the true freezing point of the tissue fluids without the body freezing and without causing any injury. Some insects in this state will resist a temperature of −28° C.

Reproduction. — In most insects reproduction is bisexual, the egg cell produced by the female will develop only after fusion with the spermatozoa1 cell set free by the male. The reproductive system consists of paired sexual glands, the ovaries of the female and testes of the male, paired gonoducts into which the sexual products are discharged and a common duct lined with cuticle, forming the vagina in the female and the ejaculatory duct in the male.

The ovaries consist of chains of developing ova termed "ovarioles." The ripe egg, with a large store of yolk and a fully formed shell, is discharged from the lowest chamber or follicle of the ovariole. But the shell is pierced at one or more points to form a micropyle through which the spermatozoa can enter the egg. The spermatozoa received by the female at copulation pass into a small sac, the spermatheca, connected by a duct to the common oviduct or'vagina. As the egg passes into the vagina several of the filamentous spermatozoa make their way into the micropyle, and one of these fuses with the egg nucleus and initiates its development. The spermatozoa received during a single act of copulation will commonly suffice for fertilizing the eggs throughout the life of the female. In the queen bee the store of sperm received during the nuptial flight lasts for several years.

In both sexes there are accessory glands connected with the reproductive system, some of which may provide nourishment for the spermatozoa, others secrete a protective cement for the egg. In the males of some insects (Lepidoptera, many Orthoptera and Coleoptera) the sperm are not conveyed to the female in a free fluid but enclosed in a membranous sac or "spermatophore" formed by the secretion of the male accessory glands. Likewise in the female, the eggs of cockroaches, locusts and some other insects are not laid singly but are cemented together in an egg capsule or ootheca.

The egg production of insects is influenced by much the same factors as is their growth. It is delayed or prevented at low temperatures; they must have adequate food with sufficient protein in it, or they must carry the requisite stores of protein over from the larval stage; and a hormone secreted by the corpus allatum is necessary. In some insects the presence of spermatozoa in the spermatheca provides a necessary stimulus for egg production; in others a full quota of sterile eggs may be laid by the unimpregnated female. As in growth or egg development, so in reproduction, periods of diapause may supervene, notably during hibernation, when no production of eggs takes place even under favourable conditions of temperature.

There are many special modes of reproduction among insects, some of them very curious. Parthenogenesis occurs sporadically in many insects; in some it is constant, and males are unknown. During their summer generations the aphids (green fly) are both parthenogenetic and viviparous. Viviparity of newly hatched larvae is common in certain flies; the tsetse fly (Glossina) gives birth to a single full-grown larva that has been nourished in the uterine cavity by special "milk glands." Polyembryony occurs in various parasitic Insects: a single egg will split up in the course of development and give rise to some hundreds of larvae. One of the most remarkable phenomena is paedogenesis, which occurs in certain midges, in which the ova in the young ovaries of the larvae or pupae ripen prematurely and develop into larvae which devour and disrupt their parent host.

BIBLIOGRAPHY.—V. B. Wigglesworth, The *Principles* of *Insect Physiology*, 2nd ed. (1942). (V. B. W.)

BIOLOGICAL CONTROL

The control of insect populations by use of parasitic, predatory or pathogenic organisms is termed biological control, as distinguished from other methods of control involving cultural practices or the use of insecticides.

It is generally conceded that under primitive conditions, undisturbed by man, populations of insects, as well as of other organisms, exist in a sort of equilibrium commonly referred to as the balance of nature. Any tendency of a species to increase beyond a certain maximum abundance results in the intensification of the natural forces that work against it and thus reduce its numbers; and, conversely, any tendency to drop below a certain minimum abundance usually results in release from the repressive forces of the environment, so that numbers tend to increase. Experience has shown, however, that the coming of man, with his world commerce, often results in a temporary upsetting of this natural balance. Many of the major agricultural insect pests throughout the world are such because they have been transported from their native habitats, where they are kept under control by enemies or diseases, to new habitats where these restraining forces are absent. The basic idea of biological control of insects, therefore, is that when a species is introduced into a new habitat and becomes seriously abundant because some of the repressive forces are left behind, such as, its insect parasites and predators, it is possible to remedy the condition by seeking out these enemies and introducing them into the new habitat.

The organisms most commonly and most successfully used as agents in biological control have been the insectivorous or entomophagous insects — those having the habit of feeding upon other insects. In biological control the entomophagous species are divided roughly into two categories, parasitic and predaceous. A parasitic insect, according to entomological usage, is one which, through its growing stages, lives and develops either within or upon a single host individual, which usually dies as a result of the parasite attack. A predaceous insect is one that requires several individuals of the prey species to bring it to maturity, this requirement necessitating the capability of moving from host to host during the growing stages. There are, however, many intergradations between the two categories and no definite line of demarcation separates them. Entomophagous insects are found in almost all the principal orders of the class Insecta, but generally speaking, the parasitic species are found mostly in the Hymenoptera and Diptera, while the predaceous species are found mostly in the Coleoptera, Neuroptera, Diptera and Heteroptera.

Each species of insect ordinarily has one or more insect enemies, and some species support a large number of insect parasites and predators. For example, the black scale (Saissetia *oleae*), a pest of oranges and olives in many parts of the world, is attacked by more than 50 species of parasites, as well as by numerous

species of insect predators such as the ladybird beetles (Coccinellidae). The gypsy moth *(Porthetria dispar).* an important pest of forest trees, has perhaps an even greater number of parasitic and predaceous enemies which depend upon it for their subsistence.

Insect parasites, like other parasites, often have very complicated life histories. A knowledge of their biology is an essential part of successful application of the biological control method. Parasitism is usually a highly specialized mode of existence. The parasite must have a means of making contact with its host species. Also, for the greater part of its life, it exists in most intimate relation with its host. This necessitates an extremely delicate adjustment between the two individuals, since the parasite must avoid killing its host until the former has completed its feeding, and still must accomplish the death of the host before the latter fulfils its reproductive functions; else the parasite would be of little or no significance in biological control. Most insect parasites, therefore, must have special biological adaptations enabling them *(1)* to come into contact with their host, (2) to obtain nourishment from the host individual, (3) to secure oxygen from within the host and *(4)* to avoid the discharge of excretory products within the host, possibly injurious to the latter. The many and various ways by which parasitic insects have attained these essential ends form one of the most interesting chapters in the entire field of biology. In fact, the biology of these species takes such a wide variety of forms that it is not possible even to outline them here. Those interested are referred to the book *Entomophagous Insects,* by C. P. Clausen (New York and London, 1940).

History. — The idea of using one species of insect to destroy another long intrigued those biologists who had observed the interrelations of insects in nature. Probably first to suggest that predatory or parasitic insects might be utilized in the destruction of insect pests was Erasmus Darwin *(Phytologia or the Philosophy of Agriculture and Gardening,* London, 1800). Darwin recommended the propagation of the syrphid fly, which he had found feeding on aphids, as a control for the latter. He also suggested that the cabbage caterpillar could be controlled by one of its parasites. presumably *Apanteles glomeratus,* if the parasite could be protected during the time it was in hibernation. Among other early English biologists impressed by the observation that populations of plant-feeding insects were reduced by insects which fed upon them were William F. Kirby and William Spence *(An Introduction to Entomology,* 1815), who suggested that the development of a means of increasing the predaceous ladybird beetles would make it possible to clear the hothouses of aphids and thus render the crops of hops much more certain.

Many other early European scientists appreciated the part played in nature by parasitic and predatory insects, and some actually attempted to utilize this phenomenon in a practical way. M. Boisgiraud, *e.g.,* in *1840,* collected carabid beetles *(Calosoma sychophanta)* and colonized them on poplar trees in France, where they destroyed the gypsy moth caterpillars. In *1843* an organization known as the Society for the Encouragement of Arts and Crafts, in Milan, Italy, offered a gold medal to the person who should succeed in demonstrating how "carnivorous" insects might be used to destroy insects injurious to agriculture. The prize was won by an entomologist by the name of Antonio Villa, who maintained that certain climbing beetles could be used to control tree-inhabiting insects, that other kinds of insects could be used to control insect pests occurring in flowers and still others to control cutworms and certain earth-inhabiting species. However, little in a practical way appears to have come from Villa's suggestions.

These attempts at biological control of insect pests were limited tc the ase of parasitic and predaceous species already inhabiting the particular area where the work was undertaken. The idea of introducing insectivorous species from another country or region seems to have occurred to entomologists somewhat later in the century, after international commerce had resulted in the introduction, into several countries. of insect pests which had not previously occurred within their boundaries. Perhaps the first suggestion of this kind was made by Asa Fitch, of New York, in *1854.* Fitch recognized that the wheat midge, destructive to wheat in the eastern United States, was a native of Europe. His study of the entomological literature indicated that in Europe it was only occasionally injurious, and that there it was attacked by several species of parasites. He maintained that the difference in injuriousness, as between the U.S. and Europe, was a result of the fact that the pest had been brought in without the parasites which kept it in check in its native habitat. Fitch, through correspondence with his entomological colleagues in Europe, actually attempted to introduce these parasites into the U.S., but nothing ever came of it.

The first transfer of an entomophagous species from one country to another, for the purpose of controlling an introduced insect pest, was made in 1873 by J. E. Planchon and Charles V. Riley, of the French and U.S. governments, respectively. Through their efforts, the predatory mite *Tyroglyphus phylloxerae,* which feeds on the grape phylloxera in the U.S., was introduced into France for control of the phylloxera accidentally introduced into that country on grape vines from the U.S. The mite became established but apparently had little effect on the phylloxera probiem, which was solved later by the use of resistant rootstocks.

In *1883* Riley imported the parasite *Apanteles glomeratus* into the U.S. from Europe to control the cabbage butterfly. This parasite became established and of considerable value, although not a complete control for the pest.

The first unqualified success resulting from the transfer of a predatory or parasitic insect from one country or locality to another for suppression of a pest, occurred when the ladybird beetle known as the Vedalia *(Rodolia cardinalis)* was brought from Australia into California, in *1889,* by the U.S. department of agriculture, for control of the cottony-cushion scale *(Icerya purchasi).* This scale was known to have been imported accidentally on nursery stock from Australia in *1869.* By *1883* it had spread to southern California and was doing enormous damage to citrus trees. It became so injurious that banks refused to make loans on infested groves, and the fruit growers finally appealed to the government in Washington for help. The entomologists of the U.S. department of agriculture set to work to develop means of combating the pest. Many recognized types of insecticides were tried and new ones invented, but none gave satisfactory results and the citrus industry appeared to be threatened with disaster. Finally, in *1888,* an entomologist, Albert Koebele, was sent to Australia to search for parasites and predators of the cottony-cushion scale, for shipment to California.

Koebele's search was successful, and two of the species forwarded, the dipterous parasite *Cryptochaetum iceryae* and the Vedalia, became established in California. The Vedalia, particularly, in the presence of so great a food supply, increased with such rapidity that within about *18* months the pest upon which it fed had all but disappeared, and countless numbers of the beetles were starving because they had consumed their own food supply and were unable to subsist upon any food other than the cottony-cushion scale. Thus an introduced pest, which had threatened an important industry providing annually many millions of dollars worth of wealth, was subjugated by the introduction of a predaceous enemy species from its native habitat, at a cost of about $1,500.

The cottony-cushion scale later found its way to other parts of the world, including New Zealand, South Africa, Egypt, Hawaii, Italy, France, Uruguay and Florida. In every case the introduction of the Vedalia was followed by speedy subjugation of the pest. This striking demonstration of the utility of biological control naturally aroused much enthusiasm for the method. Several parasite-hunting expeditions were sent out from California, and valuable insects were introduced as a result of these explorations, including the mealy bug-destroying ladybird beetle (*Cryptolaemus montrouzieri*), about which more will be said later. None, however, proved more outstandingly successful than the Vedalia.

Methods, — Biological control of insect pests may take either of two forms: (1) the importation of one or more species of entomophagous insects or pathogenic organisms, in the expectation that, when established in the new habitat, such a destructive influence will be exerted that the host will subside in numbers to a point where it will do little or no serious damage; (2) the development of means whereby the effect of an introduced or native

entomophagous insect or pathogenic organism, which is unable to subjugate its host unaided, may be increased so as to render its use as a control agency profitable.

Importation of Species.— In work of this kind, one of the most important things to be considered is the native habitat or country of origin of the pest, naturally the most logical place in which to search for effective enemies and diseases, hut not always easily determined. Often the country of origin is unknown, and it is necessary to consider many different factors before setting out on such a quest. Usually, the entomologist attempting to determine the country of origin of an insect species searches the literature for clues, assuming, of course, that the pest has been identified by an expert and that its correct name and systematic relationship are known. A search of the literature will reveal the names of the various countries in which the species has been collected. Such records are usually associated with dates, so that if the species has been dispersed since entomologists began publishing records, the locality where the pest was recorded earliest would most likely indicate the central point of dispersal, or the native habitat of the insect. Sometimes, however, of all the places where the insect is known to occur, obviously no one place is its native home because of its extreme abundance and lack of parasites. Such a situation calls for the exercise of a considerable amount of ingenuity in order to reduce the suspected regions to a small number. The alternative is a random search which might prove almost limitless. Among the factors having a bearing on the origin of an insect species discovered outside its native habitat are the following: *(1)* the natural distribution of its host plants; (2) the distribution of closely related species of insects, on the assumption that related species had a common geographic origin; and *(3)* the lines and means of transport by which the species may have been carried from its native home to the new location. Many sections of the globe can be excluded through a process of elimination, by giving due consideration to these factors, and the search can thus be narrowed appreciably.

Once the native home of the pest has been determined, or the field limited to a few pcssibilities, the actual exploration is undertaken. Trained entomologists familiar with all the biological characteristics of the pest species and experienced in the exploration for, and in the culturing and transportation of, entomophagous insects and pathogenic organisms are assigned to search the selected region. It is their responsibility to forward to the domestic station such promising species as they may discover. Entomologists similarly well qualified are located at the receiving station to care for, propagate and distribute in the infested areas the species sent in by the entomological explorers.

Suitable insectaries and other equipment are essential to proper conduction of this work. It is particularly important that quarantine facilities, in the form of insect-proof rooms, be available, since dangerous material is sometimes unavoidably included in shipments from abroad. This material may consist of host plants bearing insects not known to occur in the area of reception, whose accidental escape might result in the establishment of a new pest. In addition, the parasites and predators themselves are often attacked by other parasites, which, if permitted to escape at destination, might become established in the new habitat and interfere with the efficiency of the desired species. It is therefore necessary to exercise extreme care in the handling of foreign material, so that it may be kept under rigid control at all times.

The development of air transportation has greatly simplified the work of explcration for and transportation of beneficial insects, and the modern tendency is to transport, by air, only the adult parasites themselves, and thus avoid danger of bringing in unwanted species. Regardless of this development, special facilities providing various kinds of physical environments are necessary at the receiving end. This is particularly true when the imported species come from the southern hemisphere to the northern, or vice versa, since their development is then out of synchronization with the seasons in the area of destination, and the rhythm of their development must he upset before they can be established in the new habitat.

When sufficient material of the introduced species is available, colonies are taken to the field and liberated in areas where the host insect is abundant. If possible, especially when the host inhabits regions of varying environmental conditions, colonies are established in several types of ecological habitats, since the new species may thrive in some and not in others. Later, it is necessary to make field collections of the h'ost insect in the regions where the liberations have been made, in order to determine whether the parasite has successfully established itself in the new habitat, and to what extent it may be influencing the populations of its host.

Mass Propagation and Colonization of Species.— To increase the efficiency of entomophagous or pathogenic species introduced or already present in an area, it has been necessary to devise methods of mass propagation or culture. Many species of entomophagous insects fail to exert against the populations of their host insects sufficient pressure to control them, because certain conditions of the environment, such as extreme winter temperatures, reduce them annually to very low numbers They are thus handicapped as the season develops, since they must start with too few, individuals. From such an unfavourable beginning, they are unable to build up to controlling numbers during the season. This has led to a search for inexpensive means of propagating such species for release in the field at proper intervals, to counteract the seasonal reduction in numbers and to assist the species in becoming dcminant over the host insects.

A major problem in the production of entomophagous insects for periodic field colonization is the selection and handling of the plant material upon which the host insect may be cultured in the insectary. It has been found that mealy bugs can be grown satisfactorily on potato sprouts; the moth *Sitotroga,* however, which is used as a host in the propagation of the egg-parasite *Trichogramma,* is best grown on maize or wheat. The plant material should be of such a nature that simple equipment and methods will suffice to produce the host insects in large numbers cheaply.

For further information on this subject, the reader is referred to *Culture Methods for Invertebrate Animals* (1937), by J. G. Needham *et al.,* and *L'Infection Chez Les Insectes* (1933), by A. Paillot.

Biological Control Projects.— In addition to the Vedalia success already recounted, many other examples of profitable use of biological control may be cited, some involving the establishment of nonnative species, and others the mass production and colonization of species, both of entomophagous insects and of pathogenic organisms.

Use of Entomophagous Insects.— The Mediterranean fruit fly (*Ceratitis capitata*) was discovered in the Hawaiian Islands in *1910,* and within a few years became very destructive to several fruit crops. A search for parasites in Africa and Australia resulted in the establishment of several important species in Hawaii in 1913–14. It was found that the parasites were rather ineffective on fruits such as the orange or peach, in which the fly larva develops out of reach of the parasite. On small fruits, however, such as the coffee berry, the parasites proved very effective, particularly the parasite *Diachasma tryoni,* from Australia.

The larch sawfly (*Lygaeonematus erichsonii*), accidentally introduced into Canada from Europe, became so abundant that the larch forests of eastern Canada were largely destroyed, and the pest spread to the western provinces. The intrcduction of the parasite *Mesoleius tenthredinis,* from England, 1910–13, by the imperial parasite service, resulted in a very satisfactory control of the pest after some years.

A related species, the spruce sawfly *(Neodiprion abietis),* was first found in Canada in 1930. There it rapidly assumed epidemic proportions and defoliated thcusands of square miles of forest. The Canadian government, through the imperial parasite service, made large-scale importations of spruce-sawfly parasites from Europe during the period 1933–39. Many species were introduced, and methods for the annual production and colonization of one, *Microplectron fuscipenne,* were worked out. Hundreds of millions of individuals of this parasite were liberated in the infested forests in eastern Canada, and a high percentage of parasitization was secured.

The Japanese beetle (*Popillia japonica*) was first discovered in the eastern U.S. in *1916,* where it did serious damage to lawns, turf and many fruits and ornamental plants. In 1920 the U.S. department of agriculture began a search for the insect enemies of this beetle in the orient, a search which continued for several years. Five species of parasites were established as a result of this search, but on the whole the introductions have not been so successful as it was hoped they might be, owing largely to asynchronization of the life cycles of parasites and host in the new environment.

The alfalfa weevil *(Hypera postica)* was brought to the U.S. accidentally from Europe and by *1911* had become very destructive. Search for parasites in Europe resulted in the discovery of the parasite *Bathyplectes curculionis* in Italy, and its successful introduction into Utah in 1911–12. This parasite often destroys more than 90% of the first brood of weevil larvae and is a valuable repressive iactor in most of the areas inhabited. After its introduction, the weevil population gradually fell until now other control practices are rarely necessary.

One of the largest biological control projects carried out any place in the world has been on the gypsy moth *(Porthetria dispar)* in the U.S. This forest-tree pest originated in Europe and was brought to the U.S. in *1869.* In the *40* years following 1905, when the first importation of parasites began, the U.S. government colonized more than 50 species of foreign parasites and predators, of which *13* species became established, attacking all stages irom egg to pupa. The results are difficult to appraise, since even in its native habitat the gypsy moth is subject to severe fluctuation in numbers, but the general belief is that the introduced enemies have greatly reduced the frequency and severity of the outbreaks. By 1945 the status of the gypsy moth in the U.S. was very similar to that existing in its native home, central Europe.

The history of the brown-tail moth *(Nygmia phaeorrhoea),* another European species occupying much the same region in the eastern U.S. and Canada, is similar to that of the gypsy moth. Many parasites have been successfully introduced from Europe, and the pest seems to have subsided materially.

The satin moth (*Stilpnotia salicis*) has been very successfully controlled in the U.S. and Canada by several European parasites introduced during the pericd 1927–32, particularly by *Apanteles solitarius, Meteorus versicolor* and *Compsilura concinnata.*

One of the most successful instances of biological control is that of the so-called Levuana or coconut moth of Fiji *(Levuana iridescens).* This pest threatened to destroy the principal agricultural industry of

Fiji, *i.e.*, the production of coconuts. The Levuana moth was not known to occur outside the Fiji islands, but the entomologists sought parasites of related species and finally discovered the parasitic fly *Ptychomyia remota* attacking the related *Artona catozantka*, which feeds on coconuts in Malaya and Java. *P. remota* was successfully established in Fiji in 1925, and within a very few months had the Levuana moth under almcst perfect control, so that it was no longer a pest of any economic importance.

A very striking success in the application of the biological control method occurred in connection mith the citrus black fly (*Aleurocanthus woglumi*), a pest introduced accidentally from Asia and of great importance to citrus in the West Indies. In 1930 the U.S. department of agriculture co-operated with the government of Cuba in a search for parasites in Malaya and elsewhere. Of several species discovered, one, *Eretmocerus serius*, mas established in Cuba and within a very short time demonstrated its ability to bring the pest under control. Successful subjugation of the black fly quickly followed the introduction of the parasite into Jamaica, Panamá and Haiti.

An early and outstandingly successful example of biological control of a pest is that of the sugar-cane leafhopper (*Perkinsiella saccharicida*), in Hawaii. The insect was apparently introduced accidentally from Queensland, Australia, in the early part of the 20th century and soon became a major problem for the sugar planters, causing losses estimated at $3,000,000 annually. An extended search for parasites to control this pest was undertaken by the Hawaiian sugar planters' experiment station in 1903 and continued for many years, throughout a large part of the tropical Pacific region. Many species of parasites mere introduced, some of rvhich became established and served to reduce the injury caused by the pest. But it was not until Frederick Muir discovered the predatory bug *Cyrtorhinus mundulus*, in Australia and Fiji, and introduced it into Hawaii, in 1920, that the subjugation of the leafhopper mas complete.

One of the most interesting cases of the utilization of the biological control method, from the international viewpoint, has to do mith the woolly apple aphid (*Eriosoma lanigera*), a native of the eastern U.S., where it is attacked by the parasite *Aphelinus mali*. This parasite has been colonized in ali parts of the globe where the woolly apple aphid has preceded it, something like 50 different countries having undertaken to establish it in their infested apple orchards. The outcome of these numerous attempts has ranged all the way from complete success to complete failure, but in general this world-wide dissemination of the parasite has been a profitable activity.

Two remarkably successful instances of biological ccntrol of mealy bugs have taken place. The avocado mealy bug (*Pseudococcus nipae*) in Hawaii is under perfect control as the result of the introduction from Mexico, in 1922, of the parasite *Pseudaphycus utilis*. The citrophilus mealy bug (*Pseudococcus galzani*) was accidentally introduced into the U.S. before 1914. By 1926 it was causing an estimated damage of more than $1,000,000 per year to the California citrus industry, in spite of extensive production and colcnization of the predaceous coccinellid *Cryptolaemus montrouzieri*. In 1929 the parasites *Coccophagus gurneyi* and *Tetracnemus pretiosus* were introduced from Australia. Within two years it became evident that these introductions would prove effective, and the ultimate outcome was one of the most perfect examples of biological control of an intrcduced pest.

One of the most extensive attempts ever undertaken to bring about biological control of a pest was that in connection with the black scale (*Saissetia oleae*) in California. Koebele, during the 1890s, shipped several species of coccinellids, including *Rhizobius ventralis*, from Australia to California. In 1902 the hymenopterous egg-predator *Scutellista cyanea* was introduced from South Africa, followed by the African parasite *Metaphycus lounsburyi* and several others. Then in 1937 the parasite *Metaphycus helvolus* was introduced from South Africa. This parasite socn proved itself to be one of the most important enemies of the black scale. While the control is not perfect, heavily infested orchards have been the exception rather than the rule since the introduction of this parasite.

The cabbage worm (*Pieris rapae*) was brought under control in New Zeaiand by the introduction, through the imperial parasite service, of the parasite *Pteromalus puparum*, from Europe, during the period 1931–33.

In British Columbia a pest of various fruit and ornamental plants, the scale *Lecanium coryli*, a native of Europe, was controlled by the introducticn of the parasite *Blastothrix sericea* from England in 1928.

The first extensive use of mass propagation in biological control occurred in California, where the common mealy bug (*Pseudococcus citri*) had become an important pest of oranges and lemons. The predatory species *Cryptolaemus montrouzieri*, a ladybird beetle, was used for this purpose, methods for its mass production being developed in 1916, with culture of the host insect on ordinary potato sprouts. By 1930, when *Cryptolaemus* was being used for control of both *P. citri* and *P. galzani* 40,000,000 of the ladybird beetles mere produced and colonized annually, at a cost of about $2.50 per 1,000. In 1931 the introduced parasites *Coccophagus gurneyi* and *Tetracnemus pretiosus* had brought *P. gahani* under control, but the method continued to be used for control of *P. citri*. It is also used extensively in Spain, France and other countries where mealy bugs are pests of economic importance.

Another interesting example of the control of a pest by means of the mass production and colonization of one of its insect enemies is that of the greenhouse white fly (*Trialeurodes vaporariorum*) in England and Canada. This pest attacks a wide variety of vegetables, such as tomatoes and cucumbers, which are grown in greenhouses at certain seasons. The parasite *Encarsia formosa* is cultivated on the white fly grown on tomato and tobacco. In 1930 about 1,500,000 individuals of this parasite were utilized in the British Isles. Later the method was introduced into Canada, where up to 1938 about 1,000,000 parasites were distributed annually. In the producticn of this parasite, advantage is taken of the fact that when the white fly is being grown on tobacco, the parasite attacks it only lightly. If the tobacco plants are grown in the greenhouse along with tomatoes, the tobacco serves as a continual nursery for the production of *Encarsia*, since the parasite does not completely destroy the host on this plant, and the parasites so produced go over to the white fly on tomato plants, upon which they control the hcst.

The parasite most extensively used in mass propagation has been the little egg-parasite *Trichogramma evanescens*. This parasite attacks the eggs of a large number of species of insects, preferring, however, those of moths and butterflies. The parasite is easily produced in insectaries in enormous numbers on the eggs of the Angoumois grain moth (*Sitotroga cerealella*), and it has been utilized almost throughout the world on various pests including the codling moth, the oriental fruit moth, the sugar-cane moth borer, the cotton worm, the European corn borer and others. The results, however, have been very inconsistent. In Russia it is maintained that codling-moth infestations have been reduced as much as 75% as a result of liberations of *Trichogramma*. In the U.S. and Canada, the results have been either negative or inconclusive. In Barbados and Peru, the parasite has been reported used successfully as a control for the sugar-cane moth borer.

The development, in California, in 1943, of the potato tuber-worm method for mass propagation of *Macrocentrus ancylivorus*, an important parasite of the oriental fruit moth (*Grapholitha molesta*), marked a distinct advance in methods of mass production. The oriental fruit moth, a major pest of peach and other fruits in many parts of the world, but particularly in the U.S., is supposed to have originated in Japan or China. The U.S. department of agriculture conducted a very extensive search for the parasites of this pest from 1929 to 1936. During this period 23 or more species of parasites were colonized, but only one, *Inareolata molestae*, became established, and that only in a very limited way. Nothing of practical value came out of these introductions. Unexpectedly, *M. ancylivorus*, which is apparently a native of the U.S., with the strawberry leaf roller (*Ancylis comptana fragariae*) as its favoured host, developed a taste for the fruit moth and destroyed a high percentage of the twig-infesting larvae. It has been common practice to grow this parasite on the strawberry leaf roller for liberaticn in infested peach orchards in the eastern part of the U.S. and Canada. Discovery of the fruit moth in California, in 1942, however, was followed by the development of a new procedure for production of the parasite, it being cultured in insectaries, with the larvae of *Gnorimoschema operculella*, grown on potato tubers in trays, as host insects. During the year 1944, more than 20,000,000 individuals of *M. ancylivorus* were produced and colonized in California, at a cost about one-tenth that of culturing the parasite on the strawberry leaf roller.

It seems probable that the future will witness a considerable extension of the mass-colonization method, not only as an independent control measure, but as an auxiliary to insecticidal treatment. In some instances commercial organizaticns have undertaken the production of parasites or predators for sale to growers.

Use of Pathogenic Organisms.— Diseases caused by bacteria and fungi are often extremely destructive to insects, particularly to those existing under conditions of abnormal crowding. Entomologists attempting to culture insects in confinement often find their efforts nullified by the outbreak of a destructive bacterial or fungous disease. It seems to be the general opinicn that such organisms are so closely dependent upon conditions of the physical environment that attempts to use them in a practical way are likely to prove disappointing, with unpredictable results. Such a conclusion, however, seems too sweeping until a great deal more is known about the subject.

One of the most comprehensive tests made with bacterial diseases was that of F. d'Herelle, who in 1915 reported good results against the locust *Schistocerca peregrina* in North Africa, when cultures of *Coccobacillus acridiorum* were sprayed over the infested area. In other parts of the world and against other locusts, unsatisfactory results mere reported, and the use of this organism for locust control has not been adopted generally. Many other attempts have been made to use bacterial diseases for control of insect pests, usually with inconclusive results.

In one case, namely, that of the Japanese beetle (*Popillia japonica*) in the U.S., the use of bacterial diseases seems to have been strikingly successful. The causative organisms (*Bacillus popilliae* and *B. lentimorbus*) are cultured by inoculating the grubs of the host with spores. From the dried bodies of the diseased grubs, a standardized spore suspension is made, which is then added to precipitated calcium carbonate in such quantity that the mixture contains roughly 1,000,000,000 spores per gram. This material is then incorporated in a carrier such as talcum or marble flour, and is dusted over the infested areas.

The "milky disease," as it is called, is used extensively for Japanese-beetle control in several of the eastern states of the U.S. Experiments have resulted in 90% mortality of grubs in soil inoculated with the spores.

Many species of parasitic fungi are known to attack insects. These fungi often appear in epidemic form and almost exterminate the host species. Grasshoppers, for example, are commonly attacked by the parasitic fungus *Empusa grylli;* the chinch bug (*Blissus leucopterus*), by *Beauveria globulifera;* the apple sucker (*Psylla mali*), by *Entomophthora sphaerosperma,* etc. When conditions are right, these parasitic fungi can be very destructive to their host insects, but controlled experiments have generally cast doubt on the possibility of increasing their effectiveness by artificial means. However, a great deal of research remains to be done before the question of the practical use of fungous and bacterial diseases in the biological control of insect pests can be answered. This is a field in which relatively little fundamental work has been done.

There are many other types of fatal diseases among insects, some caused by Protozoa, others by viruses. Here, too, attempts to make practical use of such diseases have had inconclusive results, but research has been insufficient to justify abandonment of such attempts.

BIBLIOGRAPHY.—A. Paillot, *L'Infection Chez Les Insectes* (1933); A. J. Nicholson and V. A. Bailey, "The Balance of Animal Populations," *Zool. Soc., London, Proc.* (1935); Harry S. Smith, "The Role of Biotic Factors in the Determination of Population Densities," *Jour. Econ. Ent.,* 28:873–98 (1935); H. L. Sweetman, *The Biological Control of Insects* (1936); J. G. Needham *et al., Culture Methods for Invertebrate Animals* (1937); W. R. Thompson, "Biological Control and the Theories of the Interactions of Populations," *Parasitology,* 31: 299–388 (1939); C. P. Clausen, *Entomophagous Insects* (New York and London, 1940). (H. S. SH.)

INSECT BITES AND STINGS. Fortunately, few of the billions of insect bites and stings that the population of the world suffers each year result in serious disease. Malaria, yellow fever, typhus, encephalitis, tularaemia, bubonic plague, typhoid fever, anthrax and many other diseases are carried and transmitted by insects. This article concerns itself primarily with host reactions resulting from toxins peculiar to the insect itself and with measures for repelling these insects and treating the disease which their bites provoke.

Most insect bites, such as those of the fly, mosquito and flea, cause an almost immediate reaction in humans consisting of itching, redness and local swelling of the skin. This usually subsides within 2 to 24 hours without leaving any permanent mark. It is believed that this result is an allergic reaction dependent upon salivary components to which the host has developed a sensitivity via previous exposure. Infants receiving their first mosquito bite show no reaction (sensitivity) to the bite, and individuals who receive constant bites over long periods of time may develop an immunity (desensitization) and consequently develop no reaction to the insect bite. Thus. natives frequently hold the erroneous belief that parasites indigenous to the region do not bite them.

Stinging insects such as the bee, hornet or wasp give rise to intensely painful, elevated skin lesions which are transitory and believed to be due to the irritant action of formic acid and an alkaline neurotoxic substance present in the venom. Multiple stings may give rise to alarming systemic illness with fainting, collapse of the circulatory system, difficult breathing and, in rare instances, death. The honeybee leaves its stinger in the skin whereas the wasp does not. Beekeepers eventually develop an immunity to the sting of the bee and they may receive many stings without experiencing any subjective or objective response. Such an immunity can be developed experimentally by repeated injections of bee venom.

Bloodsucking lice (Anoplura) live on or close to the skin and occur in three varieties: the head louse. body louse and pubic louse. They fix their eggs to hair or clothing and periodically feed on their host. Their bites result in severely itchy skin lesions, which when scratched frequently become infected and may thus result in widespread complications.

Bedbugs which live in mattresses, walls and furniture attack their host only in the dark. Though they are usually thought of as denizens of poverty and filth, they not infrequently find their way into the environs of affluence.

Treatment. — Local applications for any bite or sting are of little value other than the removal of insect parts left in the wound or local applications of antiseptic agents to prevent infection. Anti-itch medicines such as menthol or phenol compounds may be applied. For those insects such as lice which reside on the skin, local applications of cuprex, DDT powder or lindane will destroy the insects. However, some insecticides such as DDT are not lethal for the eggs of these insects so that repeated applications over two weeks are necessary to eradicate the colony. Spraying the environs with DDT, chlordan or lindane is usually effective in destroying resident bedbugs, fleas and most other insects.

Repellents.—Much more fiction than fact clouds the question of effective insect repellents. So called oral repellents (compounds believed to repel insects after they are swallowed by the individual) have not been proved of value for the human. However local applications to the skin of such compounds as dimethyl phthalate, dimethyl carbate, Indalone and Rutgers 612 (2-ethyl-1,3-hexanediol) either alone or in combination have been shown to be very effective for general use. A good, all purpose, clothing repellent for mosquitoes, ticks, fleas and chiggers is the mixture: *n*-butyl acetanilide, 30%; benzyl benzoate, 30%; 2-butyl-2-ethyl-1,3-propanediol, 30%; and Tween 80, 10%. This mixture is diluted in one to two parts of water. (RD. B. S.)

INSECTICIDES, chemicals used for destroying insect pests. When employed to protect plants they may be applied in the form of wet sprays, aerosols or as dusts; those most commonly used for this purpose include various arsenicals, nicotine, rotenone, pyrethrum, paradichlorobenzene, DDT, petroleum oil emulsions, soaps, etc.

When it is desired to kill insects that may be present in a room, fumigation (*q.v.*) or the filling of the room with poisonous gases or vapours is resorted to. This method may also be used for plants by enclosing them in tents. Hydrogen cyanide, carbon disulphide and carbon tetrachloride are some examples of the chemicals employed in fumigation. *See* ENTOMOLOGY: *Principles of Insect Control.*

INSECTIVORA, an order of placental mammals of small size, with a dentition adapted to an insect diet. Nearly all members of this order are nocturnal and terrestrial; many, however; are fossorial or arboreal, and a few are aquatic. There are generally five toes, each terminating in a claw; the first toe is never opposable to the others in either the fore- or hind-limb. A full series of teeth, including deciduous or milk molars, is developed, and the cheek teeth as a rule are crowned with sharp cusps. The typical number of teeth is 44, arranged as shown in the formula $i.\frac{3}{3}, c.\frac{1}{1}, p.\frac{4}{4}, m.\frac{3}{3}$; occasionally there is a fourth pair of molars, while the incisors may be reduced to two pairs above and one pair below. The skull is of a primitive type, with a small brain case, the tympanic bone generally ringlike instead of forming a bulla, or bony bulb in the ear region, and vacuities are frequently present in the palate. With the exception of the Potamogalidae, collarbones are always present, and a central bone is usually present in the carpus. The uterus is two-horned; the placenta, so far as is known, is deciduate so that the uterine lining is cast out at birth, and discoidal, or disc-shaped, as in the primates and rodents; the testes are abdominal or in the inguinal canal connecting the abdominal and scrotal cavities; and the teats are numerous.

The stomach is a simple, thin-walled sac; sometimes, as in *Tenrec,* the pyloric and oesophageal openings are close together. In the arboreal forms, which probably feed on plants as well as insects, most of the species possess a caecum.

All the members of the order appear to be highly prolific, the number of young varying from 2 to 8 in the hedgehog, and from 12 to 21 in the tenrec. Scent-glands exist in many species. In most shrews they occur on the sides of the body at a short distance behind the axilla, and their exudation is probably protective, as very few carnivorous animals will touch them. In *Echinosorex* and in *Potamogale* large pouches are situated on each side of the rectum, and discharge their secretions by ducts, opening in the first named genus in front of and in the latter within the margin of the vent. In the tenrec similarly situated glands discharge by pores, opening at the bottom of deep pits.

Representatives of this order are found throughout the temperate and tropical parts of both hemispheres, with the exception of South America (where only a few shrews have penetrated), New

Guinea, Australia and the oceanic islands. *Cynocephalus,* the so-called flying lemur, was formerly placed in the Insectivora; it is now generally regarded as forming a distinct order, the Dermoptera. (*See* CYNOCEPHALUS.)

The Insectivora may be divided into nine superfamilies, three of which are extinct.

Deltatheridioidea.—An entirely extinct superfamily established for Cretaceous and early Eocene forms; it takes its name from *Deltatheridium,* of the Mongolian Cretaceous. The several skulls discovered in Mongolia were not far from the more famous but far less important dinosaur eggs. *Deltatheridium* is known from a fairly complete skull, with a braincase smaller than that of modern insectivores, and with teeth intermediate in form between those of the earliest creodonts and those of carnivorous marsupials.

Tenrecoidea.—This group and the following are sometimes considered to form a suborder of Insectivora. the Zalambdodontia, named from the peculiar cusp-pattern of the molar teeth, the main cusps of which form a triangular pattern. Three families are included here.

Family Potamogalidae is represented by the otter shrew, Potamogale *velox,* an aquatic species with otterlike fur and vertically flattened tail, found in the rivers of tropical Africa from Nigeria to Uganda and Angola. In the skull the zygomatic arch or cheekbone, is absent. The dentition: i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$=40. This insectivore is about two feet in total length, the tail being about half.

Family Tenrecidae, agrees with the Potamogalidae in the absence of zygomatic arch, but the upper molars have narrower crowns. Teats are present on both the breast and abdomen, and some forms are as spiny as hedgehogs; the group is confined to Madagascar. The incisors vary from $\frac{3}{3}$ to $\frac{2}{2}$; the canine is always present and the cheek teeth are p.$\frac{4}{3}$, m.$\frac{3}{3}$. Subfamily Tenrecinae includes the following genera: the tenrec (Tenrec ecaudatus), is a large, tailless animal, with harsh spiny hair, the incisors are $\frac{2}{3}$ and the young teeth are striped; Hemicentetes, the striped tenrec, is smaller than the tenrec, more spiny and has incisors $\frac{4}{4}$; the hedgehog tenrec (*Setifer setosus*) is hedgehoglike, having the whole dorsal surface covered with spines; the incisors are $\frac{2}{2}$. Subfamily Oryzorictinae includes four genera. Microgale is small and shrewlike, often with a long tail (*M.* longicaudata has head and body 60 mm.; tail 140 mm.) and $\frac{3}{3}$ incisors. Oryzorictes is distinguished by its shorter tail and fossorial habits. *Limnogale mergulus* is a large aquatic form with webbed toes and a long, laterally compressed tail (head and body 150 mm.). Geogale aurita has only 34 teeth; it is also aquatic.

A Palaeocene form from North America, Peroryctes, is referred to the Tenrecoidea. This helps explain the distribution of the tenrecoids. The living West Indian solenodons, the west African Potamogale and the Madagascar tenrecs are all relics of an ancient world-wide stock.

Family Solenodontidae is represented by two species, *Solenodon paradoxus* and S. *cubanus,* the former from Haiti and the latter from Cuba. The family is distinguished by the skull being constricted behind the orbits, the descent of the testes into the perineum, and in having the teats postinguinal. Solenodons, which look like huge rats, have the dentition, i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{3}{3}$, m.$\frac{3}{3}$; they have long snouts and tails and their bodies are clothed with long coarse hair. The tail is naked, the whiskers very long and the ears large.

Chrysochloroidea.—Family Chrysochloridae contains the golden moles, confined to Africa. The skull is conical and is not constricted between the orbits; the zygomatic arch and auditory bullae are well developed, the postorbital process absent. The high-crowned cheek teeth are narrowly V-shaped, with three main cusps; a talonid or fourth cusp is present in the uppers and may also be present in the lower teeth. The ears are hidden in the fur and the eyes concealed beneath the skin. The forefeet are specialized for burrowing; the third claw is enormous and scooplike, the second is also large. The hind feet are webbed, with subequal toes. The species are rich brown or gray with a metallic lustre, varying from violet and peacock green to golden bronze. *Chrysochloris,* the typical genus, has 40 (rarely 38) teeth, the lower cheek teeth without talonid. It is a little smaller than a common mole, with short tail, and ranges from the Cape to the Cameroons in Africa. *Chlorotalpa* is found from Cape Province to the Ruwenzori region; the lower molars have a talonid (also in the following genera) and the hind molar is wedge-shaped. *Chrysospalax* of Natal and the Transvaal includes several large species with coarse hair; the root of the cheek arch is greatly expanded, partly roofing the temporal fossa. *Amblysomus,* confined to South Africa, contains several species with 36 teeth.

Erinaceoidea.—The hedgehogs and the gymnuras, or rat-shrews, forming the family Erinaceidae, differ from the shrews in having a broader tympanic ring, a complete zygomatic arch, and the presence of a short pubic symphysis; the family is exclusively confined to the old world. The typical subfamily, the Erinaceinae, or hedgehogs, is easily recognized by the spiny nature of the coat, the rudimentary tail, broad pelvis, and the presence of palatal vacuities; the members of this group are distributed over Europe, Africa and a large part of Asia. Dentition i.$\frac{3}{2}$, c.$\frac{1}{1}$, p.$\frac{3}{2}$, m.$\frac{3}{3}$. The hedgehogs are divided into five genera: (1) Erinaceus, containing the common European species and about 12 other forms from Europe, Asia and the Canary Islands, ranging from Spain to China. In this genus the pterygoids and bullae are normal, the spines on the crown divided into two groups by a median parting which is narrow and inconspicuous, a hallux is present, and the third incisor normally one-rooted. (2) *Aethechinus,* found in Africa and southern Europe, has the coronal parting broad and the third incisor two-rooted. Some of the forms (four or five in number) are smaller and darker than in *Erinaceus,* Aetheclzinus *frontalis,* from South Africa, being dark blackish-brown above, and usually black below. (3) Atelerix, from northern and east Africa, differs from the above mentioned genera in the hallux 'being absent; these hedgehogs are small in size and light buff or brownish in colour. A. *albiventris,* from the Sudan, is a very pale coloured species, while *A.* spinifex, from Nigeria, is a brown form. (4) *Hemiechinus,* a genus containing a number of forms from the southern and eastern Palaearctic region; some species occur in Egypt and northern India. In these hedgehogs there is a median parting on the crown. H. *collaris* is a black form from India; another Indian species is the long-eared hedgehog, H. *megalotis.* Lastly, in (5) Paraechinus, the pterygoids are inflated, and a coronal parting is present; found in southeastern Europe, and from Egypt to India. P. *amir* is a large black-coloured species (head and body 240 mm.), and P. *dorsalis* from Arabia has the prickles on the back bright buff coloured with a dark brown dorsal marking.

The second subfamily, Echinosoricinae, is distinguished by the absence of spines and palatal cavities, the long tail and narrow pelvis. The typical genus, Echinosorex, is represented by a single species (E. *gymnurus*) in Burma, the Malay peninsula, Sumatra and Borneo. Usually the hinder parts of the body and the limbs are blackish, while the head, shoulders and medial part of the anterior back are white, but individuals may be entirely white or pale buff. These rat-shrews are of considerable size (head and body about 420 mm.). Dentition i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{3}{3}$. The lesser rat-shrews, of the genus Hylomys, are easily distinguished by their much smaller size, very short tail (head and body 140 mm.; tail 23 mm.), and dark volelike coloration. Four races have been described from Borneo, Annam, Siam, Sumatra and Tongking. A closely allied genus is the Szechuan and Yunnan *Neotetracus* in which the tail is of considerable length and the feet large (head and body 120 mm.; tail 63 mm.; hindfoot 26.5 mm). In the Philippines the group is represented by *Podogymnura truei,* in which the hindfoot is greatly elongated.

This group, in many ways the least specialized of the living insectivores, is represented in the Tertiary of Europe and North America. being known since the Eocene.

Soricoidea.—This group includes the moles and shrews, belonging to the families Talpidae and Soricidae. The molar teeth exhibit a W-pattern of cusps, like those of the insectivorous bats. The pubic symphysis is lacking and the orbital and temporal regions of the skull are confluent, there being no post-

orbital processes.

Talpidae, the mole family, is adapted for a subterranean life; the lower ends of the tibia and fibula are united, there is a descent of the testes, the tympanum forms a bladderlike bulla, the zygomatic or cheek-arch, although slender, is complete, there is no pelvic symphysis, the upper molars are five, and the first upper incisor is simple and the lower vertical. Most of the species are burrowing, but a few are aquatic; they have a predominantly animal diet. They are confined to temperate Europe, Asia and North America. Throughout the family the eyes are very small, and in some of the forms are covered with skin; the ears are short, and the forelimbs are generally more or less modified for digging. The true moles of the genus *Talpa* are the typical members of the first subfamily, the Talpinae, in which the clavicle and humerus are very short gnd broad, while there is an additional sicklelike bone on the inner side of the forefoot which is very broad. The dental formula of the genus *Talpa* is i.$\frac{3}{3}$, c.$\frac{1}{1}$, p.$\frac{4}{4}$, m.$\frac{3}{3}$. *T. europea,* the common European mole, is widely distributed over Europe and western and central Asia; the eastern limits of its range are not known. *Parascaptor* is a closely related genus containing one species, P. *leucurus,* from Assam and the adjacent country; it is a small mole with a very short tail and long snout. The genus *Scaptochirus* is considered to contain three species from China; these moles possess very large forefeet and short tails. Another closely allied genus is *Mogera,* which includes a few species of short-haired moles with short tails; dental formula i.$\frac{3}{3}$, c.$\frac{1}{0}$, p.$\frac{4}{4}$, m.$\frac{3}{3}$. These moles come from the far east; M. *wogera,* from Japan, is a large, pale vandyke-brown coloured species.

There remain four North American genera of Talpinae: (1) *Scalops,* a genus with very large forefeet and webbed toes; tail very short, slender and nearly naked, and ears and eyes quite small. *S. aquaticus,* the common mole of the eastern United States and of considerable importance as a fur-bearing animal, is found from Massachusetts to Minnesota and Colorado and southward to Florida and Texas. It is a pale sepia-coloured or slate-coloured mole, often tinged with brown, varying in length in the different subspecies, of which about ten are recognized, from barely 140 mm. to 203 mm. and in colour from light drab to dark sepia and brown. (2) *Scapanus,* a genus with very broad hands, but with toes lacking webs; the tail is rather longer, thick and scantily haired, and the general colour of the body is darker, varying in winter in some forms to black. There are several species, all natives of the Pacific slope where they take the place of the common mole *(Scalops)* of the eastern United States, which they strongly resemble in their habits. *S. townseizdi,* the best known of the group, comes from northern California, Oregon and Washington, where it is common between the Cascades and the coast ranges. It is a large mole, 229 mm. long and blackish in colour, with a plump body and a tail 38 mm. long; *S. orarius,* about 178 mm. long, with the body blackish or grayish in colour, occurs from northern California through Oregon and Washington to British Columbia. S. *latimanus,* similar or slightly larger in size but varying in colour from gray or drab to brown and black, is found from southern California to central Oregon; a larger gray form, var. *alpinus,* 190 mm. long, occurs at Crater lake. (3) *Parascalops,* is a smaller genus, with one species, P. *breweri,* the hairy-tailed mole, found in dry sandy soil from New Brunswick to Georgia and westward to Ohio; the body is blackish, often with brownish gloss; the tail is short, thick, compressed at the base, and very hairy; the toes are not webbed. (4) *Condylura,* the star-nosed mole, which is distinguished by the possession of a fringe of fleshy appendages around the extremity of the snout, 11 appendages on each side. Its general bodily size is about that of the common European mole, but the tail is much longer. The star-nosed mole is blackish in colour and about 190 mm. long; the tail, which is about 64 mm. long, is covered with coarse hair; and the toes are not webbed. One species only is recognized, C. *cristata,* the type locality of which is Pennsylvania; it occurs, but rather infrequently, in wet meadows and marshes from southern Labrador to southeastern Manitoba southward to Georgia and Indiana, often leaving its burrows and running about on the surface.

The second subfamily of the Talpidae is the Desmaninae including a series of animals rather intermediate between moles and shrews, known as the mole shrews. A number of genera have been described, the most important of which are the following: (1) *Urotrichus,* small shrewlike animals with long snouts, and hairy, almost bushy tails; forefeet not markedly enlarged, but more so than in the shrews. *U. talpoides* comes from Japan, from where a number of races have been described (head and body 90 mm., tail 2j mm.). (2) *Neurotriclcus* contains a small shrewlike species, N. *gibbsi,* with large hands and a short hairy tail (head and body 110 mm., tail 36 mm.). (3) *Scaptonyx,* allied to *Neurotrichus,* with a more hairy tail and smaller forefeet; the genus is restricted to China. (4) *Dymecodon,* contains but *a* single species, D. *pilirostris* from Japan; it is smaller than *Urotrichus* and has a proportionally longer, but less hairy tail (head and body 78 mm.; tail 40 mm.). (j) *Uropsilus* a long-nosed, long-tailed genus, with small hands and feet; the tail is short-haired; *U. soricipes* hails from China. (6) *Rhynchonax,* contains a single species from Szechuan, China, smaller than *Uropsilus* and darker in colour. (7) *Galemys* contains the water mole or western desman, from southwestern France and the Italian peninsula. This and the following species show marked adaptation to an aquatic life the toes being webbed and the tail long and flattened laterally. The snout is of considerable length, as also is the soft body fur which is otter-brown above, and yellowish-gray below. Dimensions of the species *(G. pyrenaicus)*: head and body 131 mm., tail 145 mm., hindfoot 38 mm. The last genus (8) *Desmana,* the Russian Desman *(D. moschata)* is very similar in form to *Galemys,* but much larger and more massive (total length 16 in.); it inhabits the streams and lakes of southeast Russia.

Soricidae.—The members of the next family, the Soricidae, are known as shrews. The majority are terrestrial but a few are aquatic. The family is closely related to the moles, with which it is connected by some of the subfamily Desmaninae. The species are, however, distinguished by the ringlike tympanic, incompleteness of the zygomatic arch, and the forward direction of the large lower incisor. The first upper incisor is large and hooklike, with a basal cusp. Following the front tooth above are four to six peglike teeth, known as unicuspids, and two to four below. There are differences of opinion as to the identification of these unicuspids, due to their similarities with each other, the resorption of deciduous teeth before or shortly after birth and the complete fusion of the bones of the skull at an early age. *Sorex,* the typical genus, was considered by E. Brandt to have a dental formula of i.$\frac{4}{2}$, c.$\frac{1}{0}$, p.$\frac{2}{1}$, m.$\frac{3}{3}$, and this is followed in many books; embryological studies by A. Ärnbäch-Christie-Linde suggest that the formula may be i.$\frac{3}{1}$, c.$\frac{0}{0}$, p.$\frac{4}{2}$, m.$\frac{3}{3}$; while most authors use a more conservative formula: i.$\frac{3}{1}$, c.$\frac{1}{1}$, p.$\frac{3}{1}$, m$\frac{3}{3}$. In *Sorex* and its allies the teeth are tipped with brownish-red, in the Crocidurine section the teeth are wholly white. The members of the genus *Sorex* are widely spread over Europe, Asia (north of the Himalayas) and North America. The ears are well developed, the tail long and evenly haired, without the long hairs so characteristic of *Crocidura.* The typical species *S. araneus* is the common shrew-mouse of Europe; it is distributed over the northern portions of Europe and Asia from England and Scotland eastward; southward it reaches central Spain and Italy. As with so many British mammals, it is absent from Ireland. (Head and body 65 to 80 mm.; tail 20–35 mm.; hind-foot 11–14.5 mm.) *S. minutus,* the pygmy shrew-mouse, is considerably smaller, measuring only about 52 mm. in length (head and body); found over the northern part of Eurasia from Ireland eastward, and south as far as the Pyrenees and southern Italy. In North America *Sorex* is represented by 30 or more species, including *S. cinereus,* the common American long-tailed shrew, about 100 mm. long. found from New England and Tennessee to Alaska; S. *fumeus,* the smoky shrew of the northeastern states and *S. vagrans,* the western shrew, abundant in the Rocky mountains and the Sierra Nevada. The American water shrews, formerly considered to form a separate genus, *Neosorex,* are much larger and include three aquatic species, of which the best known is *S. palustris,* characteristic of northern and mountain parts. The feet are large,

with fringes of hair on the toes. In the Asiatic Soriculus one upper unicuspid is lost (dentition: $i.\frac{3}{1}$, c.), $p.\frac{2}{1}, m.\frac{3}{3}$), the tail is relatively longer than in Sorex, equalling or exceeding head and body length. Closely allied to Soriculus is the Chinese *Chodsigoa*, which has lost the minute unicuspid premolar of the former. The single species is confined to highlands in Szechuan, Kansu and Hopei. *Blarinella* quadraticauda from western China is related to Sorex, but differs in its short tail, reduced external ears and well-developed claws. In these characters it resembles the American Blarina, but cranially it shows no approach. The tips of the teeth are lightly pigmented; dental formula: $i.\frac{3}{1}$, $c.\frac{1}{1}$, $p.\frac{3}{1}$, $m.\frac{3}{3}$. Microsorex *hoyi*, one of the smallest of mammals (76 mm. in total length), occurs in northeastern U.S. and Canada; the dental formula is the same as that of Sorex, but the third and fifth upper unicuspids are minute, hidden on the inner side of the tooth row. Notiosorex *crawfordi*, the gray shrew of southwestern U.S., has only three upper unicuspids. It is 82 mm. in total length, with the tail 26 mm. A larger species (N. *gigas*) occurs in the mountains of central Mexico. Blarina brevicaztda, the large short-tailed shrew of the eastern U.S., kills many mice as well as insects; it is dark gray in colour and molelike in appearance, with dentition $i.\frac{3}{1}$, $c.\frac{1}{1}$, $p.\frac{3}{1}$, $m.\frac{3}{3}$. Related species occur in Central America. Cryptotis, a southern genus ranging from Connecticut to South America, is also short-tailed, but is only a little larger in body than the common shrew. It lacks one upper unicuspid but is otherwise much like Blarina. *Neomys*, the Eurasian water shrew, agrees with Cryptotis in having only 30 teeth (four unicuspids), but it is aquatic. The tail is fringed with long hairs on the underside and so are the feet. The fur is very soft, dark slate-gray in colour. *Neomys* ranges from Spain and England to Lake Baikal in central Asia, northward as far as Scandinavia.

The shrews with white teeth are found in Europe, Asia and Africa. The short-haired, long-tailed shrews of Africa with four upper unicuspids are grouped together in the genus *Sylvisorex*, in some the tail is much longer than the body (head and body 60 mm.; tail 85 mm.); in others, as *S. lunaris* from Ruwenzori, the tail is about equal in length to the head and body. In the allied genus *Myosorex*, also from Africa (dentition: $i.\frac{3}{1}$, $c.\frac{1}{1}$, $p.\frac{2}{2}$, $m.\frac{3}{3}$), the tail is long and the fur soft and thick; the openings of the generative organs and vent, although close together, are distinct. Surdisorex is another white-toothed genus containing one or two species; *S.* norae is distinguished by its very short tail (head and body 92 mm.; tail 20 mm.; hindfoot 15 mm.), very soft, deep chocolate-coloured coat and large forefeet. It inhabits Kenya colony. The typical genus of this group, Crocidura, or musk shrew (dentition: $i.\frac{3}{1}$, $c.\frac{1}{1}$, $p.\frac{1}{1}$, $m.\frac{3}{3}$), is found over nearly the whole of Africa and the warmer parts of Europe and Asia; a species has recently been described from the Scilly Isles. The generative openings form a short cloaca with the anal orifice. Tail long, with a number of long, rather bristly hairs in addition to the shorter normal hairs. Some of the largest and smallest members of this genus are found in Africa; the smallest musk shrew, probably the smallest mammal, is C. pasha, from the Sudan. The Suncus shrews with an extra premolar (dentition. $i.\frac{3}{1}$, $c.\frac{1}{1}$, $p.\frac{2}{1}$, $m.\frac{3}{3}$) are considered to represent a distinct genus, Pachyura, which is found over Africa, the warmer parts of Asia, and Mediterranean region. The members of this group all have the typical crocidurine tails, with the long bristlelike hairs. *Praesorex* goliath is a giant shrew from the Cameroons (head and body 170 mm.; tail 102 mm.; hindfoot 25 mm.) related to the *Crocidura* but distinguished by its longer and harsher coat. In Solisorex *pearsoni*, another large form, the tail is shorter (66 mm.) and the fur softer and grayer. *Scutisorex* includes the "tinhatted shrews" from Uganda and the eastern Congo. The skull of this species has enormously developed lambdoid crests which extend backward and are continuous with a posterior extension of the lateral temporal crests (head and body 143 mm.; tail 77 mm.; hindfoot 20 mm.); and the backbone is extraordinarily strengthened.

Anourosorex is an allied genus containing but a single species, **A.** *squamipes*, a small mole-coloured shrew with *a* very short tail (head and body 83 mm.; tail 16 mm.; hindfoot 15 mm.). This genus, which inhabits Szechuan and Tibet, is distinguished from the closely related genus *Diplomesodon*, from the Kirghiz steppes, by the soles of the hindfeet being scaly, not hairy. The latter genus, which also contains only one species, *D.* pulchellus, is further distinguished by its longer tail. Lastly there are two Asiatic water shrews: (1) Chimarrogale, from India to Japan and Borneo, blackish gray above, white below, is distinguished by its long tail with an inferior fringe of elongated hairs; the generative organs open into the same integumentary ring as the anal orifice; the dental formula is $i.\frac{2}{1}$, c.), $p.\frac{1}{1}$, $m.\frac{3}{3}$. (2) Nectogale is similar in appearance to the foregoing genus, the "feathering" of the feet and tail being more developed; in colour it is about like a mole, whitish below.

Moles and shrews are well known from the Oligocene on, with *Nyctitherium* of the Palaeocene and Eocene of North America and Europe, forming a separate, though related family, the Kyctotheriidae. The caves of Puerto Rico have yielded a remarkable addition to the West Indian insectivores in *Nesophontes*, which became extinct in very late Pleistocene times.

Macrosceloidea.—The Macroscelidae contains the jumping or elephant shrews. These have molars the cusps of which are arranged in a W-pattern, which may resemble the crescentlike ridges characteristic of some hoofed mammals. The skull has well-marked postorbital processes. The tarsus is markedly elongated and the lower ends of tibia and fibula are joined. Dental formula, $i.\frac{3}{3}$, $c.\frac{1}{1}$, $p.\frac{4}{4}$, $m.\frac{2}{2 \text{ or } 3}$. The members of this family leap like gerbils or jerboas. The Macroscelididae may be considered to contain seven genera: (1) Macroscelides, or jumping shrews, containing two South African species M. proboscideus from Cape colony and the Orange Free State, and M. *melanotis* from Namaqualand; in this genus the lower molars are two in number and the auditory bullae much enlarged. (2) *Elephantulus* containing the jumping shrews of North, East and South Africa in which the lower molars are two in number, but the auditory bullae are normal, not enlarged. In size about equal to the foregoing genus. The various species extend from Morocco and Algeria (E. *rozeti*) southward to Somaliland, East and South Africa. (3) Nasilio, or the short-nosed jumping shrews, with three lower molars and normal auditory bullae. Like the two allied genera, Macroscelides and Elephantulus, these jumping shrews are diurnal. The genus extends as far north as Angola in the west and Kenya colony in the east. (4) Petrodromus, the four-toed jumping shrews, are distinguished from the foregoing genera in having only four instead of five toes to each front foot; the dimensions are considerably larger and the coat quite different in colour, being pale olive-green on the flanks and rufous on the back (P. tetradactylus, South Africa). The tail is long and clothed in short normal hairs. (5) Mesoctenus, closely allied to Petrodromus, but distinguished by the hairs on the underside of the tail being slightly bulbous at their ends; this genus includes two species M. *rovumae* and *M. nigriseta* from East Africa. (6) Cercoctenus, in which the bulbous, or club-shaped hairs on the underside of the tail are still more developed, two species are recognized: C. sultan from Zanzibar, Tanganyika territory and Kenya colony, and C. schwanni from Portuguese East Africa. (7) *Rhynchocyon*, the long nosed elephant shrews, in which the reduction in the number of toes is carried still further. there being only four toes to each foot. In this genus the snout is much longer, the size of the body considerably greater, and the tarsus still more elongated. The dental formula is $i.\frac{1 \text{ or } 0}{3}$, $c.\frac{1}{1}$, $p.\frac{4}{4}$, $m.\frac{2}{2}$. It has been proposed to divide the genus into two subgenera, the typical one containing the chessboard patterned species (R. cirnei, reichardi, claudi and *stulhmanni*) and *Rhinonax* including R. chrysopygus and R. petersi and its allies. Some of these elephant shrews are very handsomely coloured, R. cirnei from Nyasaland has the posterior part of its back marked with rows of alternate dark and light blotches, giving a chessboard effect. The apical portion of the tail is always white. In the subgenus Rlzinonax equally bright colouring occurs; R. (R.) petersi comes from East Africa and Zanzibar. R. (R.) *chrysopygus* (East Africa) has the body, flanks and limbs deep maroon, and the rump bright orange-yellow coloured.

Tupaioidea.—The tree shrews, family Tupaiidae, have the orbit separated from the temporal fossa by a bar of bone. Like the Macroscelidae they have a pubic symphysis, or union of the two halves of the hip bone below or in front of the pelvis, and they have been grouped with that family as a suborder of Insectivora, the Menotyphla. It is probable that the resemblances between the two groups are not indicative of close relationship but are primitive characters retained by each independently.

Many authors regard the Tupaiidae as lowly organized members of the order Primates, but others are quite unable to consider the genus *Tupaia* and its near relations, *Dendrogale, Urogale* and *Ptilocercus,* as representing anything more than a group of insectivores. Tupaiidae, the tree shrews, confined to the oriental region. in addition to the bony ring surrounding the orbit, are distinguished by the large size of the brain. The dental formula is $i.\frac{2}{3}$, $c.\frac{1}{1}$, $p.\frac{3}{3}$, $m.\frac{3}{3}$. The tupaias or tree shrews are in many ways like squirrels; they are. however, distinguished by their pointed, insectivore-like faces and light-coloured shoulder stripes. The typical genus contains a great number of species and subspecies. *T. ferruginea,* from the Malay peninsula and islands, is bright chestnut-brown in colour with an olive-brown face and tail; the majority of the members of this genus do not exceed 350 mm. (1 mm. = .03937 in.) in total length. *T. pictus,* of Borneo, is a very handsomely coloured tree shrew. chestnut and olive above, with buff shoulder stripes and a black dorsal stripe. From the Rhio archipelago comes a deep chestnut-coloured form known as *T. castanea. T. minor* is a very small species from Borneo, with a hind-foot of only 28 mm., and a total length of about 280 mm.

Tree shrews of the subgenus *Anathana* are distinguished by the inner sides of the ears being more hairy, the larger size of the lower lobe of the ear, and the coarser nasal reticulations. The species come from India and Borneo. A number of handsomely coloured tree shrews have been placed in the subgenus *Tam.* Included in this is a very brightly coloured species from Borneo and Sumatra, *T. tana. T. dorsalis,* from Borneo, is a smaller species, with a well-marked black dorsal stripe extending from the crown of the head to the base of the tail. The genus *Urogale,* allied to *Tupaia,* contains but a single species, *U. cylindura* from Mindanao, in general dimensions and appearance about as in the smaller *Tupaias,* the total length being 250 mm. The smallest members of this family are included in the genus *Dendrogale,* the total length not exceeding 23j mm. These pygmy tree shrews come from Annam, French Indo-China, Siam and Borneo.

The Asiatic pentailed tree shrew (*Ptilocercus lowi*) is also included in this family, although it differs very markedly from all the other genera. The tail is very long, with the proximal two-thirds naked, and the remaining third furnished with a feather-like fringe. This species, the only representative of the genus, is found in Borneo, Sumatra and parts of the Malay peninsula.

The tree shrews are represented by a distinct family in the Eocene of Asia (Anagalidae, for the genus *Anagale*). The relations of the tree shrews with the earliest primates, mentioned above, become the more evident through the Palaeocene and Eocene Plesiadapidae, which are referred to the lemurs.

BIBLIOGRAPHY.—G. E. Dobson, *Monograph of the Insectivora* (1883–90); W. Leche, "Zur Morphologie des Zahnsystems der Insectivoren," *Anat. Anz.,* xiii, 1, 514 (1897); numerous papers in the *Annals and Magazine of Natural History* and *Proceedings of the Zoological Society* by Oldfield Thomas; Guy Dollman, "Monograph of the African Crocidura," *Ann. Mag. Nat. Hist.,* vol. v-vii (1915–16); W. K. Gregory, "Mongolian Mammals of the 'Age of Reptiles,'" *Sci. Mon.,* 24 (1927); W. K. Gregory and G. G. Simpson, "Cretaceous Mammals From Mongolia," *Anzer. Mus. Novit.,* 225 (1926); A. S. Romer, *Vertebrate Paleontology* (Chicago, Cambridge, 1933); E. Brandt, *Bull. Soc. Imp. Nat.* (1868); A. Ärnbäch-Christie-Linde, *Morph. Jb.,* vol. 36 and 34 (1907, 1912). (J. G. D.; J. E. HL.; X.)

INSECTIVOROUS PLANTS: *see* CARNIVOROUS PLANTS.

INSEIN, a town and district of lower Burma in the Pegu division, lying immediately to the north of Rangoon. District area 1,914 sq.mi.; pop. (1941) 387,345. The district includes a large tract of the Irrawaddy delta on either side of the Hlaing or Rangoon river and on the east of the Irramaddy itself. In the west the district includes a portion of the southern end of the Pegu Yomas clothed with dense evergreen forest which, in spite of its nearness to Rangoon, was still the haunt of wild elephants in modern times. The Rangoon-Prome line of the Burma railways runs through the district.

INSEIN, the chief town (pop. [1953] 27,030), lies 10 mi. N.W. of Rangoon, of which it became almost a suburb. It has railway workshops, a government engineering school and veterinary college.

INSELBERG. An isolated hill standing above well-developed plains. in appearance not unlike an island above the sea (hence the name). Although the term is sometimes applied generally, most geologists restrict its use to such hills formed under tropical and subtropical conditions, as in Nigeria (*q.v.*), usually formed of plutonic rocks such as granite and gneiss, and characterized by steep curved sides of smooth bare rock. These bare rock domes, which may stand 1,500 ft. above the plains, are more specifically called bornhardts and display an onionlike "peeling" (exfoliation) of concentric rock shells, in thickness from a few inches to 20 ft., from the surface. A pediment, or low-angle slope slightly concave upward, is usually present at the base of the inselberg. In its later stages an inselberg may develop into a *kopje; i.e*, a residual hill composed of a pile of large boulders, in form similar to the granite tors of Devon and Cornwall. Isolated hills similar to inselbergs but formed under nontropical conditions are known as monadnocks. (J. C. PH.)

INSHTATHEAMBA or BRIGHT EYES (1854–1903), American Indian writer and lecturer who promoted public interest in reform of the U.S. government's Indian policies, was born in Nebraska on the Omaha reservation. She was the daughter of a former Omaha chief, Inshtamaza or Iron Eye. His father. Joseph La Flesche. who married an Omaha woman, was a French trader. and Iron Eye also bore his father's name. Bright Eyes was originally named Susette La Flesche but later adopted her Indian name.

She studied at a mission school on the reservation and later was educated at a private school in Elizabeth, N.J. She thereafter was a teacher in a government school on the reservation.

Bright Eyes won wide public interest in 1879 as an outspoken advocate of Indian rights. In that year she toured the eastern states to call attention to the government's arbitrary action against the Ponca tribe. In 1877 the Poncas, related to the Omahas, had been forced to leave their reservation on the Niobrara river in South Dakota and to emigrate to the southern Indian territory. The tribe found living conditions there intolerable, however, and led by chief Standing Bear traveled north on foot for about 600 mi., arriving at the Omaha reservation in March 1879. The Indians were arrested and ordered to be returned to their new home. On April 30, 1879, the federal district court held, however, that they should be freed under a writ of habeas corpus.

Bright Eyes, noted for her eloquence as a speaker, edited *Ploughed Under, the Story of an Indian Chief* (1881). She died on the Omaha reservation, near Bancroft, May 26, 1903.

INSIDE PASSAGE or INLAND PASSAGE is a sheltered sea route extending from Seattle, Wash., approximately 1,000 mi. to Skagway, Alaska. Protection from winds and storms is provided by Vancouver Island, by a series of islands lying eastward of Hecate strait and, in Alaska, by the Alexander archipelago (*q.v.*). Vacationers have favoured this waterway, both for its great natural beauty and its customary smoothness.

The greatest width of the chain of islands is about 80 mi. Their rugged topography is concealed beneath heavy forests and dense undergrowth. Several small glaciers may be seen from the channel. Rainfall is heavy, and may be expected at any season.

Navigation. — The shores of the channel drop off sharply, and in most places there is ample depth for all vessels. Anchorages are numerous. Tidal currents attain considerable velocity in places. Extensive surveys have practically eliminated unmarked pinnacle rocks which have caused several notable marine disasters. Pilotage is not required, but is desirable.

Principal towns along the passage include Victoria, Vancouver and Prince Rupert in British Columbia and Ketchikan, Wrangell, Petersburg, Juneau and Skagway in Alaska. (J. E. CL.)

INSIGNIA, MILITARY. Ever since men first organized themselves into large groups for fighting they have employed cer-

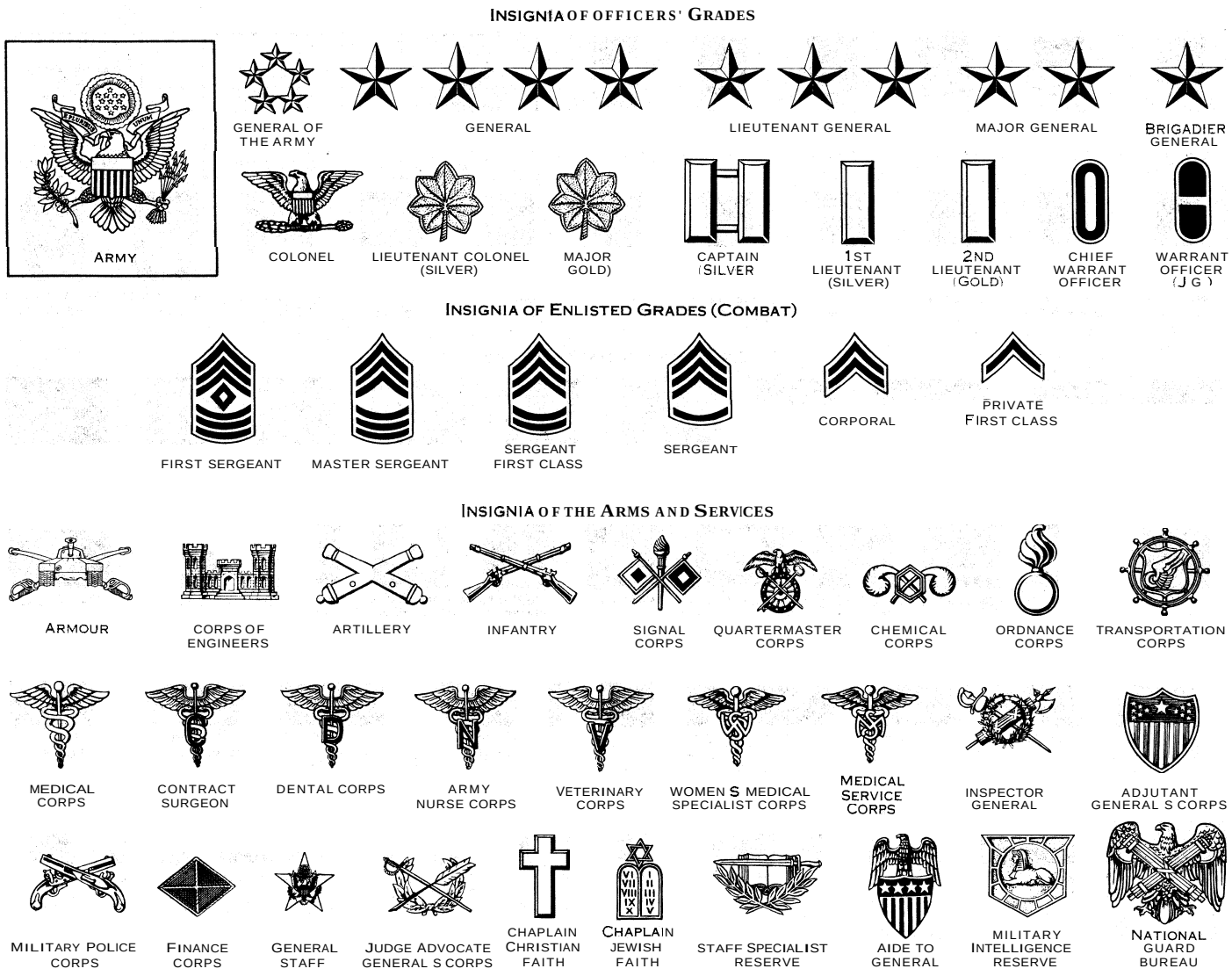


FIG. 1.— INSIGNIA OF RANK AND BRANCHES IN THE U.S. ARMY

tain signs or insignia to indicate their rank, branch of service and special duties or qualifications. Except for commanders of high rank, insignia were usually rather simple in ancient and medieval forces, but since the 18th century insignia for all ranks have developed along rather complicated and rigid lines. Many different devices have been used, including cockades, epaulets, hat cords, ribbons, buttons, badges, ornaments, bars, clasps, chevrons, stripes, braids and shoulder patches. The uniform itself may indicate a man's rank, in a general way; it may also show his branch of service. (See UNIFORMS.) Insignia of organizations are discussed in COLOURS, MILITARY.

UNITED STATES

In spite of many interesting stories about origins, the early development of rank insignia in the United States was a haphazard affair. At the start of the American Revolution it was difficult to distinguish between officers and enlisted men of the Continental army. Some "badges of distinction" were deemed necessary. Gen. George Washington wore "a light blue ribband across his breast between his coat and waistcoat." A brigadier general was assigned a pink ribbon; a major general a purple ribbon; and aides, green. Field officers were distinguished by hat cockades, red or pink. Captains wore yellow or buff cockades while lieutenants wore green. An epaulet on the shoulder with a silver star to denote the rank of general came into use near the end of the war. The colonel's eagle did not appear until about 50 years later.

Army.— The insignia of the arms and services of the U.S. army

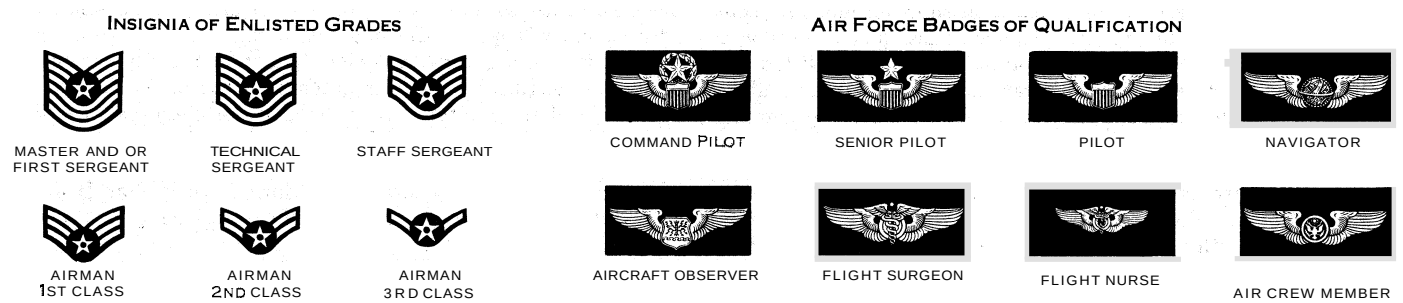


FIG. 2.— INSIGNIAOF RANK AND BADGES OF QUALIFICATION IN THE U.S. AIR FORCE. THOSE FOR OFFICERS' GRADES ARE THE SAME AS THOSE FOR THE ARMY (FIG. 1)

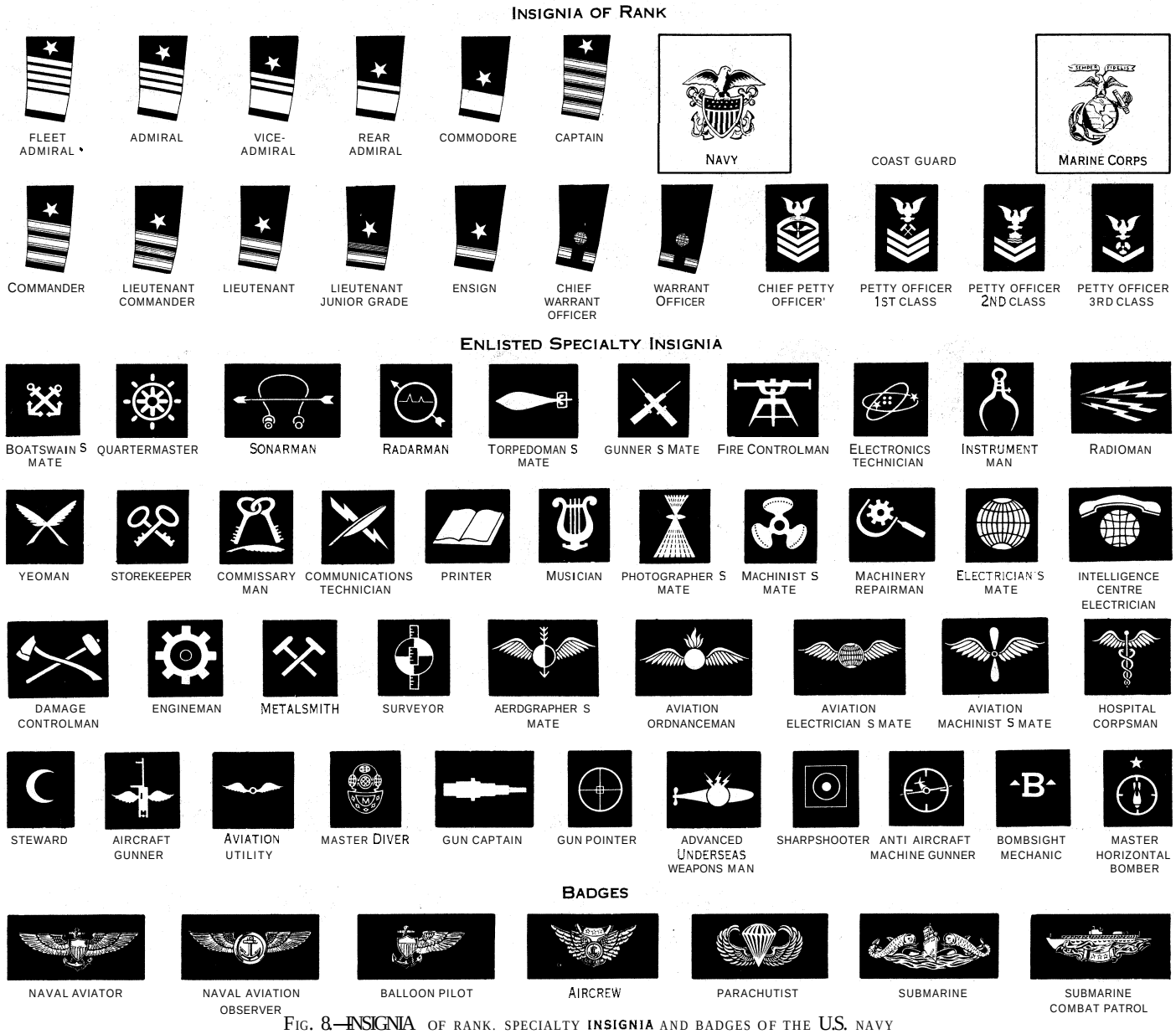


FIG. 8.—INSIGNIA OF RANK, SPECIALTY INSIGNIA AND BADGES OF THE U.S. NAVY

in the 20th century have followed a fairly consistent pattern and have borne an understandable relationship to the functions of the arm or service to which they apply. The crossed flags and torch of the signal corps and the flaming bomb of the ordnance corps are examples. (See fig. 1.) The latter is said to be the oldest of U.S. insignia, having been adopted in **1832.** Originally the flaming bomb represented both artillery and ordnance and was embroidered in gold on officers' long-skirted coats. In addition to such devices, each branch of the army has a distinctive colour — infantry, light blue; armour, yellow; artillery, scarlet; and so on

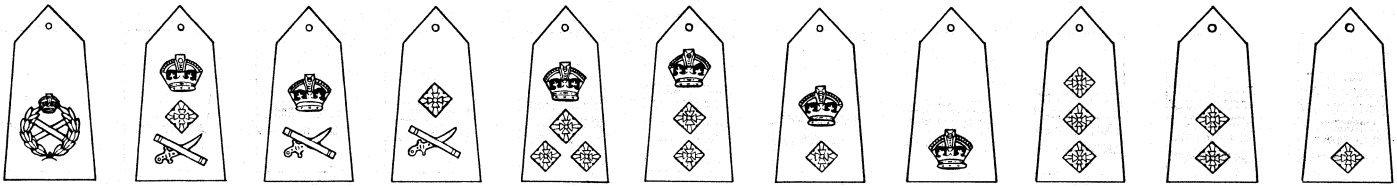
Insignia of grade are normally worn on shoulder loops by commissioned and warrant officers. Noncommissioned officers wear gold-coloured chevrons (point up) on both sleeves. Enlisted specialists wear an eagle device with varying numbers of arcs above and chevrons below on both sleeves. On some uniforms, commissioned officers wear rank insignia on their right shirt collar and on their garrison caps; enlisted men wear unit insignia or regimental crest on the garrison cap. All personnel wear grade insignia on combat helmets. Combat leaders wear a green cloth loop around the middle of both shoulder loops of the outer garment. Branch insignia are worn on the left collar or, by officers, on both coat lapels.

In 1959 the U.S. army made minor changes in the titles and insignia of enlisted grades. The two lowest grades remained unchanged but the insignia of sergeant became three chevrons without an arc or "rocker." Others were as follows: staff sergeant — three chevrons above one arc; platoon sergeant or sergeant first class — three chevrons above two arcs; master sergeant — three chevrons above three arcs; first sergeant — three chevrons above three arcs with a lozenge between the chevron and arcs; sergeant major — three chevrons above three arcs with a five-pointed star between chevron and arcs.

Members of colour-bearing units such as regiments, separate battalions and service schools wear small enameled shields bearing the regimental, unit or school coat of arms in the middle of both shoulder loops on the outer garment. Members of major commands, armies, corps, divisions and independent commands often wear distinctive shoulder patches on the upper part of the left sleeve of their outer uniform. Many of these patches were designed for units serving in World Wars I and II and the Korean war. Both officers and enlisted men may wear the shoulder patch of the overseas unit they served with during World War II or the Korean war. This is worn at the top of the right sleeve of the uniform.

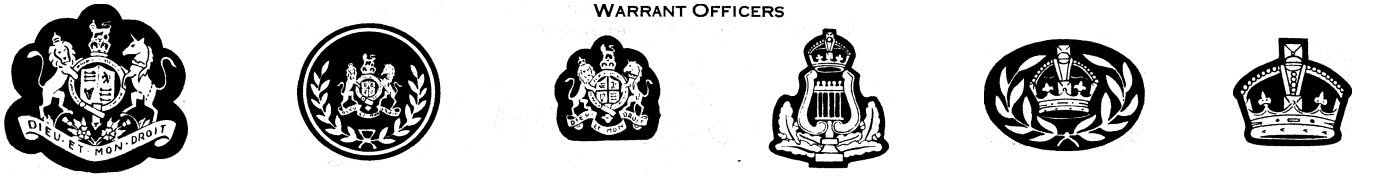
Officers on duty with the general staff of the department of the army in Washington, D.C., wear a green, black and gold medallion (general staff identification badge) on the right breast pocket.

ARMY OFFICERS' BADGES OF RANK



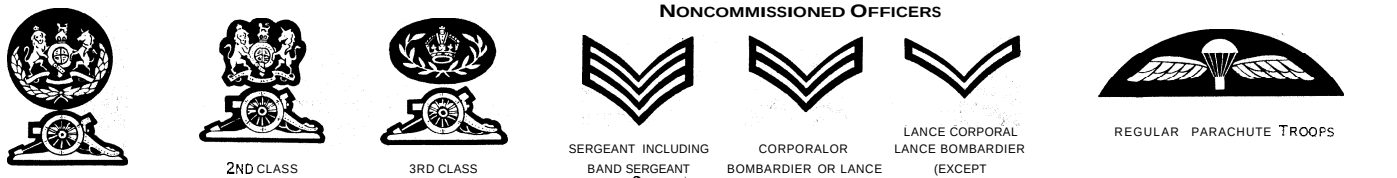
FIELD MARSHAL · GENERAL · LIEUTENANT GENERAL · MAJOR GENERAL · BRIGADIER · COLONEL · LIEUTENANT COLONEL · MAJOR · CAPTAIN · LIEUTENANT · 2ND LIEUTENANT

WARRANT OFFICERS



REGIMENTAL SERGEANT MAJOR · STAFF SERGEANT MAJOR 1ST CLASS · REGIMENTAL CORPORAL MAJOR · BANDMASTER · REGIMENTAL QUARTERMASTER CORPORAL · SQUADRON CORPORAL MAJOR AND OTHER WARRANT OFFICERS CLASS 2

NONCOMMISSIONED OFFICERS



1ST CLASS MASTER GUNNER · 2ND CLASS MASTER GUNNER · 3RD CLASS MASTER GUNNER · SERGEANT INCLUDING BAND SERGEANT (FOOT GUARDS) · CORPORALOR BOMBARDIER OR LANCE CORPORAL (FOOT GUARDS) BAND CORPORAL (QUEEN SOWN HUSSAR91 · LANCE CORPORAL LANCE BOMBARDIER (EXCEPT FOOT GUARDS) · REGULAR PARACHUTE TROOPS

NAVY OFFICERS' BADGES OF RANK

ADMIRAL OF THE FLEET · ADMIRAL · VICE ADMIRAL · REAR ADMIRAL AND COMMODORE 1ST CLASS · COMMODORE 2ND CLASS · CAPTAIN · COMMANDER · LIEUTENANT COMMANDER · LIEUTENANT · SUB LIEUTENANT AND SENIOR COMMISSIONED OFFICER · COMMISSIONED OFFICER

CAP BADGES

MIDSHIPMAN · CADET · LIEUTENANT PERMANENT RESERVE · LIEUTENANT TEMPORARY RESERVE · CHIEF PETTY OFFICER · PETTY OFFICER · PETTY OFFICER · OTHER RATINGS NOTDRESSED AS SEAMEN · LEADING RATING

DESIGNS OF BRANCH BADGES

GUNNERY · RADAR PLOT · TORPEDO AND ANTISUBMARINE · COXSWAIN · SURVEYING RECORDER · BOOM DEFENSE · SIGNAL · TELEGRAPHIST · STOKER MECHANIC · MECHANICIAN (NOT ENTITLED TO TRADE PAY) · REGULATING

NAVAL AIRMAN (OTHER THAN NAVAL AIRMAN S A M) · NAVAL AIRMAN S A M · AIRCRAFT MECHANICIAN (NOT ENTITLED TO TRADE PAY) · PHYSICAL AND RECREATIONAL TRAINING · ELECTRICAL · SUPPLY AND SECRETARIAT · ARTISAN · PHOTOGRAPHER · SAILMAKER · DIVER · SICK BERTH

FLYING BADGES

CPO COXSWAIN · NAVIGATORS YEOMAN · MASTER AT ARMS · OFFICER AND RATING PILOT · OBSERVER AND AIRCREWMAN · SU[illegible]NT (QUALIFIED PILOT) · 4 YEARS · 8 YEARS GOOD CONDUCT BADGES · 12 YEARS

FIG. 4.—BADGES OF RANK IN THE BRITISH ARMY AND NAVY. BRANCHES OF THE NAVY AND FLYING BADGES

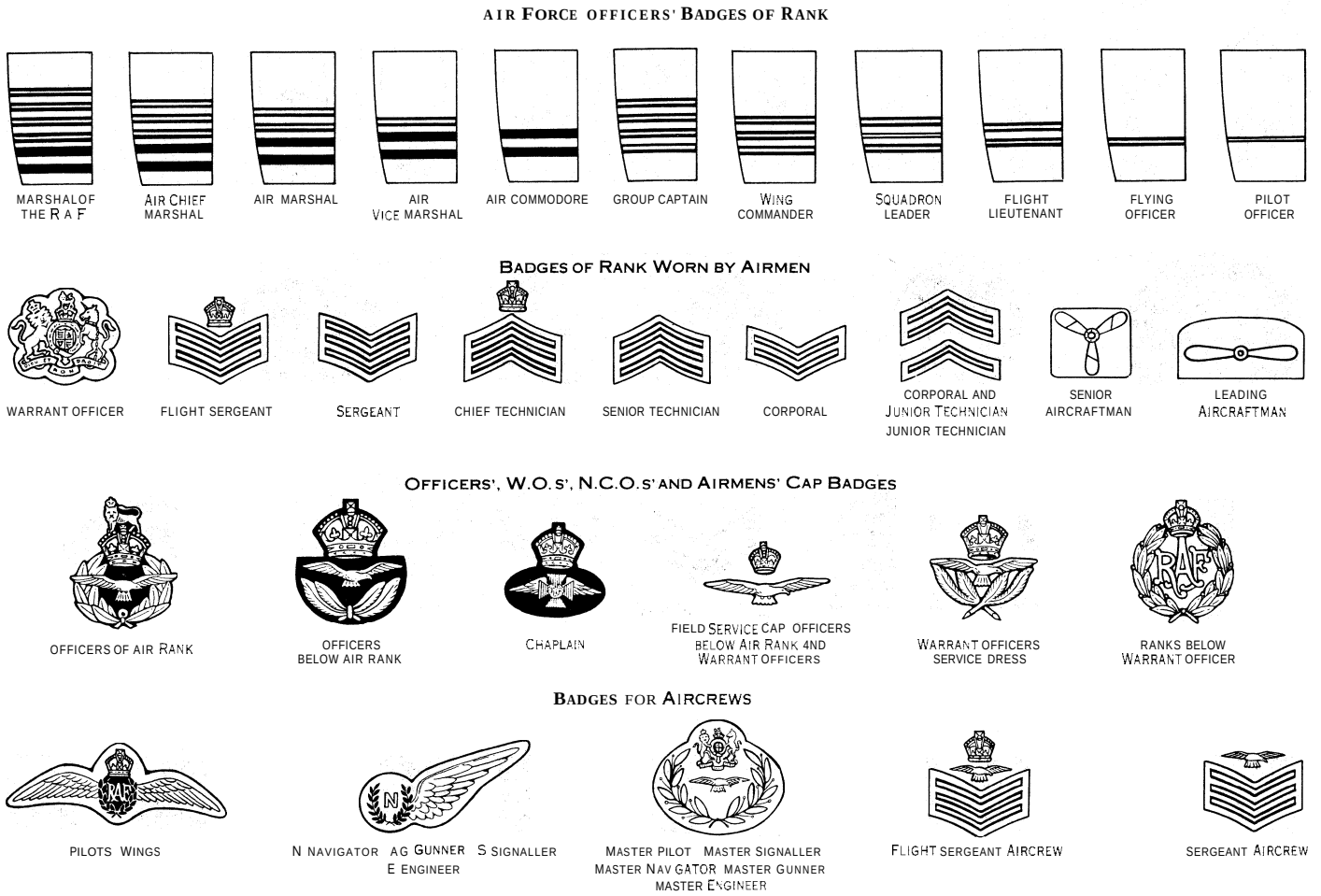


FIG. 5.— BADGESOF RANK AND CAP BADGES OF THE BRITISH AIR FORCE FOR OFFICERS. AIRMEN AND AIRCREWS

After one year's service on the army general staff, the officer is permitted to wear this insignia permanently. A similar device, the department of defense identification badge, is awarded to U.S. armed forces personnel who serve on the staff of the department of defense and is worn on the left breast pocket.

The letters "U.S." in a circle are worn by all army and air force enlisted personnel on the right coat collar and on both collars by basic trainees. Officers wear the "U.S.," without background, on both coat collars when branch insignia are worn on the lapels. On certain working uniforms the words "U.S. Army" in gold on a black background are worn on the upper left breast.

Navy.—Commissioned and warrant officers of the navy wear stripes indicating rank on coat sleeves or shoulder boards, the colour of the stripes depending on the colour of the uniform. Devices above the stripes distinguish between line and staff corps officers. Rank may also be designated by metal insignia of the army type except that warrant officers wear single bars broken by blue instead of brown. Such insignia are worn on both shoulder loops of the raincoat and on both shirt collars by line officers. Staff corps officers and warrant officers wear the rank device on the right shirt collar and the staff corps or specialty insignia on the left. As in the other services, the higher ranks (commander and above) are distinguished by braid ornamentation on visors.

Navy enlisted personnel of the three lowest pay grades are designated by diagonal stripes worn on the left sleeve. Petty officers wear chevrons (point down) surmounted by an eagle and, in the case of the top two pay grades, by one or two stars. Between the chevrons and the eagle is a device indicating the petty officer's specialty. The device, as a whole, is known as a rating badge. Until after World War II seven specialty ratings (signalman, boatswain's mate–coxswain, fire controlman, gunner's mate, torpedoman, quartermaster and turret captain) were worn on the right sleeve, all others on the left. Thereafter, all rating badges were worn on the left sleeve. Depending on the uniform, enlisted rank insignia are of silver, blue, white, khaki, silver-khaki or green. Petty officers with 12 years' good conduct wear gold rating badges.

Naval aviation badges for navy, marine corps and coast guard personnel are spread wings of gold colour worn above the left breast pocket. Submarine, parachutist and aircrew badges are worn in the same manner. The name of his ship, aircraft squadron or other special unit may be worn by an enlisted man below the rank of chief petty officer. Before World War II these unit identifying marks were worn on the hatband of the winter "flat" hat. During the war they were ordered removed and the words "U.S. Navy" substituted. In the mid-1950s identifying marks were again authorized, but were to be worn on the right sleeve just below the shoulder seam.

Marine Corps.—Marine officer insignia are the same as those for the army except that warrant officers' bars are broken by scarlet stripes rather than brown. Officers wear their rank on both shirt collars and shoulder loops. Marine gunners wear the warrant officer's rank insignia on the right collar and a bursting bomb device on the left. Naval medical officers, chaplains and others serving with fleet marine forces and wearing marine uniforms wear their rank device on the right collar and their staff corps device on the left.

Enlisted men wear chevrons of rank on both sleeves and metal chevrons on the collars of certain working uniforms. All officers and all enlisted men of lance corporal rank or above wear a scarlet stripe along the outer seam of each trouser leg with the blue uniform. The marine corps emblem is worn on all headgear, coats and jackets, and by enlisted men on both shirt collars. Rank insignia is also worn on combat helmets, utility caps and garrison caps. Shoulder patches, worn by marines during World War II, are no longer authorized. There are no branch insignia.

Coast Guard.—Coast guard officers and enlisted men wear insignia identical to those of the navy except for the officers' and chief petty officers' cap devices and the shield worn by officers in place of the navy's line or staff corps devices. Enlisted men wear the shield on the right sleeve, just above the cuff.

Air Force.—Insignia of rank for officers of the air force are the same as the army's except for warrant officers whose bars have medium blue rather than brown stripes.

Enlisted ranks are designated by silver-coloured chevrons on a dark blue background, rounded point downward, and a silver-coloured star with a centre of dark blue.

As in the other services, air force aides and attachés are distinguished by aiguillettes. These are worn on the left shoulder except for presidential aides who wear them on the right. Aides are further identified by collar insignia designating the office or commander to whom they are assigned. Air force aviation badges are spread wings of silver colour bearing identifying centre designs and worn above the left breast pocket.

Service Stripes.—Enlisted men of all services wear diagonal service stripes denoting length of active service on the lower part of the left sleeve. The World War I overseas and wound chevrons and the World War II and Korean war overseas bars may be worn on the left sleeve by personnel of the army and air force.

GREAT BRITAIN

Officers wear insignia of rank on shoulder straps; warrant officers and noncommissioned officers wear insignia on their sleeves. Cap badges and buttons indicate branch of service. (See fig. 4.)

Army.—The lower officer grades (lieutenants and captains) are indicated by one, two or three diamond-shaped stars or "pips" on the shoulder straps. The higher grades are indicated by a crown or combination of a crown and stars. Officers of general rank wear on the shoulder straps a baton and sword crossed, with either a star or crown or both. A field marshal wears crossed batons in a wreath. Warrant officers (referred to as sergeant majors) wear the following insignia on lower sleeves: warrant officer, class I, royal coat of arms; warrant officer, class II, crown. Enlisted men (referred to as "other ranks") wear chevrons, point downward, on both upper sleeves as follows: staff sergeant, three chevrons surmounted by a crown; sergeant. three chevrons; corporal, two chevrons; lance corporal, one chevron. Good conduct is indicated by chevrons, point upward, on lower sleeves.

Royal Air Force.—Insignia are worn on shoulder straps and sleeves; shoulder insignia are the same as those of the navy. Sleeve stripes range from one narrow stripe for a pilot officer to one broad and four narrow stripes for marshal of the Royal Air Force.

If service dress uniform is worn, stripes are not gold but white on dark blue trimmings. A pilot is further distinguished by a pair of wings worn on the left breast; an observer or navigator wears one wing. Noncommissioned rank marking is gray on dark blue background and follows that of the army.

Royal Navy.—Officers' ranks are indicated, generally, as in the U.S. navy. However, the rank of sublieutenant is equivalent to the U.S. rank of lieutenant (j.g.), and the sleeve insignia is a single stripe; sleeve markings of one and one-half stripes are not used. There is no rank equivalent to the rank of ensign. The British employ a "curl" above the braid ( ), where the U.S. navy uses a star, and they use various colours of "distinction cloth" between the gold braid stripes on the cuff to signify specialist branches. Executive officers wear no coloured cloth between the stripes. Noncommissioned rank indicates in each case, as in the United States, the man's specialty. (See fig. 4.)

OTHER COUNTRIES

Canada.—Insignia of the Canadian forces follow the British pattern. but the word "Canada" appears on shoulder straps or just below the shoulder seam. The wings worn by flying personnel bear the initials RCAF for Royal Canadian air force.

German Federal Republic (West Germany).—*Army (Heer).*—General officers of the army wear gray shoulder loops edged in gold except at the outer end. Gold diamond-shaped "stars" indicate rank; a gold wreath encircles the star at the outer end of the shoulder loop for all general officers. A general wears four stars; lieutenant general, three stars; major general, two stars; and brigadier general, one star. Field grade officers have gray, silver-edged shoulder loops ornamented with silver stars and a silver wreath at the outer end of the shoulder loop: colonel, three stars; lieutenant colonel, two stars; major, one star. The silver wreath is omitted for company grades: captain, three stars; first lieutenant, two stars; lieutenant, one star.

Warrant officers, master sergeant, and sergeant first class wear gold chevron type insignia on gray shoulder loops. Warrant officer I, one gold chevron with diamond; warrant officer II, two chevrons with diamond; chief warrant officer III, three chevrons with diamond. Master sergeant, two gold chevrons; sergeant first class, one gold chevron. The following enlisted men wear their gold rank insignia on the upper sleeves: sergeant senior grade, two chevrons; sergeant, one chevron; corporal technicians, three oblique stripes; corporal, two oblique stripes; private first class, one oblique stripe; recruit, no rank insignia.

All commissioned and noncommissioned ranks wear coloured collar tabs to designate branch of service. General officers wear red collar tabs and general staff officers wear reddish-purple tabs.

Navy (Marine).—Commissioned rank is shown by gold stripes on sleeve cuffs and on shoulder boards, a star being above the cuff stripes. An admiral wears one broad and two medium stripes; a vice-admiral, one broad and one medium-width stripe; rear admiral, one broad and one narrow stripe; captain, four medium stripes; commander, three medium stripes; lieutenant commander, two medium stripes and one narrow stripe in the centre; lieutenant, two medium stripes; junior lieutenant, one medium and one narrow stripe; ensign, one medium stripe.

The following ranks wear gold chevrons on both sleeve cuffs: chief warrant officer III, three chevrons with diamond at their peak; chief warrant officer II, two chevrons and diamond; warrant officer I, one diamond and chevron; chief petty officer senior, two chevrons; petty officer junior, one chevron. The next lower ranks wear their gold insignia on both sleeves between the elbow and shoulder: petty officer, 1st class, two chevrons; petty officer, 2d class, one chevron; petty officer, 3d class, three oblique marks; seaman, two oblique marks; seaman apprentice, one oblique mark; seaman recruit is without insignia or rank.

Air Force (*Luftwaffe*).—Insignia are identical with those of the army except that the collar tabs are yellow for ranks other than general officer.

German Democratic Republic (East Germany).—In uniforms and insignia the armed forces retain most of the characteristics common to the German military forces of World War II.

Army.—Officers' rank is shown on the shoulder loops. An army general wears a plaited knot made up of five loops of sets of three cords, outer cords gold, central one silver, with four five-sided silver ornaments, arbitrarily called stars. A colonel general wears the same knot as an army general, with three stars; lieutenant general wears the same knot with two stars; and major general wears the same knot with one star. Shoulder loops for all general officers are superimposed on a red background while those of field grade officers are superimposed on a solid background coloured to indicate the branch of service. A colonel wears a knot made of four silver cords and designed in six loops, with three square-shaped pips of gilt; lieutenant colonel wears the same knot with tno pips; major wears the same knot with one pip. A captain wears a shoulder loop covered with eight parallel rows of silver cord, the colour of the outside piping indicating arm or service; superimposed on the cord are four pips. A first lieutenant wears the same shoulder loop with three pips; lieutenant wears the same shoulder loop with two pips; and second lieutenant wears the same shoulder loop with one pip.

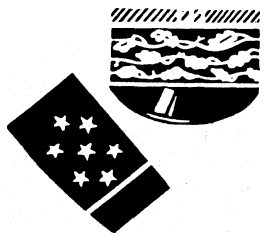
Noncommissioned officers of the first three grades wear plain shoulder loops with two parallel rows of piping, the outer row coloured to indicate branch of arm or service. A master sergeant wears two silver pips and a sergeant, first class, one silver pip; staff

corporal (*Unteroffizier*) wears the same shoulder loop with no pips. Other enlisted ranks have shoulder loops ornamented with a single strip of piping coloured to show branch or service. A staff private, first class (Stabsgefreiter) wears two white cross stripes at the end of the shoulder loop; a private, first class, wears one white stripe; and a private wears a plain shoulder loop.

Navy.—Commissioned rank is designated by sleeve braid and, for lieutenant commander and above, by gold shoulder boards similar to those of the army, but mounted on turquoise-blue background. An admiral wears three silver stars on gold shoulder board cord; on his sleeve, one broad stripe and three medium gold stripes. A vice-admiral wears two stars on his shoulder board and one broad and two medium gold stripes on his sleeve. 4 rear admiral wears one star on the shoulder board and one broad and one medium gold sleeve stripes. A captain wears a silver cord shoulder board with three gold stars and one broad gold sleeve stripe. A commander wears two stars and four medium stripes on sleeve. A lieutenant commander wears one star and three medium stripes. A senior lieutenant wears two medium stripes and one narrow stripe; his shoulder loop is the same as an army captain's, but with blue piping. A lieutenant wears two medium stripes and the same type of shoulder loop with three pips. A junior lieutenant wears one medium and one narrow stripe and two pips. An ensign wears one medium stripe on his sleeve and one pip on his shoulder loop. The lower ranks wear shoulder loops only.

Air Force.—Insignia in the main follow the army but commissioned rank is on both the shoulder loop and collar patch. General officers' shoulder loops are of gold cord mounted on a light blue background; the stars are silver; the collar patch is blue with gold ornamentation. Field grade shoulder loops are of silver cord on light-blue background; the stars are gold; the collar patch is light-blue ornamented by silver wing and wreath. Enlisted men wear plain, light-blue collar patches with white wing centred, and shoulder loops similar to those of the army but of blue piping.

France.—Army.—Commissioned insignia are worn on the kepi, the beret and shoulder loops; marshals and generals may also wear stars indicating grade on sleeve cuffs. General officers wear a khaki field kepi bearing stars; dress kepi is ornamented with gold oak leaves. Silver stars indicating ranks of combatant arms and gold stars denoting ranks in the services are superimposed on black shoulder loops: marshal of France, on shoulder loop and sleeve cuff, seven stars and on kepi three rows of gold oak leaves (see Fig. 6); general of the army, shoulder loop, cap and cuff, five stars; lieutenant general, four stars; major general. three stars; brigadier general, two stars. Officers of the rank of colonel and below wear a kepi with gold, silver or gold and silver stripes around the top to indicate rank; the cap is coloured to indicate branch of service; shoulder loops have similar stripes superimposed on them, the stripes coloured according to arm or service: colonel, shoulder loop and kepi, five gold stripes; lieutenant colonel, three gold and two silver stripes; major, four gold stripes; captain, three gold stripes; lieutenant, two gold stripes, second lieutenant, one gold stripe. Chief warrant officer, a gold stripe with a red thread. Warrant officer, one silver stripe with a red thread. Warrant officer kepis have a single gold or silver band around which a narrow red stripe is twisted.



COURTESY OF D VAN NOSTRAND COMPANY, INC.

FIG. 6.—INSIGNIA OF A MARSHAL OF FRANCE, ON KEPI AND CUFFS

Noncommissioned officers wear chevrons (point up) on both sleeves; the kepi is plain. Master sergeant, four gold chevrons; sergeant, first class, three gold chevrons; sergeant, one gold chevron; corporal. first class, two chevrons in colour of arm or service on bottom, topped by one gold chevron; corporal, two chevrons in colour of arm or service; private, first class, one chevron in colour of arm or service. Noncommissioned officers wear a similar number of bars on their garrison caps. Officer candidates wear a broken gold stripe on their shoulder loops.

Navy.—No shoulder boards are worn, but an officer's badge (small gold tab) is worn on the tip of each shoulder. Flag officer cap bands are ornamented with gold braid; caps of captains and below bear gold stripes corresponding to rank. Sleeve insignia for commissioned officers are: admiral, five silver stars; vice-admiral of the fleet, four silver stars; vice-admiral, three silver stars; rear admiral, two silver stars; captain, five gold stripes; commander, three gold and two silver stripes; lieutenant commander, four gold stripes; lieutenant, three gold stripes; junior lieutenant, two gold stripes; ensign, one gold stripe; warrant officer. first class, two narrow and one wide gold stripe; warrant officer, second class, one narrow and one wide gold stripe; chief petty officer, three diagonal gold stripes; petty officer, first class, two diagonal gold stripes; petty officer, second class, one diagonal gold stripe. Leading seaman, first class, three diagonal red stripes; leading seaman, second class, two diagonal red stripes; able seaman, one diagonal red stripe.

Air Force.—Commissioned rank is designated by gold stars or gold and silver stripes on the sleeve cuffs; no shoulder loops are worn, but an officer's badge, a small gold tab, is worn on the tip of each shoulder. General officer cap bands are ornamented with gold braid; caps of colonel and below bear gold stripes corresponding to rank: general, five stars; lieutenant general, four stars; major general, three stars; brigadier general, two stars; colonel, five gold stripes with a separation between the third and fourth; lieutenant colonel, same as colonel but the second and fourth stripes are silver; major, four gold stripes, the fourth one separated; captain, three gold stripes; lieutenant, two gold stripes; second lieutenant, one gold stripe. Warrant officer ranks are the same as in the army.

Noncommissioned officers wear shoulder loops with chevrons thereon as follows: master sergeant, one gold cross stripe, plus three gold chevrons; sergeant, first class, three gold chevrons; sergeant (professional), two gold chevrons; sergeant, one gold chevron; corporal, first class, two orange and one gold chevron; corporal, two orange chevrons; private, first class, one orange chevron.

U.S.S.R.—*Army.*—Following the Russian Revolution the Red army attempted to abolish distinctions of rank in both uniforms and insignia. However, by World War II, this policy had given way to one of specific styles for various grades, with insignia worn on collar patches and on sleeves. In 1943 new uniform regulations were promulgated by which the Red army restored the once hated shoulder-board type epaulets (pogoni) of the Imperial Russian army and reintroduced the tsarist-type standing collar and related insignia, modified in details, but generally conforming to that of the Imperial Russian army. In 1956 the Soviet ministry of defense published new uniform and insignia regulations modifying slightly and refining the general system of insignia established in 1943.

Soviet army personnel wear a variety of insignia to indicate rank or grade, arm or service, and in some cases employment. Rank or grade is shown by the ornamentation on the coat collar, sleeve cuffs and service cap; by the width and number of stripes on outer trouser seams; and by the arrangement of braid. Rank and grade are also indicated by the number, size and arrangement of stars (for officers) or stripes (for enlisted men) on the shoulder boards. Arm or service is shown by the coloured piping on uniform components, colour of service cap band, stripes and piping on shoulder boards, colour of collar tabs and by emblems on the shoulder boards, collar lapels and collar tabs. Variations in the width of shoulder boards, colour of braid, stars and rank stripes distinguish between the combatant and noncombatant officers. In addition, some emblems indicate the employment of the wearer within his arm or service.

Dress shoulder boards for all officers except those belonging to the services have silver stars on a gold background. Service branch officers wear dress shoulder boards with gold stars on a silver background. Dress shoulder boards for all army marshals and line generals have a crisscross, gold pattern and red piping; generals of technical troops wear crimson piping. Generals of the

medical, veterinary, legal and administrative services wear shoulder boards slightly narrower in width than those of other branches. Shoulder-board insignia denoting rank consist of the following: marshal of the Soviet Union, one large silver star plus national emblem; chief marshal of the arm, one large silver star surrounded by a silver wreath; marshal of the arm, one large silver star; general (general *armii*), four stars; lieutenant general (general *polkovnik*), three stars; major general (general *leitenant*), two stars; brigadier general (general maior), one star. Field grade officers are distinguished by two stripes (coloured according to arm or service) down their shoulder boards with medium-size stars on them as follows: colonel, three stars; lieutenant colonel, two stars; major, one star. Company grade officers have one stripe down the centre of their shoulder boards and their ranks are distinguished by small-size stars as follows: captain, four stars; senior first lieutenant, three stars; first lieutenant, two stars; second lieutenant; one star.

Enlisted ranks wear both dress and field shoulder boards. On the latter, the branch colour is designated by the piping, the background colour of the shoulder board being olive drab. Some field shoulder boards have claret-coloured rank stripes; others have gold or silver stripes. Emblems denoting branch of service are not worn by enlisted men on field shoulder boards. The branch colour covers the surface of the dress shoulder board and a gold metallic device (except veterinary soldiers who wear silver) denotes the branch. Black piping is worn on the dress shoulder board with the exception of artillery, armour, motor transport, medical and veterinary personnel, who display crimson piping. The number and position of the stripes used to indicate enlisted rank are: master sergeant (*starshina*), a broad transverse stripe placed on the portion of the shoulder board nearest the neck, with a medium stripe running lengthwise down the centre of the shoulder board; senior sergeant (starshi serzhant), one broad cross stripe placed nearest the neck; sergeant (serzhant), three narrow cross stripes; junior sergeant (mladshi serzhant), two narrow cross stripes; private, first class (yefreitor), one narrow cross stripe; private (*ryadovoi*), no stripes.

The colour of the arm or service is displayed on the collar tabs, on the upper edges of collars, on sleeve cuffs, on headdress and on trouser seams. In addition, the colour is also used to form the stripes and piping on dress shoulder boards.

Soviet army paratroopers and antitank personnel are regarded as specialists. **A** paratrooper wears an outline of a white parachute with a red star above the canopy on a blue diamond-shaped field; the antitank soldier wears crossed cannons on the left arm. Other specialist insignia are worn on the right breast of the uniform.

Air Force.—Soviet air force insignia follow the army pattern, with sky-blue as the branch colour.

Navy.—Insignia of commissioned officers generally follow those of the United States. For example, a star is above the top stripe for all commissioned ranks. Sleeve insignia of line officers and those of the naval engineer service are: admiral of the fleet, one broad and four medium-width gold stripes on the sleeve; admiral, vice-admiral and rear admiral each has one less medium stripe: captain, one broad stripe; commander, four medium stripes only; subcommander, three medium stripes; lieutenant commander, two medium stripes and one narrow stripe; senior lieutenant, two medium stripes; lieutenant, one medium and one narrow stripe; junior lieutenant, one medium stripe. Commissioned naval officers also wear shoulder boards patterned after those of the army.

Japan.—Army.— General officers of the ground self-defense force are identified by polished silver stars (with rounded points) worn on the collar of shirt or blouse. All other officer grades wear metallic insignia with a dull silver finish. A lieutenant general wears three large stars, a major general, two. Field and company grade officers wear their rank insignia on the uniform collars; the stars are of medium size and are mounted on a metal plate. **A** colonel wears three stars; a lieutenant colonel, two; a major, one. Company officers have small silver stars on one end of the metal plate and embossed gold bands on the other end. A captain wears one star and three gold bands; first lieutenant wears one star and two gold bands; second lieutenant, one star and one gold band. Noncommissioned officers' insignia are on the same type of silver metal plate with black stripes grooved in it as follows. master sergeant, three stripes; sergeant, first class, two stripes; sergeant, one stripe. Privates wear gold chevrons (on green background) on both sleeves between the elbow and shoulder as follows: leading private, three chevrons; private, first class, two chevrons; private, one chevron; recruit, one gold bar.

Navy.—Rank and insignia of the Japanese maritime self-defense force follow the U.S. navy pattern. Commissioned officers wear gold stripes on sleeve cuffs or shoulder boards; the device above the stripes is a gold-lace cherry blossom. The chief of the maritime staff wears a special, more ornately designed blossom. **A** vice-admiral wears one broad and two medium stripes; rear admiral, one broad and one medium stripe; captain, four medium stripes; commander, three medium stripes; lieutenant commander, two broad stripes with one narrow stripe centred; lieutenant, two medium stripes; junior lieutenant, one medium and one narrow stripe; ensign, one medium stripe. Chief petty officer wears three gold chevrons with cherry blossom above rounded top of insignia; petty officer, first class, blossom, with two chevrons; petty officer, second class, blossom, one chevron; petty officer, third class, three red chevrons topped by pink cherry blossom; seaman, three red chevrons without blossom; seaman apprentice, two red chevrons; seaman recruit, one red chevron.

On less formal uniforms, silver metallic rank insignia are worn on both shirt collars by all ranks down to and including petty officer, second class: vice-admiral, three large blossoms; rear admiral, two large blossoms; captain, three small blossoms on an oblong plate; commander, two small blossoms on an oblong plate; lieutenant commander, one small blossom on an oblong plate; lieutenant, one blossom and three pink stripes on metal plate; junior lieutenant, one blossom, two pink stripes; ensign, one blossom, one stripe. Chief petty officer wears silver plate with three black stripes; petty officer, first class, silver plate, two stripes; petty officer, second class, one stripe. All other ranks wear red chevrons on sleeves, the cherry blossoms being blue for petty officer, third class.

Air Force.—Insignia of the air self-defense force are the same as those of the army except that privates wear silver-thread chevrons instead of gold.

Italy.—Army.—Commissioned rank is shown on shoulder loops which are of silver braid for general officers. A lieutenant general wears three gold stars on silver braid; a major general, two gold stars; a brigadier general, one gold star. For prestige purposes, generals holding certain key assignments are permitted to wear four stars set on red underlining. Shoulder loops of other grades are of the same material and colour as the uniform, field grades having gold piping: a colonel wears three gold stars; lieutenant colonel, two gold stars; major, one gold star. Shoulder loops of company grade officers are plain khaki: captain, three gold stars; first lieutenant, two gold stars; second lieutenant, one gold star. Warrant officer rank is designated by longitudinal stripes displayed on the shoulder loop; the highest grade is Aiutante di Battaglia, three gold stripes on red background; warrant officer, grade I, three gold stripes; warrant officer, grade II, two gold stripes; warrant officer grade III, one gold stripe.

Enlisted ranks wear sleeve chevrons, point downward, as follows: first sergeant, one wide gold chevron above two narrow gold chevrons; sergeant, one wide gold chevron above one narrow gold chevron; first corporal, one wide black chevron above two narrow black chevrons; corporal, one wide black chevron above narrow black chevron; private, first class, one wide black chevron. Specialist (armourer, parachutist, tank driver, etc.) insignia are worn just above the chevron. Lapel patches are worn by all ranks. The colour of three-pointed lapel insignia indicates the regiment or other assignment in cavalry; the colour and combination of colours of two-pointed insignia shows the regiment or other assignment in infantry or tank corps; the colour or combination of colours of one-pointed lapel insignia indicates arm, service or regiment of any other branch.

All ranks wear metal cap insignia designating arm or service and general officers wear the same distinctive cap insignia: lieu-

tenant general, gold; other general officers, silver.

Navy.—Commissioned rank is indicated by gold braid, on cuffs and by gold stars on shoulder boards. A vice-admiral wears five gold stripes, the upper one with curl, the lower one waved; a rear admiral wears the same with one less stripe; commodore, same as rear admiral with one less stripe; captain, one broad stripe surmounted by three narrow, the upper one with curl; commander, same as captain, with one less narrow stripe; lieutenant commander, same as for commander, with one less narrow stripe; lieutenant, three narrow stripes, upper one with curl; lieutenant, junior grade, same as for lieutenant, with one less stripe; ensign, one narrow stripe with curl. Chief petty officers wear the following on their shoulder straps: class I, three gold stripes; class II, two gold stripes; class III, one gold stripe. Seamen are identified by chevrons, point downward, on their sleeves: sergeant, one broad on top and two narrow chevrons below; petty officer, one broad and one narrow gold chevron; first corporal, one broad red and two narrow stripes; seaman, first class, one narrow red stripe.

Air Force.—Commissioned rank is shown by gold patches on the cuffs; the patches are similar in design to those of the navy except that the curl is diamond-shaped. Lieutenant general, five gold stripes of medium width, upper one curled in a diamond shape, lower one waved; major general, same with one less stripe; brigadier general, same as major general with one less stripe. Commissioned officers wear a shoulder strap with gold spread wings inside gold piping. Enlisted men wear rank insignia on shoulder loops. Warrant officers are distinguished by stripes; other ranks by chevrons. Aiutante *di* Battaglia, three gold stripes with gold star superimposed; warrant officer, class I, three gold stripes; class II, two gold stripes; class III, one gold stripe. First sergeant, one broad and two narrow gold chevrons; sergeant, one broad and one narrow gold chevron; first corporal, two broad and one narrow red chevron; corporal, one broad and one narrow chevron.

Republic of China.—Army.—General officer grades are indicated by five-pointed, gold stars worn on both the right and left collar of the shirt or on both shoulder loops of the coat. Stars for generalissimo and general, first grade, are linked in a circle; the three stars of general, second grade, in a triangle—for the collar insignia. However, when worn on shoulder loops the stars are in line: generalissimo, five stars; general, first grade, four stars; general, second grade, three stars; lieutenant general, two stars; major general, one star.

Field grade officers' rank insignia consist of various sizes and numbers of gold plum blossoms worn on the right collar of the shirt or on both shoulder loops of the coat. A colonel wears three plum blossoms; they are linked in triangular fashion if on the collar, in line if on the shoulder loop. A lieutenant colonel wears two plum blossoms, a major, one. Company grade officers wear a varying number of parallel gold bars in the same fashion as field grade insignia; captain, three bars; first lieutenant, two bars; second lieutenant, one bar. There is no rank identification for junior lieutenants and warrant officers. When rank insignia are worn on the shirt, field and company grade officers wear branch of service insignia on the left collar.

Noncommissioned officers wear metal chevron plate badges on the left sleeve just below the uniform shoulder seam. No rank identification is worn by enlisted men below corporal. A master sergeant wears a red metal badge edged in gold, with three gold chevrons above a gold plum blossom, below which are from two to four gold horizontal bars, depending on the pay grade; sergeant, first class, two green metal badges edged in gold, with three gold chevrons and three gold horizontal bars below the plum blossom; sergeant, green badge with three chevrons and two bars; corporal, same as sergeant but with only one gold bar.

Metallic branch of service insignia is generally patterned after that of the U.S. army. General officers wear plum blossom insignia in lieu of specific branch insignia.

Navy.—The system of rank identification generally adheres to that of the U.S. navy. For line officers a small circular wreath of rice stalks is worn above the sleeve cuff stripes in lieu of the star of the U.S. navy. On the shoulder boards the Chinese National sun insigne is worn between the button and the rank insignia for all line officers. Flag officer shoulder boards are gold with silver stars and insignia, and black piping on sides.

Air Force.—Rank insignia worn on the shoulder loop of the blouse consist of a varying number of wide and narrow gold bars, a spread-winged eagle being near the button end of the epaulet: general, two wide and three narrow bars; lieutenant general, two wide and two narrow bars; major general, one narrow and two wide bars; colonel, one wide and three narrow bars; lieutenant colonel, one wide and two narrow bars; major, one narrow and one wide bar; captain, three narrow bars; first lieutenant, two narrow bars; second lieutenant, one narrow bar; warrant officer, no rank insignia.

In lieu of shoulder loops the same rank insignia is worn on the right collar of summer uniform shirt with specialist identification on the left collar; warrant officer wears specialist identification on both collars. Specialist insignia: for general officer, a five-pointed gold star with plum blossom, centred; pilots, spread wings with a three-bladed propeller, centred; mechanic, aircraft engine and two-bladed propeller; other specialist insignia follow U.S. army patterns.

While insignia is prescribed for enlisted airmen it is seldom worn. Instead airmen wear their name and rank written in Chinese characters on a cloth tab worn on top of the left breast pocket.

Communist China.—Up to and after its conquest of the China mainland in 1949 the Communist or People's Liberation army used no metallic badges or other insignia indicating military rank or branch of service. Commissioned officers could be recognized at times by the type of weapons carried, by coloured arm bands either worn on the right arm or wrapped around the butt of their pistols. The higher ranking officers could often be recognized by the presence of armed guards accompanying them. This largest Asiatic army at the turn of the mid-20th century exerted great efforts to conceal the identity of its commissioned and noncommissioned leaders. However, in 1956 the armed forces of Communist China adopted a new uniform system incorporating shoulder boards and insignia designating ranks and branches of service. This system was generally patterned after that of the Soviet armed forces.

Army.—All commissioned officers of the army wear shoulder boards of Soviet style except that branches of service are not indicated by coloured piping; both the stripes and piping are red. Shoulder boards have solid interwoven gold surfaces with rank insignia superimposed. For general officers, combat arms and political officers the shoulder boards are gold with silver stars superimposed; for administrative and technical staff officers they consist of a gold background with gold stars. The designs are as follows: supreme marshal, one large star wreathed by silver pine sprays, and the national seal; marshal, same as supreme marshal less the wreath around the star; senior general, four small stars aligned down the centre of the shoulder board; colonel general, three medium stars; lieutenant general, two medium stars; major general, one medium star.

All field grade ranks have shoulder boards bearing two centre red stripes between which stars are placed as follows: senior colonel, four small stars; colonel, three stars; lieutenant colonel, two stars; major, one star.

Company grade shoulder boards have one centre stripe of red. Rank is distinguished as follows: senior captain, four small stars; captain, three stars; first lieutenant, two stars; second lieutenant, one star; warrant officer, plain shoulder board. Enlisted men wear their rank insignia on red collar tabs in the shape of parallelograms. A single, gold horizontal centre stripe on the tab identifies the three top grades: senior sergeant, three stars; sergeant, two stars; corporal, one star; private, first class, two stars; private, second class, one star.

Metallic devices denoting branch of service are worn by officers and enlisted men on the red collar tabs. General officers wear red tabs with gold piping in lieu of branch insignia. There is no insignia for infantry; plain red tabs identify members of this arm.

Navy.—Shoulder boards and rank insignia are the same as army except that the stripes and piping are black. The collar tabs are

black with white or silver piping; and anchor is in the centre.

Air Force. — Insignia are the same as army insignia except that collar tabs and shoulder-board stripes and piping are sky-blue. The collar tabs bear a set of wings in the centre.

BIBLIOGRAPHY.—U.S. Department of Defense, Office of Armed Forces Information and Education, *Uniforms of NATO;* Supreme Headquarters Allied Powers Europe, Know *Your* Allies; U.S. Department of the Army, "Handbook on the Chinese Communist Army," Pamphlet *30–51* (1952); "Handbook on the Soviet and Satellite Armies, pt. i, The Soviet Army," Pamphlet *30–50–1* (1958); "Uniforms and Insignia," *U.S. Army Regulations 670–5* (1959); *U.S. Navy Uniform Regulations —(NAVPERS 15665)* (1959); "Service & Dress Uniforms for Air Force Personnel," U.S. Air Force Manual *35–10* (1959); Ministeriums für Nationale Verteidigung, Taschenkalendar der Nationalen Volksarmee— *1957* (1957); *Uniformes et Insignes Militaires* (1950); Harley Cope and Frederick C. Dyer, The *Petty Officer's Guide* (1958); *The Non*-com's Guide (1958); Gordon R. Young (ed.), The Army Almanac (1959).

(R. B. RG.)

INSKIP, JOHN SWANEL (1816–1884), U.S. evangelist and editor, was born in Huntingdon, Eng., on Aug. 10, 1816. His family emigrated to the United States and settled in Pennsylvania, where Inskip entered the ministry of the Methodist Episcopal church at an early age.

Noted for his eloquence in the pulpit, he served in various church posts in Pennsylvania and Ohio and elsewhere, and for a number of years was pastor of churches in New York city. He also edited the Christian Standard (Philadelphia). Early in the Civil War he served as a chaplain with a New York regiment.

Inskip, who became the first president of the National Camp Meeting Association for the Promotion of Holiness in 1867, won a wide reputation as an evangelist and led revival campaigns in the United States and other countries, including England, India and Australia.

In *Methodism* Explained and Defended (1851), Inskip argued against segregated seating of men and women at church services, a controversial contemporary issue in churches in western states, He died at Ocean Grove. N.J., on March 7, 1884.

INSOLATION, the amount of solar radiant energy received in a given time on a unit horizontal area at any specified place on the surface of the earth or in the atmosphere. It is usually expressed in totals for periods of a day, a week, a month or a year.

Insolation generally denotes the actual amount of energy received after depletion by the atmospheric gases, dust and clouds, although it can express a hypothetical condition, such as the energy received through a perfectly transparent atmosphere.

(H. R. B.)

INSOMNIA, or the inability to sleep adequately, is a common enough symptom in modern life and varies greatly in degree.

Three varieties of insomnia may be roughly distinguished: the inability to fall asleep at the onset for a variable period; the frequent awakening with incapacity to resume sleep for some time; the waking up at an unduly early hour with no subsequent sleep.

Every individual case must be investigated carefully on its own merits, and the physician is frequently taxed to the utmost to combat the symptom on rational and not empirical lines.

The responsible causes may have a bodily basis or must be sought in the mind. Among the former must be enumerated the evident factors of pain or discomfort from any cause: shortness of breath, cough, frequency' of urination, itching, palpitation. Febrile conditions, high blood pressure and other circulatory disturbances, toxic states and organic disease of the brain are also responsible.

In many forms of mental derangement insomnia is a frequent symptom and often heralds its inception. This is specially so in anxiety conditions, where unpleasant dreams may exaggerate the sleeplessness, and here the sufferer may fear to lose consciousness because of these experiences which he cannot control. In neurasthenia and many hysterical states insomnia is likely to be prominent.

In such psychoses as manic-depressive insanity, dementia praecox, confusional insanity and general paresis, such a symptom is generally part of the clinical picture. (C. S. R.; X.)

INSPIRATION is strictly the act of drawing physical breath into the lungs as opposed to "expiration." Metaphorically the term is used generally of analogous mental phenomena; thus we speak of a sudden spontaneous idea as an "inspiration." The term is specially used in theology for the condition of being directly under the divine influence, as the equivalent of the Greek θεοπνευστία (2 Timothy iii, 16).

Similar in meaning is ἐνθουσιασμός, enthusiasm (from ἐνθουσιάζω from ἔνθεος). Possession by the divine spirit (πνεῦμα) was regarded as necessarily accompanied by intense stimulation of the emotions.

The Doctrine of Communion.—The possibility of a human being becoming the habitation and organ of a divinity is generally assumed in the lower religions. In the popular religion of China some of the priests, known as the Wu, claim to be able to take up into their body a god or a spirit, and thereby to give oracles. The Maoris at the initiation of the young men into the tribal mysteries sing a song, called "breath," to the mystic wind by which they believe their god makes his presence known. An Australian woman claimed to have heard the descent of the god as a rushing wind.

In some savage tribes blood is drunk to induce the frenzy of inspiration; music and dancing are widely employed for the same purpose. Dionysus, the god of wine in Greece, was also the god of inspiration; and in their orgies the worshippers believed themselves to enter into real union with the deity. In Delphi the Pythia, the priestess who delivered the oracles, was intoxicated by the vapour which rose from a well through a small hole in the ground.

As the oracles were often enigmatic, they were interpreted by a prophet. In Rome the inspiration of Numa was derived from the nymph Egeria; and great value was attached to the books of the Cumaean Sibyl. In Arabia the *kahin* (priest) was recognized as the channel of divine communication. Inspiration may mean only possession by the deity, or it may mean further that the person so possessed becomes the channel through which the deity reveals his word and will. (See J. A. Macculloch's *Comparative Theology,* ch. xv, 1902.)

Prophecy in the Old Testament in its beginnings is similar to the phenomenon in other religions (1 Sam. ix, 8, x, 10–11). The prophesying in which Saul took part probably included violent movements of the body, inarticulate cries, a state of ecstasy or even frenzy. The phrase "holy spirit" in Acts, as applied to the Apostolic Church. probably indicates a similar state of religious exaltation; it was accompanied by speaking with tongues, inarticulate utterances which needed interpretation (1 Cor. xiv. 27). In every religious revival, when the emotions are deeply stirred, similar phenomena are met with. Such a movement was Montanism in the 3rd century. At the Reformation, while Luther was at the Wartburg, fanaticism broke out, and spread from Wittenberg; prophets went about declaring the revelations which they had received. The Evangelical revival in the 18th century also had its abnormal religious features. The Revival in Scotland in 1860 was marked by one curious feature — the Gospel dance — when in their excitement men and women got up and spun round and round till they were exhausted. Spontaneous praise and prayer marked the revival in Wales in 1905–06.

Prophecy, as represented by the writings of the prophets, arose out of this state of religious exaltation, but left behind many of its features. The function of the prophets was to interpret the course of history as the divine providence for the chosen people Israel, so as to communicate God's Word and Will in judgment or in mercy. They were divinely endowed for this function by their inspiration. While these prophets seem to have continued in the exercise of all their normal faculties, which were stimulated and not suppressed, yet they do claim a distinctive divine activity in their consciousness, and distinguish with confidence their own thoughts from the revealed word. That abnormal psychic states, such as visions and voices, were sometimes experienced is not improbable (see 'Theodore H. Robinson, *Prophecy and the Prophets*), but the usual prophetic state seems to have been one of withdrawal of attention irom the outer world, absorption of

interest in the inner life, devout communion and intercession with God, and the divine response in a moral or a spiritual intuition rather than an intellectual ratiocination. Possession by the Spirit in its external manifestations is ascribed to Gideon, Jephthah, Samson, Saul, Elijah; but even when the same language is used of the later prophets, it is probably such an inward state as has just been described which is to be assumed.

A feature inseparable from this later phase of prophecy is *prediction.* For the warning or the encouragement of the people the prophet as Jehovah's messenger declares what He is about to do. Thus the fall of Samaria in 722 B.C., the deliverance of Jerusalem in 701, the overthrow of the kingdom of Judah in 586, the return from exile in 537 were all heralded by prophecy. This prediction was no shrewd political conjecture, but an application to existing conditions of the permanent laws of God's government. The abnormal phenomena of inspiration, the presence and operation of the Holy Spirit, in the Apostolic Church, have already been noticed.

The New Testament.—While Paul does not deny nor depreciate these charisms, as tongues, miracles, etc., he commends as the more excellent way the Christian life in faith, hope and love (1 Cor. xii. 31). The New Testament represents the Christian life as an inspired life. It is living communion with Christ, and therefore constant possession of the Holy Spirit. Every Christian, in the measure in which he has become a new creature in Christ, is a prophet, because he knows by the enlightening of God's Spirit "what is the good and acceptable and perfect will of God" (Romans xii. 2). An occasional state of divine possession in the other religions becomes in the prophets of Israel a permanent endowment for a few select agents of God's revelation; but when that revelation is consummated in Christ, inspiration becomes the universal privilege of all believers.

Apologetics.—While there is much superstition in the view of inspiration found in many religions, and much imposture in the claims to the possession of it, yet it would be illogical to conclude that this feature of religion is altogether human error and not at all divine truth. Man's knowledge of God is conditional, and therefore limited by his knowledge of the world and himself, and has accordingly the same imperfection. The reality of a divine communion and communication with man is not to be denied because its nature has been imperfectly apprehended. We must estimate the worth of inspiration by the higher and not the lower stages, by the vision of an Isaiah or the consecration of a Paul; but at the same time we must be prepared to recognise its lowly beginnings,

In dealing with the inspiration of the Bible, to which the use of the term has in the Christian Church been largely restricted, it is important to remember that inspiration is primarily personal; and that it assumes varied forms and allows varying degrees.

Other religions besides Christianity possess their sacred scriptures and the claim of inspiration is advanced for some of them, as by Hinduism for the *S'ruti* (hearing) writings as distinguished from the *Smriti* (recollection), Zoroastrianism for the Zend-Avesta, Islam for the Koran. But Buddhism advances no such claim for its *Tripitaka* (three baskets), nor Confucianism for its classics.

Exegesis.—The Pentateuch was accepted as authoritative law by the Jewish Church in 444 B.C. About two centuries later the Prophets (including the histories as well as the prophetic writings proper) were also acknowledged as sacred scriptures, although of inferior authority to the Law. In the century before the Christian era the Writings, including Psalms and Proverbs, were included in the Canon. Palestinian and Hellenistic Judaism disagreed about the recognition of the books now known as the Apocrypha. The writers of the New Testament use the Old Testament as holy scriptures, as an authoritative declaration of the mind and will of God; but the inaccuracy of many of the quotations, together with the use of the Greek translation as well as the original Hebrew, forbid our ascribing to them any theory of verbal inspiration. By the middle of the 2nd century the four Gospels were probably accepted as trustworthy records of the life of Jesus. The Epistles were accepted as authoritative in virtue of apostolic authorship. By the end of the 3rd century the use and approval of the churches had established the present canon.

The doctrine of the inspiration of these writings in the Jewish and Christian Church now claims attention. Inspiration is first of all ascribed to persons to account for abnormal states, or exceptional powers and gifts; in this doctrine it is transferred to writings, and its effects in securing for these inerrancy, authority, etc., are discussed with little regard for the psychic state of the writers.

The New Testament affirms the inspirations of the Old Testament (Matt. i. 22, xv. 4, Mark xii 36, Acts i. 16, Romans iii. 2, ix. 25, Heb. i. 1, 1 Peter iv. 11). The term is used in regard to the Scriptures in 2 Timothy iii. 16. The Spirit of Christ is said to have been in the prophets (1 Peter i. 11); and it is affirmed that "no prophecy ever came by the will of man; but men spake from God, being moved by the Holy Spirit" (2 Peter i. 21). The constant use of the Old Testament in the New confirms this doctrine of inspiration.

Contemporary Jewish thought, as expressed by Philo, Josephus, and the Talmud according to Weber, was in agreement with this view of the Old Testament. But the nature of this inspiration must be more closely defined, and hence have arisen a number of theories of inspiration which can be only briefly mentioned. The theory of *verbal inspiration,* which was held by Plato, Philo, the Apologists, the Fathers, and the Protestant Scholastics, ignores the data which the Bible itself offers. The theory of *dynamic influence or degrees of inspiration* recognises that the human personality is not entirely suppressed by the direction and control of the Spirit; but it does not offer us any sure guidance in discriminating the human and the divine factor, and in estimating the value of the contents of the Bible. The theory of *essential inspiration* in claiming inspiration only in matters of doctrine and conduct (anticipated in Aquinas' distinction of *direct* and *indirect* inspiration, and favoured by Erasmus, Hugo Grotius, Baxter, Paley, etc.) betrays a too intellectualist standpoint in the emphasis it lays on correctness in theology and ethics, and ignores the progressive character of revelation.

Protestantism.—The theory of the Reformers (though not of their successors, the Protestant scholastics)—might be called that of *vital inspiration,* as its emphasis is on religious and moral life rather than on knowledge. While giving to the Scriptures supreme authority in all matters of faith and doctrine, the Reformers laid stress on the use of the Bible for edification; it was for them primarily a means of grace for awakening and nourishing the new life in the hearts of God's people. By the enlightening work of the Spirit of God the Word of God is discovered in the Scriptures: it is the *testimonium Spiritus Sancti* in the soul of the Christian that makes the Bible the power and wisdom of God unto salvation. By thus laying stress on this redemptive purpose of the divine revelation, the Reformers were delivered from the bondage of the letter of Scripture, and could face questions of date and authorship of the writings frankly and boldly. Hence a pioneer of the higher criticism in Great Britain, W. Robertson Smith, was able to appeal to this Reformation doctrine (quoted in Denney's *Studies in Theology,* p. 205). The Reformers' application of this theory to the Bible was necessarily conditioned by the knowledge of their age; but it is a theory wide enough to leave room for our growing modern knowledge of the Bible.

Résumé.—Briefly stated, these are the conclusions which our modern knowledge allows. (1) Inspiration, or the presence and influence of the Divine Spirit in the soul of man, cannot be limited to the writers of the Scriptures; but, comparing the Bible with the other sacred literature of the world, its religious and moral superiority cannot be denied, and we may, therefore, claim for it as a whole a fuller inspiration. (2) As different writings in the Bible have more or less important functions in the progressive divine revelation, we may distinguish degrees of inspiration. (3) This inspiration is primarily personal, an inward enlightening and quickening, both religious and moral, of the writer, finding an expression conditioned by his individual characteristics in his writing. (4) The purpose of inspiration is practical; the inspired men are used of God to give guidance in belief and duty by declaring the word and will of God as bearing on human life. (5)

As revelation is progressive, inspiration does not exclude defects in doctrine and practice in the earlier stages and their correction in the later stages of development. (6) As the progressive revelation culminates in Christ, so He possesses fullest inspiration; and it varies in others according to the closeness of their contact, and intimacy of their communion with Him. (7) As the primary function of Christ is redemptive, so the inspiration of the Bible is directed to make men "wise unto salvation." (8) It is the presence and influence in the souls of men of the same Spirit of God as inspired the Scriptures which makes the Bible effective as a means of grace; and only those who yield themselves to the Spirit of God have the witness in themselves that the Bible conveys to them the truth and the grace of God.

BIBLIOGRAPHY.—In addition to the books mentioned above, *see:* A. B. Bruce, *The Chief End of Revelation* (1881); *C. A.* Briggs, The *Bible, the Church, and the Reason* (1892); W. N. Clarke, *The Use of the Scriptures in Theology* (1906); *H.* E. Ryle, *The Canon of the Old Testament* (1892); *B.* F. Westcott, *A General Survey of the History of the Canon of the New Testament* (7th ed., 1896); W. Sanday, *Inspiration* (3rd ed., 1896); A. B. Davidson, article "Prophecy" in Hastings's *Bible Dictionary*, iv.; A. *E.* Garvie, "Revelation" in Hastings's *Bible Dictionary* (extra volume). (A. E. G.)

INSTALLATION, the action of installing or formally placing some one in occupation of an office or place. The word is used of the ceremonial induction of an ecclesiastic, such as a canon or prebendary, to his stall in his cathedral choir. Similarly knights of an order of chivalry are ceremonially led to their stalls in the chapel of their order.

INSTALLMENT CREDIT. Installment credit, or hire purchase, as it is known in Great Britain, is the means by which most durable consumer goods of the industrial nations are paid for. Wherever automobiles, refrigerators, laundry equipment and other such products play an important role in the lives of the people, installment credit is a large item in the financial structure of the country. In all the wealthy countries of the world, the greatest single use of installment credit is for the purchase of passenger automobiles. In the United States, for example, beginning in the 1920s, and with the exception of the period immediately after World War II, from 60% to 70% of automobiles have been bought on the installment plan.

Installment credit commonly refers to credit extended to families, individuals or households, as contrasted with businesses or governments. It is repayable in installments at regular intervals. In the extension of sales credit, the contract sometimes provides that the goods purchased will not become the legal property of the purchaser until every installment has been paid. As a rule, in case of default, all previous payments are forfeited to the lender and he may also take possession of the goods. The British Hire Purchase act of 1938 provided that the seller could not take back the goods without a court order if the purchaser had paid one-third or more of the hire-purchase price. Credit extended to business firms or governments is frequently repayable in installments, but such credit is not included in the concept of consumer installment credit.

Installment credit constitutes the great bulk of all short and intermediate household credit in most countries, but households also have other debts that do not provide for regular periodic payments. The total of household debts (exclusive of house mortgages) is commonly referred to as consumer credit. Installment credit may be best understood as a major part of all consumer credit.

A large volume of installment credit depends on the employment and income conditions of the public and on the types of goods which are produced and sold. A population which makes great use of installment credit is one which receives its income in regular periodic amounts, generally in the form of wages and salaries. At the same time, these incomes must be large enough for the population to be able to afford rather expensive durable consumer goods.

Accordingly, installment credit has grown in importance as larger portions of the public became periodic wage and salary earners; as these incomes'became large enough to provide for luxury durable goods; as technology provided durable consumer goods; and as the public developed a taste for these goods.

History.—Household or consumer debt is a very old human institution. So long as consumer goods have been articles of commerce, whenever they have been produced by someone other than the consumer and then bought by the consumer, there has probably been consumer credit. But in most cases and throughout most of the world's history, the extension of credit was a personal matter between the seller and the buyer; the debt was not highly institutionalized; and provision for regular periodic repayment was not set forth in a written contract.

Installment loans for the purchase of durable consumer goods, such as furniture, appeared in the 19th century, but it first received serious public attention and became of great economic importance shortly after the end of World War I. The burgeoning sales of passenger automobiles during the 1920s were made possible in large measure by installment credit. Some retailers were able to supply the money necessary to finance credit extensions. In the 1920s, however, there was a rapid growth of a new type of institution known as the finance company.

This type of firm bought instruments of indebtedness from the retailers and collected from the debtors the sums due periodically. Some of these finance companies were from their very inception owned by or closely associated with manufacturers. The most notable example was the General Motors Acceptance corporation (G.M.A.C.), which was organized in 1918. Devoted to financing the sale of General Motors products, it became the world's largest consumer finance organization. Most finance companies, such as the Commercial Credit company of Baltimore, Md.. have been independent of both manufacturers and retailers. Some operate on a large scale over an entire country, or even in several countries, while others limit their operations to small areas. In Britain and Australia during the late 1950s many finance companies came to be closely affiliated with commercial banks, but such connections did not develop in the United States.

Even before the dramatic increase in installment financing of durable goods in the 1920s another aspect of consumer financing had become a matter of social concern, particularly in the United States. In the 19th century, as an increasing proportion of the population moved into the urban centres and became employed on a wage or salary basis, cash borrowing for consumer purposes grew rapidly in importance. It came to be widely believed that social evils were related to this borrowing and that it should be publicly controlled. Such borrowing by individuals and households was not new, of course, but it was of increasing magnitude and social concern.

The commonest historical form of consumer lending has been pawnbroking; *i.e.,* the lending of money upon the security of household goods or personal effects. As pawnbroking developed in the late middle ages, it soon was subjected to legal controls. Special charters regulated the lenders' responsibility for the safety of the pledged property, the conditions of its forfeiture, the ratio of loans to value of the property, maximum loans to certain classes of people, and maximum interest rates. The most frequent maximum interest rate permitted in the late middle ages was $43\frac{1}{3}\%$, or two pence on the pound per week. Higher rates, however, were not uncommon. (See PAWNBROKIKG.)

Alongside the pawnshops, moneylenders or "loan sharks" operated during the 19th century, advancing funds in violation of the usury laws to wage and salary workers. The facts about this business are not well known, but it was believed to involve social abuses. As a result, in the United States beginning about the second decade of the 20th century, various states undertook to provide for supervised businesses to make small loans. (See MOKEY-LENDING.)

These supervised lenders, known as small loan companies or consumer finance companies, were authorized to make loans in limited amounts, charging rates in excess of those permitted under the usury laws. For example, charges might be at a rate of $3\frac{1}{2}$ cents per dollar per month on amounts up to $300. This charge was supposed to be all-inclusive, providing for investigation, collection, bookkeeping and losses as well as full interest. Such credit has sometimes been criticized on the grounds that borrowers

tend to keep themselves perpetually in debt or that lenders encourage them to borrow continuously and unnecessarily. Total loans of the licensed lenders increased from about $20.000.000 in 1917 to about $400,000,000 in 1937. Control of the operations of moneylenders in Britain was provided by acts of parliament in 1900 and 1927. These acts did not provide a legal escape from the usury laws, as was the case in the United States, but provided for controls and limitations in a field that was otherwise not subject to legal limitation.

In the United States, at the same time that escape from the usury laws governing cash loans was being provided by the small loan laws, escape was also provided in the form of durable goods sale credit by the legal doctrine of the time sales contract. Under this doctrine, if a price were placed upon a product to be sold on a credit basis, the difference between this price and the price prevailing if the commodity were sold for cash was judged not to constitute interest and not to be subject to the usury laws. The great expansion of sales of automobiles and other consumer durable goods in the 1920s in the United States was financed in large measure by installment credit without reference to the usury laws of the states.

The rapid growth of consumer credit in the 1920s aroused great public interest and discussion. The development was widely regarded by publicists as unsound from the standpoint of the general economy, somewhat immoral, and unwise from the standpoint of the financial advancement of the borrowers. Despite these widespread attitudes, the desires of the consumer and the salesmanship of retailers and manufacturers resulted in an extremely rapid growth of installment debt. It is estimated that installment debt in the United States rose from $1,000,000,000 in 1920 to $3,000,000,000 in 1929. In response to the widely expressed disapprobation of consumer credit and fears of adverse economic reaction to its growth, some economists and many representatives of finance companies developed theories that consumer credit was necessary for prosperity. They maintained that installment sales credit was necessary for the distribution of the new durable goods among broad groups of the population, and thereby to permit the development of industry on an efficient and highly productive basis.

When the 1929 depression overtook the world, consumer credit proved on the whole a very sound asset. Finance companies survived better than commercial banks, and their assets proved better than the commercial bank assets. Accordingly, the consumer credit business in the 1930s was not the subject of reform legislation. such as that enacted to deal with farm finance, home finance, corporate securities and the stock exchanges. Indeed, the record of consumer credit appeared relatively so good that the commercial banks of the United States, as they rose from the depression, rapidly entered the consumer credit business themselves. By the beginning of World War II they held $1,500,000,000 of installment paper, compared with $1,600,000,000 held by the sales finance companies and $700,000,000 held by other lenders, chiefly the personal finance companies.

But while the depression brought relatively few losses to the holders of consumer credit, it did lead to some critical examination of the subject. Some observers continued to feel that installment credit would contribute substantially to economic instability. Some thought that the collection of funds from the income stream by holders of installment paper during economic depression contributed substantially to a decline in consumer expenditures and to the furtherance of economic collapse. They thought that this might have been a factor in the 1929–33 depression and again in the 1937–38 recession. The completion of some major studies of consumer credit about the end of the 1930s in the United States helped to form a basis for adoption of special government wartime controls of consumer credit. The lack of confidence in general monetary controls *(see* CENTRAL BANK) that developed during the 1930s created a favourable climate for the consideration of special credit controls when excessive credit expansion threatened upon the outbreak of war.

In the United States special regulation of consumer installment credit was adopted by the federal government for the first time in Aug. 1941. These controls were premised on the lack of effective general credit controls, the desire to channel materials into avenues most necessary for the prosecution of the war and possibly a widespread feeling that consumer credit is unwise from either a personal or social standpoint. Consumer credit controls generally took the form of a down payment requirement or limits on the amount that could be borrowed in relation to the value of the object to be purchased. and limits on the period over which repayment could be extended. In Great Britain the wartime control of consumer credit was a part of price control. It was primarily a control of the rate of finance charge and mas chiefly a means of preventing the use of finance charges to circumvent the control of other prices. From 1943 to 1947 an outright prohibition of installment buying or hire purchase trading of most commodities was enforced.

Control After World War II.—The significance of consumer credit controi was small during the war because the production of most goods customarily financed with installment credit was brought to a halt. At the end of the war, consumer credit controls took on a new role. As production of consumer goods was resumed. the supply was far less than the demand. Continuation of consumer credit controls helped to limit demand, and this in turn contributed to solution of the problem of allocating the limited supply among consumers.

The British government after the war placed restrictions from time to time on capital issues of hire purchase companies. Such limitations were in operation from 1945 to mid-1954 and again from Feb. 1955 to Feb. 1959. In the United States, the government had difficulty deciding when to relinquish control over consumer credit terms. Restrictions were first dropped on Nov. 1, 1947, but in the face of continued inflation, excessive demand for consumer durable goods, and limited general monetary controls, special consumer credit limitations were again put into effect from Aug. 16, 1948, to June 30, 1949.

With the outbreak of hostilities in Korea, regulation of consumer credit was reinstituted in the United States in Sept. 1950 and continued until May 1952. The lack of such controls after that date may be explained in part by the availability of general credit controls, such as the purchase and sale of securities by the central bank, the adequate supply of consumer goods, the difficulties of enforcing such controls and the lack of public agreement that the special control of consumer credit is socially desirable. During the three periods when consumer credit has been under control by the federal government in the United States, administration of the control has been in the hands of the federal reserve system (*q.v.*), implemented by its regulation W.

Just as the United States was abandoning consumer credit controls in 1952, Great Britain was adopting such controls. From 1952 to 1960 the United States made no use of such regulations, but they played an important role among the economic stabilization instruments exercised by the British government. Credit limitations related to British price control disappeared with the abolition of price control on April 30, 1953. In the meantime, on Feb. 1, 1952, England had entered upon a full-scale control of hire purchase as a means of general economic policy implementation. This type of control was in use the greater part of the time during the following decade, Feb. 1952–July 1954, Feb. 1955–Oct. 1958, and again beginning in April 1960. During the periods when controls were in effect the prescribed time for repayment was usually 24 months, while the initial deposit requirement for automobiles, as an example, varied from time to time from 15% to 50%.

Adoption of consumer credit control in Great Britain after it was abandoned in the United States may have been due to several factors. Other means of general credit control may have been more effective in the United States, where the cash reserve requirements on the commercial banks are very effective. Central bank influence on bank cash reserves in the United States exercises a greater influence on total demand than do the general controls of the Bank of England. Furthermore, the balance-of-trade problem of Great Britain, the extent of economic planning, and controls in other fields have created a greater predilection for specific

controls of consumer credit.

The nature and timing of consumer credit controls in Canada for purposes of economy stabilization have been similar to developments in the United States. Indeed, it may be said that the 1950s saw the United States and Canada move away from consumer credit controls as an instrument for procuring economic stability, while many other countries were making substantial use of the device.

Consumer Spending Decisions.—Installment credit is used for two chief purposes: the purchase of durable goods that are acquired only occasionally, and other large expenditures that cannot readily be paid out of current income. Installment credit enables consumers to spend within a limited time period more than their current income. Purchases made in one month can be paid for out of the income of several months. Tax and insurance payments. annual vacation costs and school tuition payments may be expenditures of such a character.

Consumers may obtain the use of durable goods by a variety of methods: (1) Other assets may be liquidated. (2) Previously accumulated savings may be used, or funds may be saved out of current income until enough is saved to buy the commodity or service. (3) Monthly payments may be made over a period of time. (4) Goods may be obtained by lease or rental. (5) Relatively cheap goods may be bought at the outset and later he discarded or exchanged and better goods acquired as current income permits, the process being repeated indefinitely. If, for example, the $300 that might be required as down payment on a $3,000 car is devoted to purchase of a used car and the amount that mould be required to make the monthly payments on the new car are accumulated, a better used car costing $1.500 can be bought after about a year, or a new $3,000 car can be bought after something over two years.

These methods are obviously not altogether distinct or mutually exclusive. but their enumeration is of some value in thinking about the subject of consumer credit. It is scarcely possible to demonstrate that one method of acquiring consumer goods is better than another. Each of them is used, and each best meets the needs of some consumers. It may be argued that the saving up and working up methods are best or cheapest, but this suggestion is rather pointless for people who cannot bring themselves to follow the necessary procedures. It may he that for the great bulk of the population it is psychologically impossible either to save up money for major expenditures or to improve methodically the quality or quantity of its durable goods. Yet the consumer may genuinely desire, in spite of costly finance charges, to use installment credit for the high quality durable goods and major expenses, such as vacations. in preference to goods and services which may be simultaneously financed out of current income.

The quantity of consumer credit has depended and will depend on the pattern of goods and services bought by consumers. On the other hand, the availability of consumer credit has determined, to some extent, the pattern of goods and services bought. To the extent that increased levels of consumption take the form of using durable goods, such as automobiles, or engaging in concentrated expenditures, such as vacations or Christmas gifts, consumer credit increases in volume. When expenditures of these types are increasing relative to others, consumer credit will tend to grow more rapidly than income. Consumer tastes, however, may turn toward the leasing of durable goods, the utilization of services, such as commercial laundries, recreation or the purchase of expendable goods. Such expenditures, which do not involve long-term installment credit, can drop the growth rate of installment credit until it is even with or lower than the growth rate of income.

Borrowing to buy goods such as automobiles bears some relation to the probable length of efficient life of the purchase. A periodic reduction of the debt by a certain amount may correspond roughly to the rate of depreciation. A very common period for paying for a new automobile in the United States in the late 1950s was three years. The longer the average useful life of a product, the greater may soundly be the maturity of the indebtedness.

Many consumers see fit to borrow at interest rates ranging from 8% to possibly 20% while holding liquid assets nhich yield from 2% to 4%. While such a practice may seem irrational and undesirable, this may not be the practical fact. The consumer may feel that if he borrons, he will be under the discipline of repaying, while if he uses his liquid assets, he will not replace them, and later he will be in a worse financial position than if he had borrowed.

Accumulation of savings and simultaneous borrowing at much higher rates of interest. even from the same institution, may be in a sense costly or wasteful, but this may be the only way in which many households can regulate their spending and contribute to personal peace of mind and maximum satisfaction. The millions of consumers who borrow year after year, even though they have liquid assets, belie the belief that consumer installment credit is a great swindle. In the main, the users like such credit because it enables them to make the best adjustment to the need for financial planning.

Installment credit has sometimes been thought of as a means whereby the individual or family can early enjoy a level of living which is justified only by the anticipation that income will be higher at a later stage of life However, the major consumer uses of installment credit do not offer much to this end of evening out consumption over an individual's or family's life span An automobile buyer, 22 years of age, may reasonably expect a higher income at age 35. but the payments on the car must be made nithin the next tno or three years.

Consumer credit does not on the whole provide a means for maintaining a family's level of living in the case of temporary decline of income. Debt is incurred primarily at times of increased employment, increased overtime and rising nage rates. It may be argued that since the monthly payments must on the whole continue to be paid at a time of declining income, spendable funds are made more uneven by installment credit. Some consumer installment debt is incurred at times of reduced income, but such credit plays a small role compared with credit associated with prior or simultaneous increases of incomes. Automobile loans and other types of consumer credit rise in times of increased employment and income; the cash loans of the consumer finance companies, the credit unions and the commercial banks also increase most in time of prosperity.

Cost of Consumer Credit.—Installment credit outstanding in the United States by 1960 amounted to over S40.000.000.000, and total finance charges each year were from 15% to 18%. It thus appears that consumers paid more than $6,000,000 000 per year for the use of the installment credit method of acquiring their purchases.

The reason for this high cost is that the extension of credit to consumers generally involves cost to the seller or lender. In a few instances. such as the sale of electricity and gas to consumers, either prepayment or credit is technically necessary. In this and some other cases the extension of credit may be less costly to the seller than would collection of cash simultaneously with supplying the goods or service. But, generally speaking, the seller incurs extra costs by virtue of not collecting cash at the time of the sale. In the case of the simple charge account, which is technically payable soon after the receipt of a monthly bill. the costs are generally borne by the seller or, in a sense, by the customers (both those paying cash and those buying on credit). A specific charge is almost always made for all types of installment credit. Compared with other types of credit, the charges for this kind are quite high. While governments and businesses with good credit standing have commonly been able to borrow for 4, 5, or 6 cents per dollar per year, consumers borrowing relatively small amounts, and having a less reliable or undetermined credit status, have commonly paid from 8 to 42 and more cents per dollar per year.

Provision of consumer credit requires a large and complicated organization for investigation of the borrower, keeping records and collecting delinquent accounts. Provision must also be made for losses. Costs vary greatly, depending upon the size of the credit and the character of the borrower. The cost of investigating borrowers and making collections is much less per dollar in

the case of large loans than in the case of small loans. Accordingly, the rate of interest charged must be higher on small borrowings than on large. Lenders who confine their business to persons of a relatively high degree of financial responsibility can lend at lower rates than can those who lend to the financially less reliable. This may be one reason why rates charged by the commercial banks are generally less than the rates charged by some other classes of lenders. Credit unions are also able to make small charges on loans because they have lower costs for investigation, collection and loss. Needless to say, it behooves the wise borrower to patronize the lowest-priced lender who will recognize his eligibility for credit. The level of rates paid by consumers for loans has sometimes reflected their unwillingness or inability to bargain or shop around, and some lenders have made very high and, in a sense, unjustified profits. But. in the main, the level of charges has been necessitated by the costs involved.

Consumer Protection.— Historically. consumer credit in the United States has had either to operate illegally or to find some way to avoid the usury laws of most states. Many states have prohibited lending at a charge of more than about S cents per dollar per year. Many states have also provided that under government supervision loans can be made by special institutions up to limited amounts at rates above the usury rate. They have generally provided these limits by h \ rather than by making provision for their determination by administrative action as is generally the case with public utility and other governmental price control. The other chief way in which consumer credit charges higher than those permitted by the usury laws have been practical has been for the price of goods sold on installments to be higher than the cash price.

After World War II, this means of circumventing the usury laws was questioned. Some influential observers came to regard the charges as extortionate; some court decisions indicated that the sales price doctrine should not be regarded as a legitimate means of circumventing the usury laws, but as a violation of them. As a result, many states provided by law for interest on sales credit beyond the basic usury limit.

The cost of consumer credit has long been a matter of public and social concern. By way of reform it has been suggested that lenders be required to give better information to borrowers (buyers) regarding credit costs. Information requirements may be of several kinds. The law might require, for example, the quotation of both the credit sales price and the cash sales price. Such is the basic nature of the British acts of 1938 and 1954 and of laws enacted in about half the states of the United States after World War II. An alternative information requirement may be for the credit cost to be stated in the form of a rate per annum on the unpaid balance. This was the nature of proposed legislation introduced into the U.S. senate in 1960 (S. 2755–86th congress, 2nd session). *See* also CREDIT UNION; DEBTOR AND CREDITOR LAW; MONEY-LENDING; PAWNBROKING; USURY.

BIBLIOGRAPHY.—Board of Governors of the Federal Reserve System, *Consumer Installment Credit,* vol. i–vi (1957); Wallace P. Mors, *Consumer Credit Facts for You,* 2nd ed. (1959), *Small Loan Laws of the United States,* 12th ed. (1958); Ralph Harris, M. Naylor and Arthur Seldon (eds.), *Hire Purchase in a Free Society* (1961); Siegfried Schimanski, *Zur Theorie des Konsumentenkredits* (1958); Friedrich A. Lutz, *Der Konsumentenkredit* (1954). For current data, *see* Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin.*

(H. Jo.)

INSTERBURG (CHERNYAKHOVSK), a city at the point where the Angerapp and Inster rivers join to form the Pregel river, about 50 mi. E. of Königsberg (Kaliningrad), after 1945 in east central Kaliningrad *oblast,* Russian S.F.S.R.; it was formerly in the province of East Prussia. Pop. (1959 est.) 30,000.

The junction of railways to Memel and Allenstein, Insterburg became known for its considerable trade in cereals and wood and for the horse breeding carried on extensively in the neighbourhood. In addition to flax spinning and iron founding. industries such as the manufacture of machinery, cement, leather and beer were developed there. The town church has been celebrated for its fine mood carvings.

Insterburg, the "burg" on the Inster, was founded in the 14th century by the knights of the Teutonic order. Having passed to the margraves of Brandenburg, the village which had sprung up round the castle received civic privileges in 1583. During the next century it prospered greatly, partly a result of the settlement in it of several Scottish trading families. In 1679 it was besieged by the Swedes; in 1690 it suffered severely from a fire; and in 1710–11 from pestilence. It was occupied by the Russians in 1914 and again in Jan. 1945.

At the Potsdam conference it was awarded to the Russians, who renamed it after the Soviet general who led the forces that captured it during World War II.

INSTINCT (Latin *instinctus,* "impulse," "instigation"). Popular and literary use of this word is loose: it has been applied to behaviour driven from within ("the mating instinct asserts itself in spring"), to nonlearned behaviour ("the kitten knows instinctively where t~ find the mother's nipple") and to unconscious or unpremeditated behaviour ("I put my foot on the brake instinctively"). In studies of animal behaviour it has often been applied to relatively complex behaviour which serves a vital end, is at least partly caused by an internal urge and need not be learned. However, it is being realized that the dichotomy instinctive—noninstinctive based on this complex of criteria, or even on any one of them, is not helpful, and modern students of animal behaviour prefer to classify behaviour in a very different way. Yet the aspects mentioned—of adaptedness, of causal organization and of development of behaviour in the individual—remain central themes of investigation.

Adaptedness.—A great many aspects of animal behaviour contribute to survival, and the functional significance of even the most trivial details is the object of research. Most behaviour involves processes in the sense organs, in the nervous system, in the muscles and in hormone-secreting glands, and each of these processes is adapted to contributing toward survival. This is demonstrated in such diverse phenomena as the simple prey-catching movement of the praying mantis, the more complicated action chains such as the "dance" of the honeybee scouts; such complexly adjusted movements as bird flight; the sensory refinements employed in species and individual recognition; symbiotic relationships such as those between flowers and their pollinators; the employment of learning when the situation demands it; the cooperation between individuals in social behaviour; and many other phenomena. In short, the correct functioning of behaviour is recognized as being subject to ruthless pressure of natural selection just as any other life process.

Yet it is obvious from the many things an animal does not do that animal behaviour is remarkably restricted in many respects. Many ground-breeding birds can roll an egg back into the nest, but they invariably use the clumsy method of balancing it against the bill, although a foot or a wing would be better tools and possess the required muscular equipment; gulls, although capable of learning, rarely learn to select a hard substrate when smashing shells by dropping them from the air. Further, unusual circumstances often lead to miscarriage of behaviour and so reveal the limitations of adaptedness.

Thus, animal behaviour, while highly complex, variable and adapted, is yet restricted in scope and seems on the whole to be limited by the machinery evolved in adaptation to the demands of survival under natural conditions.

Even the criterion of learned or nonlearned does not allow a simply dichotomous distinction between two types of behaviour. Learning probably applies to more than one type of adaptive change in behaviour machinery during the life of the individual. Learning by imitation is extremely rare in animals; examples from apes have been reported, as they have from some birds which learn their full song by hearing fellow members of their own species, but most animals develop the behaviour typical of their species even when reared in isolation. Isolated canaries, for instance, build typical canary's nests when mature. However, many animals learn by practice. While birds develop the basic pattern of flight without practice, subsequent perfection of skill does depend on it; this may happen extremely rapidly as in cormorants, where one abortive landing attempt may suffice to cause striking improve-

ment with the second attempt. Yet many skills develop without practice; thrushes smash snails expertly when encountering them for the first time.

Even behaviour which is neither imitated nor learned by practice may be subject to learning in another way: it can be conditioned; *i.e.*, change its responsiveness to outside stimuli. Thus pigeons learn to respond to water by drinking, and many songbirds learn to avoid obnoxious insects after one or a few penalized responses. Yet many animals react selectively to appropriate situations the first time they meet them: gull chicks hatched in an incubator respond by crouching to the alarm call of their own species and peck selectively at the parent's bill tip when soliciting food; some butterflies respond selectively to blue and yellow flowers or paper substitutes the first time they feed. In other instances such changes in responsiveness are independent of experience; *e.g.*, the appearance of reproductive responses of many animals upon reaching maturity. Even animals which learn a great deal may fail to apply their ability to learn as widely as human beings would do, and this would seem to indicate in the latter a nonlearned "predisposition to learn"; gulls which learn very readily where their nest is located have no predisposition to learn where to smash their shells.

Thus many behaviour patterns are at the same time learned and nonlearned, the growth of their machinery being the result of complicated interactions between internal and environmental ngents. To make a sharp distinction between learned and nonlearned leads to a false dichotomy when applied to behaviour; rather it should be applied to influences governing the development of behaviour machinery, and modem studies try to unravel the interaction of a great variety of inherent and external growth-controlling factors.

Complexity. — Instinctive behaviour has often been considered to be more complicated than simple motor patterns such as reflexes, which have been said to involve "the whole animal." However, this difference is no longer regarded as important, for there seem to be all gradations from simple to complex movements; a frog wipes its side or back with a hind leg when the skin is irritated, and this, although a very simple movement, shows relatively good orientation and is thus more complex than the simplest possible reflex. On the other hand the newly born chicks of many birds crouch at the parents' alarm, and although this is usually called instinctive it is simpler than a frog's wiping reflex.

While it is useful to analyze behaviour into its components, it is not useful to prejudice such analysis by the application of a dichotomy between complex and simple movements and to draw an arbitrary line between instinctive and noninstinctive movements on this criterion.

Causal Organization. — The distinction between behaviour caused by an internal urge and purely reactive behaviour is also considered false, partly because most behaviour is neither purely reactive nor purely spontaneous. Modern research tends to avoid the catchword "instinct" as applied to behaviour patterns, and instead tries to unravel the causal organization of behaviour without prejudice.

Although there is only fragmentary knowledge on the subject, it is already clear that behaviour is organized in hierarchical systems with excitatory and inhibitory relationships of many kinds, and with complex interrelationships between causal chains. These systems are never completely at rest and their excitatory state is subject to continuous change.

The initiation of movements (*i.e.*, the change from one type of activity to another) can be caused by external stimuli or by internal changes or by both combined. Thus many animals of the temperate zones respond to increasing day length (received by light-sensitive organs) by changes in the activity of hormone-secreting glands, which make the animals migrate, select a suitable habitat and proceed with nest building, courting a mate, etc. In all these activities an animal responds in a variety of ways to sensory stimulation, yet a reduction of the sex hormone level (for instance, by castration) abolishes the readiness to respond to many of these very stimuli.

There are many indications that the central nervous system in the intact animal is continually stimulated both by internal agents (humoral, sensory, nervous) and by the "rest output" of peripheral sense organs, and that the machinery of each major behaviour system is never completely at rest. Apart from this, there seem to be humoral and nervous agents which control the general excitatory state. Which behaviour pattern is performed at any one moment seems to depend on the particular unbalance of the conditions facilitating or inhibiting the various systems. On the other hand the external stimuli which, given a certain state, initiate a response are specific. Their effectiveness depends first of all on the sensory equipment of the animal, which is often very different from human equipment and from that of other species.

Thus bats are sensitive to ultrasonic vibrations; many insects can see ultraviolet radiation; on the other hand, the majority of animals cannot hear properly. Second, the stimulus situation eliciting or inhibiting a particular response is often very restricted: the males of some butterflies, for instance, pursue any moving object when they are in sexual condition, irrespective of its shape and colour.

Which of the available sensory information is responded to is often controlled by the internal condition or "mood," and it is known that this condition can centrifugally affect the responsiveness of sensory systems.

Most behaviour patterns are sequences or chains of simpler movements. Such action chains often begin with searching behaviour which may be spontaneous, and this is continued until the next link in the chain appears. The switch from one link to the next is sometimes caused by internal changes, as has been demonstrated for the mating chain of the male fruit fly, but in other instances it is mainly caused by external stimuli, as for instance in the hunting behaviour of the digger wasp *Philanthus triangulum*. Probably both internal and external control of switching are involved in most instances. Each link itself is a complex movement of variously integrated muscle movements.

Many behaviour chains terminate in an end act such as swallowing food, or in the perception of an end situation such as a shelter out of reach of a predator; the end of a chain is usually marked by an internal change indicated by a reduced readiness to perform the same chain again. This "drive reduction" is often caused by "negative feedback," *i.e.*, information reaching the system as a consequence of the activities performed or of the situation reached, which counteracts the stimuli evoking these activities. Thus reduction of the feeding drive in rats partly results from food stimulating the stomach after ingestion; the readiness to fly in the saturnid moth *Automeris* is reduced by the activity of the central nervous flight mechanism itself.

The part played by feedback systems in behaviour is certainly highly varied and complex, but whether central nervous fatigue or other depletion phenomena can contribute to drive reduction is uncertain.

There is interaction between the major behaviour systems as well as between the various parts of each system, but on the whole major systems inhibit each other mutually, so that at any particular moment the movements of the most strongly aroused system appear to the exclusion of all others. When two systems are simultaneously aroused, various "conflict movements" may occur. These may consist of components of the two patterns combined in a "mosaic"; they may be intermediate or "compromise" movements; the full movement of one pattern may appear with a different orientation; components of both patterns may appear in quick alternation; or a completely irrelevant movement may be performed ("displacement activity"). Interaction on lower levels is responsible for the co-ordination of limbs in locomotion, or even of parts of limbs such as fin rays. Such interaction is partly controlled by the central nervous system, partly by reflex loops, and it may affect both the temporal order and the amplitude of contractions.

Instincts. — Neither innateness, nor spontaneity, nor complexity, therefore, is useful as a criterion for the separation of instinct from other behaviour categories. The term "an instinct," however, has been used as a name for the machinery responsible for the organization of major, functionally unitary behaviour systems,

such as feeding, mating, antipredator behaviour, etc., and when used in this way, it is a term comparable to digestive system and merely indicates a phenomenon to be studied. However, in view of the conceptual confusion which the use of such different criteria has created even this usage of the word is increasingly avoided.

Evolutionary Aspects.—Since the growth of the machinery underlying many elements of behaviour, whether affected by the environment or not, is often very stable in successive generations, many motor patterns are relatively constant during evolution, and this is why closely related species are usually similar in their behaviour. Yet evolutionary change does occur and as a consequence no two species behave exactly alike.

Simple mutations have been shown to effect behaviour changes. Much indirect evidence has been collected showing that natural selection can account for adaptive evolutionary change. Conversely, behaviour also affects evolution; such activities as habitat selection, food selection and mate selection seem to have been instrumental in the splitting-up of species.

Animals and **Man.**—It is too early for an assessment of the ways in which human behaviour has evolved from the ancestral animals' roots. There is, on the one hand, no doubt about the large differences between man and all animals, exemplified by such capacities as foreseeing the future outcome of a planned course of behaviour; man's extremely complicated learning abilities which in turn allow him to pass on acquired knowledge from generation to generation; his tendency to use moral criteria; the retardation of certain aspects of ontogeny which, for instance, prolongs the infantile curiosity or tendency to explore; his ability to utilize specific experience for general purposes; etc.

On the other hand it is becoming increasingly clear that these could well be differences of degree. Man's freedom of action is undoubtedly limited by his evolutionary past. The best way to gain insight in this problem is through comparative studies, particularly of those species most closely allied to man. A major obstacle hampering such work is the fact that man has two sources of knowledge about his own behaviour of which only one can be used for the purpose of comparison. Every human being can observe his own behaviour as if he were an outsider, and record his observations in the same way as behaviour of animals.

Subjective experiences however are not directly observable in animals and cannot therefore be used for comparison. Because our everyday language deals with both types of observables it is not suited as a tool of behaviour research. This is perhaps the main reason why a strictly scientific comparison of the behaviour of animals and man has not yet proceeded very far,

See also ANIMAL BEHAVIOUR; ANIMAL SOCIOLOGY; PSYCHOLOGY, COMPARATIVE.

BIBLIOGRAPHY.—P. P. Grassé *et al., L'Instinct* (1956); J. S. Huxley, *Man in the Modern World* (1947); K. Lorenz, *King Solomon's Ring*, Eng. trans. by Marjorie K. Wilson (1952); W. H. Thorpe, *Learning and Instinct in Animals* (1956); N. Tinbergen, *The Study of Instinct* (1951); J. Z. Young, *Doubt and Certainty in Science* (1951).

(N. TN.)

INSTRUMENT, that which can be used as a means to an end, hence a mechanical contrivance, implement or tool; the word is more particularly applied to the implements of applied science, in mathematics, surgery, surveying, etc., while those of the handicrafts are generally known as "tools." A specific use of the term is for the various contrivances used to produce musical sounds, "musical instruments."

In law an "instrument" is any formal or written document by which expression is given to a legal act or agreement. This is a classical use of the Lat. *instrumentum*, a document, record. The term may be used in a wide sense, as a mere writing, meant only to form a record, or in a particular sense with reference to certain statutes.

For example, the Stamp act of 1891 defines an instrument as an expression including every written document; for the purposes of the Forgery act of 1861 a post-office telegram accepting a wager has been defined as an instrument.

INSTRUMENTATION is the aspect of music which deals with timbre and with the technical possibilities and characters of instruments and voices. The treatment of the orchestra has for the last hundred years been the most popular branch of the art. Hence the vogue of the narrow term "orchestration." The colloquial word "scoring" is the only adequate name for an art that ought to include all other aspects of timbre and performance, such as chamber music (*q.v.*), pianoforte writing and organ registration.

Method of Study.—The first requisite for good scoring is an imagination exercised by training. Rules are not enough; and neither is mere practical experience. Schumann's scoring grew worse as experience discouraged him; and a student who masters good rules without training his imagination merely protects himself from learning by experience. Many musicians who ought to know better are doing serious mischief by denying the possibility of arm-chair score-reading. Exaggerated claims are harmless for they are nearer to the truth of what an accumulation of study can achieve. The common-sense of the matter is obviously this: the arm-chair reader can vividly imagine effects that he has heard; he can recognise similar effects when he sees them in a score that is new to him; and so with effort and practice he can realise the effect of known sounds in new combinations. The complexity of the combinations has, in reason, little to do with the difficulties of imagination; and familiarity with the type of music is always a paramount factor.

William Wallace, in *The Threshold of Music*, seems to believe that modern progress in orchestration has produced new cerebral powers. This is a fallacy: listeners or conductors who have become familiar with Richard Strauss's orchestration will vividly imagine the sounds of a page of the master's latest and fullest scoring long before scrutiny has shown more than the main entries and the general type of colouring. But such readers may get nothing but abstract grammatical propositions from a page of Palestrina if they have never heard pure polyphony sung without accompaniment in a vaulted building. The music of each great period has its own proper scoring which sounds well under its proper conditions. The student should take opportunities of hearing each kind of music well produced; and he should multiply his experience by reading the scores of all periods, besides those of his own day. An imagination thus trained is obviously useful to conductors. It is not less useful to composers, for it is no mere antiquarian lore but a widely generalised capacity to imagine correctly all kinds of significant musical sounds. Its possessor will never produce the woolly scoring of the unimaginative composer who goes by rule; and if he makes errors of calculation these will be remediable as errors of imagination are not.

Rules are useful in preventing errors of calculation. The only extant treatise on instrumentation that gives correct rules is the posthumous work of Rimsky-Korsakov. Starting with the proposition that good scoring is good part-writing. this brilliant and fantastic Russian composer lays down surprisingly severe rules for combining good part-writing with well-balanced orchestral values. At first it seems incredible that any free art could live on such terms; yet the marvellous purity of Mozart's orchestration supports Rimsky-Korsakov's system in an art a century earlier and far more complex. For there is less wonder that Rimsky-Korsakov's colouring should be pure since his ideas never overlap, and his hundreds of illustrations from his own works consist (except for a few scraps of recitative) exclusively of a-bar or 4-bar phrases that repeat themselves. We shall not learn Mozart's art from this, and rules will not endow us with Rimsky-Korsakov's imagination. Nor was that imagination equal to distinguishing blunders from subtleties in the score of his friend Moussorgsky's *Boris Godounov*. Much less, then, is it to be trusted when he dismisses Beethoven's orchestration with the remark that the execution of Beethoven's ideas is far inferior to their conception. This really means that the narrow cross-section of Beethoven's ideas that comes within the aesthetic range of Russian ballet-music could have been scored more easily and brilliantly by a Russian composer in 1890. Apart from this, Beethoven is doubtless not infallible. But perkiness starves the imagination.

Pure 16th Century Polyphony.—In the article HARMONY (*q.v.*) the grammar of pure polyphony is shown to be equivalent

to the art of vocal scoring. A modem choir soon learns the truth of the 16th century rules when it faces the task of unaccompanied rehearsal. The old rules secure singability as well as euphony. But they also leave the composer's imagination free for many subtleties. Our stereotyped full chorus of soprano, alto, tenor and bass is roughly that of the 16th century, though we have forgotten the ways of the genuine boy-alto who delights in manly growls down to D and becomes shy above A in the next octave. The 16th century knew no other alto, and Palestrina has 17 ways of grouping 4 parts and 12 different ways for 3 parts, besides equally various 5-part and 6-part grouping. In 8-part works for double choir the two choirs are often contrasted, as in Palestrina's motet and mass *Hodie Christus natus est,* where the second choir, led by the altos, makes a terrestrial antiphony to a choir of angels.

The infinite subtleties of 16th century part-writing are beyond the scope of this article and very remote from the experiences of any instrumental music. But every conductor and every composer may learn much from Palestrina's and Lasso's devices of producing by part-crossing beautiful progressions that would be crude if the planes of tone were not kept distinct. In all later periods the distinction of planes of tone is a fundamental principle. In the 16th century it enters into these delicate intricacies, and appears more obviously in the rule formulated by the first composers for double and triple choirs, viz., that the harmony of each choir must be complete even when all are singing together. Lasso disregards this rule, but its common-sense becomes evident when the choirs are on opposite sides of the building.

Archaic Instrumentation. — At the end of the 16th century monody arose. It was the art of non-polyphonic vocal declamation with an instrumental accompaniment. With characteristic acumen the Italian monodists promptly recognised that voices and instruments will not meet on the same plane of tone. Not all composers understood the new problems. The habit, in private performance, of using viols to replace missing voices in madrigals had gone far to make composers incautious in dealing with more penetrating instruments. The flat-backed viols with their husky and reedy tone (nowadays still noticeable in the double-bass) were already giving place to the royal family of the violin in all its sizes; this family was no longer on singing terms with voices; yet many composers at first saw no difficulty in using any instrument as equivalent to any other instrument or voice at the same pitch. Schütz (1585–1672) writes for triple and quadruple choirs of voices mixed with instruments. He writes the words under the instruments as well as under the voices; he often merely designates a part *Vox instrumentalis;* but he also takes the trouble to suggest *Tromba o flauto,* as if these instruments, in low register, had the same weight! Beauty often emerges from the chaos— associated with some practical suggestion that leaves us in doubt whether the composer knew what he achieved; as when Schütz proposes that his wonderful *Lamentatio Davidi,* a perfectly scored masterpiece for bass voice, 4 trombones and organ, should be played with two violins an 8vo higher as a substitute for the first two trombones!

Continuo Instrumentation. — By the time of Bach and Handel instrumentation had become a mature art; but an art depending on conditions no longer familiar to us. When these conditions are restored the resulting aesthetic system completely justifies itself. It recognises that no group of instruments can make homogeneous harmony like a vocal chorus, but that all instrumental scoring consists normally of a top, a bottom, and a *tertium quid* that completes the harmony but remains in the background. Bass instruments support the bass; all other instruments, whatever their pitch, are aesthetically top parts, and their most elaborate counterpoint does not profess to make their tones blend. They are woven into patterns of coloured threads, not blended like the colours of a landscape. The *tertium quid* is provided by an organ or a harpsichord; and it obeys the normal grammar of choral harmony. Only a keyboard instrument can provide such harmony ready-made on one plane of tone. At the present day one of the commonest faults of unimaginative scoring is the habit of treating the orchestra like a 4-part chorus. Continuo orchestration shows the true principle with drastic clearness, but it shelves the problem of how to keep subordinate parts in their places. The continuo player represents an army of slaves upholding an aristocratic civilisation.

Besides gaining a capacity to attack discords boldly, the vocal chorus has undergone a radical change in the treatment of the bass voice when supported by instruments. When the tenor is low but still interior to the harmony, the bass is no longer obliged to go lower, but is free to sing in its upper register, crossing freely above the tenor but relying on instruments which double it an 8ve lower as the true bass. Bach and Handel never once cross the bass over the tenor in any other way; the tenor in such places never gives the true bass. And Bach's so-called unaccompanied motets thus show in every line that they were conceived as supported by at least an instrumental bass. In fact. unaccompanied choral writing practically disappears from classical music between Palestrina and Schubert. It appears modestly in part-songs, and is first taken fully seriously by Brahms; though some older conductors of choral societies honourably kept up its tradition.

The basis of the continuo orchestra was, as now, the string band, an instrumental chorus of first and second violins, violas and violoncellos, supported an 8ve lower by double-basses which are never independent. Wind instruments did not form a complete mass of harmony but stood out against the strings in double or triple threads of each timbre, except when (as often in Handel) they doubled the strings. Flutes were used much more in their lower registers than we think fit in modern orchestration. In the organ-loft of a vaulted building low flutes are more effective than in ordinary concert-rooms. The ordinary flute is called traverso. The term flauto, with the use of the treble clef on the bottom line, indicates the flute-à-bec, a kind of flageolet, with rather a higher range. Bach uses pairs of each kind in the *Matthew Passion* but not in the same movements.

Oboes are also used in threes or pairs, and the ordinary oboe alternates with a variety a 3rd lower, the oboe d'amore, with the bell (and therefore the tone) of a cor anglais. Strauss has revived it. The real cor anglais figures in Bach's orchestra as the oboe da caccia or the taille. Some authorities tell us that one or other of these was not an alto oboe but a tenor bassoon. It is easier to relabel a museum specimen than to rewrite the whole of Bach's oboe da caccia music.

Bassoons hardly ever emerge from doubling the bass. The *Quoniam* of Bach's *B* minor Mass is a bass solo accompanied by a horn, two bassoons and continuo. It would be delicious if we could find proper acoustic conditions for it and could handle the continuo discreetly enough. A great moment is the rising of the spirit of Samuel in Handel's *Saul,* where the bassoons are as ghostly and awesome as the prophet's message. In large enough numbers they would also astonish us in Handel's scoring of the "thick darkness" in *Israel in Egypt.* Handel, whose oratorio performances were on a large scale, must have had more reed-tone than string-tone in his orchestra; for he often had 20 oboes and 20 bassoons. Multiplication greatly mellows the tone of an instrument; and we, who seldom hear more than 4 oboes in unison, even in Mahler's 8th symphony, must not hastily judge our ancestors on this point.

Trumpets and horns, not being provided with modern valves, could produce only the natural harmonic series of the key to which their length of tube was set. That series does not close up into anything like a scale until the 8th harmonic. Accordingly trumpeters devoted themselves to acquiring extraordinary command of the delicate distinctions of high lip-pressures *(enzbouchures)* between the 8th and 20th harmonics. A long mouthpiece, with a little play in its adjustment, enabled the trumpeter to correct the out-of-tune 11th, 13th and 14th harmonics. (This secret was already forgotten by 1785, so that Burney, describing the Handel Centenary Festival, tells us that whenever the G and G♯, alternately represented by the 11th harmonic, were heard in "The trumpet shall sound" displeasure was seen on every countenance.) Humbler players called themselves *Principal-blaser* and produced the lower notes to which the tight-tipped clarino-player could not descend. Horn-players developed a similar hazardous technique of high notes. In modern performances special training and special instruments are required for early 18th century trumpet and horn

music. A modern tendency to strain all instruments up to high notes has facilitated this revival. Trombones, when they occasionally appear in continuo orchestration, are treated exactly like choral voices, and are, indeed, mainly used in unison with the chorus. A soprano trombone at first completed the group but Bach already had to replace it by some kind of slide-trumpet (corno da tirarsi).

Bach's full orchestra consists, then, of the string band (preferably larger than he ever had) oboes (ordinary or d'amore) in pairs or threes, flutes or flutes-à-bec in pairs or threes, bassoons (taken for granted) in unison with the basses, three trumpets (two clarini and one principal) three horns (not often used together with the trumpets) and a pair of kettle-drums. If the string band is large the wind parts, other than the trumpets, should be doubled, trebled, or (in festival performances) multiplied. The organ supplies the continuo in choruses, and the harpsichord supplies it in solo movements The pianoforte is really (as Philipp Emanuel Bach already urged) better than the harpsichord, if only the player will avoid a self-assertive touch.

The orchestral combinations of solo movements range from Handel's perfunctory *tutti unisoni* to Bach's and Handel's richest schemes. Instruments obsolescent from incompatibility or feebleness live awhile in the arias and recitatives, protected from competition with the orchestra; and so we learn from Bach's *Passions* and *Trauer Ode* the use of the lute and viola da gamba, and from Handel's *Alexander Balus* the use of the theorbo, a large double-necked lute. Each movement has its own scheme of instrumentation as a set pattern which cannot change while the movement lasts.

The scheme of a chorus with independent full orchestra is in three planes of tone. These planes do not interfere with each other, and each plane has variants of the same harmonic scheme which would produce appalling collisions if all were projected on to a single plane (say, in an arrangement for two pianofortes). The principal plane is that of the voices. Above it, mostly higher in pitch, all the instruments that are not doubling the bass flourish with more rapid detail than the voices. Behind, and supporting the whole, is the continuo which moves more slowly than the chorus. The bass is common to all the planes, though it is enlivened by instrumental details. The results of this scheme, realised by competent execution under scholarly guidance, are as true in our age as they were when Bach and Handel wrote. Scholarship must show us the right conditions for performance, but it need not recover too precisely the actual original conditions. An old man who had been a chorister under Bach at Leipzig once told Wagner's teacher, Weinlig, how Bach's cantatas were performed. His account was, "It went atrociously and we always got a flogging afterwards."

Symphonic **Orchestration.**—Gluck (*q.v.*) laid down one of the cardinal principles of symphonic as well as dramatic orchestration when he said that instruments ought to be used according to dramatic vicissitudes. This means that for Gluck it is neither sufficient nor often possible to use them according to a set pattern. Another cardinal principle results from the disappearance of the continuo. This first happened merely by neglect, as the severe training needed for it repelled a generation of musicians excited by non-polyphonic styles. But mere neglect soon passed into a disposition to make the orchestra provide its own continuo. If old music sounded hollow without a continuo, why should not new music contrive better? This at once put many instruments into categories unrealized by Bach and only sporadically realized by the eclectic Handel. An instrument could now have two values: one, the old cantabile function; the other a capacity to provide unobtrusive notes for the background. Holding-notes for the horns revealed a wonderful beauty and usefulness in this way, with all a singer's power to s ell and diminish the sound.

The bassoons became the hardest worked wind instruments in the early symphonic orchestra, for they could do everything required of continuo-work, from doubling the bass to supplying the many notes the natural horns could not reach. Their tone, so beautifully if unwittingly described in *The Hunting* of *the Snark* as "meagre and hollow but crisp, like a coat that is rather too tight in the waist, with a flavour of will-o'-the-wisp" had a most useful capacity for vanishing; and "too tight in the waist" is a very apt description of instruments which, like the bassoon and the viola, show in their half-veiled tones the results of a compromise between the dimensions proper to their pitch and the practicable stretch of human hands.

The viola had at first a curious position in the early symphonic style. That style was so unpolyphonic that the viola could for a long time find nothing to do but to double the violoncello in the upper octaves as the basses double them in the lower. The result is so good that in early symphonies it is carried out mechanically even where it takes the violas above the second violins. But Mozart uses this primitive device with full imaginative insight in mature works where he hardly less often divides the violas into two independent parts.

The trumpets of the symphonic orchestra have become degraded to the fanfares and signallings of the Principal-blaser. The clarino player was finally ousted by players of a cheap substitute called the clarinet, which could play high trumpet parts with ease, if with rather a vinegar tone. But the clarinet had a wide compass; these trumpet-sounds are its worst. Below them it had a rich cantabile octave, and below that a few rather dull notes; and below these a coldly mysterious and reedy lowest octave, the chalumeau register. The dull middle notes proved astonishingly useful for continuo purposes; they are higher than the bassoon can attain without self-assertion, and they are not limited like the horn notes. Gluck uses the clarinet only in this neutral region; and even Mozart gives the instrument nothing better when the orchestra is in the key of D. This primitive treatment survives as late as Beethoven's and Symphony, and revived by him in quite a late work, the fugal overture, *Zur Weihe des Hauses* (op. 124).

But when Mozart uses clarinets in the keys of A major, E major, E flat and B flat he reveals the clarinet as richer and more resourceful than any other wind instrument. The chalumeau octave is deliciously nutty in arpeggios, and dramatically hollow in sustained notes. The cantabile octave is magnificent (see the trio of the minuet of the great E flat symphony, for its contrast with echoes on the flute and with low arpeggios on the second clarinet). The military high notes (or "fife sounds") Mozart does not care for. Beethoven's view of the clarinet is less sympathetic than Mozart's, his idea of its cantabile register being just a tone too high. Schubert understands it perfectly.

The oboe can never efface itself. Run through the individual wind-parts of some such encyclopaedic score as Wagner's *Meistersinger* and you will be astonished at the unfailing beauty of the oboe parts and at the large tracts of drudgery in the excellent, uncomplaining clarinets.

The flute has no power in its lower octave and blends with other instruments in none, except, paradoxically, with extremely high Bach-like trumpet notes (if the experiment were ever tried). But in its top octave (from A to A) it is a very adequate and euphonious treble to the wind-band, and gains greatly by doubling. Haydn hardly ever writes his orchestral flutes high enough and often seems to expect low notes to be heard under conditions that would not have satisfied Bach. It is possible that his long period of experiment at Esterhazy did him less good than he or historians have thought. His Esterhazy symphonies show that he had a primitive orchestra diversified by astonishing solo players. He was able at Esterhazy to produce horn-passages that would astonish Bach. But in the world outside he found that orchestras, though better in the rank and file, were seldom troubled by virtuoso members. In his Iast symphony the theme of the finale is a typical and easy horn tune, but he dare not give it to the first horn of Salomon's London orchestra except under cover of a tutti! All his mature scoring is full of strokes of genius but deeply marked with signs of disillusion.

Beethoven's Instrumentation.— Beethoven enlarged the range of orchestral thought more than any composer between Gluck and Wagner. The circumstance of his deafness made him the victim of some miscalculations; and pedantic views of orchestration lead many critics to exaggerate these into grounds for a worse perkiness than Rimsky-Korsakov's damaging patronage of

Beethoven's scoring. Two things must be learnt by everybody who wishes to understand Beethoven; first, that errors of calculation are not the same thing as errors of imagination; secondly, that a symphony is not an opera. Beethoven's errors of calculation are no greater than those of any composer who has not been able to hear a rehearsal of his own orchestral work. Their correction, as shown by Weingartner *(Ratschlage),* is rquivalent to any pianoforte player's control of his own touch, and would amount to little more than a conductor's ordinary exercise of his skill were they twice as extensive.

Errors of imagination do not exist in Beethoven's art; and only a school of criticism by rule of thumb would suppose that they did. Compared with Mozart's, Beethoven's scoring is rough, redundant and capricious. But Beethoven's ideas are not Mozart's and can be expressed neither in Mozart's nor in Wagner's scoring. When critics tell us that bars 5–8 of the first movement of Beethoven's 8th Symphony are badly scored, all they mean is that to let two oboes and a flute crowd in upon a quiet phrase in the clarinet is not a proper way to score the first fateful appearance of a Wagnerian *leit-motif,* which may not be heard again for an hour. But it is an admirably dramatic and symphonic way to score a formal phrase which is going to be shouted at the top of the full orchestra immediately afterwards. The conductor need only say four words to the oboes, "Let the clarinet through," and the passage becomes perfectly clear. But it is already intelligible without any such precaution, and only bad playing can spoil it.

The symphonic orchestra which suffices for Beethoven, and for Brahms two generations later, consists of strings, pairs of flutes, oboes, clarinets, and bassoons, one or two pairs of horns, a pair of trumpets and kettledrums. Trombones, reserved for climaxes, are used in spacious 3-part harmony, and Beethoven requires them in three sizes, alto, tenor and bass. For lack of the alto trombone many of Beethoven's top notes must nowadays be lowered; and then our smart young orchestrators blame Beethoven for his ill-balanced chords. The full wind tone is extended upwards by the dangerously shrill piccolo, and downwards by the contrafagotto which gives the bass a richness without asserting itself. The big drum, cymbals and triangle are called "Turkish music" and, when used at all by Beethoven, are used according to Viennese ideas of Turkishness. Beethoven's intentions, whatever we may think of their execution, cover the whole field of symphonic art; and it is to dramatic orchestration that we must look for any addition to his range of thought.

Dramatic Orchestration. — The change from continuo-orchestration to the symphonic style was, as we have seen, essentially a change towards drama. Hence the dramatic and symphonic styles do not become separated at once; and with Mozart, who was equally happy in both, they are not easy to distinguish. The distinction is. even in Mozart, a paradox to people who think that opera is the most dramatic form of music. Sonatas and symphonies, even by Mozart, turn out to be far too dramatic for the stage. The fight at the beginning of *Don Giovanni* is perfectly adequately represented in musical sequences which would be too cold for any but his earliest symphonies. Theatre music will no more stand a symphonic environment than stage scenery will stand daylight.

And yet there is no limit to the refinement of dramatic orchestration whether in Mozart or Wagner. The gradations that a symphonic composer uses in 20 bars must be spread over a hundred in any continuous part of an opera, even on Mozart's scale. Here we already have a reason why opera should encourage very delicate gradations. Wagner's scale is given by the three minutes of the chord of E flat at the beginning of *Das Rheingold;* but still more significant is his management of a tensely emotional quarter of an hour with no more orchestra than strings and two horns, without double-basses, in the first act of *Die Walküre.* His enlargements of the orchestra all have an ultimate effect of purifying the timbre and so removing complications from the method of scoring. There was nothing new in large orchestras: both Mozart and Beethoven had rejoiced in performances with double wind; and in Wagner's early Dresden days Spontini requisitioned "douze belles contrebasses" for the performance of his operas. The experienced Wagner of Bayreuth is contented with eight.

A great stimulus was given to all orchestration by the invention of ventil trumpets and ventil horns. When these instruments thereby acquired a complete scale the aesthetics of all brass instruments needed reconsideration. Unimaginative composers of course saw no difficulty. A trumpet penetrates everything else like a red-hot poker, so why not give it the melody in every tutti? Wagner thought otherwise; he felt that brass tone was coarse unless it was used in large harmonic masses, and he accordingly invented new brass instruments to make the masses complete and coherent. Meanwhile he took his wind instruments in threes instead of twos. Already in the comparatively simple scores of *Der Fliegende Hollander* and *Lohengrin* this greatly clarified the colour-scheme. Half the art of scoring for wind instruments in the classical symphonies consists in making the best of the fact that instruments of contrasted tones will not make homogeneous triads when taken in couples. In *Tristan und Isolde* the threefold arrangement (two oboes and cor anglais; two clarinets and bass clarinet) adds its advantages to the maturest Wagnerian harmony, with a polyphony as profound as that of Beethoven's last quartets. In the tetralogy of *Der Ring des Nibelungen* Wagner takes his wind groups in fours, and introduces his new brass instruments. They originated in the bass-tuba which had come to replace the grotesque ophicleide and the still more primitive serpent as a bass to the trombones. These makeshifts had served Mendelssohn's purpose and failed to serve Berlioz's. The tuba could put an imposing bass below the trombones. Its tone is fat and puffy whereas that of the trombone is red-hot. A sensitive ear may notice, and a wise ear may refuse to notice, that the tuba is putting a black line below the red. But Wagner saw the possibility of a new aesthetic value here; and so in his tetralogy five tubas ranging from contrabass to high tenor show as clear a contrast from trombones as oboes from clarinets (Rimsky-Korsakov utterly fails to grasp this point).

The composers, having learnt new powers from such enlargements, can henceforth use these powers without extra apparatus. The orchestration of *Die Meistersinger* is the most complex in all Wagner, just because it is written for Beethoven's orchestra plus one tuba and a harp, and, of course, the now ubiquitous ventil horns, the most perfect of all continuo-players. In *Parsifal* the extra tubas are abandoned but the remaining contrabass-tuba has permanently won its independence of the trombones.

It seems paradoxical to leave Berlioz out of account in a history of instrumentation. Yet, short of a detailed appreciation of his individual strokes of genius, all that can be said of him is that he drew attention to the subject in an epoch-making but capricious treatise, and that he achieved all that was possible to a highly imaginative musician who happened to hate polyphony. And that is more than some critics might expect. But it cannot have much direct influence on more ordinary musicians.

Post-Wagnerian Instrumentation. — A great many loudly proclaimed "new" tendencies in orchestration are nothing but the discovery of some single elementary principle. It would be quite easy to write a history of post-Wagnerian scoring in which single characteristics from each of the historic schools here described were assigned haphazard, one to each living composer; and quite impossible to argue against its results. The silliest a *priori* theories seem incontrovertible if we forget how music is actually made. If, for example, we believe that music is made for instruments instead of instruments being built to make the best music they can, we may come to believe in the theory ascribed to Stravinsky, that each instrument should produce no passages that are not peculiar to its own timbre and inappropriate to any other. This is as if no gentleman should ever say anything that could be said by a lady; and vice versa.

When we have dismissed all such precious nonsense, several real phenomena remain. New harmonic ideas, such as multiplanar harmony, depend inextricably on instrumentation as surely as did the classical grammar of counterpoint. Less important is what Richard Strauss has called *al fresco* orchestration. This means a perception that there is not only safety in numbers, but a high aesthetic value in the average result of sixteen wild-cat attacks at

a passage that no individual can play properly. It is doubtful whether that is the real reason of the spiendour of such passages. For one thing, the splendour is enhanced by rehearsal, and in the best orchestras the players eventually learn such passages fairly accurately.

Mahler made a systematic study of the possibilities of very large orchestras; almost a quarter of the size of that of our Crystal Palace Handel festivals, but with music specially written for them. His 8th Symphony is a choral symphony requiring at least 750 performers, and going much more satisfactorily with 1,000. Berlioz never really contemplated anything larger. Such propositions are not decadent; they are severely disciplinary and require an imagination of the highest efficiency. On a large scale most orchestral colours fade; especially horns, which must be greatly multiplied if they are to tell.

More fascinating to most artists, and more practical in the present lean years, are the aesthetics of small groups and chamber-orchestras. But this is a subject which cannot be pursued here. It is as much as a young composer's prospects are worth to come before modern critics without a new aesthetic system of his own invention. But a general article cannot deal with such private affairs. (D. F. T.)

INSTRUMENT OF GOVERNMENT, the name given to the decree, or written constitution, under which Oliver Cromwell as "lord protector of the commonwealth" governed England, Scotland, and Ireland from Dec. 1653 to May 1657.

The Long Parliament was expelled in April 1653 and the council of state dissolved; the Little, or Nominated, parliament which followed ended its existence by abdication; and Cromwell, officially lord general of the army, with a new council of state, remained the only recognized authority in the country. It was in these circumstances that the Instrument of Government, drawn up by some officers in the army, prominent among whom was John Lambert, was brought forward, and after certain emendations accepted by Cromwell on Dec. 16. Consisting of 42 articles, the Instrument placed the legislative power in the hands of "one person, and the people assembled in parliament"; the executive power was left to the lord protector, whose office was to be elective and not hereditary, and a council of state numbering from 13 to 21 members. The councillors were appointed for life; 15 were named in the Instrument itself, and Cromwell and the council were empowered to add six. To fill vacancies parliament must name six persons, of whom the council would select two, the choice between these two being left to the protector. A parliament was to meet on Sept. 3, 1654, and until that date the protector with the consent of the council could make ordinances which would have the force of laws. After the meeting of parliament, however, he had no power of legislation, nor had he any veto upon its acts, the utmost he could do being to delay new legislation for 20 days. A new parliament must be called "once in every third year," elaborate arrangements being made to prevent any failure in this respect, and for five months it could not be dissolved save with its own consent. The parliament, composed of a single chamber, was to consist of 460 members—400 for England and Wales, and 30 each for Scotland and Ireland—and the representative system was entirely remodelled, growing towns sending members for the first time, and many small boroughs being disfranchised. A large majority of the English members, 26j out of 400, were to be elected by the counties, where voters must possess land or personal property of the value of £200, while in the boroughs the franchise remained unaltered. In Scotland and Ireland the arrangement of the representation was left to the protector and the council. Roman Catholics and all concerned in the Irish rebellion were permanently disfranchised and declared incapable of sitting in parliament, and those who had taken part in the war against the parliament were condemned to a similar disability during the first four parliaments. The protector was empowered to raise a revenue of £200,000 in addition to a sum sufficient to maintain the navy and an army of 30,000 men, and religious liberty was granted "provided this liberty be not extended to Popery or Prelacy." The chief officers of state were to be chosen with the consent of parliament, and a parliament must be summoned at once in case of war. The practical effect of the Instrument was to entrust the government of the three countries to the parliament for five months out of every three years, and to the protector and the council for the remainder of the time. Although the Instrument bristled with possibilities of difference between parliament and protector, "it is impossible," as Gardiner says, "not to be struck with the ability of its framers."

Cromwell governed according to the Instrument until the meeting of parliament on Sept. 3, when he endeavoured to obtain parliamentary sanction for the Instrument. Prolonged disputes followed and he dissolved the parliament on Jan. 22, 1655, without obtaining his object. Regarding the Instrument as still in force, the protector sought for a time to rule in accordance with its provisions; but new difficulties and growing discontent forced him to govern in a more arbitrary fashion. A second parliament met in Sept. 16 j6, and in the following May Cromwell assented to the Humble Petition and Advice, which supplanted the Instrument of Government.

The text of the Instrument is printed in S. R. Gardiner's *Constitutional Documents of the Puritan Revolution. See* also *S. R.* Gardiner, *History of the Commonwealth and Protectorate,* vols. ii. and iii. (1897–1901); and T. Carlyle. *Cromwell's Letters and Speeches,* ed. S. C. Lomas (1904)

INSTRUMENTS, ELECTRICAL MEASURING. Although the electrical power and communication industries are the largest users of electrical measuring instruments, most branches of science and technology depend on electrical measurements for information and for the control of processes and machines. Indeed. it would be difficult to find a research laboratory or a modern factory in which electrical measuring instruments do not, in one way or another, play a vital role.

The varied uses of electrical instruments make it desirable first to consider broadly the principles on which they operate, before undertaking a detailed examination of representative types. This article, therefore, is divided into the following sections:

I. Electrical Units
II. Absolute Measurements
  1. Lorenz Apparatus
  2. Current Balance
III. Primary Electrical Standards
  1. Standard Ohm
  2. Standard Cell
IV. Indicating Instruments
  A. Current and Voltage Measurements
    1. Potentiometer
    2. Galvanometer
    3. Permanent Magnet Moving-Coil Instruments
      (a) Rectifier Instruments
      (b) Thermocouple Instruments
      (c) Electronic Voltmeters
    4. Iron-Vane Instruments
    5. Electrodynamic Instruments
    6. Electrostatic Voltmeters
    7. Instrument Transformers
  B. Power Measurements
    1. Electrodynamic Wattmeter
    2. Electrostatic Wattmeter
    3. Bolometer
  C. Energy Measurements
    1. Commutator Watt-Hour Meter
    2. Induction Watt-Hour Meter
  D. Resistance Measurements
    1. Ohmmeter
    2. Wheatstone Bridge
  E. Capacitance and Inductance Measurements
V. Recording Instruments
VI. Bibliography

In most instruments with which electrical current, voltage or power are measured some property of the electrical quantity to be measured is used to evoke a mechanical force: and it is this mechanical force which gives a measure of the electrical quantity. The reaction between a magnetic field and a current-carrying conductor, the attraction or repulsion of electrically charged bodies, are effects that are commonly used to produce such a force. More elaborate means are frequently employed—the heating effect of electrical current in a conductor may be used to raise the

temperature of a thermocouple junction, generating an electromagnetic force (e.m.f.) and producing a current in an auxiliary measuring circuit.

Photoelectric and photovoltaic cells are also employed as the sensing elements of -electrical measuring instruments. In the measurement of such electrical quantities as resistance, inductance and capacitance, an instrument which utilizes a mechanical force is commonly employed to detect or measure the current or voltage produced in some element of a bridge, potentiometer or other network in which the unknown quantity is being measured by comparison with other similar quantities of known magnitudes. Thus at the heart of most electrical measuring instruments is an element which converts an electrical into a mechanical effect for detection or measurement.

I. ELECTRICAL UNITS

In any measurement, the value describing the quantity must necessarily be assigned in terms of some unit. The units in which electrical quantities are measured have been defined in such a way that they are simply related to the internationally accepted units of length, mass and time (metre, kilogram and second) which form the basis of mechanical measurements. Karl Friedrich Gauss showed in 1833 that magnetic quantities could be measured in terms of mechanical units, and he proposed units (which he called absolute, abbr. abs.) that were based on mechanical units of length, mass and time.

This concept was amplified by Wilhelm Weber, who showed in 1851 that a complete system of electrical units could be defined in terms of mechanical units. The work of Gauss and Weber formed the basis of a decision by the British Association for the Advancement of Science to define and establish a system of electrical units based on the metric system of mechanical units. Experimental determinations, sponsored by the association, led to the issuance in 1864 of the British association ohm, which was intended to embody the unit of resistance so defined. This unit was found later (1878) to differ by more than 1% from its intended absolute value, but the principles on which the British association units were based gained international acceptance at the Paris Electrical congress of 1881. This congress also described "reproducible" standards which should embody as closely as possible, the "absolute units of resistance and of current. The ohm was to be represented by the resistance at 0° C. of a column of mercury 106.3 cm. in length, having a uniform cross section (very nearly 1 sq.mm.) and a total mass of 14.4521 g. The ampere was to be represented by the unvarying current that would deposit 0.001118 g. of silver per second from a silver nitrate solution. Public bill 105, passed by the United States congress on July 12. 1894, made these units, embodied in the reproducible standards and defined in terms of the metric units, the legal units of electrical measure in the United States.

It was recognized that the units embodied in the reproducible standards did not correspond exactly to the absolute units defined in terms of the mechanical units and, to avoid confusion. the former were designated as "international" units. In 1910 representatives of the national laboratories of France, Germany, Great Britain and the United States carried out measurements at the national bureau of standards in Washington, D.C., and assigned values to standard resistors and standard cells from each of the collaborating countries, in terms of international units. From that time until 1948, the 1910 determinations and the international units served throughout the world as the basis for electrical measurements.

A series of determinations of the units of resistance and of current directly in terms of mechanical units, performed in the national laboratories of several countries, culminated in 1948 in the adoption of a new set of absolute units which differed by a few hundredths of a per cent from the previously accepted international units. At the same time the International Committee on Weights and Measures recommended that the metre be used as the unit of length and the kilogram as the unit of mass in defining the electrical units. Thus all electrical measurements derive ultimately from the prototype metre and kilogram preserved at the International Bureau of Weights and Measures in Sevres, Fr., and from the second defined in terms of the motion of the earth.

While the differences are small between the international units used in measurements before Jan. 1, 1948, and the absolute units employed since that date, these differences are by no means negligible in accurate measurements. The differences in these units are given in the accompanying table.

Conversion Table for Electrical Quantities
International Units to Absolute Units

Resistance	1 int. ohm	= 1.000495 abs. ohms
Electromotive force	1 int. volt	= 1.000330 abs. volts
Current	1 int. ampere	= 0.999835 abs. ampere
Charge	1 int. coulomb	= 0.999835 abs. coulomb
Inductance	1 int. henry	= 1.000495 abs. henrys
Capacitance	1 int. farad	= 0.999505 abs. farad
Power	1 int. watt	= 1.000165 abs. watts
Energy	1 int. joule	= 1.000165 abs. joules.

II. ABSOLUTE MEASUREMENTS

The basic measurements which must be performed to establish the electrical units in terms of mechanical units require the utmost care in the design and construction of the required instruments and a very high degree of skill in their operation in order to assign sufficiently accurate values to the primary electrical standards. These considerations have effectively limited absolute electrical measurements to the national laboratories which, in the various countries, are legally charged with the duty of establishing and maintaining standards.

The national bureau of standards (Washington, D.C.), the National Physical laboratory (Teddington, Eng.), the Physikalisch-Technische Reichsanstalt (Berlin) and more recently the P-T Bundesanstalt (Braunschweig), have all carried out such determinations, as have the national laboratories of Japan, the U.S.S.R., Canada and Australia. Their results have been intercompared by means of the standards maintained at the international bureau in Sevres; and there is no doubt that the electrical units are closely the same throughout the world.

The absolute determination of two of the electrical units permits the assignment of values to all the others through simple relations, such as Ohm's law. Hence, all of the important absolute measurements have been either ohm or ampere determinations. There are various ways in which the ohm and ampere can be determined in terms of length, mass and time; a single example of each will serve to illustrate the principles involved.

1. Lorenz Apparatus. — This device, sometimes used in the ohm determination, is one of the simplest to describe. It consists of a metal disk which rotates in the magnetic field of a coaxial cylindrical coil that carries a current **I.** If M is the mutual inductance between the coil and disk (the magnetic flux through the disk for unit current in the coil) and n is the number of revolutions per second of the disk, any radius of the disk cuts across the whole flux MI each revolution or MnI lines of force per second. This, by definition, is the e.m.f. $E = MnI$ developed between the centre and edge of the disk. If the current in the coil also passes through a resistance R it develops a potential difference $V = RI$ between the terminals of the resistor. The e.m.f. E is compared to the potential difference V by opposing them to each other with a galvanometer as the detector of their difference. When the speed of the disk is varied, a speed can be found at which $E = V$ or $MnI = RI$, so that $R = Mn$. The mutual inductance M is a constant of the apparatus and can be computed from the dimensions and number of turns in the coil and the diameter of the disk. It will be observed that resistance has been determined as the product of a calculable mutual inductance and a frequency (revolutions per second).

Other ohm determinations have employed different forms of calculable mutual inductors or calculable self inductors, but in each instance resistance is determined as the product of an inductance that can be calculated from measured coil dimensions (length) and a frequency (time). It should be noted that the combination of a calculable capacitance and a frequency may equally serve to determine resistance as a function of length and

time.

2. Current Balance.—The current balance. used in absolute ampere determinations, is an instrument in which the force between current-carrying conductors is measured. In one form the balance has a coil of wire suspended from one arm of an accurate equal-arm beam balance. This coil carries the current **I** to be measured. It is free to move in the field of a coaxial fixed coil which carries the same current.

The force between the fixed and movable coils is $F = I^2 \partial M/\partial X$, where $\partial M/\partial X$ is the rate of change of their mutual inductance with displacement along the line of motion. The weight of the movable coil (in the absence of current) is counterweighted at the opposite end of the balance beam, and the force. upward or downward between the coils when carrying current. is balanced by an added mass m on the appropriate balance arm. This force is mg, where g is the acceleration of gravity at the place where the experiment is performed. The two forces being equal, we may write

$$I\partial M/\partial X = mg \text{ or } I^2 = \frac{mg}{\partial M/\partial X}.$$

The coils are so constructed that the value of $\partial M/\partial X$ can be computed from measurements on the coils. It should be noted that the current is measured in terms of mass, length and time.

Because the measured current exists only at the time of measurement, the experiment is used in practice to assign a value of e.m.f. to a standard cell by opposing this e.m.f. by an equal potential difference IR, developed by passing the measured current **I** through a resistance R of known value.

Thus, both an absolute ohm and an absolute ampere determination are required to assign an e.m.f. value to the cell; but the combined determinations yield two physical standards (a standard resistor and a standard cell) in terms of which the electrical units are always available in the intervals between absolute determinations.

III. PRIMARY ELECTRICAL STANDARDS

Although the values of the electrical units are initially assigned through absolute ohm and ampere determinations, they are preserved and made continuously available in the various national laboratories in terms of groups of 1-ohm resistance standards and of standard cells of known e.m.f. These groups of resistors and cells are designed to be as stable as possible and are compared at intervals with each other and with similar standards from other national laboratories to insure that their values remain constant.

1. Standard **Ohm.**—Manganin is the resistance alloy used in all standard resistors and in most precision resistors of high quality. It consists of about 84% copper, 12% manganese and 4% nickel; it is characterized by its low temperature coefficient of resistance and its low thermal e.m.f. against copper. Its resistivity is about 25 times that of copper.

The Thomas standard, designed by James Thomas in 1930, has become generally recognized as the most stable of 1-ohm standards. In its construction, bare manganin wire is wound on a mandrel and annealed at 550° C. in an inert atmosphere. It is then slipped on a silk-insulated metal coil form, fixed in place without introducing mechanical strains, and hermetically sealed in a dry double-walled container. After the wire has attained equilibrium with the small amount of air sealed in with it between the double walls of the container, no further change of resistance occurs. A group of 1-ohm Thomas-type standards is used to maintain the value of the ohm at the U.S. national bureau of standards. No member of this group has changed by as much as 1 part in 1,000,000 over a 10-year interval.

2. Standard Cell.—Early attempts to establish a stable reference standard of voltage were not entirely successful. The Daniel1 cell (1836) had electrodes of copper and zinc with zinc sulfate as electrolyte, and produced an e.m.f. of 1.08 v. However, such cells lasted only a few weeks and were reproducible only to about 1% accuracy.

The Clark cell (1872) used electrodes of mercury and zinc amalgam in a saturated solution of zinc sulfate to produce an e.m.f. of about 1.43 v. These cells were also rather short lived and had a relatively large temperature coefficient of e.m.f. The Weston cell (1892), with electrodes of mercury and cadmium amalgam in a saturated solution of cadmium sulfate, has an e.m.f. of about 1.0186 v. at 20° C. and represents a great improvement over the earlier standards. When properly made from suitably purified materials, Weston cells can be constructed to have the same e.m.f. within a few microvolts, and may be expected to maintain a constant value over many years.

Some of the cells which were constructed in 1906 as part of the primary standard of e.m.f. for the United States are still in use at the national bureau of standards after more than half a century. The e.m.f. of the cadmium normal cell at any temperature t° C. is given by the formula

$$E_t = E_{20} - 0.0000406(t - 20) - 0.00000095(t - 20)^2 + 0.00000001(t - 20)^3.$$

When kept in a controlled temperature environment and properly used, the cadmium normal cell is the most accurate standard of voltage known. The average e.m.f. of a group of such cells in a constant-temperature bath is used at each of the national laboratories as the standard of e.m.f.

A second form of cadmium cell having the same electrodes but with an unsaturated solution of cadmium sulfate as electrolyte (becoming saturated at 4° C.) is much used as a standard of e.m.f. for general laboratory and measurement work. It has a useful life of only about ten years, but its temperature coefficient of e.m.f. is much smaller than that of the saturated cell (about $\frac{1}{8}$ as large) and it will tolerate much rougher usage.

IV. INDICATING INSTRUMENTS

In a quite general way, instruments which indicate the value of current or voltage in an electrical circuit have certain features in common. The quantity to be measured is caused to produce a mechanical force on a pivoted or suspended member: tending to rotate it. The rotation is opposed by a mechanical spring, and the equilibrium position of the movable element, where the torque resulting from the action of the electrical quantity is just balanced by the counter torque of the displaced spring, depends on the magnitude of the electrical quantity. This equilibrium position is indicated by a pointer attached to the moving element, and its reading on an appropriate fixed scale is a measure of the electrical quantity.

Such a mechanical system, rotating about a fixed axis under the action of opposing forces, will tend to oscillate about its equilibrium position unless damping means are provided to absorb the energy of motion and bring the system to rest. Two types of damping are regularly used. Magnetic damping utilizes conductors which form a closed electrical circuit and move in the field of a permanent magnet. The motion of the conductor in the field induces an e.m.f., and the resulting current dissipates energy as heat in the resistance of the circuit. The circuit may be the local eddy-current circuit of a metal vane or sheet attached to the moving element, or it may include the coil which forms the moving element (as in a galvanometer) together with the external circuit to which it is connected. Fluid damping makes use of the viscous flow of air (sometimes oil or another liquid) across a moving element to absorb the energy of motion. In practice a vane, attached to the rotating element of the instrument, moves with small clearance in a closed chamber. The air which it compresses ahead of it as it moves flows back over its edge and provides the desired energy absorption. In either fluid or magnetic damping, energy of motion is absorbed by the damping mechanism and dissipated as heat in bringing the moving system to rest. In the design of an instrument, damping is usually adjusted to he somewhat less than critical, *i.e.*, the moving system overshoots its equilibrium position slightly and quickly settles back to its proper indication.

Instruments whose indicating element turns in bearings have additional frictional forces which oppose motion. Because the deflecting torque is always small, it is essential that bearing friction also be minimized. and such bearings usually consist of hardened steel pivots turning in sapphire cup jewels with the bearing contact area held to the smallest value which will support the weight of the moving system. Where friction must be further reduced,

diamond pivots in sapphire bearings have been used to advantage. Bearing friction can be avoided altogether by suspending the indicating system from thin metal ribbons or "torsion bands" which also act as the instrument springs. This is done where the deflecting torque is extremely small (in galvanometers) or where the instrument has to endure heavy shock or vibration in use.

A. Current and Voltage Measurements

Instruments used to measure current or voltage have many features in common. In fact. any instrument whose basic response is to current can be adapted to the measurement of voltage and an instrument which responds to potential differences can be adapted to the measurement of current. This follows from Ohm's law. that the voltage E appearing across a resistance *R* which carries a current *I* is the product of the current by the resistance $E = IR$. Thus, if a known resistance be connected in series with a current-sensitive device, the response of the instrument is a measure of

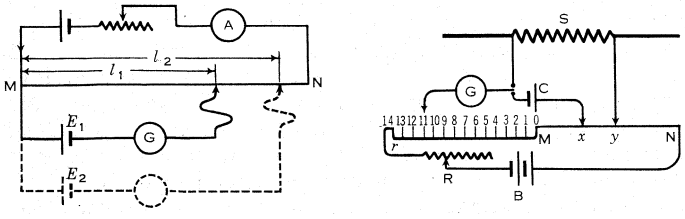


FIG. 1.— POTENTIOMETER
(A) Slide-wire type: (B) Compton type

the voltage across the combination.

Similarly, if a voltage-sensitive device be placed across a known resistance carrying a current. the instrument response is a measure of the current in the resistor.

1. Potentiometer. — The potentiometer is the most precise instrument available for measuring direct current or voltage. It consists of a circuit in which voltages are compared with the known e.m.f. of a standard cell. An elementary potentiometer could be a long uniform slide-wire *MN* (see fig. 1 A), which carries a fixed current **I.** If R is the resistance of the wire per unit length, the voltage difference between two points on the wire separated by a distance *l* is $E = RIl$. Then if a cell of known e.m.f. E_1 in a series with a galvanometer G to detect the presence of any potential difference, is connected to two contacts on the slide-wire and one of them is moved until the galvanometer indicates that the voltages are equal, $E_1 = RIl_1$, where l_1 is the distance between the contacts at balance.

On substituting another cell of e.m.f. E_2 and moving the contact until a voltage balance is again obtained at a separation l_2, then $E_2 = RIl_2$. If the wire is uniform and the current, measured at the ammeter A, remains constant between the two balances,

$$\frac{E_2}{E_1} = \frac{l_2}{l_1} \text{ or } E_2 = E_1 \frac{l_2}{l_1}.$$

The unknown e.m.f. E_2 is thus determined from the known e.m.f. E_1 and the ratio of slide-wire lengths required to balance E_1 and E_2 against the potential drop along the wire.

The potentiometer can be made direct reading and at the same time more convenient to operate by the following modification, known as the Compton potentiometer (see fig. 1 B). Suppose the slide-wire is 1 m. long, its resistance 10 ohms and it carries a current of 0.01 amp. The total voltage drop along it will be 0.1 v. or 0.0001 v. per millimeter. Then any number of fixed resistors of 10 ohms each can be connected in series to one end of the slide-wire and, for the same current, will each have a voltage drop of 0.1 v.

The diagram of fig. 1 B shows a potentiometer with such a slide-wire MN, a standard resistance S and a dial of 14 fixed coils, whose current is supplied from a battery B and adjusted to proper value with rheostat R by using a reference cell C. If C were a cadmium cell having an e.m.f. of 1.0187 v., the left-hand contact (on the dial) could be set on the eleventh contact of the dial (1.0 v.) and the right-hand contact at 187 mm. from the left-hand end of the slide-wire (0.0187 v.). The total voltage drop will exactly balance the e.m.f. of the reference cell (1.0187 v.) when the current is brought to its proper value by adjusting the rheostat R, and the potentiometer is ready for use. Any other source of voltage up to 1.5000 v. can now be substituted for C and balanced by varying the positions of the dial and slide-wire contacts. At balance the voltage may be read directly from the dial and slide-wire contact positions.

Higher voltages, up to 1,000 v. or more, can be measured by using a volt box, which consists of a group of series resistors of known ratio such that, when the high voltage is placed across the group, a low voltage (within the range of the potentiometer) appears across a section and is measured. The total voltage is then the potentiometer reading multiplied by the volt-box ratio. For example, a volt box could be made up with 10,000 ohms resistance and tapped at a point 100 ohms from one end. This voltage divider would have a ratio of 100:1 and could be used to measure voltages up to 150 v. on the potentiometer described above. If a current is to be measured. it is passed through a resistance (1 ohm, 0.1 ohm, 0.01 ohm, etc., depending on the magnitude of the current) and the voltage drop across the resistor is measured with the potentiometer. For example, a current of 100 amp. through a 0.01 ohm shunt would develop a voltage drop of 1 v., and this could be measured on the potentiometer.

The potentiometer is not only the most precise of all D.C. instruments, but is also the basic tool in a measurement program. It measures voltage and current in terms of standard cells and standard resistors that need not be more than a single step removed from the primary electrical standards. Simultaneous measurements of current and voltage can be used to measure power, since power is the product of current and voltage in a circuit. Thus, the potentiometer is the instrument with which D.C. ammeters, voltmeters and wattmeters are calibrated.

2. Galvanometer. — The galvanometer, for indicating extremely small currents. is usually a suspension instrument. In its common form, the d'Arsonval galvanometer, the deflecting system consists of a light coil of wire suspended between the pole pieces of a permanent magnet by means of a copper or gold ribbon a few thousandths of an inch wide and less than a thousandth thick. A small mirror, mounted on the coil, serves as an optical pointer and indicates the coil position by reflecting a light beam onto a fixed scale.

Current is conducted to and from the coil by the suspension ribbons, and the reaction of the current in the coil with the radial magnetic field in which it is suspended produces a torque that tends to rotate the system. The action can be likened to that of a tiny motor winding up a spring.

Modem galvanometers may have a sensitivity of as much as 1 mm. of deflection (on a scale 1 m. distant from the mirror) for a current of 0.00001 μamp. (10^{-11} amp.), with a coil resistance of 800 ohms. Current sensitivity is increased by using more turns of finer wire in the moving coil and by reducing the cross section and stiffness of the suspension ribbon.

Galvanometers may also be used for the detection or measurement of very small voltages in closed electrical circuits. In this instance it is advantageous to use a few turns of relatively coarse wire in the moving coil. A galvanometer having a resistance of 12 ohms and a response of 1 mm. for 0.1 μv. (10^{-7} v.) in a 2;-ohm circuit is an example of a modern voltage-sensitive instrument. In general, current-sensitive instruments are characterized by relatively high resistance, while voltage-sensitive instruments have low resistance.

In addition to appropriate current or voltage sensitivity, it is important in selecting and using a galvanometer that consideration be given to the resistance of the circuit in which it is to be used. This should be equal to or slightly greater than the critical damping resistance of the instrument in order that the moving system slightly overshoot its equilibrium position and come to rest in the minimum possible time. If the circuit resistance is too low. the galvanometer will be overdamped and its motion will be sluggish; if too high, the galvanometer will be underdamped and the moving system will oscillate about its equilibrium position with gradually decreasing amplitude.

In addition to its use for the detection and measurement of minute currents or voltages of constant value, the galvanometer may be used ballistically to integrate a transient current or voltage pulse of short duration. The electric charge in a capacitor can be measured by allowing it to discharge through a galvanometer and observing the magnitude of the moving system's first excursion from its rest position. The response of the instrument to a current of short duration defines the coulomb sensitivity. The deflection is proportional to the time integral of current, or to electric charge.

Similarly, a voltage pulse arising from changes in a magnetic field linking a coil of wire is a measure of the total change in coupling between the field and coil, the time integral of voltage during the change. This type of response is defined by the e.m.f.-time (or flux-linkage) sensitivity of the galvanometer.

Thus. a galvanometer has four different sensitivities which describe its performance in various applications. It is of interest to note that only one of them, current sensitivity, is completely defined solely by the galvanometer design constants — the strength of the magnetic field in which the coil moves, the area turns of the coil and the stiffness of its suspension. Voltage, coulomb and e.m.f.-time sensitivities are all functions of resistance of the circuit to which the galvanometer is connected. Both steady-state and transient voltage response increase with decreasing circuit resistance, while response to a transient current increases with increasing circuit resistance.

As stated above, the galvanometer and numerous other types of indicating instruments make use of the reaction between a magnetic field and a current-carrying conductor to achieve a measure of the current in the conductor, or of some related quantity. However, it is not essential that the current be carried by an indicating element suspended in the field of a fixed magnet system as is done in the d'Arsonval galvanometer.

Similar response can be accomplished, and with equal sensitivity, by making a magnet the moving element, and conducting the current through fixed coils. In galvanometer applications the chief advantage of this alternative construction is that the suspensions of the moving system, which do not now have to carry current, can be made of extremely fine quartz fibres, with much reduced stiffness. As the response of the indicating system depends on balance between the driving torque (resulting from the interaction of the magnetic fields of magnet and current) and restoring torque (resulting from suspension stiffness), the lower driving torque available in this arrangement is compensated by reduced suspension stiffness.

The principal disadvantage of the moving magnet, fixed-coil galvanometer is that its response is affected by the ambient magnetic field to a much greater extent than is the fixed magnet, moving-coil arrangement. For reasonable performance a moving magnet galvanometer must be elaborately shielded from external magnetic fields by a series of nested enclosures of high-permeability material, and for best results the construction must also be astatic, *i.e.,* the moving magnet and coil system must be arranged in matched pairs in such a manner that the torques resulting from a uniform external field will be in opposite directions and neutralize one another, while the torques are additive that result from the reaction between the suspended magnets and the current in the coil pairs. Despite the high sensitivity that can be achieved with this arrangement, it is little used in modern practice because of the difficulty of achieving adequate shielding from external magnetic fields.

3. Permanent Magnet Moving-Coil Instruments. — This basic class of instruments is used for indicating direct currents and voltages. The indicating system is similar to that of the d'Arsonval galvanometer. A coil with an attached pointer rotates in the field of a permanent magnet. In order that the angular response of the moving system be uniform, the magnet structure is designed so that its field is radial throughout the length of the air gap in which the coil turns.

Another design requirement is that the magnet maintain an unchanging field in the air gap, so that the calibration of the instrument shall not change in time. This requirement leads to the use of the characteristic horseshoe shape for instrument magnets of tungsten or chromium steel, whose length must be very great compared to their cross section for optimum energy storage, and to short thick magnets when dispersion-hardening steels such as alnico are used.

The moving-coil system usually turns on pivots in jewel bearings, and the attached pointer moves over a graduated scale from which the value of current or voltage is read. In this construction spiral springs are used to conduct current to the coil and to supply the required counter torque. In some instances the moving system is suspended between taut metal bands which act both as springs and as current leads. This construction avoids the friction of mechanical bearings, and is used in some types of precision instruments.

For low current values (microammeters and milliammeters with ranges up to perhaps 20 milliammeters [ma.]) the current to be measured is carried by the springs and coil of the instrument. Larger currents would produce a significant temperature rise in the springs and alter their stiffness. Consequently, currents larger than 20 ma. are passed through a resistor (or shunt) across which a millivoltmeter is connected in parallel. Thus a voltage-sensitive element, responding to the voltage drop (up to 50–100 mv full scale) across the current-carrying shunt, is used to measure larger currents. Its scale is marked. of course, in terms of current in the shunt. All permanent magnet moving-coil ammeters use such a parallel circuit arrangement. For small currents the shunt may be within the instrument case. For large currents, where a substantial amount of heat must be dissipated by the shunt, it must be external to the instrument.

In measuring voltages it is always desirable that the current drawn by the instrument be small in order to minimize both the power consumed by the instrument and the load it imposes on the voltage source. Hence, for the measurement of direct voltages, a permanent magnet moving-coil system which will attain full-scale deflection with a current in the range from 0.1 to 10 ma. is used together with a series resistor (or multiplier) of such resistance that the rated voltage of the instrument produces full-scale current. The instrument scale is marked to read the voltage impressed on the combination of moving element and multiplier. Here also, for low and moderate ranges where the power dissipation is small. the multiplier is incorporated into the instrument case; for high ranges the multiplier is frequently external and must be connected in series with the instrument.

Permanent magnet moving-coil instruments respond to the average value of their operating current and so, while they are ideally suited to the measurement of undirectional currents and voltages, they cannot be directly used for the measurement of alternating currents, which vary rapidly and continuously between equal values in opposite directions, so that the average value is zero. The torque produced on the moving system of such an instrument would reverse in direction with each reversal of current, with the result that the coil could never move from its zero position, or at most would vibrate about it with small amplitude. However, such indicating systems can be adapted to the measurement of alternating currents by one of several devices.

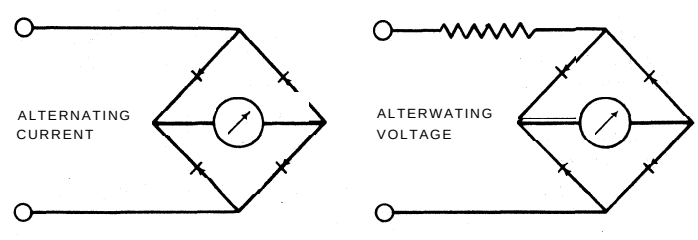


FIG. 2.—RECTIFIER INSTRUMENT CONNECTIONS
(A) Milliammeter; (B) voltmeter

(a) Rectifier Instruments. — Copper oxide and other types of dry rectifiers can be used in combination with permanent magnet moving-coil indicating systems in the construction of voltmeters and low-range milliammeters for measuring alternating voltages

and currents in the power and audio-frequency regions.

A full-wave four-element bridge-type rectifier, connected as shown in fig, 2, is used with the A.C. input impressed across one bridge diagonal and the D.C. milliammeter connected across the other. For voltmeters a resistance of appropriate value is connected in series with the input terminals. The rectifier assembly consists of copper disks, $\frac{3}{16}$ in. or less in diameter, with a surface layer of cuprous oxide, assembled into a stack with appropriate electrodes and sealed in a housing. Small disks are used to keep the current density high in the rectifying surfaces (with low consequent forward resistance). and to keep the capacitance of the bridge low in order to reduce the errors of the instrument at the higher audio frequencies. The milliammeter responds, as mould any D.C. instrument, to the average value of the current in its moving coil.

For engineering applications the root-mean-square (r.m.s.) value of current or voltage is generally desired, and consequently the scales of most rectifier instruments are marked in terms of r.m.s. values for an assumed sine-wave input. This scale convention coupled with the actual response to average rather than r.m.s. vaiues results in errors of indication on nonsinusoidal inputs. Also both the forward and reverse resistances of the rectifier elements have large but different temperature coefficients of resistance, resulting in a substantial temperature coefficient of indication. Because of their frequency, wave form and temperature errors, rectifier instruments must be considered as devices of low or moderate accuracy. However, they are very rugged, have high sensitivity and are quite suitable for audio-frequency applications in which accuracy requirements are moderate. Also. the D.C. mechanism is directly available when the rectifier is disconnected. Consequently, this type of instrument is widely used in compact test sets with which, by suitable switching, both A.C. and D.C. currents and voltages can be measured.

Such instruments, with a large number of A.C. and D.C. current and voltage ranges, are very convenient for use on the test bench, in electronics laboratories and in servicing electronic and electrical equipment.

(b) *Thermocouple* Instruments. — The permanent magnet moving-coil systems for alternating current and voltage measurements are also employed in thermocouple instruments. The current is passed through a heater element (usually a fine wire) in thermal contact with one junction of a thermocouple. The thermocouple, consisting of wires of two different metals or alloys joined together in series, has the property of generating a small e.m.f. where the junction points between the dissimilar metals are at different temperatures. Thus, at the thermocouple junction in contact with the hot wire, an e.m.f. is generated which is proportional to its temperature rise and hence to the square of the current to be measured. The thermocouple circuit is completed by a low range D.C. millivoltmeter and its scale is marked in terms of the r.m.s. value of heater current.

A thermocouple voltmeter uses the same arrangement but with the addition of a resistance in series with the heater element. In this instance the millivoltmeter scale is marked in terms of the r.m.s. input voltage across the resistor-heater combination. Since the instrument responds to the square of the heater current, no wave form error results on nonsinusoidal inputs.

Depending on the size and resistance of the heater element, current indicating instruments are made with full-scale ranges from 1 ma, to 100 amp. At higher current ratings a thin-walled tube rather than a wire is used as the heater element. With proper heater construction and thermocouple arrangement, such instruments can be used to indicate current with negligible error from D.C. to 1 mc. in frequency, and with small errors up to 100 mc. They are much used for radio-frequency current measurements and, with suitable precautions, can also be used as transfer instruments. In this latter application, mhere their response is identical for equal values of direct or alternating current, they can be used to calibrate instruments that respond correctly only to alternating currents, *i.e.*, to transfer an A.C. calibration back to the basic D.C. standards by means of the potentiometer, standard cell and standard resistors.

Thermocouple voltmeters make use of heater elements of low current rating (a few milliamperes) and are useful from D.C. up through the audio-frequency range without serious error. With properly constructed resistance multipliers, having negligible inductive or capacitive residuals, the frequency range can be extended upward to 1 mc. or more. These instruments can also be used for transfer measurements from direct to alternating voltages if proper precautions are observed.

(c) *Electronic* Voltmeters. — Vacuum-tube voltmeters also make use of D.C. indicating elements. In one of its simpler forms, such a voltmeter has an input circuit in which a miniature diode is arranged to charge a capacitor. A low-range D.C. milliammeter or a microammeter is connected with a high series resistance across the capacitor, and the current is a measure of the input voltage. If the discharge time of the resistor-capacitor combination is long compared with the period of the input voltage, the current in the D.C. meter is practically constant, and the response depends on the peak value of the input voltage.

Thus the lower frequency limit of the arrangement is determined by the time constant of the discharge circuit; the upper frequency limit for operation without substantial error is fixed by the distributed parameters of the input circuit and may be 100 mc. or more. It is fairly general practice to mark the scale in terms of r.m.s. values for an assumed sine-wave input and, as the response is to peak values, wave-form errors will appear on a nonsinusoidal input.

It should be noted that in the above arrangement, as is usual for indicating instruments, the power required to accomplish and maintain a deflection is supplied by the source on which a measurement is being made. This is not true of all electronic voltmeters. Starting with the same input circuit, a diode and capacitor, the voltage of the charged capacitor may be impressed on the grid of a triode or a more elaborate vacuum tube which acts as the initial element of a D.C. amplifier.

In such an arrangement the auxiliary power source which is an integral part of the amplifier supplies the power to operate the indicating instrument, and the drain on the measured source is extremely low. This is of great importance if the voltage from a high-impedance source is being measured.

There are many types of electronic voltmeters that use elaborations of the basic circuits above. The performance of the amplifier may be stabilized by a feedback loop of appropriate design. Also, such a circuit may be preceded by an attenuator for multirange operation, or by a preamplifier to extend the range of measurements to lower voltages. A typical commercial electronic voltmeter has an input impedance of 8 megohms at low frequencies, an input capacitance of 10 micromicrofarads, ranges from 0.1 to 150 v. and a frequency influence of no more than 3% up to 50 mc. and 12% at 100 mc.

4. Iron-Vane Instruments. — These are the commonest type of ammeters and voltmeters for laboratory and switchboard use at commercial-power frequencies. Such instruments can be built to measure current or voltage to all the accuracy needed for most engineering work, and still be produced more cheaply than any other type of A.C. instrument of equal accuracy and ruggedness. A vane or plate of high-permeability steel, together with spring, pointer and damping structure, forms the moving element of the instrument. This vane is situated in the field of a stationary electromagnet consisting of a coil of wire and, usually, a second iron vane which is fixed in position. The excitation of the electromagnet derives from the current or voltage to be measured, and the motion of the vane. when the electromagnet is excited, is always such as to increase the flux through it. Thus the torque produced by the reaction between the magnetic fields of the stationary and moving elements is in such a direction as to increase the inductance of the combination.

The energy stored in the magnetic field of a current-carrying inductor is proportional to the second power of the current, and it follows that the torque in the moving element increases with the square of the current in the fixed coil. Hence the response of the instrument is to r.m.s. current or voltage.

It should be noted that in this construction the measured cur-

rent does not go through the moving element, and the sole function of the instrument spring is to provide the required counter torque. Approximately 200 amp.-turns are required to produce a deflection of 90° in the actuating coil of a portable instrument with a 5-in. scale. The coil, about 1 in. high, may be mound with the needed turns of appropriate size wire for any desired range; *i.e.*, 40 turns for a 5-amp. instrument or 200 turns for a full-scale current of 1 amp. For the highest range that is possible in a 200 amp.-turn instrument—200 amp.—a single turn casting is used. For a milliammeter, a coil of 4,000 turns will give a full-scale sensitivity of 50 ma.; such a coil, connected in series with an appropriate resistance, is used in a voltmeter. Throughout the entire group of instruments the iron structure and moving system are identical.

The operating magnetic field of an iron-vane instrument is relatively small, at most 60–75 gausses at full-scale deflection. As a consequence, moderate external fields will have a significant effect on the deflection unless the entire operating system, coil and vanes, is enclosed within a magnetic shield. For example, an error of as much as 10% may result frdm operating an unshielded instrument in a 5-gauss field; but the corresponding error in a properly shielded instrument may be no more than a few tenths of 1%.

While the most common use of iron-vane instruments is at commercial-power frequencies, they are by no means limited to these applications. They can be used effectively at frequencies well above 1 kc. However, the frequency range over which an individual iron-vane instrument may be employed without significant errors of indication is quite limited; both ammeters and voltmeters should be calibrated at a frequency that does not differ by more than 10% from that at which they are to be used.

The change of response of an ammeter with frequency results principally from eddy currents in the iron vanes and other metal parts of the structure within and around the coil. These eddy currents, whose magnitudes are proportional to the square of the frequency, give rise to local magnetic fields that modify the reaction between the iron vane and the field of the coil carrying the measured current. Thus, the torque of the moving system and the indication of the instrument for a given current is a function of frequency. This eddy-current effect is also present in voltmeters, but here there is another important source of frequency error. The inductance of the instrument's current coil, proportional to the square of the number of turns, becomes quite large in a voltmeter, whose coil may have several thousand turns. Consequently the combined impedance of the coil and series resistance increases substantially with increasing frequency, while the voltage at the instrument terminals, required to provide operating current in the coil, increases at a corresponding rate.

As the voltmeter scale is marked in terms of the voltage needed at the instrument terminals to produce the operating current, the frequency range of the instrument is limited by the impedance change. The operating range can be substantially increased by shunting a portion of the voltmeter multiplier by a capacitor to compensate for the coil inductance but, since capacitive reactance decreases, there will be an upper frequency limit at which compensation is no longer adequate.

5. Electrodynamic Instruments. — Electrodynamic ammeters and voltmeters are usually made only in the best accuracy classes (laboratory standard and portable standard instruments) and are little used outside the calibration laboratory, although instruments of a similar construction are used almost universally to measure electric power. This is because they are much better adapted to make precise measurements of po er than is any other type of instrument, whereas, for current and voltage measurements, the less expensive and more rugged iron-vane instruments are adequate in most engineering work.

Electrodynamic instruments are, however, used in the laboratory to check the calibration of other less precise A.C. ammeters and voltmeters, and to transfer calibrations from D.C. standards to instruments that respond correctly only to alternating currents and voltages.

Electrodynamic instruments make use of the magnetic fields of two sets of coils, one fixed and the other movable. Each coil carries a current which is a function of the current or voltage to be measured. and the reaction between the fields of the fixed and movable coils supplies the torque for the moving system. Here also, as in the iron-vane instruments, the energy storage in the magnetic fields of the coils is proportional to the square of the coil current, and electrodynamic instruments respond to r.m.s. current or voltage.

In the usual construction a moving coil is pivoted or suspended in the field of a pair of fixed coils, and has attached to it springs, pointer and damping vane. The moving-coil current is carried by the instrument springs and is limited to a fraction of an ampere. As the available torque is small, the weight of the moving system must be kept low. The result is a structure that is considerably less rugged than is the moving system of an iron-vane instrument.

The operating field is usually less than 60 gausses for full-scale deflection, and either the entire operating mechanism must be protected by a magnetic shield against external fields or the coil system must be astatic so that the presence of external fields will not result in any net deflecting torque.

In an electrodynamic voltmeter the fixed and moving coils are connected in series to carry the entire current, and a suitable multiplier fixes the voltage range. A low-range electrodynamic milliammeter would also have its coil system connected in series to carry the entire current. However, as the current capacity of the instrument springs limits the moving-coil current, higher current ranges make use of a parallel-coil arrangement. The fixed coils, which can have whatever current capacity is required, carry all but a small fraction of the measured current and have in series with them a resistor of appropriate size and current capacity. The moving coil, also with a resistor in series, is connected in parallel with the fixed-coil-resistor combination. The time constant of each branch of the circuit, *i.e.*, the ratio of inductance to resistance, must be the same in order that the division of current shall not change with frequency. Modem electrodynamic ammeters are seldom built in ranges above 10 amp. A current transformer together with a 5-amp. instrument is generally used for precise measurement of higher currents.

Frequency errors in electrodynamic ammeters arise from two causes. Metal present in coil supports and other parts, and in the instrument shield, will have eddy currents induced in it and will cause a change in deflection with changing frequency, in the same manner as for an iron-vane instrument. However, by proper construction eddy-current errors can be kept to a considerably lower level than is possible in the iron-vane ammeter. In addition to eddy-current errors, another must be expected. Because of the parallel branches, the ammeter coils operate in a closed loop of comparatively low impedance, and the coupling between fixed and moving coils will produce a circulating current in this closed loop, resulting in a torque which is a function of frequency. Frequency errors in electrodynamic voltmeters arise from eddy currents and from the self-inductance of the coil system. These also are similar in kind but smaller in amount than are to be expected in iron-vane voltmeters.

Before using an electrodynamic instrument in transfer measurements, the difference in its performance on D.C. and at the desired frequency should be checked.

6. Electrostatic Voltmeters. — In this type of instrument the deflecting torque results from the action of an electric field on charged conductors (electrodes). Such instruments are useful at low voltages when no appreciable current can be drawn from the circuit. They can also be designed for use at extremely high voltages. In fact the total range of voltage covered, with small errors in measurement, is greater than for any other class of deflecting instrument. They are built regularly in ranges from 50 to 100,000 v. Any good electrostatic voltmeter can be considered as a low-loss capacitor, so that on D.C. voltage, the operating current (after the initial charging current) is merely the very small leakage current required by the insulation resistance of the instrument (which may be as much as 10^{14} ohms).

On A.C. voltages the current is determined by the capacitance of the instrument and the frequency, the operating current in-

creasing with increasing frequency as the reactance decreases. A 15,000-v. instrument, having a capacitance of 20 micromicrofarads, would require 120 μamp. for full-scale deflection at a frequency of 60 c.p.s.

In low-voltage electrostatic voltmeters the fixed and moving systems consist of groups of flat interleaved sector plates. As fixed and movable plate systems are insulated from each other, a voltage impressed between them results in the appearance of charges of opposite sign on the two sets of plates. The force of attraction between these charges produces a torque which is opposed by a spring or, in the case of a suspended system, by stiffness of the suspension bands.

In higher-voltage instruments, where large clearances must be maintained between the electrodes to prevent electrical breakdown of the surrounding air, fixed and moving elements may be sectors of coaxial cylinders, or the combination of a fixed flat disk and a moving cylindrical sector. Damping may be either by means of a vane attached to the moving element, moving with small clearance in a closed sector box, or by means of a disk which moves in the field of a permanent magnet.

Energy storage in the electric field of the voltmeter is proportional to the square of the voltage between its electrodes, and the response of the voltmeter is to the r.m.s. value of the impressed voltage. Operating torque is always small in electrostatic instruments, and may be increased only within rather narrow limits by increasing the capacitance between the fixed and moving electrodes. If either the number of plates or their area is increased, the weight of the moving system will be greater, with a consequent increase in bearing friction. If capacitance is increased by decreasing electrode separation, a limit is reached in low-voltage instruments at the mechanical clearance required for reliable operation, and at high voltages by the clearance needed to avoid corona or electrical breakdown.

Electrostatic voltmeters have a response that is independent of frequency and indeed, if they are suitably constructed and operated, they have no differences in indication on direct or alternating voltage. Thus, they can serve as transfer instruments to determine the difference between A.C. and D.C. response of other types of instruments. In fact, the National Physical laboratory of Great Britain employs electrostatic instruments as their basic transfer standards in the same way that the national bureau of standards of the United States uses electrodynamic instruments.

7. Instrument Transformers. — Ratio devices in the form of transformers are needed to extend the range of alternating current instruments. so that current, voltage, power and energy can be measured with instruments of moderate size and capacity. This is important in the laboratory, and of even greater importance in commercial metering. Here power is frequently handled in large blocks at high currents and voltages, and it is necessary that the devices used to measure large currents or high voltages be both accurate and of low power consumption. The requirement of low power consumption precludes the use of shunts for current measurements beyond a few amperes and of series resistors in voltage circuits beyond a few hundred volts.

A transformer consists of two coils of wire, closely coupled by means of a magnetic circuit of high permeability which threads through both coils. It is the property of such an arrangement that when one coil (the primary) is excited by an alternating current, an alternating voltage of the same frequency is induced in the other coil (the secondary). If the secondary circuit is completed by an external impedance that is very large compared with the impedance of the transformer winding, the ratio of the voltages at the primary and secondary terminals of the transformer is very nearly the same as the ratio of turns in the primary and secondary windings. This is an elementary picture of a voltage transformer. On the other hand, if the secondary circuit of the transformer is completed by an impedance that is very small, the ratio of currents in the primary and secondary circuits is very nearly equal to the reciprocal of the primary-secondary turn ratio, and one has a current transformer.

Thus, the two basic types of instrument transformers (for voltage or current transformation) are similar in that each consists of a primary and secondary coil closely linked by a high-permeability magnetic core. They differ in details of construction and in the conditions under which they operate. A voltage transformer, used to step voltages down from high to low values, may have many times as many turns in its primary as in its secondary winding. It supplies a very small operating current to the high-impedance voltage circuits of the instruments connected across its secondary winding, at a voltage which is a known fraction of the voltage across its primary winding. A current transformer, used to step currents down from high to low values, may have many times as many turns in its secondary as in its primary winding; in fact, the primary winding is often either a single turn or even the high-current conductor passed through the central window of the magnetic core. It supplies the low-impedance current elements of instruments or meters connected across its secondary winding with a current which is a known fraction of the current in its primary winding.

Voltage transformers are usually designed with a 120-v. secondary, and current transformers with a 5-amp. secondary. Primary voltages may be 200,000 v. or more in some instances, and the rated primary current of current transformers sometimes ranges as high as 12,000 amp. Both by refinement of design and by the use of high-quality magnetic core materials, the modern instrument transformer produces a current or voltage for the instruments connected across its secondary terminals that is within a few hundredths of 1% of the intended value, and consumes very little power in its operation. Good instrument transformers reflect accurately, on a known reduced scale, the current or voltage of their primary circuits, and thus serve to broaden enormously the range of A.C. values that can be measured with relatively simple instruments.

B. Power Measurements

The power at any instant in an electric circuit is the product of that current in the circuit and the voltage across its terminals at that instant, and is a measure of the rate at which energy is being transformed or made available. For direct current under steady-state conditions, power can be calculated from a measurement of any two of three quantities — current **I**, voltage E, resistance R— by using the appropriate one of the following relations

$$\text{Power} = EI = I^2R = E^2/R.$$

In the case of an alternating current the instantaneous power varies continuously as the current and voltage go through a cycle of values.

If the current and voltage are both sinusoidal, the time average of power, which is usually the quantity of interest, is given by the expression

$$\text{Power} = EI \cos \phi$$

where E and **I** are the r.m.s. or effective values of voltage and current respectively, and ϕ is the electrical angle between them. Cos ϕ is the power factor and may assume any value between unity and zero as the phase angle between voltage and current varies from 0° to 90°.

1. Electrodynamic Wattmeter. — This instrument, of similar mechanical construction to the electrodynamic instruments already described, is well suited to the measurement of A.C. power at low frequencies. The field coils of the instrurnent are connected in series in the circuit so that their current is that of the load being measured, and the moving coil (with appropriate resistance) is connected across the load so that its current is proportional to the load voltage. Then the instantaneous torque from the reaction of the field-coil current with the moving-coil current is proportional to the product of the current and voltage in the circuit, and hence to the instantaneous power. As the variations of instantaneous pomer are too rapid for the moving system to follow, the equilibrium position it takes up will correspond to the average torque and therefore to average pomer. The instrument scale is marked in watts. The voltage and current elements are brought out to separate terminals so that they may be connected properly to the load circuit.

For small or moderate currents (up to 5 or 10 amp.) the load current is sent directly through the field coils of the wattmeter.

For voltages up to perhaps 300 v., the moving-coil circuit, including a series resistor to limit its current to 25 ma. or less, is connected directly across the load. When power measurements involve larger values of current or voltage, instrument transformers of appropriate ratios are used to step down at the instrument to values that can be applied to a wattmeter having a 5-amp. current range and 150-v. voltage range.

The use of electrodynamic wattmeters for power measurements is restricted to low frequencies, a few hundred cycles per second at most, because of eddy currents and self-inductance of the moving-coil circuit, both of which tend to alter the phase relation between the magnetic fields of the current and voltage elements of the wattmeter, and give rise to errors of indication that increase with increasing frequency. These frequency errors can be made negligibly small at commercial-power frequencies by suitable design and construction, and the electrodynamic wattmeter is much used as a transfer instrument for the calibration of other A.C. instruments in terms of D.C. measurements of current and voltage. Such D.C. measurements can be referred readily to the basic electrical standards of resistance and e.m.f. by means of a laboratory potentiometer.

2. Electrostatic Wattmeter. — The electrostatic wattmeter is substantially free from eddy-current and inductance effects, and can be constructed to be independent of frequency over a much broader range than can the electrodynamic instrument. Hence, it also is used as a basic transfer instrument by several of the national standards laboratories. However the available torque is quite small, as with all other electrostatic instruments. Because its construction is inherently delicate and the techniques of operation require great care and skill, the electrostatic wattmeter is almost never used in routine power measurements. The instrument torque results from the electric field between fixed and moving electrodes, but the electrode arrangement is more elaborate than in the electrostatic voltmeter.

There are two sets of stationary electrodes maintained at a potential difference proportional to the load current. This potential difference is provided by the voltage drop across a resistor that carries the load current. The voltage drop across the load is impressed between the moving element and the midpoint of this shunt (*i.e.*, at the mean potential of the two stationary electrodes). The instantaneous torque is proportional to the product of load voltage and load current at any instant, and the deflection of the moving element is proportional to the average power into the load.

3. Bolometer. — The wattmeters described above are designed to measure power into a load, and are applicable only at low frequencies. The accurate measurement of power into a load becomes more difficult with increasing frequency, and no simple or even adequate techniques are available for such measurements at radio or microwave frequencies. However, the power output of a generating circuit can be accurately measured at any frequency by absorbing the output and converting the electrical energy to heat. This can be done in the laboratory with a calorimeter in which the rate of heat production, measured by differential temperature rise, is a measure of the power output of the generator.

A more convenient means of measuring power output is with a bolometer bridge. A thermistor element, having a very large temperature coefficient of resistance, forms one arm of a Wheatstone bridge and is arranged to absorb energy from the generator. Its resistance change, as its temperature rises with the absorption of energy, becomes a measure of the power output of the generator. Such a device can be calibrated in terms of the product of the measured direct current and voltage required to produce the same resistance change in the thermistor.

C. Energy Measurements

The measurement of electrical energy is, from the viewpoint of economics, one of the most important of electrical measurements. Where electric power is generated or consumed, the commodity that is sold is energy, the time integral of power. The basic unit of power is the watt, and the corresponding unit of energy is the watt-second or joule.

More familiar units are the watt-hour (3,600 watt-seconds) and the kilowatt-hour (36×10^5 watt-seconds or 1,000 watt-hours). This latter unit, the kilowatt-hour, is the energy unit commonly used in billings for electrical service.

1. Commutator Watt-Hour Meter. — Developed by Elihu Thomson in 1889, this device is commonly used for metering D.C. energy. It is essentially a small motor provided with a magnetic brake and geared to a register or set of dials, whose count is proportional to the total number of revolutions. The gear train between the rotor shaft and the register dials is of such a ratio that the dials read directly in kilowatt-hours. The motor field consists of a few turns of heavy copper wire carrying the current of the load being metered.

The armature (or rotor) current is proportional to the line voltage. In this respect the instrument resembles the electrodynamic wattmeter, and its driving torque is proportional to the product of load current and line voltage. The armature has a silver commutator and silver- or gold-tipped brushes; it is carried on jewel bearings to minimize friction. For proper operation it is essential that the rotor speed be proportional to driving torque (and to the power being metered), and this is assured by providing a retarding or braking torque of sufficient magnitude to keep the speed of rotation rather low.

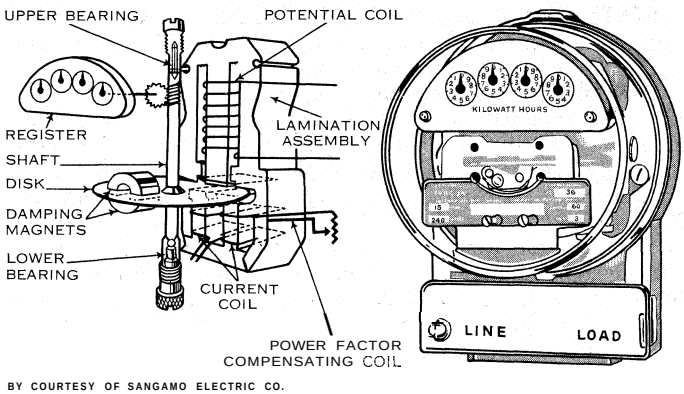
An aluminum disk is attached to the motor shaft and intercepts the flux of a permanent magnet. As the disk rotates, eddy currents are induced in it by the flux that it cuts, and the counter torque which results from the reaction between these eddy currents and the field of the magnet is proportional to the disk speed. Therefore, the speed of rotation of the motor shaft is proportional to the load power, and its total number of revolutions over a time interval is proportional to the energy consumed by the load during the interval.

2. Induction Watt-Hour Meter. — The induction watt-hour meter is used almost universally for metering A.C. energy. Its principle of operation, identical with that of the induction motor, may be understood by considering two laminated electromagnets A and B, situated on either side of an aluminum disk and displaced slightly from one another along its periphery. The alternating magnetic field of A induces eddy currents in the disk that intercept the field of electromagnet B, producing a torque on the disk. Conversely eddy currents induced in the disk by electromagnet B intercept the field of magnet A, and react to produce a torque. If the magnetic field of B lags in phase behind the field of A, the two torques are in the same direction and their sum is proportional to the product of the currents producing the fields and to the sine of their angular phase difference.

To produce a torque in the rotating disk proportional to load power, one of the electromagnets (say A) is wound with a few turns of heavy mire and is connected to carry the load current. The other electromagnet (B) is wound with many turns of fine wire and is connected between the power lines so that its current is proportional to load voltage. This electromagnet is designed to have a very large inductance and the current in its coil lags almost go" behind the voltage producing it. By using an additional shading coil, the flux of this magnet intercepted by the disk, is made to lag precisely go° behind the voltage and, since the sine of go° is unity, maximum torque is developed if the current in the series coil (electromagnet A) is in phase with the voltage, *i.e.*, for a unity power-factor load. As in the commutator meter, the aluminum disk passes between the poles of a permanent magnet to provide a braking torque proportional to speed.

A gear train drives a register whose count is proportional to total revolutions of the shaft, and thus to energy consumption, providing a basis for billing the power customer.

Fig. 3 shows a single-phase meter such as is employed to meter the energy used in the ordinary household. Other meter types have two driving elements for a three-wire distribution system, or three elements for a four-wire system. For very large currents, where huge blocks of power are metered for an industrial customer, the current coils of the watt-hour meter are connected through current transformers. When the metering must be done at high voltages, voltage transformers are also used to connect the meter to the power lines.



BY COURTESY OF SANGAMO ELECTRIC CO.

FIG. 3.— SINGLE-PHASEWATT-HOUR METER
(Left) schematic; (right) assembled

Because of the very large number of meters in use, and the high total value of the electrical energy consumed annually, a great deal of engineering talent has been devoted to refining watt-hour meter design. A modern meter may be expected to have an accuracy of nearly 1% over a wide range of loads and at temperatures ranging between the extremes of winter and summer, and to retain this accuracy over a period of many years with little or no maintenance.

D. Resistance Measurements

Depending on the accuracy required, it is possible to measure a resistance with a deflecting instrument called an ohmmeter, or compare its value with that of a known resistance in a ratio network such as the Wheatstone bridge.

Deflection methods generally may be expected to yield an accuracy of a few per cent, whereas bridge methods may be used with ordinary precautions for work nhich requires values to o 1% and, with care, to o.01% or better. In the national standardizing laboratories and in other laboratories having comparable equipment, nominally equal resistances can be compared in a bridge network to 1 part in 10,000,000.

1. Ohmmeter.— Ohmmeters are of two types. The series ohmmeter, which forms a part of many inexpensive multipurpose testing instruments, consists of a D.C. milliammeter in series with a small dry-cell battery and an adjustable rheostat. A gap in this circuit is provided with binding posts or test leads so that the resistance to be measured can be inserted conveniently into the circuit. With the test gap shorted out, the milliammeter is set by means of the rheostat to a reference point on its scale marked zero. The pointer position with the gap open, so that there is no current in the circuit, is marked infinity.

When a resistor is connected across the gap to complete the circuit, the instrument pointer assumes a position intermediate between the zero and infinity marks, and the scale is marked in terms of resistance.

The ratio (or crossed-coil) ohmmeter represents a substantial improvement. as its reading is nearly independent of supply voltage and it need not be set to a reference mark each time it is used. It is a permanent magnet instrument with two moving-coil systems arranged so that their torques oppose one another. The circuit, containing a voltage source, is so arranged that the current in one coil is proportional to the voltage across the resistor to be measured. The current through the other moving coil goes also through the resistor. Thus the torques resulting from the currents in the two moving coils represent respectively the voltage across the resistor and the current through it. As these torques oppose one another, the instrument pointer takes up a position representing their ratio, the quotient of rhe voltage by the current in the resistor.

The instrument scale is marked in resistance units. Such instruments, with a supply voltage ranging from 500 to 5.000 v. are used for measuring the resistance of electrical insulation. and their scales are usually marked in megohms. A somewhat similar type of crossed-coil instrument is arranged for four-terminal measurements, and its scale may be marked in microhms.

2. Wheatstone Bridge.— The Wheatstone bridge consists of two parallel branches (as shown in fig. 4), carrying currents i_1 and i_2 respectively. supplied from a common voltage source. If the individual resistors of one branch, say p and r, have a ratio of fixed value, the resistors in the other branch can be brought to the same ratio by adjusting the value of one of them. The ratios are equal when the potential drop caused by the current i_1 in resistor p is equal to the potential drop resulting from i_2 in q. Simultaneously, of course, $i_1 r = i_2 s$. Thus, when the resistance ratios are equal in the two branches, there is no potential difference across the galvanometer; and its zero indication demonstrates balance in the bridge. For this condition $p/r = q/s$ or $q = s \times p/r$. The value of the resistor q is determined from a known ratio p/r and a known resistance s. At balance it is also true that $p/q = r/s$ and it follows that the galvanometer can be interchanged with the voltage source in the network without affecting the balance condition.

This interchangeability is, in fact, characteristic of any bridge network. and can frequently be used to advantage, by placing the voltage source and the detector of unbalance to obtain best sensitivity: *i* e., larger detector response to a given proportional unbalance of the bridge and, hence an observable response to a smaller unbalance.

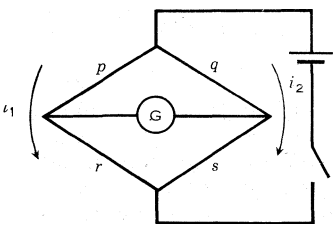


FIG. 4.— WHEATSTONE BRIDGE

If the voltage sensitivity of the galvanometer is known for the circuit resistance which it encounters in the bridge, its response to any specified proportional departure from the balance condition can be computed easily. The unbalance voltage e, acting to deflect the galvanometer, is given by the formula

$$e = E\Delta\frac{pr}{(p+r)^2} = E\Delta\frac{qs}{(q+s)^2},$$

where E is the supply voltage at the bridge terminals and Δ is the proportional unbalance. It should be noted that the alternative formulas provide for a departure of any arm from the balance condition; *i.e.*, the expression is used which includes the unbalanced arm.

The Wheatstone bridge is regularly used in a variety of forms for the precise measurement of resistance in the range from 1 ohm to 100 megohms. For a resistance less than an ohm. the resistance introduced at the terminals of the bridge when connecting it into a circuit becomes increasingly important with decreasing total resistance. For example. if the terminal resistance amount to o oor ohm and the resistor itself is o 01 ohm, the terminals contribute 10% of the whole. Hence, the precise definition and measurement of low resistances must avoid inclusion of these terminal resistances.

Low-valued resistors in the precision class have four rather than two terminals, the current being introduced through one pair and the potential drop measured between the other pair. The resistance of a four-terminal resistor is defined as the ratio of the voltage difference between the potential terminals to the current entering and leaving the current terminals. Bridges for measuring or comparing four-terminal resistors must have two pairs of ratio arms rather than one. The Kelvin bridge netnork shown in fig. 5 is such an arrangement.

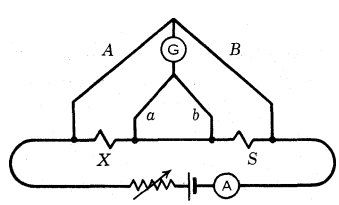


FIG 5.— KELVIN BRIDGE

E. Capacitance and Inductance Measurements

Alternating current networks similar to the Wheatstone bridge are used to measure capacitance or inductance. One of the network branches may form a ratio pair and the other branch may be used to compare one inductor with another, or one capacitor with another. The value of the unknown element is determined from a

known standard of the same kind, and the known ratio. The ratio arms of the bridge may be made up of two resistances, two inductances or two capacitances.

In any A.C. bridge, balance is possible only when there is no potential difference across the detector at every instant throughout the A.C. cycle. Thus, the ratio arms should have the same time constants, and the elements being compared should have equal phase angles. In other words, both magnitude and phase-angle balances are required in an A.C. bridge. This usually means that a resistance must be inserted in the arm containing one or the other of the elements being compared, to bring their phase angles to equality.

The Wheatstone network can also be arranged in a form known as the product-arm bridge, in contrast to the ratio-arm network just described. In this arrangement a capacitor can be compared to an inductor in the opposite arm, the remaining opposite pair of arms being resistors. Thus a capacitance can be measured in terms of an inductance and the product of two resistances, or an inductance can be measured in terms of a capacitance and a product of resistances.

To summarize the possibilities, if two capacitors (or two inductors) are to be compared in a four-arm bridge, they must be in adjacent arms. If a capacitor is to be compared with an inductor, they must be in opposite arms.

V. Recording Instruments

In industrial and laboratory operations it is often necessary to have a record of the variations of voltage, current, power or some related quantity over an extended time interval. To make such a record, moving a pen over a paper chart, requires much more power in the operating mechanism of the instrument than is needed merely to indicate with a pointer the value of an electrical quantity. Direct-writing recorders have moving systems similar to those of the corresponding indicating instruments except that the torque requirements may be a hundred or even a thousand times greater. Some kind of a clock mechanism must also be incorporated into the instrument to move the chart paper at a uniform rate.

A second type, called a servo-recorder, has a small motor which takes its power from an auxiliary source and moves the pen across the paper. Servo-recorders make use of either a bridge or a potentiometer network in which a quantity is measured in terms of the balance position of a slide-wire that forms part of the network. When the network is unbalanced, the output of a detector or sensing element is fed into an amplifier. The amplifier output is applied to the motor which drives the slide-wire and the recording pen in the proper direction to restore balance to the network. Large numbers of servo-recorders are used in industrial plants to record temperatures of furnaces or stills, using a thermocouple or resistance thermometer, or to record, by means of an electrical weighing device, the rate of flow of a material used or produced. In short, servo-recorders can be used to make a continuous record of any quantity which can, by some type of transducer be made to produce an electrical signal.

Frequently the amplifier output from the unbalance signal, or the position of the recording pen, is used to initiate controlling devices so that the entire operation is automatic except for supervision.

Bibliography.--B. Hague, *Alternating Current Bridge Methods*, 3rd ed. (1932), *Instrument Transformers* (1936); F. Harris, *Electrzcal Measurements* (1952); H. Curtis, *Electrical Measurements* (1937); E. Golding, *Electrical Measurements and Measuring Instruments* (1940); C. V. Drysdale and A. C. Jolley, 2nd ed. rev. by G. F. Tagg, *Electrical Measuring Instruments* (1952); A. Palm, *Elektrische Messgerate und Messeinrichtungen* (1948).

Continuing sources of information on electrical measuring instruments include the transactions of the American Institute of Electrical Engineers, the Institute of Radio Engineers and the Institution of Electrical Engineers (London). Other journals are *Review of Scientific Instruments*, *Journal of Scientific Instruments* (London,), *Archiv für Technisches Messen.* and *Zeitsrhrift für Instrumentenkunde*.

See also the technical publications of the various national laboratories, which are also useful, as are the electrical instrument specifications of the American Standards Association and of the corresponding standards bodies of other countries. (F. K. H.)

INSTRUMENTS, MATHEMATICAL: see Abacus; Computing Machines, Electrokic; Mathematical Instruments; Office Machines and Appliances.

INSUBRES, a Celtic people of upper Italy, the most powerful in Gallia Transpadana. Their origin is obscure. Livy, whose account (v. 34) is not reliable, regards them as Aedui who came into Italy over the Mont Genèvre pass. By about 400 B.C. the Insubres were controlling a large area around their capital city Mediolanum (Milan). From 222 to 194 B.C. they were frequently at war with the Romans. In 222 B.C. they were defeated at Clastidium by M. Claudius Marcellus, who gained the *spolia opima* by slaying with his own hand their king Viridomarus; and in 194 B.C. they were finally subdued by L. Valerius Flaccus.

Thereafter their separate identity was gradually obscured. The area was given Latin rights in 89 B.C. and full Roman citizenship in 49 B.C.

INSULATING MATERIAL. The advantages of heat insulation must have been known very early in history. The comforts of fur clothing and snowhouses of the Eskimo, for example, certainly were realized hundreds of years ago. Wood was used for insulating steam boilers, engine cylinders and pipes early in the 19th century.

The extensive development of commercial insulation, however, dates from about 1900.

Purposes of Heat Insulation. — The chief use of insulation is to retard the rate of heat flow. This may reduce the heat flow outward from a building or furnace, for example, or inward to a cold-storage warehouse. Great savings in fuel and electricity are made possible by the proper installation of insulation and it is often used to prevent condensation of water vapour on the inside of factory roofs where the manufacturing process requires or develops a high relative humidity, as in cotton or paper mills. Cold-water pipes in buildings are frequently insulated solely to prevent condensation and consequent dripping on warm humid days. Working and living conditions can often be made more comfortable by the use of insulation.

Buildings can be made cooler in summer and the working conditions around furnaces, hot flues, etc., improved. The addition of insulation to buildings, bake ovens, furnaces, etc., will tend to produce a more uniform temperature distribution.

The low heat capacity of insulating firebrick is an important factor in saving fuel used by intermittently heated furnaces. The time required to reach a desired temperature may be reduced by the use of lightweight insulating firebrick to one-quarter that needed when conventional heavy firebrick is used.

Insulation is sometimes applied to structural steel in buildings to reduce the fire hazard. Underwriters' tests indicated that unprotected structural steel collapses quickly in a hot fire. The thermal expansion of concrete roof slabs can be much reduced by the use of insulation.

Proper insulation also will minimize the formation of lath patterns on walls of plaster on wood lath.

Factors Affecting the Value of Insulation. — The coefficient of thermal conductivity or K value of insulating materials increases with an increase of temperature. The loose fibre type generally increases much faster than the more solid type such as corkboard or 85% magnesia, as shown below:

Glass wool	2.1 lb/cu ft.	0 28 @ 100° F.	0.55 @ 300° F.
85% magnesia	12 lb/cu ft.	0.38 @ 100° F.	0.43 @ 300° F.

When referring to a K value of an insulating material, it is important to note the temperature corresponding. For insulating materials used at temperatures below 70° F., provision should be made to prevent moisture from entering the insulation. For water has a *K* value more than ten times that of most insulating materials, and if it is present in the insulation the effective K value is increased materially and usually other difficulties develop. In cold-storage plants as well as houses, water vapour tends to enter from the warmer side and condense in the cooler parts of the insulation. Thus every effort should be made to seal the warmer side of such walls so that they will be impervious to water vapour. This is a serious problem when extremely low temperatures are encountered. In general, for any given insulating material, the K

value will increase with density but there are notable exceptions in the case of many loose fibrous materials and some powders. Bagasse (sugar cane fibre) has a minimum K value at a density of four pounds per cubic foot, the K value increasing if the density is made greater or less than this amount. Another factor that tends to increase the K value of a few insulating materials is radiation through the material and, in special cases of loose fibrous materials. there may be convection currents of air transmitting heat from the warm side to the cool side.

Types of Insulation. — Heat insulating materials may be roughly classified as follows: (1) powders, such as diatomaceous earth, silica aerogel, sawdust, etc.; (2) loose fibrous materials similar to eelgrass, glass wool, rock wool, shredded redwood bark, etc.; (3) blanket insulation, consisting of glass wool, rock wool, wood fibres. etc.. enclosed by paper. cloth or wire mesh; (4) board or block insulation. such as corkboard. fibreboard, expanded glass block, 85% magnesia, vermiculite block, etc.; (j) insulating refractories such as diatomaceous earth and kaolin bricks; (6) heavy refractories such as fire clay, magnesite, silica bricks, etc.; (7) reflective insulation, consisting usually of aluminum foil with an adjoining air space. Reflective insulation is effective because it reflects a high percentage of the radiation striking it and also emits a small percentage of the amount of heat radiated by ordinary (nonmetallic) surfaces under the same temperature conditions.

Reflective insulation is based on entirely different principles from those of conventional insulation.

See also HEATING AND VENTILATION.

BIBLIOGRAPHY.—W. H. McAdams, *Heat Transmission,* 3rd ed. (1954); G. B. Wilkes, *Heat Insulation* (1950); M. Fishenden and O. A Saunders, *Introduction to Heat Transfer* (1950); American Society of Heating and Ventilating Engineers, *Heating, Ventilating and Air Conditioning Guide* (annually); American Society of Refrigerating Engineers, *ASRE Data Book* (biannually). (G. B. Ws.)

INSULATING MATERIAL (ELECTRICAL). Electrical insulation is nonconducting material used to hold electrical conductors in position, separating them from each other and from surrounding structures. Insulation forms a barrier between energized parts of an electric circuit and confines the flow of electric current to wires or other conducting paths as desired. The insulation of electric circuits is a necessary requirement for the successful operation of all electrical apparatus.

Various types of materials are used as insulation, the selection being made on the basis of the specific requirements of each application. The copper conductors used in the electrical wiring in homes are insulated from each other and from the building by rubber or by plastics. These materials are low in cost, long lived and sufficiently flexible to withstand necessary bending. Extension cords of heating appliances are usually insulated with asbestos. a material which is capable of aithstanding high temperature nithout deterioration. Overhead power lines operating at high voltage are supported on porcelain insulators which are unaffected by outdoor exposure. Paper is used to insulate the small nires of telephone cables and the conductors of high-voltage power cables; in the latter case the paper is impregnated with insulating oil to improve the quality of the insulation. Large electric generators and motors which operate at high voltages and high temperatures are insulated with mica In some applications, solid insulation is used in conjunction with liquid or gaseous insulation. For example. in high-voltage transformers. solid insulation provides mechanical rigidity while insulating oil contributes to increased insulation strength and serves to carry heat out of the structure.

Electrical insulation is ordinarily regarded as a nonconducting material, but is, in fact, better described as a poor conductor or a substance of high resistance to the flow of electric current. Different insulating and conducting materials are compared with one another in this regard by means of a material constant known as the resistivity, the resistance measured across identically dimensioned samples of the several materials. The resistivities of a number of insulating materials are shown in the table, column 2, along with the resistivity of copper, the most commonly used conductor material. As may be seen, the resistivities of the insulating materials are vastly greater than the resistivities of the metal. Nevertheless, in the normal operation of electrical equipment, minute conduction currents flow through the insulation separating the energized parts and a small amount of heat is thereby released within the insulation.

Under the influence of ordinary voltage application, insulation has extremely high resistance to current flow. However. if the voltage gradient (volts per centimetre thickness of insulation) exceeds a critical value, the resulting rearrangement of the atomic structure of the material results in a sudden decrease in the resistance of the material to such an extent that high-value currents may flow through local regions. Such a change leads to breakdown or "puncture." In the case of solid insulation, puncture represents permanent damage to the material, whereas in the case of liquid or gaseous insulation, the interruption of the current flow and the removal of the offending overvoltage restores the material to substantially original conditions. The puncture strength of several insulating materials is shown in the table.

Characteristics of Insulating Materials

Material	Resistivity ohm-cm.	Puncture strength volts per cm.	Relative permittivity
Air (20° C., 760 mm. Hg)	$V_5 \times 10^{16}$h	3×10^4	1.0
Amber			4.3-5.5
Bakelite			4.8-5.5
Glass	2×10^{13}	$0.5\text{–}3.0 \times 10^6$	5.4–9.9
Mica	2×10^{17}	$3.5\text{–}7.0 \times 10^6$	2. j–6.6
Oil	1×10^{12}	1.0×10^5	2.2–4.7
Paper		$1.0\text{–}4.0 \times 10^5$	2.0–2.6
Porcelain	3×10^{14}	1.0×10^5	5.7–6.8
Quartz	$j \times 10^{18}$	$2.0\text{–}2.5 \times 10^5$	3.5
Rubber	1×10^{13}		2.0–3.5
Copper	1.6×10^{-6}	...	...

Data from *Standard Handbook for Electrical Engineers,* 8th ed. (McGraw-Hill Book Company, Inc., New York, London, 1949). Electrical properties may vary considerably, depending on the processes of material preparation and the methods of test.

Two conducting bodies separated by insulation form a capacitor which is said to possess capacitance, the ability of the assembly to store electric charge under the application of voltage. The capacitance is influenced by the relative permittivity of the material employed as insulation. The relative permittivity of a material is defined as the ratio of the two capacitance values: (1) the capacitance between the two electrodes separated by the insulating material; and (2) the capacitance of the same electrodes with vacuum replacing the subject material. The relative permittivities of several insulating materials are shown in the table.

The insulation material separating two electrodes is stressed when normal voltage is applied to the electrodes and this stress is reversed with each reversal of the applied voltage. This change of stress involves molecular rearrangement within the insulation with the attendant release of a small amount of heat with each reversal. If the applied voltage is of low frequency (such as 60 cycles per second), this release of heat is ordinarily of little concern. At the high frequencies employed in many communications systems (millions of cycles per second), this heat release may be evident by insulation temperature rise and by a loss of energy from the electric circuit. Special plastics, ceramics and glasses, exhibiting very low loss at high frequency, have been developed for the communications industry.

Insulating materials are subject to many deteriorating influences, the most important of which are moisture absorption and chemical changes. Porous materials. such as cotton and paper, must be effectively sealed against moisture, usually by immersion in oil or by impregnation with insulating varnishes. Silicone varnishes are used extensively as they form a very effective barrier against moisture and can withstand fairly high temperatures.

Insulating materials deteriorate under influences which change their chemical structures. Chemical changes which progress very slowly at room temperatures are. in some cases, greatly accelerated at elevated temperatures. For this reason, many types of electrical apparatus have specified maximum operating temperatures.

If operated at higher temperatures, insulation life will be noticeably shortened. Some organic compounds are damaged by exposure to ultraviolet light and corona, a product of high-voltage

stress in air. *See* also ELECTRIC POWER. (J. R. E.)

INSULIN is a protein hormone secreted into the blood by cells situated in the pancreas; its chief function is to regulate sugar metabolism. Insulin. extracted from the pancreas of certain domestic animals. is administered to persons suffering from diabetes mellitus. in whom there is an absolute or relative deficiency of insulin. It is also used to some extent in the treatment of mental disease.

In the Mammalia, in which the pancreas is well defined, the insulin-secreting cells lie in scattered groups. called the isles of Langerhans, distributed among the relatively much larger groups. or acini. of pancreas cells. In certain fishes in which the pancreas does not occur as a definite gland but is spread out diffusely in the mesentery, the islet cells form compact encapsulated glands called the principal islets, which are often of considerable size and contain no pancreatic (acinar) cells.

In 1889 J. von Mering and Oscar Minkowski found that complete extirpation of the pancreas in dogs immediately caused severe diabetes, and it was not long before the hypothesis was formulated that this must be due to the withdrawal from the body of a hormone having the function of regulating the metabolism of the carbohydrates.

The name insulin was first suggested for a hypothetical internal secretion of the pancreas by J. de Meyer in 1909. Many attempts were made to extract it from the pancreas, but with little success. In 1921, however, Sir Frederick Banting and Charles H. Best, working in the laboratory of J. J. R. MacLeod, found that extracts of partially degenerated pancreas and later of normal pancreas contained the hormone.

These observations demonstrated that insulin does exist in the pancreas, and the next step was to devise a method for extracting it in more purified form and in quantity from normal pancreas. Alcohol was found to be a suitable extractive, in that it dissolved the insulin and at the same time eliminated undesirable contaminants. Crude insulin prepared in this way by Banting and Best was first administered to human patients in Jan. 1922. Later J. B. Collip succeeded in sufficiently purifying the alcoholic extracts, by a process of fractional precipitation, so that they could be injected subcutaneously in man without causing local irritation. Very potent extracts were also prepared from the principal islets of fishes. Further purification of the extracts was effected by precipitating the insulin, either by adjustment of the reaction (isoelectric precipitation) or hy means of picric acid followed by treatment with alcoholic hydrochloric acid (insulin hydrochloride).

The function of insulin is to promote the formation and storage of glycogen (a complex sugar), of fat and of protein; it increases the burning of sugar and decreases its excessive nerv formation from protein; it helps in the regulation of potassium and phosphate metabolism. Insulin counteracts the inhibitory effects of several other hormones on these processes.

When insulin is absent from the blood. as after surgical removal of the pancreas or when the islets are destroyed by disease (diabetes). less sugar is used and sugar production takes place in the liver more rapidly. The blood sugar becomes very high (hyperglycemia) and sugar appears in the urine (glycosuria). At a later staae substances known as ketone bodies also appear in the blood and urine (ketonuria) being derived from the incomplete oxidation chiefly of fatty acid but partly also of certain of the amino acids Death ultimately occurs, either because of starvation caused by the excessive using up of the available foodstuffs of the body or because of toxic effects for which the ketone bodies are believed to be largely responsible (diabetic coma). Insulin promptly removes all these symptoms when injected under the skin or into a blood vessel; it is inactive when given by mouth, because it is destroyed by the digestive ferments of the intestine The effect passes off in a few hours, so that the injections must be repeated at least twice daily unless some material is combined with the insulin to slow the rate of its absorption. There are available various forms of slow-acting insulin.

When insulin is injected into normal animals the blood sugar. which usually stands at about o 10%, rapidly diminishes; nhen it reaches a level at between o 04% and o 05%, curious symptoms supervene.

In most of the laboratory animals these hypoglycemic symptoms consist at first of nervous overexcitability leading to convulsions. and later of coma and fall of temperature. That the symptoms are related to the disappearance of free glucose from the blood is indicated by the fact that they are promptly removed by restoring glucose to the blood. either by giving sugar by mouth or by injecting solutions of glucose. Glucose is conspicuously more efficient as an antidote than any other sugar, even than mannose and laevulose which are so closely related to it chemically. The mechanism by which excess of insulin causes hypoglycemia in the normal animal is an exaggeration of its usual action; *i.e.*, it increases the burning of sugar and its storage as glycogen and fat.

There are no true substitutes for insulin, though a great variety of oral hypoglycemic agents have been tested. Some of these are related to guanidine (*q.v.*) and have produced liver injury. A series of compounds resembling the sulfonamides in chemical structure also have been tested in animals and man. One of these, called tolbutamide, produces very little toxicity in human subjects and gives very promising results in certain older mild cases of diabetes. Since tolbutamide, unlike insulin, is a substance foreign to the body, careful watch must be kept for many years to make certain that no ill effects appear. Some insulin, either natural or administered, must be available in the body for the hypoglycemic effects of tolbutamide or related drugs to be exerted. This agent is not effective in childhood diabetes or in the adult diabetic who is in acidosis or coma.

Since insulin can be prepared in crystalline form (J. J. Abel and E. M. K. Geiling) it may be weighed out for medicinal use, but it is more convenient to use it in liquid form, which keeps well in acid reaction. The strength of the liquid in actual insulin is determined by biological methods, one of which depends on the lowering of blood sugar in a normal rabbit. The strength is gauged in units, one unit of insulin being originally defined as the amount that on subcutaneous injection will lower the percentage of blood sugar to the convulsive level. 0.045%, for a period of five hours in a fasting rabbit of two-kilogram weight. In order to ensure uniformity in the strength of insulin manufactured in different countries. the health committee of the League of Nations set up a sufficient quantity of dried insulin.. Later this original "yardstick" was replaced by purer, more potent standard preparations. Testing laboratories maintain their own standards, but they can have them checked against the international standard from time to time. By such international uniformity in strength of insulin, the diabetic patient is insured against variable dosage. The present international standard contains approximately 2 j units per milligram.

See also ANIMAL EXTRACTS; DIABETES MELLITUS; HORMONES; PANCREAS. (J. J. R. MACL.; C. H. B.)

INSULL, SAMUEL (1859–1938), **U.S.** public utilities executive, known for his contributions to good utility operations and his mistakes in utility financing, was born in London, Eng., Nov. 11, 1859. In 1881 he went to the United States as private secretary to Thomas A. Edison. In 1892 he was appointed manager of the Edison Co., in Chicago, Ill. He became a U.S. citizen in 1896. He formed his first holding company, Middle West Utilities, in 1912. After his ambitious holding company pyramid collapsed in 1932, Insull fled to Europe.

He was returned to Chicago in 1934, and tried three times on charges of fraud, violation of federal bankrupting laws and embezzlement, being acquitted each time.

Insull died July 16, 1938, in Paris.

See Francis X. Busch, *Guilty or Not Guilty, (1952).* (J. R. LT.)

INSURANCE. The present article is an introduction to the general subject of insurance (see *General Considerations,* below). For more specific information the reader is referred to the separate articles listed below.

INSURANCE, MISCELLANEOUS contains a description of certain forms of property insurance. Other important fields of property insurance are dealt with in ENGINEERING INSURANCE; FIRE INSURANCE; MARINE INSURANCE; MOTOR VEHICLE INSURANCE; RIOT AND CIVIL COMMOTION INSURANCE; and TORNADO AND WIND-

STORM INSURANCE. In all these cases the properties insured are normally tangible. Articles on the insurance of intangible property items are CREDIT INSURANCE; REINSURANCE; and TITLE INSURANCE COMPANY.

The chief articles on personal insurance are LIFE INSURANCE: GROUP INSURANCE; and CASUALTY INSURANCE, although the latter has aspects of social insurance. The article FRIENDLY SOCIETY deals partly with charitable and partly with insurance matters.

The most important articles in the field of social insurance are SOCIAL SECURITY; UNEMPLOYMENT INSURANCE; PENSIONS; and WAR PENSIONS; also the article VETERANS ADMINISTRATION, U.S., contains portions important for insurance. Some of the institutions anteceding social insurance are treated in the article POOR LAW.

Not strictly in the field of insurance but very pertinent to the field are the articles ANNUITY; SUPERANNUATION; BONUS; GUARANTEE; and LIFE EXPECTANCY. (X.)

GENERAL CONSIDERATIONS

Insurance may be described as a social device whereby a large group of individuals, through a system of equitable contributions, may reduce or eliminate certain measurable risks of economic loss common to all members of the group. Its primary function is to substitute certainty for uncertainty, as regards the economic cost resulting from the accidental occurrence of disastrous events. Its effect is to spread the cost which normally would fall upon a single individual in an equitable manner over the members of a large group exposed to the same hazard.

Throughout the history of the institution, the terms insurance and assurance have been employed more or less interchangeably. A suggestion by Charles Babbage as early as 1826 that the word assurance be reserved for contracts relating to life was never generally adopted. From the beginning. the term insurance seemed to find greater favour in the United States.

Risk and Insurance.—Not all risks are insurable, nor is insurance the sole method of dealing with economic risk. Risk itself is the result of hazard. Risk is the chance of loss; hazard, the source of the loss. Hazards may be classified as (1) physical or (2) moral, or as (1) those affecting all members of a community alike, such as business cycles and earthquakes, and (2) those affecting only particular individuals, such as fire and theft. Risks based on a moral hazard are not regarded as insurable. Many of those affecting all members of a community alike, such as unemployment arising out of the business cycle, are insurable only by the device of social insurance to be discussed later.

For insurance purposes it is important to distinguish the two broad classifications of risk, namely (1) pure risk and (a) business or speculative risk. The first is unilateral and negative. involving only the chance of loss. The second is bilateral, including the alternative possibilities of loss or gain. The latter is usually sought by those willing to incur the chance of loss as an appropriate price to pay for the prospect of a possible gain. Only pure risks are regarded as appropriate subjects for insurance. In addition, to be insurable, a risk must be measurable in quantitative terms, for which purpose the law of large numbers and the theories of probability and chance are employed. The law of large numbers is based on the observation that the larger the number of instances taken, the closer the result approaches the theoretical probability. Probability of loss may be expressed as a fraction, of which the denominator is the number of units exposed to loss and the numerator the number expected to be lost within a given period. Assuming adequate data on exposure and loss probability of loss then becomes the ratio of losses to exposed units. To convert the probability of loss into "expectation of loss" or value of the risk. the probability of loss is multiplied by the average value of the units exposed to loss. Assuming, for example, the average value to be $10,000, and probability of loss 10/10,000, the expectation of loss will be 10/10,000 × $10,000 or $10.00. This amount may be called the pure premium or the individual loss-cost-share applicable to each unit in the group. Thus, if each unit in the group contributes this amount and experience conforms to the expectation, all losses will be covered.

In addition to the requirement that risks, to be insurable, must be of the pure variety as described above, and must also lend themselves to measurement in quantitative terms, certain other conditions must be met before the institution of insurance may function. (1) The risk must be genuine, must exist for large groups of people, and its existence must be recognized by a sufficient number to warrant the establishment of an organization or organizations to insure it. (2) Persons exposed to the risk must feel a sense of responsibility for the possible loss and its consequences. (3) Those concerned must possess the resources with which to pay their pro-rata share of the cost or the premiums. (4) The magnitude of the potential loss must be sufficient to cause a real hardship for the individuals upon whom actual losses may fall (magnitude, of course, is important only relatively to the resources of the individual). (5) The events concerned must be accidental, or fortuitous in character; they must occur according to the laws of chance and not be subject to control by those seeking to insure. Finally, (6) a catastrophe hazard must not exist. The character of the risk must not be such that a single occurrence may cause the loss of a substantial proportion of the units concerned.

Risks which ordinarily meet the requirements for insurance, classified according to what may be lost, fall into two broad categories, those which involve loss of income, and those which involve losses of property. Those in the first group may be called personal risks, since they result from hazards to persons, and the forms of insurance which may be applied are called personal insurance. Loss of income to the individual or his dependents may result from death, disability from accident or illness, unemployment, or old-age. Insurance applying to those in the second group is called property insurance. Loss of property may result from damage or destruction of specific property by fire, windstorm, hazards of the sea. earthquake, water leakage, explosion, riot and civil commotion, vandalism, theft, forgery, and, in the case of vehicles and their contents, collision. In addition, loss of property may result from the liability to pay compensation to injured employees under a workmen's compensation statute, or to pay damages because of injury to the persons or property of others. because of negligence in personal conduct or in the maintenance or operation of physical property.

Voluntary or Commercial Insurance.—The modern institution of insurance is divided into the two broad categories of voluntary or commercial insurance and compulsory or social insurance, both relying on the same basic principles but differing in many details of philosophy and organization. The description of insurance as set out above applies equally to both categories. A somewhat narrower definition may be employed, however, to describe those forms falling within the voluntary or commercial category. A widely cited definition was first enunciated by the court in the case of *Lucena* v. *Crawford*, 2B & PNR 269 (H. L. 1806): "Insurance is a contract by which the one party. in consideration of a price paid to him adequate to the risk, becomes security to the other that he shall not suffer loss, damage, or prejudice by the happening of the perils specified to certain things which may be exposed to them." The document evidencing the transaction is known as a policy and the price paid is the premium. Those seeking insurance are required to have an insurable interest. *i.e.*, they must stand to lose by the happening of the event contemplated; otherwise the transaction would constitute merely a wager and would be unenforceable if not actually illegal. Where a proper insurable interest exists, payment of a loss becomes an indemnity, not a gain as would be the case with a wager. Because such interests attach to persons, and because the character of the person is an important element of the risk. the insurance contract is spoken of as a personal contract and is not transferable without the agreement of all parties.

The business of voluntary or commercial insurance as usually conducted falls into four general divisions—life, fire, marine and casualty. In England the term accident insurance is applied to the branch of insurance for which the term casualty is used in United States practice. Marine insurance, which traces its origin back

to the Italian traders of the 1 jth century or earlier, continues as a specialized branch of the business.

In England, particularly, aviation risks are usually insured by marine companies, along with other transportation risks. Life insurance, known to have existed in England as early as 1583. did not merge with other forms to any great extent and only to a limited degree do life insurance companies provide other forms of personal insurance. The sale of annuities is usually coupled with that of life insurance.

Fire insurance, originating in its modern form following the great fire of London in 1666, continued for many years to be concerned with the fire hazard exclusively. Not until the 20th century were the hazards of wind, water damage. explosion and other so-called "allied fire lines" added extensively to the list of those insured by fire companies. The expansion of this branch of fire insurance company operation was particularly marked in the United States.

There, also inland transportation hazards are usually insured by the fire companies.

Personal accident insurance, which came into being about the middle of the 19th century, is a specialized branch of the business, having expanded to include the hazards of illness, hospital and surgical expense and related costs of illness and accident. Other special forms such as steam boiler explosion, glass breakage, employer's liability, public liability, workmen's compensation. automobile insurance as well as corporate bonding are handled by specialized insurers or, in the United States, by so-called casualty carriers.

Only after 1948, in the United States, could a single company on a wide scale offer insurance of virtually all the forms mentioned above. with the exception of life insurance and annuities. This limited "multiple-line" underwriting, as long practised in the rest of the world, was, in the second half of the 20th century, permitted by the laws of nearly all of the states.

The extent to which the various property hazards are insured at different times and in different parts of the world tends to vary with the amount of property subject to loss and with general commercial and industrial development. While life insurance. which may be regarded as typical of their personal forms, depends upon the availability of income for its purchase, the extent to which income is so employed seems to depend more upon the customs and attitudes of the people.

Organization of Commercial Insurance. — The organization for the conduct of insurance on a commercial basis consists of four principal parts, as follows: (1) insurers, whose principal function is to assume and carry the risk; (2) a field organization, the principal function of which is to maintain contacts with the public for the writing of insurance and the settlement of losses; (3) intercompany organizations called associations or bureaus, with a variety of functions including the establishment of standards, the making of rates, research, institutional advertising, dissemination of information, influencing legislation, and other activities designed to promote the interest of insurers; and (4) organizations of agents, called associations or boards. performing many of the functions listed under (3), designed in general to promote the interests of agents.

Insurer organizations fall into two classes, those organized as private enterprises, including individual underwriters. syndicates of underwriters, and corporations or joint-stock companies organized on a capital stock basis; and those organized as co-operative enterprises, including mutual companies or associations, reciprocal or interinsurance exchanges. and a number of special types. Although important at one time, the practice of individual underwriting, so-called because of the practice of indicating acceptance of the risk by a signature written at the bottom of the policy, together with an indication of the fraction to be assumed, largely disappeared. except as carried out through Lloyds of London. The capital stock form of organization is employed to provide all forms of commercial insurance but dominates in the property insurance fields. In general, mutual companies dominate in the field of life insurance.

In property insurance mutuals play a minor role but are a growing factor in the various forms of liability insurance, especially in the United States.

Field Organizations are maintained through a variety of channels. The functions include selling, inspection of property, to some extent underwriting (in this sense, acceptance or rejection of applications or conditions of acceptance to be imposed), and investigation and settlement of claims. Home offices of insurers may, of course. maintain direct contact with the public through their own salaried employees. Inspection and claims are sometimes handled in this way, but sales only rarely. Branch offices, or. particularly in the United States, general agencies, usually stand between the insurer and the sales force. Only in the Cnited States did the insurance agency become a full-time business or profession. Elsewhere direct selling or the use of part-time agents remained the rule. In Great Britain. bankers, merchants and other business or professional men act as agents, and even large owners of property may receive commissions on the insurance sold, in effect, to themselves: a practice frowned upon in the United States.

Associations.—The tendency toward association is highly developed in the insurance business — partly because of the highly technical character of some phases of the business and the need for exchanging ideas, and partly the desire on the part of various groups within the business to establish and maintain standards. A desire to provide protection against damaging legislation played a part in association activities in the United States. In the United States, also, state statutes encouraged property insurers to associate for rate-making purposes.

Government Regulation.—The importance of insurance in modern economies. its technical nature and the difficulty faced by most persons in attempting to appraise contracts and the companies offering them led to some measure of government regulation in all countries. The extent of the regulation varied, however. In the United States. it is quite detailed. Until the 1940s, regulation had been regarded as coming within the exclusive province of state and local governments. In a U.S. supreme court decision in 1944 (Cnited States v. Southeastern Underwriters Association et *al.*, 322 U.S. 533) it was ruled that insurance is commerce and, since insurance transactions traverse state lines. the business falls within the regulatory powers of congress under the commerce clause of the constitution. Subsequently, congress adopted the McCarran act (Public Law 15), giving the states until Jan. 1, 1948 (later extended to June 30. 1948), to revise their regulations so as to meet certain standards laid down in the act. The system of state regulation as revised apparently proved acceptable to congress.

In contrast to extremely detailed regulation in the U.S., British insurance is subject to only a minimum. pursuant to the Companies act, 1929, and the Assurance Companies act, 1909 and 1946.

Social Insurance. — The second broad division of the insurance field, social insurance, is of much more recent origin than voluntary or commercial insurance. The shift from an agricultural and handicraft economy to modern industrial society in the western world brought with it a new type of social insecurity for which social insurance was evolved as at least a partial solution. Germany, under Prince Otto von Bismarck, was the first nation to establish a system of social insurance on a national scale. Sickness insurance, compensation for industrial injuries, old-age and invalidity insurance were included in the original program and survivors insurance was added later. The schemes initiated in Germany relied upon existing institutions for their administration in so far as possible — funds established by community, industry or occupation in sickness insurance. workmen's compensation by trade associations, and old-age and invalidity insurance by territorial institutes. All funds were mutual and costs were shared by employer and worker or borne by the employer alone.

The principle of utilizing existing institutions generally was followed in other countries. Compensation for industrial accidents, received world wide acceptance, but provision for insurance varied widely. Compulsory sickness insurance was adopted in many European countries before World War II. At the same time, a shift from noncontributory pensions to compulsory old-age insurance was well under way. Twenty-one countries. 16 of them in Europe and j in Latin America had such plans, and in many

cases survivors' insurance and invalidity coverage had been-added. Several European countries follo ed England's lead in adopting unemployment insurance.

Social insurance made its appearance in the United States during the 1930s. Following the adoption of old-age pension plans by a number of the states and an unemployment insurance law by one (Wisconsin), the Social Security Act of 1935 provided for federal financial participation in state old-age pensions. aid to dependent children and to the blind, federal old-age and survivors' insurance, and inducement to the states to adopt unemployment insurance plans. After 1935, amendments have increased benefits and extended the scope of old-age and survivors' insurance.

By 1953 the International Labour office estimated that about one-tenth of the world's population had some form of social insurance protection. Included were about 150,000,000 in 45 countries having old-age, invalidity or survivors insurance; about 125,000,000 protected against loss of income resulting from sickness or maternity; about 90,000,000 entitled to unemployment compensation: and 200,000,000 entitled to medical care. (J. E. Hs)

INSURANCE: MISCELLANEOUS. Under this head are considered various types of insurance which are not dealt with under separate heads (see INSURANCE).

Burglary, Robbery, Theft and Larceny. — Insurance against these causes of loss is written on personal property in banks, hotels, stores, offices, factories and dwellings. Each of the perils is defined by policy conditions. Briefly. burglary. requires forcible entry of which there is physical evidence, robbery requires a taking by force or violence, larceny is the unlawful taking of property by an employee with intent to defraud, and theft embraces loss by any dishonest act, including burglary, robbery and larceny.

Banks usually insure against loss by burglary and robbery, and stocks of merchandise are insured against burglary only. Residence contents are covered against burglary, theft and larceny, and! when insured under the personal property floater policy, against all risks, wherever located. Open stocks of merchandise are usually insured under conditions of average (80% coinsurance). To collect full indemnity for a partial loss the insured must have insurance for the agreed percentage of the value exposed to loss.

Messenger, paymaster, interior robbery, safe deposit box, mercantile safe, and money and securities polices cover currency, coins, bullion, uncancelled stamps and contracts representing money or other property, such as stocks. bonds, etc.

Another type of policy covers money and securities against loss through dishonesty, destruction or disappearance. This comprehensive policy, issued to commercial concerns, combines protection once available only under five separate policies.

All Risks. — Jewellery, furs and works of art- may be insured against all risks wherever located, except losses caused by deterioration, vermin and war. The personal property floater on private residence contents is an all-risk policy, excluding only coverage on aircraft, motorboats and automobiles.

Fidelity Bonds and Suretyship. — Corporate suretyship has largely replaced personal guarantees for fidelity, honesty and performance of contracts. Honesty may be insured for individual employees in specified amounts and for groups of employees subject to a limit of recovery in any one loss. The honesty of any employees holding specified positions may be covered. Public officials, court officers, trustees and other persons occupying positions of trust are usually required to furnish bond for faithful performance. The obligor who gives bond, the obligee to whom the bond runs and the surety which guarantees the performance are all parties to the bond. Building and supply contractors are usually required to furnish a surety bond. Under all bonds the surety investigates the character and past record of the obligor; and, under contract bonds, his financial and skilled ability to perform the contract to be guaranteed.

Plate Glass. — Essentially an insurance against breakage, the risk of fire is excluded from the plate-glass policy. Only glass specified in the policy is insured. and wooden framework and lettering. The latter, unless specially insured, is not covered. Premiums are calculated according to the superficial area and type of glass to be insured. Stained and other valuable glass, lettering and painting are rated on a percentage of value. Although the policy provides' that the insurance company may replace damaged glass or reimburse the insured in money. the company nearly always elects to make replacement.

Third-Party Insurance. — Indemnities in respect of the legal liability of individuals or corporations to pay compensation to third parties for personal injuries or damage to their property caused by negligence on the part of an employer or his employees, or by defects in the ways, works, machinery or plant used in the employer's business, are almost universally sought. Policies are issued to cover the insured's entire legal liability, excluding, however, liability to a member of his family or to a person in his service. or liability assumed under contract. Within the limits of indemnity selected the insured is relieved of all monetary responsibility, including law costs incurred in defending claims) fraudulent or otherwise. All claims negotiations are conducted by the insurers who may if they wish relieve themselves of all further liability at any time by paying to the insured the maximum sum for which they are liable in respect of any one accident. The limit of indemnity stated in the policy is the insurance company's limit of liability ior all damages arising out of one occurrence. Policies suitably modified may be obtained by almost every kind of business. For individuals and householders the comprehensive personal liability policy provides this protection.

Property Owners Indemnity. — Called "O. L. & T." (owner's, landlord's and tenant's) liability insurance. these policies protect the insured against claims by third parties for bodily injury and damage to property sustained on owned or occupied premises. Claims of this nature arise out of allegedly slippery floors, stairs with broken treads or without. guardrails, acts of domestic animals, falling shingles. copings or ceiling plaster and similar causes. Claims by servants and other employees are not covered. For private dwelling owners or tenants the insurance under O. L. & T. policies is included with other coverage under the comprehensive personal liability policy.

Hail. — Hail insurance is carried mostly to protect growing crops, policies being written for the principal ones. The coverage is limited to a given maximum amount per acre for each type of crop, and the rates vary with the crop and the territory. In general the liability of the insurance company applies only aiter the crop is in a healthy growing condition.

Earthquake. — Coverage against loss by earthquake or volcanic eruption in some earthquake zones is written under supplemental contracts attached to fire insurance policies. with a deductible of 5% of the value of the insured property. The "fall of building" clause in the fire policy may be deleted for an additional premium. Elsewhere such insurance is written under separate policies with average conditions (50% coinsurance). A "bridging the gap" endorsement in these policies assumes loss by fire if the fire insurance ceases when the insured building is caused to fall by earthquake. In the United States, the Pacific coast and some of the most populous eastern states are in the zones carrying the highest earthquake insurance rates.

Tourist Baggage. — This limited form of insurance against loss by fire, transportation perils and theft covers wearing apparel, travelling equipment. portable typewriters and similar personal effects. while in transit or in the custody of common carriers, hotels, or parcel check rooms. This protection is included in the personal property floater policy.

Explosion. — Damage to the insured's property and claims by third parties for bodily injury or damage to their property, when caused by explosion of power boilers. pipes. flywheels, engines, and machinery are insured by casualty insurance companies. Explosion damage caused by heating boilers with a pressure of less than 15 lb., their connections and appurtenances in dwellings, factories and office buildings is insured by fire and casualty insurance companies.

Use and Occupancy. — Known also as business interruption indemnity or net earnings insurance, this form of consequential

loss insurance is widely carried by manufacturers and by retail and wholesale merchants. It may be purchased on a gross earnings basis with coinsurance conditions or upon net earnings with a daily or weekly limit of liability. It indemnifies for loss of earnings and fixed expenses which would have been earned by the business of the insured if not interrupted by the occurrence of the peril insured against, such as fire: windstorm, explosion or earthquake.

A form of use and occupancy insurance called extra expense insurance is frequently carried by banks. newspaper publishers and laundries. to reimburse them for the extraordinary expense of carrying on their services in rented quarters. or hiring the services of competitors to prevent interruption of business, follon-ing an insured catastrophe in their own premises.

Health.—When purchased in conjunction with accident insurance. coverage is obtainable by employed men and women to pay a weekly sum while the insured is totally disabled by illness, and a lesser sum while partially disabled. Policies are issued to those between ages 16 and 49. and. at increased premium rates. to those between ages 49 and 54. Payments are usually limited to 104 weeks. The rates for women are generally about 35% to 40% higher than for men. Coverage may be added for hospital Eees. nurse hire and surgical Eees upon payment of an additional premium. Policies may be had at reduced rates when the insurance payments begin one to four weeks after the beginning of disability.

Group Insurance. — This term usually applies to life and accident and health insurance. and to pension or annuity contracts. written to cover a group of lives such as all of the employees of one employer. The rates are based upon averages without physical examinations or individual applications.

(L. E. F.)

Hospital, Medical and Surgical. — The development of nongovernmental health insurance was a phenomenon of the first half of the 20th century. Although there were earlier experimental ventures. the British hospital schemes and Blue Cross plans in the United States and Canada after 1930 first provided popular mediums suitable for widespread effectiveness. Australia developed a pattern of government subsidy to approved private programs.

In England. the voluntary schemes gave way in 1948 to national health insurance under the Labour government, although some schemes continued to provide supplementary coverage. On the European continent. universal governmental programs providing benefits at varying levels became the general pattern; programs in some countries were begun in the 19th century.

The Canadian Hospital and Diagnostic Services act of 1958 provided nearly full hospital service in public nard accommodations; the program is administered by the provinces, all of which except Quebec had elected to participate in the program by Jan. 1959. Thereafter the United States remained the only important country without some form of compulsory national health insurance.

Blue Cross plans, sponsored by hospitals and the medical profession, pioneered in coverage of dependents and such risks as maternity. and provided certain items of hospital service regardless of their actual cost, usually in semiprivate rooms.

Commercial insurance companies in the United States. which prior to 1930 concentrated their health activities on loss of income insurance, followed Blue Cross by developing indemnity coverages providing dollar amounts toward room accommodations and a multiple of that amount (frequently ten times) toward ancillary services.

Surgical and medical coverage developed later, but began to catch up with hospital coverage in the middle of the century. Proportionally, independent programs extended further in the field of medical insurance than in either hospital or surgical coverage. Their basis of operation, usually through group medical practice, facilitated this. (A. G. S.; X.)

For aviation insurance: *see* AIR LAW; damage to machinery insurance: *see* ENGINEERING INSURANCE; drivers' policies: *see* MOTOR VEHICLE INSURANCE; lightning insurance: *see* FIRE INSURANCE; riot and civil commotion insurance: *see* RIOT AND CIVIL COMMOTION INSURANCE; social insurance: *see* SOCIAL SECURITY; soldiers' insurance: *see* WAR PENSIONS; tornado insurance: *see* TORNADO AND WINDSTORM INSURANCE.

INSURGENCY, the status of being in armed rebellion. (To distinguish insurgency from aggression and belligerency, *see* AGGRESSION; BELLIGERENCY.) The objective sought by insurgents may be either a change of government or independent statehood. Insurgency has sometimes been described as a status intermediate between tranquillity and civil war. But what degree of organized control of armed forces and territory is necessary to transform an insurgent band into a rebel government fighting a civil war cannot be precisely defined.

Illustrative of this problem was the situation in Greece following World War II, which was characterized by uncertainly delimited and transitory territorial control. Greek insurgents operated from Albanian, Bulgarian and Yugoslav territory to which they fell back when hard pressed, only to recross the Greek border at another place.

Ill-defined limits to insurgent territory are common in the earlier stages of rebellion. An example is China before the Communists had consolidated their territory and established regular and extensive battle lines.

In international law an insurrection is a rebellion that has not attained the status of belligerency. Belligerent status arises from recognition of that status by existing states at the discretion of each. States recognizing belligerency assume duties of neutrality toward both parties.

Recognition of insurgency is a recognition of fact. It may entail limited intercourse with insurgent authorities and acquiescence in some of their acts of war. It does not entail the acceptance of duties of neutrality by the foreign state. The insurgents' right of making war is restricted to the territory and forces of the legal authorities and to foreign forces actively engaged in hostilities against the insurgents. For example, no right of visit and search of neutral vessels on the high seas is admitted by a state recognizing insurgency.

The parties to the four Geneva conventions of 1949 concerning war victims *(see* GENEVA CONVENTIONS) undertook certain duties toward insurgent forces complying with the laws of war. Minimum standards were established for the treatment of persons who had taken no active part or who had surrendered or been rendered *hors de combat* during "an armed conflict not of an international nature." These standards were made applicable not just to states but to "each party to the conflict," thereby embracing insurgents. *(See* PRISONERS OF WAR.)

Several terms have been used to describe units that fight under an insurgent banner. The terms revolutionaries and rebels have been applied to insurgents generally. both civilian and military. In both internal and international war, "volunteer" has been used to describe units hastily formed at the approach of an enemy and also units of foreign personnel, including, in Communist usage, the large numbers of Chinese engaged in the Korean hostilities. The term *francs-tireurs* ("free shooters"), describing French units formed during the Franco-Prussian War. has sometimes been used to refer to guerrilla bands in general. *Guerrilla* and *partida* (partisan), Spanish terms dating at least from the Napoleonic Wars, refer to irregular forces that strike and then melt into the populace.

Because partisans often are hard to distinguish from civilians, many writers have regarded them as illegal units. However, after World War II the Allied war crimes tribunals did not treat all partisan groups as outlaws. The 1949 Geneva Convention on the Treatment of Prisoners of War accorded benefits in both internal and international conflicts to members of irregular units that conform to the Hague Regulations on Land Warfare (1907) requiring a commander, an emblem recognizable at a distance, arms carried openly and obedience to the laws and customs of war. Insurgents are violators of the national law of their country and subject to punishment under that law. The Geneva 1949 regulations require judicial procedures in trials for treason and similar offenses. Insurgents possess privileges that expire with the loss of quasi-sovereignty. Only a successful insurgent community acquires the

more enduring rights and obligations of sovereignty. *See* also WAR; GUERRILLA WARFARE; BANDITRY. (W. L. GD.)

INTEGER: see NUMBER.

INTEGRAL CALCULUS: see CALCULUS, DIFFERENTIAL AND INTEGRAL.

INTEGRAL EQUATIONS. An integral equation is one in which the unknown function $f(x)$ appears in the integrand of some integral. One of the standard forms of such equations is

$$f(x)=g(x)+m\int_a^b K(x,y)\,f(y)\,dy$$

where $f(x)$ is the unknown function, m a parameter, while $g(x)$ and $K(x,y)$ satisfy certain continuity conditions.

The equation given above is customarily called a Fredholm equation after the Swedish mathematician. E. I. Fredholm, one of the early workers in this field, while one for which $g(x)=0$ is sometimes referred to as a Volterra equation, after the Italian mathematician, Vito Volterra.

The introduction of such equations is probably due to Pierre Laplace (1782) who considered integral equations of a simple type in conjunction with his work on differential equations. J. B. Fourier also considered particular integral equations in his work on expanding functions in terms of series of trigonometric functions. N. H. Abel in 1823 proposed a generalization of the problem of determining the curve for which the time of descent of a particle is a given function of the vertical height, the solution of which involved an integral equation. After that, many problems in physics arose whose solution involved the use of integral or integrodifferential equations. the latter being equations which involve both integrals and derivatives of the unknown function.

In the early part of the 20th century, integral equations were assiduously studied by David Hilbert and his followers. Later, extensions were made by considering equations of this type which involved the newer types of integrals, such as the Lebesgue or Stielties integral. Various criteria for the existence of solutions of such equations and methods for obtaining the solutions have been developed. Generally, solutions are found in terms of series or sequences of functions by methods involving series, successive substitutions. determinants, etc.

The equation

$$f(x)=m\int_a^b f(y)\,K(x,y)\,dy$$

has the obvious solution $f(x)=0$. It can be shown that other solutions exist for suitably chosen values of m, called characteristic values, and that associated with them is a sequence of orthogonal functions, the characteristic functions. Properties of these functions and the problem of expanding arbitrary functions in terms of series of them have been studied.

Integral equations are also closely related to certain boundary value problems which arise in differential equations. In the study of problems in physics involving the flow of heat or electricity, potential theory. or the motion of a vibrating membrane, differential equations arise whose solutions must satisfy certain boundary (side) conditions.

It was early noted that the solutions of such problems mere related to the solutions of certain integral equations. These relationships have been studied, and many of their applications discussed:

INTELLECTUALISM, a term applied, sometimes in a derogatory sense. to the tendency to emphasize or overemphasize the importance of thought at the expense of feeling or volition, or even of sensation and intuition. In moral philosophy intellectualism tends to identify virtue with knowledge, evil with ignorance.

In the theory of knowledge intellectualism or rationalism attaches more importance to thought than to sensation or intuition. In ontology it conceives the ultimate nature of reality to be some kind of intelligence, or at least regards the universe as intelligible through and through.

In Psychology it treats cognition as the primary mental function, as more fundamental than feeling or volition. In *aesthetics* it stresses the importance of the ideas expressed in. or suggested by, the object of aesthetic appreciation. In the sphere of religion intellectualism tends to attach supreme importance to theological doctrine or to religious philosophy rather than to religious sentiment or intuition.

INTELLIGENCE. The word intelligence (*inter-legentia*) was introduced by Cicero as an almost literal translation of Aristotle's term dia-noesis. In the scholastic psychology derived from Aristotle, its use implied a preference for the twofold classification of mental characteristics into intellectual or cognitive (*i.e.*, discriminative and directive) characteristics, as contrasted with dynamic or orectic (*i.e.*, affective and conative), which Aristotle proposed in place of the threefold scheme favoured by Plato. "Intelligence" was thus the abstract quality common to. and peculiar to, all "intellectual" processes; *i.e.*, sensation, perception, memory. imagination, reasoning and the like (see PSYCHOLOGY).

With the decline of the scholastic faculty psychology, the term dropped out of use, but it was revived by Herbert Spencer, who gave it a biological interpretation. The conception of intelligence as an inherent characteristic of the human mind he expressed by describing it as inherited and therefore innate; and. as its distinctive behavioural manifestation, he emphasized the way in which the more intelligent type of animal adapts or adjusts its activities in the face of its complex and ever-changing environmental circumstances.

In the writings of Spencer and his successors — Sir Francis Galton, Alfred Binet, Cyril Burt and C. E. Spearman — the word intelligence therefore acquired a standard meaning as a technical term, and has usually been held to imply three basic distinctions: (1) it connotes a cognitive or intellectual capacity, as distinct from other characteristics of the total personality; (2) it implies a general quality (i e, it enters into all types of intellectual processes and is not specific to any one type of ability); (3) it is an inborn or innate quality, as distinct from those abilities that are acquired through individual experience at home, at school or elsewhere.

In the first instance this concept of an inborn, all-round, general ability was derived mainly from introspection, general observation and philosophical speculation or reason. The conclusions so reached therefore required to be more closely checked and verified by experiment and statistical analysis. The leaders in this scientific approach were Galton (*Human* Faculty, 1883, and later writings), Binet (1890–1911) and students of animal psychology such as C. Lloyd Morgan (1890), E. L. Thorndike (1910) and Wolfgang Kohler (1915). The first effective tests of intelligence (partly suggested by those of Galton) were developed by Binet and his collaborators in France, revised for other countries by Burt (Britain), W. Stern (Germany) and Lewis Terman (U.S.) and the earliest systematic studies (based on the statistical methods introduced by Galton) were those of Karl Pearson, Spearman, Burt, Thorndike and William Brown.

The method adopted by the leaders in their numerous inquiries involved a combination of experimental testing and statistical analysis. It consisted essentially in observing what mental capacities tend to go together, and it led to the theory that there does exist in human beings a single broad mental power (additional to various special abilities) which may be called general intelligence On comparing the efficiency of various types of test, it appears that intelligence is revealed particularly in good use of verbal symbols. ability to perceive analogies. capacity to abstract and classify, mathematical ability, problem solving and those capacities for understanding relations and causal connections which have been increasingly invoked in experiments on intelligence.

Some educators believe erroneously that intelligence is defined by a mere average score on whatever combination of such subtests a psychologist happens to use. But the exact weights to be given are actually fixed through intelligence's being uniquely and objectively defined by the simple structure criterion in factor analysis. The typical mental processes in such "highly g-saturated" performances can be seen by inspecting such modern tests as the

Stanford-Binet, the Murray House tests and Raven matrices in Britain, the American Bellevue-Wechsler and A.C.E., the Cattell Culture-Fair scales and the Thurstone Primary Mental Abilities battery.

Biological Conditions. — The effects of age and of inheritance as indicated by results obtained with tests of intelligence (as above defined) have become well understood through the work of such researchers as Terman, Burt and Jean Piaget. There is a rapid augmentation of reasoning and perceptual ability between 3 and 6 years of age, followed by a flattening of the development curve around 14 years of age. Indeed, after 14 there is negligible increase in the basic ability to understand the most general relations.

Nevertheless, the individual increases his actual problem-solving capacity by increased knowledge and can better perceive relations in special fields when given close acquaintance with the particular problems of those fields. After the age of about 23 there is actually a slight decline in score on speeded intelligence tests (*i.e.*, as they are usually given), but, if reasoning capacity without speed is tested, no such decline occurs. unless and until senility supervenes. Considerations of age trend. brain injury, effect of speed limits and content have lent support to a theory by R. B. Cattell that after childhood it is necessary to deal with two distinct but highly correlated general ability factors. fluid ability, which resides most in perceptual and speeded tests and shows age changes, and crystallized ability, which is invested in more specific intellectual habits and unspeeded tests, showing no age decline.

No significant differences in intelligence have been found between men and women, and it is not even certain that qualitative differences, as shown by the somewhat higher scores of men in mechanical reasoning and of women in verbal ability, may not be considered as temporary cultural effects. On the other hand, there is ample evidence from comparing the intelligence of identical twins reared in different homes with that of, for example, unrelated children reared together that intelligence is largely inherited. Burt among others presented evidence for the inheritance of differences in intelligence, the correlations and other constants agreeing closely with what mould be expected if intelligence (like stature and other graded characters) were transmitted in accordance with the Mendelian laws for multifactor inheritance.

The usually accepted figures, based on the soundest and most extensive studies (*e.g.*, of Barbara Burks in the U.S. and Burt in Britain) employing verbal intelligence tests, assign 75% to 80% of the observed test variation in the general population to genetic factors and the rest to environmental physical and mental conditions and opportunities in home and society. Later work by Cattell, G. F. Stice and N. F. Kristy, using the Culture-Fair tests and improved statistical designs, gives a value of 78:22 to the heredity: environment variance ratio in the general population. but shows that this arises from a 70:30 ratio for intelligence variation within families and a 93:7 ratio for variation *among* families. In all these researches. whatever unreliability exists in test administration and scoring tends to inflate the percentage assigned to environment. By contrast, no experimental design has been found for reliably assigning to heredity and environment the true fractions of the appreciable differences of average intelligence test score found among widely different races.

Piaget, G. D. Stoddard, G. A. Ferguson and others experimented and hypothesized on the manner in which environment produces its effects, leading to concepts, based as yet on statistically insufficient experiment, of the trial-and-error formation of "schemata" and "transferable generalizations" in the mind of the child. On the other hand there is no clear evidence of imprinting; *i.e.*, of exercise at the right maturational moment being essential to development of function. Psychologists have given insufficient attention to physical, especially uterine, environment as a source of the observed environmental, nonhereditary variance in intelligence.

Social and Educational Associations and Uses of Intelligence Measures. — Tests of intelligence are validated in a pragmatic sense by the widespread finding that what is called intelligence in social and educational evaluation turns out to be closely identified with what is measured. Thus children drafted to schools for mental defectives score very low, selective schools average above other schools, and universities above high schools. Test scores are predictive of educational success and of occupational success in most (especially complex) occupations.

Socially there is a slight tendency for higher social class (or complexity of occupation) to be associated with higher intelligence score, even on culture-free intelligence tests, and this fits the school observation that some trend exists for better mental capacity to segregate to better social status levels. Nevertheless, the greatest absolute storehouse of high mental capacity is the lower middle class — skilled and semiskilled workers — because it is the largest class in sheer numbers.

Since it has been shown that. even in the same social class, less intelligent parents tended, in the first half of the 20th century, to produce a larger fraction of the following generation, it is probable that. apart from dominant genes and a survival rate favouring the intelligent, a decline occurred in average intelligence in industrial countries in the first part of the century. However, a survey around 1950 showed that the negative correlation of intelligence with family size had been much reduced in Britain and had practically vanished in Sweden.

Surveys in the U.S. suggested that the national resources of intelligence, for supplying persons fitted for training as higher scientific, administrative and professional workers, are not so great as once had been thought. Of persons with the requisite intelligence and monetary support to obtain, for example, a medical degree, perhaps only one-fifth also have the persistence to face continuous study or the temperamental qualities to deal with the emergencies and social demands of such a profession.

Attention to resources of intelligence. particularly in regard to manpower for scientific research, led to application of intelligence tests still more widely in industry and education. Their use in selecting for military promotion and specialized training in World War II was very extensive. In the U.S. systematic surveys of community intelligence were proposed and pursued by J. B. Wolfle, R. L. Thorndike and others, while in Britain the nation-wide systematic guidance of children at 11+ years of age into different educational streams, affecting curriculums and careers, is made about equally on intelligence tests and on school achievement at the time.

Physiological Basis of Intelligence. — This is a complex matter about which only a few basic concepts receive general agreement. From a comparison of differential animal species it has long been evident that intelligence is closely correlated with the size of the cortex or that fraction of the brain which is not directly concerned with internal bodily adjustments, muscular balance, etc. Brain operations on animals show that the decline in problem-solving capacity, as well as in the ability to learn complex habits, is just about proportional to the weight of brain removed. Brain injuries in man point to the same relation. A particular habit or capacity may be lost through injury and may be relearned, but there tends to be a loss in general power of abstraction and problem solving roughly proportional to the extent of cortical damage. In the human brain certain areas appear to be definitely associated with relatively specific bodily functions; *e.g.*, the area at the back of the head with visual perception, other areas with hearing, touch, smell, etc., others again with voluntary movement.

Intelligence, however (in the technical sense), according to most anatomists, is associated with somewhat general structural qualities characterizing the brain cortex as a whole. Thus, microscopic studies of the brains of low-grade defectives show that their nerve cells are comparatively few in number and exhibit comparatively few branches, and both the cells and their branches appear to be arranged far more irregularly than those of the normal person of the same age.

No drug that significantly increases intelligence in normal persons is known. Caffeine in coffee (as well as Benzedrine and related drugs) produces increased problem-solving ability, largely by improving memory and alertness. However, in depressed mental patients such drugs have been shown also to lead to significant improvements — returns to normal — in general intelligence-test performance.

On the other hand, there are many special physiological influences that will reduce intelligence. Twenty grams of alcohol will produce, in the average person, a measurable decline in intelligence-test performance or other forms of judgment; failure of thyroid secretion produces a considerable decline, as is well known through the history of cretinism; and failures of judgment are rapidly produced by anything that interferes with the supply of oxygen to the brain.

Intelligence in Animals. — The capacity of animals, even of the higher apes, to perceive complex relationships is far below that of adult man and seldom exceeds the level of a three-year-old child, yet it is of the same nature as the intelligence of man. Blind trial-and-error behaviour, the very antithesis of intelligence, is common in animal behaviour. But if animals are presented with sufficiently simple problems, such activity is observed to give way to a thoughtful pause, followed by sudden insight and rise to a new level of adaptive but untaught behaviour. In Kohler's classical experiment a chimpanzee given two hollow sticks, each too short to reach a banana outside the cage, was observed thinking and then fitting one stick into the other to provide a new tool long enough to do the job. Similar switches from random behaviour to "insightful" solutions have been observed experimentally in dogs and even in hens. However, the majority of complex and seemingly very intelligent things that animals do represent either inherited patterns, which go mildly astray anywhere outside the natural environment, or are the result of prolonged, blind. trial-and-error learning, as in most circus animals. Most of their relation-perceiving capacity is concerned with spatial or very simple causal relations, and they conspicuously lack the ability to abstract, generalize and deal with relations between abstractions which makes possible man's use of general symbols in language, mathematics, etc. See also ANIMAL BEHAVIOUR; PSYCHOLOGY, COMPARATIVE.

Relation of Intelligence to More Specialized Abilities. — Spencer, in his account of the development of cognitive capacities in the race and the individual, held that the general cognitive capacity which he termed intelligence progressively developed into more specialized abilities. The application of factorial methods to the results obtained with mental tests provided some confirmation of this view. Between 1913 and 1917 a series of investigations among British school children of various ages provided conclusive evidence for certain special abilities (*e.g.*, verbal, numerical, manual and spatial abilities) as well as more formal capacities such as memory and imagination.

Among younger children the general factor of intelligence accounted for the greater part of the individual differences; but aith increasing age there appeared increasing specialization, most of the more specific abilities maturing before the end of the pubertal period. In the U.S. a number of researches carried out between 1930 and 1950 by Louis Thurstone and his colleagues threw further light on the number and nature of these more specialized capacities.

The primary abilities (as Thurstone termed them) include what may be labeled as verbal, numerical, spatial, reasoning, perceptual and other capacities of restricted form. A person may develop to a considerable extent in all aspects of one of the forms of ability without equivalent development in the others, though there is also some tendency for all of them to be related as different manifestations of one general intelligence. The causes of these differential developments, whether innate or depending upon interests and environment, are not known.

The measurement of intelligence and of primary abilities was first undertaken with such objectives as that of giving better guidance to pupils in school, selecting men for more complex occupations and, at the lowest levels of ability, separating children who are merely retarded in school through absence, etc., from those who are feeble-minded.

The movement which then began succeeded brilliantly in a practical sense and added greatly to the theoretical grasp of intelligence and its associations. On the practical side the separation of mental defectives became far more reliable than it had been, and the special needs of those who lack that minimum of intelligence necessary to take care of themselves came to be better understood. Bright children also can be picked out with greater reliability than by ordinary examinations, and good predictions of their rate of learning can be made. For example, future performance in such areas as essay writing, mathematics and classics, are closely associated with level of intelligence, but drawing, geography, music and athletics are less predictable, because they depend more on special aptitudes.

Intelligence Contrasted With Related Powers. — The reverse procedure from that of predicting adult accomplishment from childhood performance was carried out in Terman's studies of the childhood records of well-known men of genius. These performances, compared with those of living children of known ages, show that children who became geniuses showed intelligence decidedly above their age, though some (*e.g.*, Charles Darwin) did not do well in school. Genius, as the follow-up studies of highly intelligent children show, requires something more than intelligence — perhaps also that touch of madness of which John Dryden wrote ("Great wits are to madness near allied, and thin partitions do their bounds divide"). But intelligence is the first ingredient. Creative imagination has a considerable association with intelligence, though always some indefinable additional power is found at work.

On the other hand, though intelligence, as capacity to comprehend, must be analyzed out from the total realm of intellectual performance, it is astonishing to see how many apparently unrelated powers are actually considerably dependent upon intelligence. Though memory can be conceptually separated from intelligence. goodness of memory (in all but rote, or meaningless, memory) is highly related to goodness of intelligence. The size of the vocabulary, for example, is an excellent indication of intelligence. Again, intelligence operates not only in reasoning but in almost every act of perception, so that the ability to judge where a ball will be in a game of tennis involves intelligence. However, although it is clear from both human and animal psychology that by intelligence is meant the capacity to perceive and handle relationships, and that by higher intelligence is meant capacity to handle more complex relationships. the logician has not yet come to the psychologist's aid by indicating criteria through which the "complexity level" of a relationship, in the hierarchy of relationships, can be independently stated. Until that is done. there is some degree of circularity in the definition of higher intelligence. See also PSYCHOLOGICAL TESTS AND MEASUREMENTS; PSYCHOLOGY; THINKING AND PROBLEM SOLVING, PSYCHOLOGY OF.

BIBLIOGRAPHY. — C. L. Burt, *Factors of the Mind* (1940); R. B. Cattell, *Personality and Motivation Structure and Measurement* (1957); W. C. Halstead, *Brain and Intelligence* (1947); W. Kohler, *The Mentality of Apes,* trans. by E. Winter (1925); J. Piaget, *The Origins of Intelligence in Children,* trans. by M. Cook (1953); L. M. Terman and M. A. Merrill, *Measuring Intelligence* (1937); L. L. Thurstone, *Primary Mental Abilities* (1938); P. E. Vernon, *The Structure of Human Abilitias* (1950). (R. B. C.)

INTELLIGENCE, ANIMAL: see ANIMAL BEHAVIOUR; PSYCHOLOGY, COMPARATIVE.

INTELLIGENCE, MILITARY AND POLITICAL, the acquiring of information on a national scale, usually about a rival. but sometimes about an ally or a neutral country. Counterintelligence (or security) is the safeguarding of a country's own secrets. Although mainly related to war and to defense measures in peacetime, intelligence and counterintelligence are also concerned with the collection and safeguarding of diplomatic, economic and industrial information. Clearly the acquisition and safeguarding of information are closely associated; in most countries they are both the concern of the same organization.

The effectiveness of counterintelligence measures may often depend on the amount of positive intelligence available; correspondingly. the efficient acquisition of information may hinge on adequate security. Intelligence work involves not only the collection of information, but also its collation and the estimation of its value and reliability, and the making of reasonable deductions from it.

The outstanding examples of intelligence designations in accordance with the general purpose for which the intelligence has been

produced are strategic and tactical. Strategic intelligence is designed primarily to satisfy the needs of the strategic planners and policy makers of national governments or very high-level commands.

Tactical intelligence, which is known also as both combat and operational intelligence, is intended chiefly for use by military tactical commanders and units. For example, the broad intelligence which influenced the Allied decision to attempt a major landing on the Normandy peninsula in World War II was strategic; the detailed intelligence used in the preparation of military plans for carrying out this strategic decision was tactical.

Designations of intelligence according to subject matter are numerous and continue to multiply with the increasing division of labour and specialization in large and complex intelligence organizations, especially at the government or strategic level. For example, military intelligence, which was once the comprehensive term for all intelligence relating to military matters, has been partially superseded in practice by army, air and naval intelligence. Each of the latter three, in turn, has been broken up into several fields of intelligence specialization. Order-of-battle intelligence, for instance, deals largely with the organization, strength, disposition, weapons, equipment, logistics, training and tactics of armed forces.

Geographic intelligence, the comprehensive term for land. sea and air data required for military plans and operations, includes several subdivisions of major importance, such as topographic, hydrographic, weather and meteorological intelligence. Transportation intelligence, which was once an integral part of geographic intelligence, has itself become a separate major field. Tremendous advances in the weapons and equipment of warfare have led to the emergence of technical intelligence as a field of vital importance to national security everywhere. Part and parcel of technical intelligence is scientific intelligence, which has brought forth its own progeny of intelligence specializations on nuclear fission, electronics, guided missiles, telecommunications and chemical and biological warfare.

The fields of political, economic and sociological intelligence have come to be regarded as having great importance for a nation's armed forces as well as for its foreign service. Military scientists are in general agreement that the military planner and policy maker must know the governmental structure, the political groupings, the national policies and objectives, the industrial complex and the social matrix of a potential enemy. Moreover, commanders of forces operating in foreign countries must be similarly informed if they are to deal effectively with guerrilla and resistance activities, satisfactorily administer local government on a wartime basis and conduct a sound psychological program. The fact that the Nazis either did not have or did not use adequate political, economic and sociological intelligence on the Soviet Union has often been cited as a significant factor in the failure of the World War II invasion of the U.S.S.R. by Germany.

Historical. — From earliest times, rulers and governments have attempted to acquire information about rival countries, and rival armies about their opponents and about the topography and other matters in a probable theatre of military operations. Local military information during a campaign, or before battle, was sometimes obtained from local inhabitants, but more often by means of cavalry patrols, while long-term information was obtained through agents (or spies), traitors and casual travelers.

Indeed, the history of intelligence, as distinct from military reconnaissance in the field, is very largely the story of agents and spies. To define a spy precisely is difficult and the word has slightly different meanings according to the country and conditions. A man seeking information while dressed in military uniform is generally considered not to be a spy or an agent but a scout who, if apprehended, is entitled to treatment as a prisoner of war. On the other hand, one whose role is to obtain secret information, by clandestine methods while dressed as a civilian, is an agent or spy and in most countries is liable to the death penalty if caught.

Further, an individual may be a traitor as well as a spy or an agent if he works for a foreign country against his own. Difficulties arise in interpreting these definitions in the case of irregular forces who do not wear proper or easily recognizable uniforms and with revolutionary forces. (*See* ESPIONAGE; PRISONERS OF WAR.)

From the middle ages to the late Renaissance diplomacy and intelligence were so closely bound together that foreign ambassadors were sometimes regarded as little better than spies. In particular, the Venetian republic established embassies and missions abroad and made a point of obtaining what would now be considered remarkably full intelligence reports from its ambassadors and agents. In England espionage was a serious business by Elizabeth I's reign, when an elaborate intelligence system was organized by Sir Francis Walsingham (*q.v.*) in order to obtain information from the continent. mainly from Spain. So great was Walsingham's enthusiasm for intelligence work that, in the absence of public funds, he devoted almost the whole of his considerable private fortune to furthering it.

More than a century later, in the reign of Queen Anne, the chief organizer of British intelligence was Daniel Defoe, who may be said to have been the founder of the modern British secret service — a role in which the author of *Robinson Crusoe* is not familiarly known.

Espionage flourished in the Napoleonic Wars and it is difficult to select individuals for special mention. Perhaps Napoleon's great intelligence organizers, Joseph Fouché and René Savary (duc de Rovigo), were the best known and most successful. Much of Napoleon's military success was a result of the diligence with which his famous chief of staff, Marshal Louis Alexandre Berthier. collected information in the field.

Until several years after the Napoleonic Wars intelligence activities were greatly restricted by the limitations of communications. The horse was in those times the swiftest means of travel on land and the sailing ship by sea. These were also the quickest agencies for passing information, with the exception of the carrier pigeon — popularly believed to have been used to convey the result of the battle of Waterloo to Nathan Mayer Rothschild in London. This means, however, was not practised extensively or properly understood until later, by which time it had been superseded by telegraphy.

The limitations of the times were naturally less hindrance to the collection of long-term, or strategic, information than to that of tactical or battle intelligence. Rival navies were nearly always completely in the dark about each others' movements, the first warning of the approach of an enemy squadron invariably being given by the lookout in the crow's-nest of a scouting frigate only a few miles ahead of the main fleet. On land, comparatively large armies could bivouac or maneuver within a few miles of each other in mutual ignorance. In spite of his considerable force of cavalry Napoleon was unaware of the direction of the withdrawal of Marshal Blücher's Prussian army after Ligny and Quatre-Bras and was largely surprised when it reappeared on the battlefield of Waterloo 48 hours later.

Developments Since the Mid-19th Century. — The latter half of the 19th century saw revolutionary changes in means of transport and so of passing information. Railways, the steamship, the submarine cable and the telephone, and the internal-combustion engine all played their part. Together with developments in other fields, these increased the tempo of diplomacy. Under these conditions a good intelligence service paid large dividends and in consequence the great powers tended to maintain intelligence organizations of ever-increasing size and efficiency. The 20th century was to witness the introduction and rapid development of aircraft and the universal use of wireless telegraphy — two inventions which further increased the potentialities of a good intelligence system.

Apart from new scientific aids, the general conditions of World War I favoured intelligence activities in neutral countries. In western Europe — the main theatre of war — the rival armies faced each other in static positions at close quarters for four years, on a front extending from the English channel to Switzerland. This line of battle was flanked by neutral countries — the Netherlands and the Scandinavian countries to the north and Switzerland to the south — where spies and agents of both sides could work in com-

parative safety. British intelligence earned a deservedly high reputation during the years 1914–18. Two of its earliest successes were the immediate and unobtrusive arrest on the outbreak of war of practically all enemy agents in the United Kingdom, and the acquisition of the German naval cipher, which, for some time, gave the British admiralty prior notice of all major movements by the enemy fleet. M.I.5 became a legendary organization and. it must be confessed, often got credit which was properly due to other agencies.

World War I produced many agents who worked in neutral countries as well as from belligerents. Among the best-known was the German Kapitan Franz von Rintelen who was sent to the United States in 1915 to sabotage American aid to the Allies. The security measures in neutral America at that time were lax, as the United States had up to then escaped the intensive espionage activity which Europe had experienced for centuries. In consequence von Rintelen had considerable success, until U.S. entry into the war in April 1917 put an end to his activities. Perhaps the most publicized spy of all time was the Dutch-born agent known as Mata Hari (born Margaret Gertrude Zelle) who operated in Paris, Rome, Vienna, Berlin and other continental cities, from 1905 until her execution as a spy in France in Oct. 1917.

Long before the outbreak of World War II in 1939 intelligence and counterintelligence had ceased to be solely concerned with diplomatic and military secrets; it became one of the main duties of a national intelligence service to uncover industrial and scientific data on which the war potential of its enemies, or likely enemies, increasingly relied.

After the end of hostilities in 1945 "cold warfare" conditions, and the development of nuclear weapons. further extended the scope of the work of the intelligence organizer as well as of its urgency. There was hardly a field of human activity which was not liable to be probed by the intelligence agent, or which had not taken on a security aspect.

The methods of obtaining intelligence have been largely misrepresented by fiction writers and film producers. In popular estimation intelligence is usually associated with the glamorous spy, disguise, forged passports and clandestine meetings. It is untrue to say that these methods are never employed, but they are the exception rather than the rule. A very considerable part of all useful intelligence is gained by routine methods: from the press, through travelers, businessmen and others who may pick up something in the course of their normal work; by piecing together a number of apparently trivial facts which in isolation are worthless, but together may be of considerable value. The professional agent or spy is, generally speaking, sparingly employed, or reserved for missions of special urgency. Most of those who provide information are casual agents with no professional status in the intelligence world.

The so-called international spy is, however, worthy of mention. Mostly men, but sometimes women, they may be said to be products of the 20th century. Invariably persons with little or no national loyalties, they are often of mixed race, frequently with a grievance against their own country. Many have criminal records. Their information is rarely of much value; they work for the highest bidder. but are quite prepared to double-cross their first employer if they find a better one. Nevertheless, they flourished in considerable numbers in the period between World Wars I and II. Paris, Brussels, Geneva, Cairo and other cities where communications meet and international affairs are conducted, were their clearinghouses. They were thoroughly unreliable, and their haunts were usually well known to the police and security agencies. Yet, a few of them seem to have had some success, and even standing, in the intelligence world, as was revealed by a number of arrests and trials in the 1930s.

Intelligence in World War 11.—By reason of the development of scientific equipment, and the world-wide and fluid nature of military operations, intelligence during 1939–45 reached a high pitch of activity and efficiency. In most theatres of land operations there was no continuous and heavily manned front line; sometimes the belligerents became inextricably mixed. The number of different nationalities involved and the frequent difficulty of distinguishing friend from foe made the work of the agent and military intelligence personnel profitable in countries such as Belgium and France (1939–40 and 1944–45), Norway (1940), the middle east, Burma and Malaya. Conversely, counterintelligence was much more difficult.

The means of gathering information was greatly increased by scientific developments. Aircraft, and particularly photographic reconnaissance, made it possible to unmask installations and troop dispositions in both the strategic and tactical fields. Wireless interception and ability to "break" mechanically even the most intricate cipher or code, made the acquisition of information by this means a regular feature of intelligence procedure.

In this connection it should be noted that the United States' intelligence successfully broke the Japanese cipher before Pearl Harbor. This enabled the United States government to have prior information of Japan's generally hostile intentions, although it did not give early warning of the actual time, place or manner of attack. See CRYPTOLOGY.

Deception was practised to a greater extent than ever before. Every plan of operations was masked by a skillfully prepared "cover plan"—in other words a bogus plan which the enemy was intended to discover and to regard as the real plan. Before the battle of El Alamein in Oct. 1942 a concentration of troops was simulated by means of dummy tanks, vehicles, camps and water points. Before the landings of U.S. and British troops in Normandy in June 1944 a most elaborate cover plan was designed with the object of giving the Germans the impression that a landing in the Pas-de-Calais was contemplated. Large camps and vehicle parks were established in Kent and Essex, and bogus wireless traffic was maintained in order to direct attention toward the Dover and Calais areas and away from Normandy. A possible landing in Norway from the east coast of Scotland was also simulated on the wireless.

The older intelligence methods were greatly extended in World War II. Elaborate Allied espionage systems were organized in Norway, Denmark. the Netherlands, Belgium, France, Greece, Burma, Malaya and other occupied territories. Contact was maintained by means of clandestine wireless sets and personnel dropped by parachute or landed from submarines or small craft. (In Japan a most successful spy was the German press correspondent Richard Sorge, who was a member of the Nazi party but nevertheless a convinced Communist and a Soviet spy.)

Intelligence in the Cold War.—After 1945 many new factors arose which affected intelligence work. International frontiers were redrawn; countries with centuries of independence became satellites of the U.S.S.R.; colonial and protected countries gained full independence. As an outcome of these great changes many thousands of persons became displaced and stateless and many others left their old homelands and sought sanctuary elsewhere. These conditions made infiltration by agents, and the path of the spy, comparatively easy. In addition, the division of most of the world into two sharply defined blocs—eastern Communism and western democracy—produced subversive elements of a new type. Educated men and women holding responsible positions in the west had, for what they believed to be idealistic motives, defected to Communism. Conversely, individuals from Communist countries sought and obtained political asylum in the west.

In Sept. 1945 Igor Gouzenko, an official in the Soviet embassy in Ottawa. defected to Canada and thereby uncovered the activities of Klaus Fuchs and Alan Nunn May who were employed in Britain in nuclear research work of the greatest secrecy. The extent to which these two men's subversive activities helped the U.S.S.R. is difficult to judge. but they may have assisted Russia considerably in developing the atom bomb, and thereby hastened the end of the British-U.S. monopoly.

At that time Bruno Pontecorvo was also employed in Canada on atomic research. In 1950 he disappeared from Helsinki, Fin., and went to the U.S.S.R.. where he remained.

In 1954 a Soviet agent, Vladimir Petrov, and his wife, who were both employed at the Soviet embassy in Australia, dissociated themselves from the U.S.S.R. and were given political asylum by the Australian government. This disclosed a vast network of

Soviet espionage in Australia. Not all these individuals were professional agents. With some their defection was due to genuine, if misguided, ideological beliefs.

The number of defections from one ideology to another in the years after World War II was greatest from east to west. In Berlin alone tens of thousands crossed permanently from the eastern to the western sectors each year, whereas the numbers in the opposite direction were small. Only a very few were spies; but some were, and it demonstrated the ease with which agents could be transferred to the west from eastern Europe. Nor was Berlin the only place. Similar facilities existed in many parts of Europe where east-west frontiers were contiguous, and in many parts of the world outside Europe; *e.g.*, Hong Kong. After 1945 the opportunities for '(planting" agents in research establishments, service units, government offices, docks and factories increased.

As a consequence of such conditions the security side of intelligence developed and expanded in all national intelligence organizations. Security in Great Britain was clearly easier than in most countries. Its position as an island made it possible to impose strict control over entry and exit, and its population was unusually homogeneous. This reduced the number of likely traitors and the chances of subversive activities. States with land frontiers with other countries had a much more difficult security problem. The U.S.S.R. had the additional anxiety of satellite states and a large non-Russian population of doubtful loyalty. Although otherwise favourably placed from the security point of view, the United States had a less homogeneous population than Great Britain and this is reflected in the very elaborate security organization which it maintained.

The Korean War (1950–53).—This conflict provided unique opportunities to both sides for the acquisition of tactical information. After the first few weeks, when operations had stabilized, it was very difficult for either side to make a tactical move of any significance without its opponents receiving prior warning. This was due very largely to the fact that North Koreans and South Koreans are of the same race, speak the same language and dress in a similar manner. This made the task of the native intelligence agent a relatively easy one.

Conversely, the task of those responsible for tactical security was more difficult. On the other hand, it was probably more difficult for both sides to gain useful strategic information than is customary in modern war—due to the North Korean and Chinese "volunteer" forces possessing practically no aircraft, and the strategic reconnaissance of UN aircraft being confined, for political reasons, to areas south of the Yalu river. In this connection it should be noted that the original attack by North Korea on the Republic of Korea (South Korea) in June 1950 was to a very large extent a surprise, as was the participation of Chinese troops in Oct. 1950.

Modern National Intelligence Organizations.— The general pattern of intelligence systems in all countries is very similar. In all there is a higher directing organization in the home capital which deals with political, economic and industrial intelligence, security policy and, where necessary, co-ordinates intelligence work in the separate fighting services. Intelligence organizations are represented abroad at embassies, consulates and vice-consulates. Within the fighting forces intelligence is organized, collected and sifted by the service intelligence staffs.

Although the general organization and methods of collecting information are common to most countries, there is a marked difference in security, or counterintelligence, methods. In most democracies the conduct of security measures is somewhat limited by the need to proceed according to ordinary law, which is applicable to military and police personnel engaged in security duties in the same way as to other citizens. In many other countries the secret police, who are responsible for security, have exceptional powers of arrest, detention and interrogation.

It is one of the chief duties of the security side of a national intelligence organization to safeguard the system and methods by which it operates. It is, therefore, not surprising that detailed information concerning the organization of intelligence in various countries is scanty. The following notes give in outline the organization in the four major countries: the United States, Great Britain, France and the U.S.S.R.

United States.—The United States has shown great generosity and understanding in giving asylum, and a home, to large numbers of political refugees and stateless persons from Europe. This liberal immigration policy since 1945, although it has served the country well, has placed emphasis on the security side of intelligence, since among so many foreigners, without inborn loyalty to the United States, some were almost certainly spies. The three fighting services have their own intelligence services; in addition there are many other agencies which deal with various aspects of intelligence. All intelligence is controlled by the Central Intelligence agency (CIA), which was established in 1947 to work under the National Security council. The functions of the agency are: (1) to advise the National Security council on security matters; (2) to co-ordinate all departments and agencies in relation to intelligence; (3) to correlate, evaluate and distribute intelligence information to the appropriate agencies; (4) to deal with certain matters common to all intelligence agencies; (5) to perform such other intelligence functions as the National Security council may direct.

A body known as the Operations Coordinating board is also concerned with the security side of intelligence. The director of the CIA is a member of this board, the purpose of which is to provide for the integrated implementation of national security policies by the many agencies involved.

Great Britain.—The central organization for British intelligence is the Joint Intelligence bureau which is responsible for: (1) coordinating intelligence in the three fighting services; (2) intelligence work common to all three fighting services; (3) economic and scientific intelligence; (4) intelligence relating to guided missiles and other new weapons.

Each fighting service has its own intelligence organization. Those of the Royal Navy and Royal Air Force are mostly concerned with technical matters; that of the army is of a more general nature and on a larger scale. Before the formation of the Joint Intelligence bureau after World War II, military (*i.e.*, army) intelligence was the agency mainly responsible for many items of general intelligence now within the province of the Joint Intelligence bureau.

The acquisition of intelligence overseas is to a considerable extent the responsibility of the service intelligence organizations, mainly the army. Counterintelligence at home is vested in a number of agencies. Those primarily responsible are the Joint Intelligence bureau and the three service intelligence organizations, but the civil police, through the home office, are also closely concerned. The personnel of intelligence agencies have no powers of arrest, detention or interrogation. The general procedure is that the intelligence agencies provide the information, while Scotland Yard and the various city and county police forces act on the information.

Sometimes the civil police in their normal anticrime work unearth espionage activities. The special security agencies and the civil police work in close co-operation.

France.—Each of three fighting services has its own intelligence department, known as the deuxikme bureau, which deals with various aspects of intelligence. These three service bureaux are linked to the headquarters of the deuxikme bureau at the ministry of defense. All security matters (including counterespionage) are dealt with by S.D.E.C.E. (Service de Documentation Extérieure et de Contre-Espionnage) and D.S.T. (Direction de la Surveillance du Territoire). Each ministerial department is responsible for its own security. Security within the armed forces and services is the responsibility of the *securité* militaire. As in Great Britain all security agencies work in close co-operation with the civil police.

U.S.S.R.—Before the 1917 Revolution Russian intelligence was primitive and inefficient; security was confined largely to the investigation of movements and plots against the regime. After the early 1930s a highly efficient Soviet intelligence and counterintelligence system spread its net over every phase of national life and over activities of the U.S.S.R. in foreign lands. At the

beginning of the 1960s, under the direction of the State Security committee, there were three main branches of the organization, located within the U.S.S.R.: (1) the M.V.D. or ministry of internal affairs; (2) the G.R.U. or chief intelligence directorate of the Soviet army; and (3) the intelligence set up within the secretariat of the Communist Party of the Soviet Union which is responsible for furthering Communism in foreign countries. Each of these branches handles a variety of intelligence and security matters in foreign countries, but there is much overlapping and many of the subject headings fall outside the term "intelligence" as known in non-Communist countries.

The following are among these activities: sabotage; political and military intelligence sections (including secret intelligence groups) organized by Soviet embassies in foreign capitals: guerrilla movements (actual and potential); spy groups and intelligence agents; and agitation and propaganda for the Communist parties. Contrary to the custom with most countries, where intelligence is in the hands of specialists, it can be said that every Soviet citizen in a foreign country is in some degree a Communist agent or an agent for some branch of the intelligence system of the U.S.S.R.

International Intelligence.—NATO has no intelligence organization of its own, but relies on those maintained by its member countries. The signatories of the Warsaw treaty are believed to rely very largely on the Soviet intelligence system which is known to operate extensively in the satellite countries.

BIBLIOGRAPHY.—J. W. Thompson and S. K. Padover, *Secret Diplonzacy: a Record of Espionage and Double-Dealing, 1500–1815* (1937); F. Routier, *L'Espionnage et la trahison en temps de paix et en temps de guerre* (1914); W. Nicolai, *The German Secret Service* (1924); R. W. Rowan (ed.), *Modern Spies Tell Their Stories: Personal Narratives of Many Exploits in Secret Service* (1934), *The Story of Secret Service* (1939); R. Boucard, *The Secret Services of Europe* (1940); V. Kalcdin, *High Treason: Four Major Cases of the St. Petersburg Personal Court Branch* (1936), *The Moscow-Berlin Secret Services* (1940); B. Newman, *Secrets of German Espionage* (1940; published in U.S. as *German Secret Service at Work*, 1940); Curt Riess, *Total Espionage* (1941); M. Ronge, *Kriegs- und Industrie-Spionage: Zwölf Jahve Kundschaftsdienst* (1930); U. Caimpenta, *Lo spionaggio inglese* (1936); A. Seid, *Der englische Geheinzdienst* (1940); Sir Paul Dukes, *The Story of ST 25: Adventure and Romance in the Secret Intelligence Service in Red Russia* (1938); I. Gyomai, *Trebitsch-Lincoln: Le plus grand aventurier du siècle* (1939); Ian Colvin, *Master Spy: the Incredible Story of Adnziral Wilhelm Canaris* (1951); C. A. Willoughby, *Sorge: Soviet Master Spy* (1952; published in U.S. as *Shanghai Conspiracy*, 1952); Paul Leverkuehn, *Gernzan Military Intelligence* (1954); Sherman Kent, *Strategic Intelligence for American World Policy* (1949). (C. N. B.)

INTELLIGENCE TESTS: *see* PSYCHOLOGICAL TESTS AND MEASUREMENTS.

INTEN, FERDINAND VON (1848–1918) German pianist. was born at Leipzig on Feb. 23, 1848. He attended the Leipzig conservatory between 1862 and 1866, where he studied under Moritz Hauptmann, Ernst Richter, Karl Reinecke. Ignaz Moscheles and Louis Plaidy. After leaving the conservatory he toured in Germany until 1868, when he made his debut in New York city. Inten remained in New York where he enjoyed some popularity as a teacher (Frank and Walter Damrosch were among his pupils) and performer of chamber music. In 1876–77 he again toured Germany. He died in New York in January 1918.

INTENDANT, in certain countries an official title having the same general sense as "superintendent" (from Lat. *intendere,* "to apply the mind to." "watch over"). Thus in Germany it is applied to the head of public institutions (*e.g.,* state theatres) and both in France and in Germany to certain military offices connected with the *intendance militaire* and *Intendantur* respectively (*i.e.,* approximately the equivalents of the British quartermaster general's and financial departments of the war office and of the quartermaster general and fiscal director of the U.S. army and their branch services).

In France the name was used in early times to designate a functionary invested by the king with an important and durable commission. The most famous of these functionaries. however, the intendants of provinces *(intendants das provinces)* date from the last 30 years of the 16th century. Originally used to restore order after the civil wars, their functions were at first extraordinary and temporary; but a few were retained as permanent state officials, and in time they came to be fairly generally distributed over the kingdom. The existing territorial divisions were kept, each intendant being placed over an intendancy (which usually corresponded with a *généralité*), save where slight modifications were necessary for administrative purposes. In the 13th and 14th centuries the monarchy had organized a species of inspection (*chevauchée*) over the provincial functionaries, which was performed by the masters of petitions (*maîtres des requêtes*). In the 16th century this inspectorate was revived and passed to the intendant. who became the resident supervisor of the other functionaries in his district; its connection with the old *chevauchée* is plainly shown by the fact that the intendants were almost always selected from the *maîtres des requêtes.* The early intendants had been largely concerned with the troops; eventually special military intendants (the only ones that exist in modern French law) were created, but the *intendants des provinces* retained certain military duties.

The early intendants were called indifferently *intendants de justice* or *intendants des finances.* These came to be different offices later on. however. Their powers were fixed by the commission. they received from the king, whose direct general representatives they became in each *généralité,* with authority over the other officials. whom they were empowered to censure, suspend or sometimes even replace. They were in constant touch with the king's council. with which they were connected by their original rights as *maîtres des requêtes.* In the first half of the 17th century they met with some opposition from the governors of provinces. who had formerly been the direct political representatives of the crown. and also from the *parlements,* which traditionally intervened in the administration, especially by means of *arrêts de règlement* (decisions. from which there was no appeal. regulating questions of procedure, civil law or custom). The intendants, however. were energetically supported, and so complete was their triumph that in the 18th century governors of provinces could not enter upon their duties without formai credentials *(lettres de résidence).*

The intendants had wide powers in the drawing by lot of the militia and in the royal labour service (*corvées*) for the making and repair of the highroads and were largely concerned with the administration of the tax called the *taille,* in which they effected useful reforms.

They were the sole administrators of the principal direct and indirect imposts created in the second half of the 17th century and in the 18th century and had full powers to settle disputes arising out of these taxes. Because of the vast size of the districts allotted to the intendants (there were no more than 33 intendants in 1788), they were allowed to delegate their powers to subintendants (*subdélégués*), who were, however. not royal officials, but merely mandatories of the intendant. Decisions of the intendant could be carried to the king's council, and those of the *subdélégué* to the intendant.

In the latter half of the 18th century, these royal commissions tended to become hereditary in certain families and were increasingly conferred on members of the nobility. In consequence, the intendants became more and more intermediaries between the localities and the central government rather than agents of an encroaching bureaucratic machine! as they had been under Louis I They continued, however, to share the unpopularity of the so-called "ministerial despotism" of the monarchy. Necker attempted to undermine their importance by creating experimental provincial "administrations" in Berry and Haute Guyenne in 1777–78. Though Calonne and Loménie de Brienne preserved the intendants when reforming French local government in 1787. their authority declined rapidly after that date. Their power collapsed in the provincial revolts of 1788 and the general desire in France for greater decentralization led to their abolition by the Constituent Assembly in 1789.

BIBLIOGRAPHY.—Gabriel Hanotaux, *Origines de l'institution des intendants de province* (Paris, 1882), with the cricitism by E. Esmonin, "Observations critiques sur le livre de Hanotaux," *Bulletin de la Société d'Histoire Moderne* (Jan, 1933); Allen Johnson, *The Intendant as, a Political Agent under Louis XIV* (1899); Charles Godard, *Les Pouvoirs*

des intendants sous Louis XIV (Paris, 1901); M. Berlet, *Les Tendances unitaires et provincialistes en France a la fin du XVIII^e siècle* (1903); Paul Ardascheff, *Lrs Intendants de province sous Louis XVI*, Fr. trans., 3 vol. (Paris, 1909); A. Esmein. *L'Intendant du XVIII^e siècle* (Paris, 1912); M. Lhéritier, *Tourny, intendant de Bordeaux* (Paris, 1920); G. Pagès, *Etudes sur l'histoire administrative et sociale de l'ancien régime* (Paris, 1938); H. Fréville, *L'Intendance de Bretagne,* 3 vol. (Rennes, 1953), mhich contains the best general bibliography.

INTENT, in law, is a state of mind consisting of a desire that certain consequences shall result from an act. Intent, concurring with a wrongful act, is a basis for both civil and criminal responsibility.

In criminal law, the state of mind required is expressed in the maxim of *mens* rea (guilty mind), which includes reckless as well as intentional disregard of consequences. Some crimes require only negligence—a kind of legal fault akin to *mens* rea. Crimes of strict or vicarious responsibility require no state of mind (see CRIMINAL LAW). Civil liability may also rest upon either intention, recklessness, negligence or strict liability (see TORT).

(R. C. DY.)

INTER-ALLIED CONTROL IN WAR: see WAR CONTROL OF FOOD; WAR CONTROL OF SHIPPING.

INTER-ALLIED DEBTS. "Inter-Allied debts" is the name given the financial obligations incurred between the governments of the Allied and associated powers during and after World Wars I and II. These obligations were distinct from the internal indebtedness arising from the war in that they were incurred by borrowing abroad, and they differed from conventional foreign indebtedness in that they were the responsibility of governments rather than of individuals or private corporations. The problem of international war finance is cast in terms different from domestic fiscal problems. and international borrowings differ from internal borrowings in that they are necessitated not by an inability to tax but by limited resources.

In World War I all Allied nations except the United States —which entered 19 months before the Armistice—found it necessary to resort to foreign borrowing, and the accumulated indebtedness which emerged was one of the most troublesome problems of the peace. Together with reparations (see REPARATIONS), it was the source of more tension, friction and discussion, diplomatic and otherwise, than any single international problem, excepting the depression, of the two decades between the two world wars.

WORLD WAR I DEBTS

By its pre-eminent financial position in the world in 1914, Great Britain became banker to the Allied and associated powers and retained this function until the United States entered the war. When the United States entered the conflict on April 6, 1917, it immediately became banker to the Allies, for British resources had dwindled in the interim; in addition to its financial operations, the United States supervised all Allied purchases in the U.S. By the four Liberty Loan acts, the congress of the United States authorized the extension of loans to Allied and associated powers to an amount not exceeding in the aggregate $10,000,000,000, the terms of the loans being substantially the same as those on domestic issues. The funds placed at the disposal of the Allies nere raised by the sale of bonds to individuals in the United States.

Amount **and** Nature **of the** Loans.—From Oct. 1914, when borrowing began, to July 1921, when U.S. loans ceased, the gross total of loans extended among the Allied nations was approximately $26,000,000,000. This gross figure is reduced considerably, however, by the cancellation of mutual debts. Net indebtedness stood at somewhat more than $16,000,000,000 when the war came to an end in 1918 (this figure excludes mutual debts among the Allies). In the next 2½ years approximately $4,300,000,000 was lent, mainly by the Gnited States, bringing the grand total of inter-Allied indebtedness to $20,780,732,000. The United States was the only country to go through the war without contracting net indebtedness to any nation. Britain emerged from the war in a creditor position, having borrowed approximately $4,200,000,000 and loaned $7,500,000,000, but because it borrowed mainly from the United States and loaned to its European allies it was in a debtor position with respect to the United States.

The total inter-Allied debt was contracted in two periods, the first between Aug. 1914 and April 6, 1917, and the second between the latter date and July 1921. The first ally to encounter financial stress was Russia, to which Britain loaned in all $2,472,000,000. In addition, Russia obtained franc credits to the value of almost $1,000,000,000, sold treasury bills to individuals and financial institutions in London and Paris and obtained advances from the U.S. and neutrals before it left the war in 1917. Although France had extensive foreign investments, large gold stocks and a considerable industrial plant, it was forced by a combination of circumstances to seek loans from Britain as early as the autumn of 1914. The first of these was raised by selling treasury bills in the London market, a process mhich yielded $379,000,000 by 1917.

The first treasury bill sales were followed by drafts on Britain against French gold deposits there, yielding $937,200,000 from deposits of $260,300,000. In 1915 France shared with Britain the proceeds of the Anglo-French loan of $500,000,000 raised in the U.S. through private agencies. Despite its stringent position, France loaned its allies about $3,000,000,000 throughout the war period, of which $2,500,000,000 were net loans. Italy entered the war in May 1915, after having been assured of receiving war credits from Britain. Total sterling credits to the value of $764,000,000 were obtained by a gold deposit of $80,700,000 before April 1917, and after that additional net credits from Britain and other countries of $2,270,000,000.

In the first period of the war, Great Britain loaned $3,655,000,000 and in the second period somewhat more than $3,500,000,000. (Britain was not under the necessity of borrowing before the floating of the Anglo-French loan of 1915.) From 1915 to April 1917 Great Britain borrowed $1,394,000,000, of which $1,065,000,000 was from private agencies in the United States; from that time to the end of the war period in 1921 it borrowed about $4,000,000,000, of which $3,696,000,000 was from the United States. In the second period of the war the greatest portion of all lending was done by the United States. In the 19 months that the U.S. was in the mar, its gross loans amounted to $7,077,000,000 of the authorized $10,000,000,000. For about two years after the Armistice, the United States continued to extend loans in order that munitions in process of manufacture could be financed, war stores on the battle fronts liquidated and funds furnished for relief and rehabilitation.

By July 1921 the aggregate of loans by the U.S. government was $10,338,000,000. To this should be added loans of about $1,910,000,000 extended to the Allies by private agencies in the United States.

TABLE I.—*Net Inter-Allied Debts, 1914–IS, and Post-Armistice Debts*
(In thousands of dollars)

Borrowing nations	Lending nations						
	Great Britain	Canada	France	Italy	United States	Argentina	Total
Great Britain	—	229,663			3,696,000	93,427	4,019,090
British empire	479,301						479,301
Belgium	434,192		534,610		171,780		1,140,582
Cuba					10,000		10,000
France	1,682,852		—		1,587,281		3,270,133
Greece	90,338		154,979				245,317
Italy	1,855,008	176	74,952	—	1,022,631		2,952,767
Montenegro	932						932
Portugal	61,273						61,273
Rumania	78,051		220,406				298,457
Russia	2,471,845	36	955,157	6,972	187,730		3,621,740
Serbia	90,715		297,413		10,605		398,733
Total at Armistice	7,244,507	229,875	2,237,517	6,972	6,686,027	93,427	16,498,325
Post-Armistice advances	224,809		289,500	115,800	3,652,298		4,282,407
Grand total	7,469,316	220,875	2,527,017	122,772	10,338,325	93,427	20,780,732

Source. Based on H. E. Fisk, *The Inter-Ally Debts*, p. 345 (New York, 1924).

The greatest part of the proceeds of inter-Allied loans was expended within the lending country. This was particularly true of the loans made by the U.S. government. Of the more than $10,000,000,000 advanced, almost all was spent within the United States, the major expenditure being on munitions and foodstuffs, each of which took about 25% of the total. A minor portion was used to liquidate some of the private loans made in the Cnited States to the European Allies.

Financial differences among the Allied powers were stilled for the length of World War I, but almost immediately after the Armistice the problem of indebtedness became a disturbing one. During the war most of the loans were freely granted as one element of military collaboration. and detailed questions relating to their ultimate settlement were deferred until after victory. In the U.S. congress the loans were freely spoken of as America's contribution to the war in lieu of the immediate dispatch of armed forces, which was impossible.

After the defeat of Germany, however, U.S. attitudes shifted, and the loans came to be considered bona fide obligations of European governments to the government of the United States, on which payment of interest and principal was expected as soon as feasible. There then began protracted negotiations looking toward a definitive settlement of the entire debt problem, including the problem of reparations. The failure of the world to make this settlement was a disturbing factor throughout most of the years between World Wars I and II.

Attempts at Settlement. — From the beginning it was generally recognized that the position of the United States! as the largest creditor nation and the only net creditor of importance with respect to all Allied nations, made it the keystone in the entire financial structure of the postwar world, and that all efforts at settlement necessarily involved it. Before the peace conference assembled at Paris in 1919, it was suggested to the United States that the debt problem be discussed concurrently with the treaty, and it was strongly intimated that a general cancellation of all inter-Allied debts would be in order. The United States countered by proposing full payment of all intergovernmental war debts, to be effected through the funding of the debt in two series of bonds, each at 5%, with payments on the principal of the debt to begin in the tenth year after funding. Although Great Britain accepted the proposal as a basis for negotiations, nothing came of it, an3 in 1920 Britain twice repeated its interest in general cancellation. A definite program of funding was finally inaugurated in 1922 when the American Foreign Debt Funding bill was signed, authorizing a refunding of the Allied debts to the extent of $11,000,000,000 with a maximum maturity of 25 years and minimum interest rate of 4.25%. Although congress once again stated its opposition to any reduction of the debt, the interest rate fixed by the bill actually constituted a reduction of about 43% on the total of all loans due the United States, for the original rate was 5%.

As Great Britain was apprised of the unalterable intentions of the United States, it made known to its debtors that under the circumstances payment would be expected of them in amounts sufficient to cover its payments to the C.S. Discussions began in 1923 with France. leading in 1929 to final approval of a settlement program whereby France was to redeem its obligations over a period of 53 years in annual payments ranging from £4,000,000 to £14,000.000, with the right to request a revision should France's receipts from Germany on reparations account fall to less than half the amount called for under the Dawes plan. Italy agreed to pay its debt in 62 annual instalments of £4,500,000. With the exception of the U.S.S.R., all other countries made agreements or paid their debts. In 1930 France signed funding agreements with its major debtors, exclusive of the U.S.S.R., to which its loans had been heaviest.

The coming of the world depression in 1929 swept away Germany'ability to meet its reparation obligations and, because receipt of reparations was one of the conditions of settlement: reopened the entire question of inter-Allied indebtedness. To avoid a financial crisis in June 1931, Pres. Herbert Hoover instituted with general approval a one-year moratorium on all intergovernmental debt payments. The following year the Lausanne conference was held, ostensibly to discuss German reparations but also to reconsider the entire problem of war debts. The conference agreed to reduce Germany's reparations to a token amount, but ratification of the agreement was subject to a new and drastic

TABLE 11.—The Repayment of U.S. War Loans Before Suspension of Payments in 1932

Country	Total of scheduled payments (000)	Per cent reduction at 4.25%	Amount repaid (000)	Per cent repaid	Balance of scheduled payments (000)
Austria	$24,614.9	70.5	$862.7	3.50	$23,752.2
Belgium	728,434.5	53.5	52,191.2	7.16	676,243.3
Czechoslovakia	312,811.4	25.7	20,134.1	6.44	292,677.3
Estonia	37,707.6	19.5	1,248.4	3.31	36,459.2
France	6,847,674.1	52.8	486,075.9	7.10	6,361,598.2
Great Britain	11,105,965.0	19.7	2,024,848.8	18.23	9,081,116.2
Greece	20,330.0	67.3	4,127.1	20.30	16,202.9
Hungary	4,754.4	19.6	556.9	11.71	4,197.5
Italy	2,407,677.5	75.4	100,829.9	4.19	2,306,847.6
Latvia	15,790.5	19.3	761.5	4.82	15,029.0
Lithuania	15,069.5	20.1	1,238.0	8.21	13,831.5
Poland	481,674.8	19.5	22,646.3	4.70	459,028.5
Rumania	122,506.2	25.1	4,791.0	3.91	117,715.2
Yugoslavia	95,177.6	69.7	2,588.8	2.72	92,588.8
Total	22,220,188.0		2,722,900.6	12.25	19,497,287.4

Source: *Annual* Report *of the* Secretary of the Treasury, *1943*, p. 672.

settlement of inter-Allied debts. The United States, with which the decision ultimately rested. was still averse to any such program and in the following year refused even to discuss the problem at the World Economic conference in London. After the expiration of the Hoover moratorium in July 1932, Britain. Italy and a number of smaller nations met their December payments while France and others defaulted. In 1933 token payments were made by Britain, Czechoslovakia. Italy, Latvia. Lithuania and Rumania. After that time the United States received payments only from Finland. all its other debtors having defaulted.

Amounts Repaid. — The total amount unpaid on inter-Allied debt account is given in Tables II and III. Of the total scheduled payments (throughout the entire period of repayment) of $22,220,188,000, the total amount repaid by the end of 1932 when all payments virtually ceased was $2 722,900,600, or 12.25%, leaving approximately seven-eighths of the total scheduled payments in abeyance. The discounted value of the unpaid balance is, of

TABLE 111.—Receipts and Payments of Major Debtors, 1924–31
(In millions of dollars)

Country	Receipts from		Payments to			Net payments (excess receipts +, excess payments −)
	Germany	All major debtors	United States	Great Britain	Total	
Great Britain	**564.9**	**881.3**	1,122.1	...	1,122.1	**− 240.8**
France	1,426.0	1,426.0	**220.8**	197.1	417.9	+1,008.1
Italy	203.2	203.2	33.0	107.1	140.1	+63.1
Belgium	182.2	182.2	39.8	12.2	52.0	+130.2
Total	2,376.3	2,692.7	1,415.7			+1,277.0

Source: H. G. Moulton and Leo Pasvolsky, *War* Debts *and World* Prosperity, p. 299 (New York, London, 1932).

course. much smaller. Table III relates inter-Allied debt payments and total inter-European payments with amounts paid to the United States. From all their major debtors the European countries received $2,692,700,000 and paid to the United States $1,415,700,000. Excess receipts over payments were $1,277,000,000. From Germany they received $2,376,300,000, the difference between this amount and that paid the United States being $960,600,000.

Obstacles to Settlement. — The failure of the world to settle the problem of intergovernmental indebtedness must be attributed ultimately to its greater failure to re-establish economic order following World War I. There are two ways in which such obligations can be met: by the shipment of gold on the part of the debtor nation, or by the shipment of goods and services, either directly to its creditor or to a third country. Only the latter is a practicable method of repayment. Because the debts had to be paid in cash (with the exception of a certain portion of German reparations), the paying countries would have had to increase their exports in order to obtain the currency of the creditor country. Had inter-

national trade taken this course, the debt problem would probably have solved itself. The debtor countries would have obtained U.S. and British exchange by increasing their sales either to these countries or to countries from which the U.S. and Britain had imported and were in debt.

That the actual course of indebtedness was quite different is attributable to three factors, one of which was the attitude of the debtors toward their obligations. From the start, the moral basis of the loans was obscure.

Although the debtor countries eventually agreed that the debts were legal, they were never wholly convinced that they were under an ethical obligation to pay. This original obscurity was not dispelled by the attitude of the U.S. government at the time it extended its loans. Once the original difficulty was eliminated and the programs of settlement completed, the ethical question again emerged, this time in the relation between inter-Allied debts and reparations. Initially imposed in order to make Germany responsible for some of the losses wrought by the war, reparations eventually became a major source of revenue out of which to make payments to the United States.

The second obstacle to settlement was provided by the condition of world trade. The expansion of foreign trade so necessary to a liquidation of the debt was stifled by a resurgence of economic nationalism throughout the world. While the United States was demanding that all its debtors come to terms, it was simultaneously raising tariff barriers that diminished the possibility of payment. Large amounts of European imports, which would have furnished means of payment, were in competition with the output of certain U.S. industries which demanded protection of their special interests, and the United States was placed in the awkward position of both demanding payment and denying its possibility. Cast over the impediments to trade was the monetary disorder that afflicted almost every nation of Europe, making both private and public settlements the more difficult. That funding agreements were actually negotiated and payments made on inter-Allied debt and reparation accounts for the period between 1922 and 1931 must not be laid to an economic miracle but to the action of private U.S. investors who extended loans to the debtor nations. These loans, which were made purely as investments, provided much of the dollar exchange with which payments on intergovernmental account could be made, and their effect was to defer the date of ultimate settlement and to transfer a part of the debtor nations' obligations from public to private creditors.

After 1930 most of these loans ceased and new obstacles to international trading were erected which made many of the barriers of the 1920s slight by comparison. Quotas and other forms of import restriction were devised, and exports were promoted with ever-greater vigour. The collapse of the gold standard after 1931 brought in its wake monetary regulations which added more obstacles. The only nation which made any effort to prevent a total strangulation of international trade was the United States, which after more than a decade of restricting its imports—culminating in the extremely high schedules of the Smoot-Hawley tariff of 1930—reversed its position and by a program of reciprocity invited a general reduction of trade barriers throughout the world. By this time, however, all but one of its debtors had in fact, if not form, defaulted on their debts.

The third factor operating against a debt settlement was the world depression that began in 1929. By its severity the depression intensified the trade and monetary disorder noted above. Yet it was not a phenomenon distinct from these.

The extreme deflation and unusual length of the economic crisis of the 1930s may be traced to the domestic and international economic policies pursued throughout the world after the war, which had the effect of making prices rigid in internal and international markets, of creating immobilities within and between nations, and, generally, of making recovery from the depression more remote and difficult. As the impediments to trade raised obstacles'to a settlement of the debt, so they gave root to the world depression.

DEBTS IN WORLD WAR II

World War II did not leave in its wake a flood of intergovernmental obligations such as had plagued the world during the interwar period. The entire amount of United States government credits utilized by other countries bet een mid-1941 and mid-1945 did not exceed the $1,100,000,000 mark, as compared with six times that much lent by the United States during World War I. A quantitatively much more important legacy of the war was close to £4,000,000,000 of sterling balances which British Commonwealth countries and dependencies of Great Britain had accumulated in London during the first half of the 1940s.

That no larger war debt to the United States mas incurred was due to two factors: the neutrality legislation, which controlled United States foreign policy in the early phases of the war, and the subsequent enactment of the Lend-Lease act of March 11, 1941, which in effect pooled the resources of the Allies and made U.S. aid available in the form of grants rather than loans.

Cash and Carry Under Neutrality.— The neutrality and related legislation which was enacted in the United States during the 1930s mirrored a strong desire to keep that country out of foreign wars. The unhappy status of the World War I debts was a disappointment to many. Disillusionment about the precarious foreign situation—Mussolini's attack on Ethiopia, the Spanish civil war, etc.—gave way to "isolationism." In connection with the entry of the country into World War I. strong resentment was felt in many quarters against bankers and munitions makers. whose business policies were scrutinized by a special senate committee on investigation of the munitions industry from 1934 to 1936.

The Johnson act of 1934 did indeed make unlawful the placement of loans in the United States by foreign governments in default of their obligations to the United States. The Neutrality act, passed in 1935, amended in the following years and again revised in 1937, called for the embargo of shipments from the United States to countries involved in war and prohibited the purchase of securities issued by such countries. These measures did not operate against the placement of orders for munitions and other materials in the United States as long as the purchasing country was not involved in actual warfare, and such orders were indeed forthcoming from Britain. France and other European nations in 1938 and 1939. In 1939, when war seemed imminent, Secretary of State Cordell Hull submitted proposals for modification of the neutrality legislation, pointing out that "no matter how much we may wish or may try to dissociate ourselves from world events, we cannot achieve disassociation." Under the Neutrality act of 1939, which became law on Nov. 4, the embargo provisions of the earlier legislation were in effect repealed. The act insisted, however, on "cash and carry": exports to the belligerents were not to involve the extension of credit or the use of U.S. vessels.

Under the cash and carry rule of the Neutrality act of 1939, Britain, which also had taken over French orders in the United States when France fell. was compelled to finance its ever-increasing purchases in the United States from its gold and dollar resources. A rapid decline of these assets ensued, and by the close of the year 1940 the gold and dollar resources of the United Kingdom had fallen to little more than $2,000,000,000, compared with $4,500,000,000 in Aug. 1939.

Transition to Lend-Lease.— Gradually, however, and especially after the beginning of the German campaign in western Europe in the spring of 1940, the neutrality legislation ceased to be a significant instrument of U.S. foreign policy. Indicative of the changing atmosphere was the transfer to Britain of surplus stocks of munitions valued at more than $43,000,000. This was arranged in June 1940, after the retreat from Dunkirk, where the British had lost large quantities of military supplies. Thereafter, the United States government continued to supply war materials from its surplus, in addition to materials purchased from private manufacturers. In Sept. 1940 arrangements were made for the transfer by the United States to Britain of 50 over-age destroyers, originally valued at $75,000,000 and recommissioned at a cost of $20,000,000, while the United States was to receive rights to establish naval and air bases in Newfoundland and in the islands of Bermuda, the Bahamas. Jamaica, St. Lucia. Trinidad and Antigua and in British Guiana. Pres. Franklin D. Roosevelt appealed to the United States to become "the great arsenal of democracy,"

pointing out that "we have furnished the British great material support and we will furnish far more in the future." The pooling of resources without attachment of financial strings, as exemplified by the destroyer agreement, was fully implemented by the Lend-Lease act of March 11, 1941. The act empowered the president of the United States, "in the interest of national defense," to make available to governments whose defense he deemed vital to the defense of the United States a widely defined range of "defense articles." not excluding essential civilian needs. Aid was to come forth on terms "which the President deems satisfactory," including "payment or repayment in kind or property, or any other direct or indirect benefit" at the discretion of the president.

TABLE IV.—*Lend-Lease Aid Supplied by the United States, by Receiving Countries, 1941–47*
(In millions of dollars)

Receiving country	Amount	Receiving country	Amount
Total	50,244	Iran	5
		Iraq	1
American republics	501	Liberia	82
Belgium and possessions	150	Netherlands and possessions	251
British Commonwealth	31,938	Norway	47
China	630	Saudi Arabia	19
Czechoslovakia	1	Turkey	43
Egypt	2	U.S.S.R.	10,982
Ethiopia	5	Yugoslavia	32
France and possessions	3,224		
Greece	82	Not assigned by country	1,849
Iceland	4		

*Detail does not add to total because of rounding.
Source. National Industrial Conference Board, Inc., *Economic Almanac for 1949–1950, 1951–52*, p. 430 (New York, 1948–51).

Credit Extended by the United States, 1941–45.—Lend-lease aid was not exclusively forthcoming in the form of grants. For relatively small amounts, payment in cash or strict credit terms were stipulated. Such current lend-lease credits, utilized mainly by the American republics between mid-1941 and mid-1945, amounted to $112,000,000. During the same period, $237,000,000 in silver was lent for monetary and industrial use, mainly to India, the United Kingdom and the Netherlands, to be repaid in kind. Unrelated to lend-lease, there were also. during this period, loans of the Export-Import Bank of Washington, an instrumentality of the United States government, amounting to $329,000,000 and placed mainly among the American republics. China and Canada. During that period loans also were forthcoming, in an amount of $417,000,000, from the Reconstruction Finance corporation, another instrumentality of the United States government. These credits add up to $1,096,000,000, a sum dwarfed by the $50,000,000,000 of lend-lease aid. More than one-third of the credits, $380,000,000, was repaid from 1941 to 1945.

TABLE V.—*Reverse Lend-Lease Aid Received by the United States, by Supplying Countries, 1941–45*
(In millions of dollars)

Supplying country	Amount	Supplying country	Amount
Total	7,819	China	4
		France and possessions	868
Belgium and possessions	191	Netherlands and possessions	2
British Commonwealth	6,752	U.S.S.R.	2

Source: National Industrial Conference Board, Inc., *Economic Almanac for 1949–50 1951–52*, p. 431 (New York, 1948–51).

The largest amount involved in these credits was a loan commitment of $425,000,000 made by the Reconstruction Finance corporation to the United Kingdom in July 1941. This loan, of which $390,000,000 was disbursed, was obtained on the pledge as collateral of British-owned assets and their earnings in the United States. It was to carry interest of 3% and to be repaid within 15 years. Since the earnings of the pledged collateral were larger than anticipated, the loan was paid off within little more than ten years.

Lend-Lease Settlements; Postwar U.S. Loans.—New lend-lease aid came to a halt after V-J day in Sept. 1945. United States assistance continued on a large scale, but during the immediate postwar years a substantial part of it came forth in the form of loans. Only after 1948, when the European Recovery program was established, was more emphasis again placed on grants rather than loans. The ratio of grants to credits. which had been approximately 50 to 1 during 1941–45, became 2 to 1 during 1946–50. In 1947 credits actually exceeded grants by a margin of $1,500,000,000.

Altogether the United States credits utilized during the five postwar fiscal years 1946–50 added up to $10,400,000,000, an amount nearly ten times greater than the wartime credits of 1941–45. The largest single item among the credits of the postwar years was a loan to the United Kingdom of $3,750,000,000, to be repaid after Dec. 31, 1951, in 50 annual instalments. Interest was set at 2% and a waiver of interest was provided for situations of financial stringency. The loan commitment, unparalleled in its magnitude among peacetime credits, was part of a comprehensive Anglo-C.S. financial and trade agreement, signed on Dec. 6, 1945, in which Britain undertook to reorient its policy with the aim of bringing about greater freedom of trade.

TABLE VI.—*United States Foreign Assistance, Fiscal Years 1941–45 and 1946–50*
(In millions of dollars)*

Grants, credits and returns	1941–45	1946–50	Grants, credits and returns	1941–45	1946–50
Grants utilized			Credits utilized		
Lend-lease	46,728	1,945	Lend-lease silver	237	54
Civilian supplies, occupied areas	813	4,871	Lend-lease settlements	—	1,256
UNRRA and related aid	83	3,443	British loan	—	3,750
Chinese stabilization and military aid	380	238	Surplus property (including merchant ships)	—	1,335
Technical assistance and inter-American aid	58	123	European recovkry	—	991
European recovery		6,744	Other	—	322
Other	66	1,789	Total credits	1,096	10,443
Total grants	48,128	19,153	Returns		
			Reverse lend-lease	7,828	133
Credits utilized			Return of lend-lease ships	14	297
Reconstruction Finance corporation loans	417	70	War account cash settlements	32	120
Export-Import Bank of Washington	329	2,651	European recovery counterpart funds.	—	333
Lend-lease credits	112	14	Principal collected on credits	380	1,305
			Total returns	8,253	2,188

*Detail may not add to totals because of rounding.
Source: Based on U.S. Department of Commerce, *Foreign Aid* by *the United States Government 1940–1951* (Washington, 1952).

Second in line were loans of the Export-Import bank. These added up to $2,700,000,000 in 1946–50, with France receiving $1,200,000,000 in 1946–48. Third in importance were the lend-lease settlements concluded after V-J day with most major recipients, in which these undertook to pay for the value of installations and for deliveries still forthcoming. The total amount of obligations thus incurred was $1,300,000,000. Another $1,300,000,000 was the purchase price of surplus property sold to foreign governments.

Intergovernmental Obligations Other Than U.S. Credits.—Apart from the sterling balances, discussed below, only relatively minor intergovernmental debts were incurred to creditors other than the United States during World War II. In the beginning of the war, France and the United Kingdom had concluded the economic agreement of Dec. 1939, under which each country was to use its own currency to acquire what it needed of the other country's currency, with no transfers of gold to become necessary. British purchases in Canada were financed by means of an interest-free loan of $700,000,000 in April 1942, which was applied to sterling balances accumulated before, and by a free gift of $1,000,000,000, which covered requirements until early in 1943. On May 20, 1943, Canada passed the War Appropriation (United Nations Mutual Aid) act, patterned after lend-lease, and subsequently thereto British wartime requirements were met chiefly on a grant basis. In 1946 Britain negotiated a loan of $1,250,000,000 from Canada.

Sterling Balances.— The principal inter-Allied debts incurred during World War II up to V-J day were the so-called sterling balances which members of the British Commonwealth (other than Canada), British dependencies and a number of other countries accumulated in London during the war. Before the war these balances, or holdings, of sterling stood at £500,000,000. They were then composed mainly of reserves which the respective countries and territories maintained in London, the financial centre of the area composed by them. By the end of 1945 the sterling balances had risen to close to £4,000.000,000, with approximately half held by India, Burma and middle eastern countries. The bulk of the accumulations then consisted of payments for supplies imported to Britain and of British disbursements abroad for military installations, troop pay and the like. As so large a part of the sterling balances resulted from disbursements made in defense of India, Burma, Egypt. the middle east and other regions, the assumption of this burden by Britain was an act of economic chivalry whose wisdom was questioned in many quarters. After the war, the liquidation of the sterling balances proceeded only slowly; requiring, as it did, "unrequited" exports to the holding countries from Britain and thereby adding to Britain's economic difficulties. Moreover, the obligations represented by the sterling balances exceeded the value of Britain's foreign investments, which had been reduced by wartime liquidation, turning that country into a debtor on international account.

BIBLIOGRAPHY.—H. G. Moulton and Leo Pasvolsky, *War Debts and World Prosperity* (1932); H. E. Fisk, *The Inter-Ally Debts* (1924); *Reports on Lend-Lease Operations* (1941 *et seq.*); Edward *R.* Stettinius, Jr., *Lend-Lease, Weapon for Victory* (1944); U.S. Department of Commerce, *Foreign Aid by the United States Government, 1940–1951* (1952). (W. D. G.; H. W. SL.)

INTER CAETERA, a papal bull of May 4, 1493, defining areas of sovereignty over newly discovered lands, was issued by Alexander VI after reports of the first voyage of Christopher Columbus reached the pope and the Spanish and Portuguese rulers.

Under this bull and one of May 3, a line of demarcation was drawn 100 leagues west of "the islands commonly known as the Azores and Cape Verde," and the rulers of Castile and León were confirmed as the sovereign power over all lands already discovered or to be discovered west of that line which were not "in the actual possession of any Christian king or prince."

Portugal. which held colonies along the coast of Africa, was to retain its rights and privileges east of the line. In September of the same year, the pope expressly confirmed in another bull the Spanish rulers' right to hold lands to the "eastern region and to India."

Under the treaty of Tordesillas, June 7. 1494, the Spanish crown agreed to move the line of demarcation 370 leagues west from the Cape Verde Islands, thus giving Portugal a claim to Brazil.

INTERCALARY (Lat. *intercalare,* "to proclaim"), a term applied to a month, day or days inserted between other months or days in order to adjust the reckoning of time to the revolution of the earth around the sun, the solar year *(see* CALENDAR). From the meaning, "something placed between," intercalary is also used for something which comes between two types. In botany, the term is used of growth between the apex and base of an organ, such as the growth in length of an iris leaf; or of the internode of a grass haulm.

INTERCOLUMNIATION, in architecture, the distance between the columns (*q.v.*) of a colonnade; usually defined by the number of times in which the bottom diameter of the column is included in the distance between the two closest points on adjacent columns. Thus the distance between the centre lines of two columns is one diameter more than their intercolumniation. The intercolumniation of classic columns was systematized at an early date, and the following standard intercolumniations have been listed by Vitruvius and others: (1) pycnostyle, equal to 1½ diameters; (2) systyle, 2 diameters; (3) eustyle, 2¼ diameters, so-called "well-columned," as the one most generally satisfactory; (4) diastyle, 3 diameters; (5) areostyle, 4 diameters; and (6) areosystyle, a complex form in which the columns are arranged in pairs with the distance between the pairs greater than the distance between the columns of each pair, as in the colonnade of the Louvre. Paris (by Claude Perrault, 166j). No such absolute standardization of intercolumniation as Vitruvius' list would suggest exists in classical work; frequently all the intercolumniations of a single colonnade differed, with the widest in the centre. The list must therefore be considered. like the so-called rules for the orders. merely as a summary of the averages. *See* ORDER.

INTERDICTION, in Scots law, was a process of restraint applied to prodigals and others who, "from weakness, facility or profusion," were liable to be imposed upon. The result was to prevent the person interdicted from effectively alienating his heritable property without the consent of his interdictors. It left him competent to dispose of his movables. In voluntary interdiction the prodigal himself took the initiative in binding himself not to do anything to affect his estate without the assent of the interdictors. Judicial interdiction was imposed by order of the court either at the instance of an interested party or acting in the exercise of its equitable jurisdiction or *nobile officium.* Interdiction was abolished by the Conveyancing (Scotland) act. 1924, s. 44. (A. D. G.)

INTERESSE TERMINI, in law, an executory interest. being the right of entry which the grant of lease confers upon a lessee. Actual entry on the lands by the lessee converts the right into an estate. If the lease, however. has been created by a bargain and sale, which still exist in some places, or by any other conveyance under the English Statute of Uses, not requiring an entry, the term vests in the lessee at once. This doctrine was abolished by the Law of Property act. 1925, s. 149.

INTEREST, in ordinary usage, is the price paid for the use or forebearance of money or its equivalent, or for damages for its detention, Simple interest is that computed solely on principal. Compound interest is that paid upon interest where accrued interest is added to the principal sum and the whole treated as a new principal. For a discussion of borrowing and lending and the historical development of the practice of charging interest on loans, *see* MONEY-LENDING. For a discussion of interest on investments, *see* STOCK and BOND (IN FINANCE). For the meanings of interest in economics, *see* CAPITAL AND INTEREST.

(M. R. N.)

INTERFERENCE OF LIGHT: *see* LIGHT: *Waves and Interference;* INTERFEROMETER.

INTERFEROMETER. An interferometer is an instrument which makes use of the interference of waves for the purpose of measurement. After an introduction which includes a classification of interference effects, this article is divided into the following sections:

I. Interferometers Using Division of Wave Front
  1. The Väisälä Interferometer
  2. Michelson's Stellar Interierometer
II. Interferometers Using Division of Amplitude
  1. Fizeau-Laurent Surface Interferometer
  2. The Jamin Interferometer
  3. The Michelson Interferometer
    The Structures of Spectral Lines
    Evaluation of the Metre with Light Waves
  4. The Twyman-Green Interferometer
  5. The Linnik Interference Microscope
  6. The Mach-Zehnder Interferometer
  7. The Bates Wave-Front Shearing Interferometer
  8. The Fabry-Perot Interferometer
    Analysis of Hyperfine Structures in Line Spectra
    Measurement of Line Width
    Determination of Precision Wave Lengths
    The Evaluation of the Metre
    Refractive Index of Air
  9. The Echelon and Lummer Plate Interferometers
III. Multiple-Beam Interferometry
  1. Some Applications of Multiple-Beam Interferometry
    Microtopographies of Surfaces
    Thickness of Thin Films
    Oscillations of Piezoelectric Crystal Plates
    Fringes of Equal Chromatic Order
    Studies on Opaque Objects (Metals, etc.)

This article will be devoted entirely to optical interferometers, which can be conveniently divided into two broad groups. In the first, metrical interferometers, light waves of known wave length are used for the measurement of metrical or optical lengths. In

the second group, interference spectroscopes, the objects under study are the light waves themselves (see SPECTROSCOPY). Because the wave length of visible light is only of the order of & of a millimetre, metrical interferometers can only be used for the evaluation of quite small differences in length; nevertheless it is possible to compare large lengths provided they only differ by small amounts. Thus it becomes convenient to subdivide metrical interferometers into those used for measuring quite small lengths and those which can be used for the evaluation of lengths up to as much as 100 m.

Although the existence of phenomena due to optical interference was known to Robert Boyle, Robert Hooke and Sir Isaac Newton as early as about 1665, it was not until 1802 that the fundamental mechanism was clarified by Thomas Young, who was the first to enunciate the theory that optical interference involves the principle of coherence and the principle of superposition (see LIGHT). The essential features are (1) that light beams from two independent sources, being incoherent, can only combine their intensities; but (2) light beams from any one point of a source, which may have traveled over different paths and then come together again, being coherent, can combine their amplitudes, and this can lead to stationary fluctuations of intensity in space, called interference fringes. An interferometer is essentially an optical system that divides a beam of light from a source into two (or many) beams which follow different paths and then are recombined. If there are differences in either the optical or metric paths, then each wave-length difference leads to a shift of one interference fringe. Thus small differences become measurable.

Varieties of interference fringes were discovered successively during the first half of the 19th century by Young, A. J. Fresnel, Sir John Herschel, Sir David Brewster, Humphry Lloyd. Wilhelm Haidinger. Fox Talbot, F. Billet and others. They were treated as academic curiosities until J. C. Jamin in 18j6 invented his celebrated interference type of refractometer (*q.v.*), followed in 1859 by A. H. Fizeau who carried out an ingenious interferometric test of the water-velocity-drift formula proposed by Fresnel. Then in 1862 Fizeau applied thin-film fringes to the measurement of the thermal expansions of small bodies. Following Fizeau there were many developments. leading to a great expansion of interest in the subject by the mid-20th century and increasing use of interferometers for precise physical measurement.

Classification of Interference Effects.—Interference phenomena can be conveniently classified according to (1) chromatism; (2) wave division; (3) fringe localization; (4) multiplicity.

1. Some interference phenomena can be produced with white light; others require an approximately monochromatic source. The line uidth (departure from true monochromaticity) imposes restrictive limitations in many interference experiments.

2. The condition of coherence requires the division of the wave front into separate beams. This can be done either by (a) division of the wave front by slits or apertures or (b) division of the amplitude of a wave front by the double act of partial reflection and partial transmission at a reflecting interface.

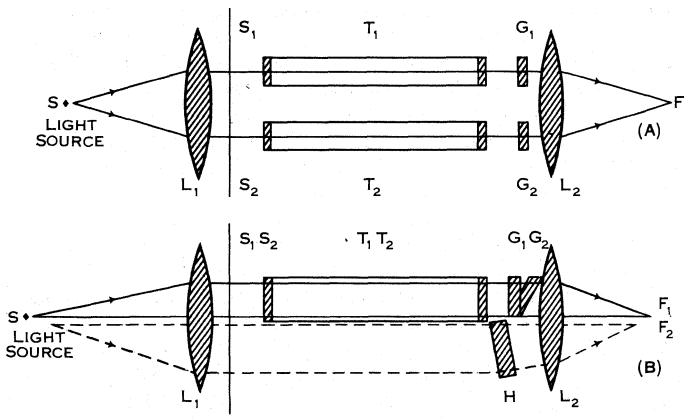


FIG. 1.—(A) PLAN AND (B) ELEVATION DIAGRAMS OF THE INTERFERENCE REFRACTOMETER

3. Fringes, according to their mode of origin, may be non-localized (*i.e.,* extend into space), localized on a surface or appear at infinity.

4. While many interference systems use two interfering light beams (two-beam interference) others use many geometrically related beams (multiple-beam interference). Correct use of multiple beams leads to a considerable reduction in the widths of the interference fringes and thus to an increase in sensitivity and accuracy.

I. INTERFEROMETERS USING DIVISION OF WAVE FRONT

In such instruments a coherent wave front is divided, usually by two parallel slits or by two separated mirrors. The Rayleigh interference refractometer, described in 1896 (see REFRACTOMETER), incorporating the modern improvements of F. Haber and F. Löwe (1910), is widely used for the determination of the refractive indices of gases and liquids. A diagram is shown in fig. 1.

Fig. 1(A) shows a plan view and fig. 1(B) an elevation view. From a slit source S, light rendered parallel by the lens L_1 falls on two fairly uide slits 1 cm. apart (S_1S_2). After passing through the tubes T_1T_2 and a compensating device G_1G_2 (invented earlier by Jamin), the beams are reunited at F by the lens L_2. Fringes appear

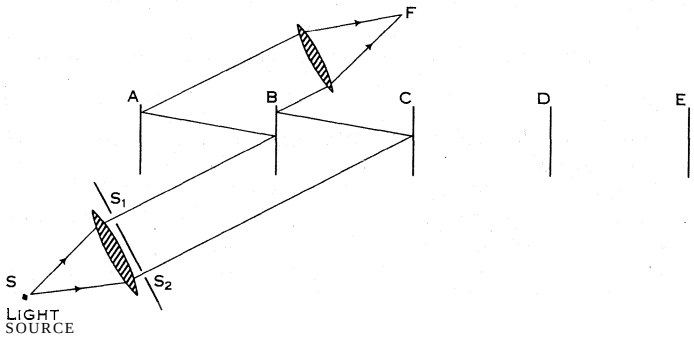


FIG. 2.— INTERFERENCESYSTEM INTRODUCED BY V. VAISALA

at the lens focus and are viewed with a high-magnification cylindrical lens.

As shown in fig. 1(B). T_1T_2 occupy only the upper half of the field of view so that similar systems of fringes appear at F_1 and F_2, the lower set at F_2 becoming a reference-fixed system, which is brought close to the movable system at F_1 with the tilted glass plate H. The Jamin compensator G_1G_2 consists of tu-o similar glass plates inclined at a small angle, the beam from the two separate slits going through separate plates. By a slight rotation, a small path difference can be introduced into either path so as to compensate any differences created in T_1 and T, by differential gas filling. The fringe displacement per degree of rotation is predetermined with light of known wave length, the final observations being made with white-light fringes; for by this means the central achromatic white-light fringe enables exact identity of path to be re-established with the compensator. If one tube is evacuated, then for a tube length L the refractive index μ is given by $nX = (\mu-1)L$ in which X is the wave length of the calibrating light and n the number of fringes which the compensator reintroduces. A shift of $\frac{1}{40}$ fringe is just measurable, and for tubes 1 m. long this corresponds to a change in refractive index of 1×10^{-8}.

1. The **Väisälä** Interferometer.—A striking adaptation of this interference system was introduced by V. Vaisala (1927) for the purpose of measuring very long paths (*e.g.,* of the order of 100 m.) for use as a base line in geodetic survey. Two arrangements were used. In the first (fig. 2), light from S, separated by the two slits S_1S_2, produces fringes at F, after reflection from mirrors A, B, C. If white light is used, then fringes are only seen if AB is equal to BC to within a light wave or two. If AB is a substandard metre then BC can be matched equal to this to within a fraction of a light wave. The length AC is now 2 m. BC can now be matched against CD by altering the inclination of the incidence of the beams on the mirrors, so an accurate length AE is secured. The system does not depend on the lengths of AB, CD, etc., but

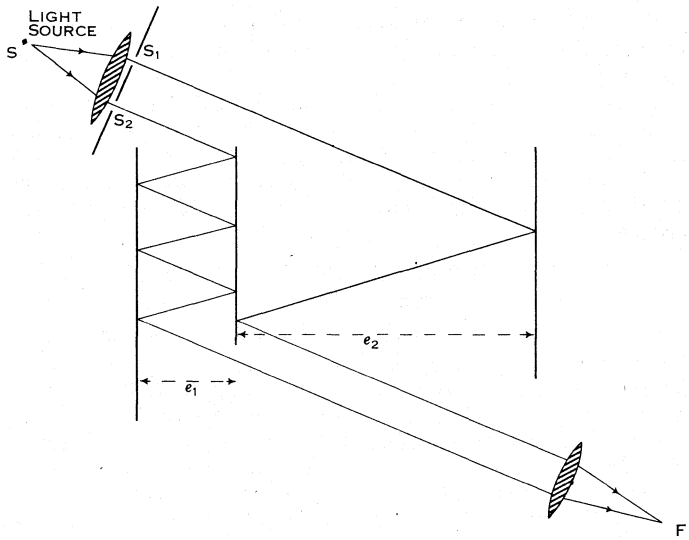


FIG. 3.— MODIFICATION OF THE VÄISÄLÄ INTERFERENCE SYSTEM

on their differences. Because of difficulties due to inclinations of beams, atmospheric disturbances and earth microtremors the method is restricted to an upper limit of roo m.

In a later modification a step-up procedure was adopted as indicated in fig. 3. In practice a step-up ratio $\frac{e_2}{e_1}$ of 5:1 was the largest that could be used. To determine 50 m. to within one wave length is a precision of one part in 10^8.

2. Michelson's Stellar Interferometer.— In 1868 Fizeau described an elegant method for measuring the angular separation between tno distant objects (slits or stars) by superposing and confusing the independent fringe patterns given from each source by a two-slit device which divided the separate wave fronts from each source. Thus. in fig. 4, let F be the fringe pattern from the one source appearing at the lens focus. Let the other source produce a similar pattern at F_1. If the F_1 fringe system is displaced from the F fringe system by half a fringe width. then maxima fall on minima, and no fringes are visible. This happens when the angular separation of the two slit sources (θ) equals $\frac{\lambda}{2a}$, or odd multiples thereof. By this technique, J. M. Stephan (1878) tried to measure the angular diameters of stars. He failed insofar as stellar distances are so great that no available telescope had an aperture big enough to give an a value sufficiently large. The first success on astronomical objects nas achieved by A A. Michelson. in 1890, who uith the large Lick telescope determined the angular diameters of Jupiter's moons (some 1 sec. of arc). Then in 1920 Michelson hit upon the ingenious device of effectively increasing a by building large girder extensions onto a massive telescope, thus constructing his celebrated stellar interferometer. The method as applied to a refracting telescope is shown in fig 5. B and C are small rectangular mirrors fixed over the telescope objective, E being a screen to cut out direct light from the star. The mirrors A and D can be moved out symmetrically. In effect the aperture of the system (a) becomes AD. Now while for two separate point sources the fringe dissonance occurs at $\theta = \frac{\lambda}{2a}$ it can be shown that a dissonance will also be produced by the separate parts from one disk-shaped source of angular diameter 8, and this occurs when $\theta = \frac{1.22\lambda}{a}$.

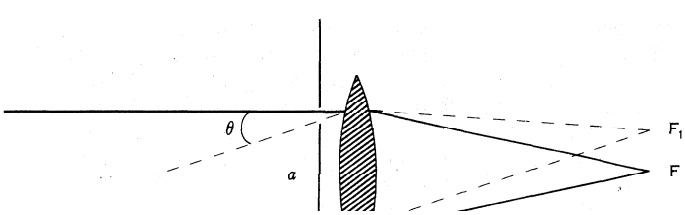


FIG. 4.—METHOD FOR MEASURING THE ANGULAR SEPARATION BETWEEN TWO DISTANT OBJECTS. DESCRIBED BY A. H. FIZEAU IN 1868

For the first star examined, Betelgeuse, the fringes vanished when a was 10 ft. 1 in., leading to an angular diameter θ of a mere 0.05 sec. of arc a quantity far too small to be detected even by the largest telescope using ordinary visual methods. An extensive program was under way in the late 1950s in several observatories, and many stellar diameters have been determined.

II. INTERFEROMETERS USING DIVISION OF AMPLITUDE

The first interference effects seriously studied, Newton's rings, involved division of amplitude. A fraction of the amplitude of an incident plane wave front is reflected from one face of a thin film and a second comparable fraction from the other face, the two recombining to give interference fringes. If very strict attention is paid to parallelism of the incident light. the two faces need not be close together and can indeed be centimetres apart. The fringes produced by division of amplitude are governed by the expression $nX = 2\mu t \cos \delta$ in which n is the order of interference, t the separation between the two surfaces in medium of refractive index μ and 6 the angle of incidence. It is often convenient to use an air medium (taking μ as unity) and parallel light of normal incidence ($\cos \theta = 1$); then with light of one wave length the fringes

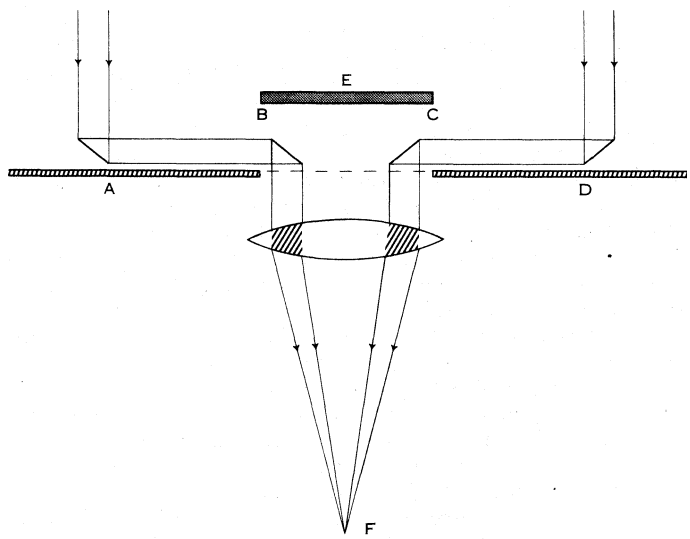


FIG. 5.— DIAGRAM OF STELLAR INTERFEROMETER DEVELOPED BY A. A. MICHELSON IN 1920

follow any variations in t. They are therefore called fringes of equal thickness. If, on the contrary, t is constant (*i.e.*, parallel-sided plates), then by using an extended range of angles of incidence (a range of 6 values) there result circular ring fringes. First discovered by Haidinger in 1849, these are called fringes of equal inclination since each arises as the envelope or locus of rays making the same inclination to the normal to the plates.

Interferometers which use fringes of equal thickness will be considered first. Fizeau's classical determinations (1861–64) of the thermal expansions of small polished crystals, using a variation of Newton's rings, introduced the first interferometer explicitly using division of amplitude for metrical determinations. A modern variant (U.S. bureau of standards) is shown in fig. 6.

A, the main surface of which is optically plane, is cut from fused quartz, which has a low thermal expansion. On a polished knife edge at B rests a quartz optical flat. The specimen C whose expansion is required is cut so that there remains a thin air film betueen A and B, with the two surfaces nearly parallel. Between these, the localized wedge fringes of equal thickness are formed with monochromatic collimated light. On heating, the relative

expansion of C to A leads to movement of the fringes. A correction for the small expansion of A is predetermined by using as C a material of known expansion.

1. Fizeau-Laurent Surface Interferometer. — An optical system. originally due to Fizeau (1862). was adapted by L. L. Laurent (1883) into an interferometer now extensively used in the optical industry. It reveals departures of polished surfaces from the plane. and enables the optical polisher to see and remove surface defects. The system is shown in fig. 7. A small pinhole A, at the focus of a well-corrected lens L. is illuminated with monochromatic light. The surfaces to be matched are a reference plane C_1 and the workpiece C_2. Incidence on C_1 is normal; and by setting a slight angle betneen the two surfaces, fringes of equal thickness are seen at E through interposition of a reflector at D. Laurent was the first to realize that these fringes constitute a contour map of the surface, being in effect contour lines which change successively in height by $\frac{A}{2}$. It is this fact which proved so valuable to the optical industry.

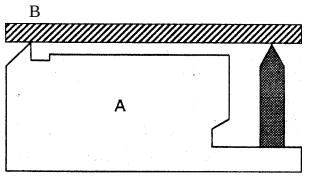


FIG. 6.—MODERN VARIANT OF AN INTERFEROMETER USING DIVISION OF AMPLITUDE

An interesting extension was proposed in 1893 by Lord Rayleigh, who pointed out that a steady liquid surface could be used as a reference plane. The workpiece can be held either above or below the surface. H. Barrell and R. S. Marriner (1940) tested the flatness of quite large plates in this way and had no difficulty in detecting errors as small as $\frac{\lambda}{10}$. Curvature of the earth causes a hillock $\frac{\lambda}{100}$ high over a 25-cm. diameter disk, and it is found that surface tension effects vanish 2.5 cm. from the disk boundary.

2. The **Jamin** Interferometer. — In 1856 Jamin described an interference refractometer which exploited the fringes of equal inclination discovered by Brewster in 1817. Brewster fringes form nhen light is reflected back from two identical thick parallel plates inclined at a slight angle to each other. Jamin used Brewster fringes formed under the special condition of 45° incidence as illustrated in fig. 8. Two thick identical glass blocks, P and Q, are set nearly parallel. The hatched faces are heavily silvered. A narrow beam of parallel light, incident at A. divides and traces the two paths XBCD and AFGD. recombining as two beams of the same intensity in the direction E, where straight line fringes of equal inclination are observed with a telescope set on infinity. Secondary reflections such as GP and DH are cut out by suitable stops. The two plates I and J constitute the Jamin compensator. Initially the two tubes T_1 and T_2 are evacuated, and with white light the central achromatic white fringe is set on the telescope cross wire. Introduction of gas into one tube leads to a fringe displacement; and the fringes are then brought back with the compensator, which has been precalibrated with monochromatic light.

3. The Michelson Interferometer. — It is probable that no single instrument has more profoundly influenced modern physics than the Michelsbn interferometer (1881). With it Michelson laid the experimental foundation to the theory of relativity. established the existence of hyperfine structure in line spectra, standardized the metre in terms of light waves and measured the tidal effect of the moon on the earth. Modifications have been used for testing lenses and prisms, as refractometers and also for the examination of surface microtopographies.

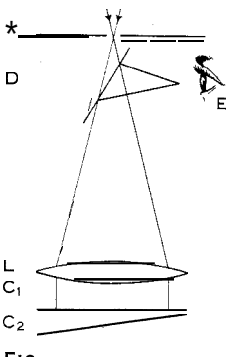


FIG. 7.—FIZEAU-LAURENT SURFACE INTERFEROMETRY SYSTEM

The instrument consists of a half-silvered mirror A (fig. 9) which divides a light beam incident at 45° into two equal parts, one of which is transmitted to the mirror M_2 and the other reflected to the mirror M_1. The beams retrace their paths and recombine in the direction B where fringes form. An observer looking along BA sees the mirror M_1 and also M_2', the image of M_2. The mirror M_2 can be moved parallel to itself with a fine-pitch screw on an accurately machined bed. Both M_1 and M_2 can be tilted with screws. The observer sees fringes formed in the air film $M_1 M_2'$. If the two planes M_1 and the virtual image M_2' are parallel. then circular fringes of equal inclination appear. If they are inclined, then fringes resembling wedge fringes are seen. If, further, the two planes intersect, then where they cross, white-light fringes are obtained (*i.e.*, in the region near to zero path difference). A means is thus available for setting AM_2 equal to AM_1 to within a small fraction of a light wave, usually estimated to be some $\frac{\lambda}{80}$.

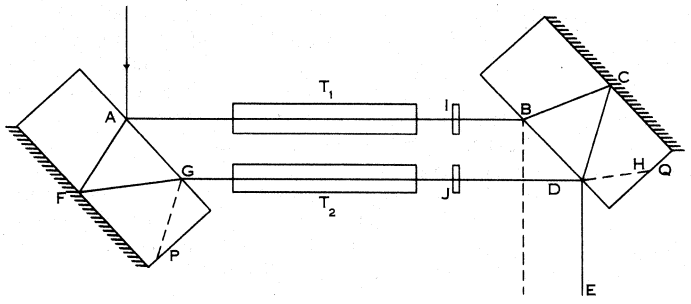


FIG. 8.— INTERFERENCE REFRACTOMETER DESCRIBED BY J. C. JAMIN IN 1856

To secure these white-light fringes, the two optical paths AM_1 and AM_2 must be the same for all wave lengths. Since the reflecting film A is on the front of a glass block, an identical compensating block is placed parallel to A in the path AM_1.

One of the first applications of this instrument was the carrying out of the celebrated Michelson-Morley experiment (see RELATIVITY and MICHELSON-MORLEY EXPERIMENT), an attempt to measure the relative motion between earth and ether. The interferometer was set up with equal arms, and rotated so that at one time light traversed AM_1 along the direction of motion of the earth and shortly after this in a contrary direction. With the particular instrumental dimensions used, computation predicted a fringe shift of 0.4 of a fringe. No shift exceeding 0.04 of a fringe was found. On this "null" result the whole superstructure of relativity physics was constructed.

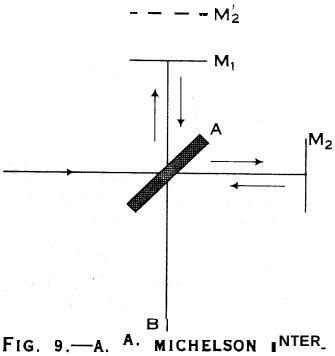


FIG. 9.—A. A. MICHELSON INTERFEROMETER (1881)

R. J. Kennedy confirmed the result in 1926, using a greatly increased sensitivity. On the mirror A and across half of it he deposited an extra silver film of thickness $\frac{\lambda}{20}$. At the boundary the fringes showed a discontinuity of $\frac{1}{10}$ of a fringe. Broad fringes were arranged to give a practically uniform tint of the illumination on either side of the step, both sides being equally off the true maximum. A very small displacement led to one side, brightening up relative to the other. Indeed. the remarkably small quantity of $\frac{1}{1000}$ of a fringe was detectable, corresponding to an optical path change of a mere 2.5 Å.

The *Structures* of Spectral Lines.--Of considerable importance to atomic nuclear physics is the study of nuclear spin and magnetic properties obtained from measurements of the hyperfine structures of spectral lines. Such structures were first detected by Michelson using his interferometer. In 1891 Michelson made a systematic study of the visibilitp of the fringes given by a range of spectroscopic lines. Defining fringe visibility from the intensity of the maxima and minima as $(I_{max} - I_{min})/(I_{max} + I_{min})$ he plotted these visibilities as a function of the separation between

the interferometer plates. The visibility is determined only by the width and complexity of the spectral line. For a theoretically monochromatic line the visibility curve is a horizontal straight line, but of course even a single line has a width due to a variety of factors. which leads to a smooth curve. If in addition the line has hyperfine structure components, then maxima and minima appear in the visibility curve.

Michelson invented a most ingenious harmonic analyzer which mechanically performed a Fourier analysis on the visibility curve. giving the original line shapes and line structures which had synthesized to produce the observed visibility curve. By this means the close structures of the lines of the hydrogen spectrum were obtained. One important observation was the finding that the red cadmium line 6438 Å was single and narrow. Thereupon Michelson adopted this narrow line as his standard in his next classical research, namely the evaluation of the standard metre interferometrically in terms of light waves.

Evaluation of the Metre with Light Waves.——The metre is internationally defined as the distance between two fine scratches on a bar of platino-iridium kept at Sèvres, near Paris. Rlichelson (1892) set himself the problem of counting the number of red cadmium light waves in this length. The line width is such that no fringes are visible with a path difference exceeding 20 cm.. and in any case there are some 1,500,000 waves to the metre. Thus a system of subdivided standards. called etalons. was adopted. The first was 10 cm.. and this was halved progressively eight times to 0.3906 mm., a length containing about 1,200 fringes and therefore reasonable for direct counting. The number of fringes in this smallest etalon A was directly counted by matching its front face against the interferometer movable mirror. retracting the latter slowly and counting until the mirror coincided with the back face. Coincidence was assured with white-light fringes. but the counting was carried out in red cadmium light. This etalon was doubled up against the next etalon B. and the only measurement which then had to be made was the difference $B \sim 2A$. This procedure was repeated until the exact length of the 10-cm. etalon was obtained. Finally this was stepped up ten times against itself. and this exactly known length then matched against the standard metre. The final result, given to 1 part in 2,000,000, was 1,553,163.5 red cadmium waves to the metre.

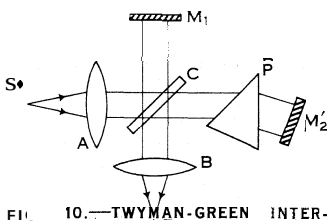


FIG. 10.—TWYMAN-GREEN INTERFEROMETER (1916) AS IT IS USED FOR TESTING A PRISM

4. The Twyman-Green Interferometer.— In 1916 F. Twyman and A. Green introduced a slight modification, adapting the Michelson interferometer for lens and prism testing and this became standard equipment in optical workshops. The essential feature is the introduction of strict Fizeau-type collimation by using a point source of monochromatic light at the focus of a well-corrected lens. The way in which the interferometer is used for testing a prism is shown in fig. 10 and for testing a lens in fig. 11. With a perfect prism P, a plane wave incident on P returns as such to D and a uniform field of illumination is seen. Local errors, either of surfacing or as knots in the glass with different refractive index, distort the wave front. The optician can then suitably correct these by working the glass until the emerging wave front is plane. For testing the lens L the plane mirror M_2 is replaced by a convex mirror M and the light strikes this normally, to retrace its path. Imperfections in the lens result in fringe distortions which can be interpreted in terms of spherical aberration, coma, astigmatism, etc.

5. The Linnik Interference Microscope.—A valuable modification was the interference microscope of W. Linnik (1926), which permits evaluation of surface microtopography to fringe accuracy in the up-down direction, and with magnifications up to 1,000 times across the surface in extension. The system is shown in fig. 12. A is the beam splitter, P the surface under examination and Q a reference flat. L_1 and L_2 are carefully matched high-power microscope objectives (usually 4-mm. lenses) so that L_1 together with lens systems L_3 L_4 constitutes a high-power microscope. One sees through this the surface P crossed with the fringes formed by P and Q so that the microtopography is contoured by fringes. Several interference microscopes were developed in which division oi amplitude takes place in a specially designed objective. An example is that of J. Dyson (1950).

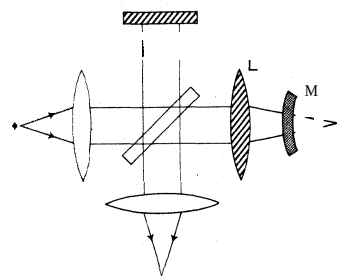


FIG. 11.—TWYMAN-GREEN INTERFEROMETER AS IT IS USED FOR TESTING A LENS

6. The Mach-Zehnder Interferometer.—Ernst Mach and L. A. Zehnder (1891) independently developed a modification of Jamin's interferometer, which though difficult to adjust has been widely used for studying air flow around models of aircraft. The svstem is shown in fir. 13. The mirrors A, and A_2 are half-silvered while B_1 and B_2 are fully silvered on the front faces. The object (aerodynamic model) is supported in the air chamber D through which a high-velocity air jet is blown. D_1 is an identical compensating chamber. Local pressure variations, due to flow. lead to local refractive index changes so that the flow pattern is revealed by fringe distortions.

There are two reasons why this instrument is better than Michelson's for aerodynamics. First, the optical circuit is such that the light traverses the observation chamber one way only. whereas in Michelson's instrument it passes and returns. Strong local refractive index variations have a prismatic action and displace the beam which would not quite retrace the same path on the return journey. Second, and more important. is the question of fringe localization. In Michelson's instrument the fringes are localized on the mirror M_1 (*see* earlier figures) whereas in the Mach-Zehnder system the fringes can be placed so as to coincide with the object in D. Thus both object and fringes can be photographed sharply in focus.

7. The Bates Wave-Front Shearing Interferometer.— W. J. Bates (1947) slightly modified the Mach-Zehnder system, with considerable advantages for the testing of large lenses or large curved mirrors. Using a collimated beam, he produced interference between two displaced parts of the same wave front by the shearing arrangement shown in fig. 14. A perfect lens gives a spherical wave which falls on the beam splitter A_1, and by tilting A, one secures two overlapping wave fronts Y and Z. The images from these wave fronts can be localized on A_2 and if these wave fronts are truly spherical, then any tilting of A, leads to no change in the field of view. If the wave front departs from the spherical, changes are seen which can be interpreted. Important is the fact that a large mirror or lens is matched against itself so that a large reference plane is not required.

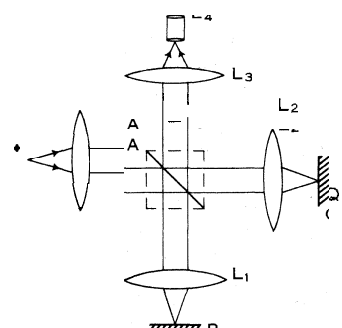


FIG. 12.—SYSTEM OF LINNIK'S INTERFERENCE MICROSCOPE (1926)

8. The **Fabry-Pérot** Interferometer. — Ranking almost in importance optically with the Michelson interferometer is that of C. Fabry and A. Pérot, which has an interesting history. In 1836 G. B. Airy had computed the effect on interference fringes of taking into account the successive multiple reflections (neglected previously because of negligible intensities). He showed that if light is incident at angle θ onto a plane parallel plate of thickness t then the transmitted intensity has the form

$$1 + \frac{4R}{(1-R)^2} \sin^2\left(\frac{2\pi\mu t}{\lambda} \cos\theta\right)$$

in which R is the reflection coefficient. This formula remained a forgotteh academic curiosity until A. Boulouch in 1893 drew at-

tention to the fact that when the reflectivity R is high (say, exceeding 80%) then this formula establishes that a profound sharpening in the fringes will take place. Indeed. Boulouch proved this to be the case experimentally.

However. it remained for Fabry and Pérot (1897) to realize the full implication of this when they produced their celebrated variable-gap interferometer. This consists of two very accurately worked planes (errors not exceeding $\frac{\lambda}{80}$ in the best instruments) maintained by optically worked spacers strictly parallel, to within a quite small fraction of a light wave. The tno plates, called an etalon. are coated with a thin transmitting film of high reflectivity (originally sputtered silver). Reflectivity should exceed 90%, and with modern techniques 95% and even 97% reflectivities are achieved with only perhaps 1.5% absorption, the rest being transmitted. Special techniques are needed to secure such low absorptions.

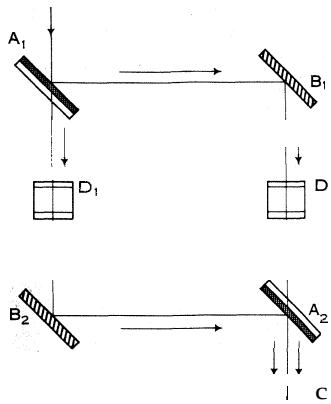


FIG. 13.—MACH-ZEHNDER INTERFEROMETRY SYSTEM, DEVELOPED IN 1891

This simple instrument is an extremely powerful optical system. Being essentially a parallel air plate, it produces Haidinger rings, localized at infinity. However. the important feature is that the successive multiple reflections, diminishing very slowly in intensity because of the high reflectivity, lead to the formation of very sharp narrow fringes. Fringes can be defined by their half width; *i.e.*, that fraction of an order occupied by the width at a region where the fringe intensity is half the peak maximum value. For reflectivity 95% the half width is about $\frac{1}{60}$ of an order separation, and as one can set to $\frac{1}{5}$ of a fringe width, this setting corresponds to $\frac{1}{600}$ of a wave length.

Only a brief resumé can be given of the many and varied uses of this admirable interferometer.

Analysis of *Hyperfine Structures* in Line Spectra.—The instrument is very widely used for the high resolution needed for revealing hyperfine structures in line spectra. At a wave length of 5,000 Å, a reflectivity of 95% and a plate separation of 10 cm. (which has been used) give a resolving power of some 20,000,000, so that one can resolve components separated by a mere 0.0002j A. Compare this with the resolving power of 100,000 available in the first order of a typical high-quality large diffraction grating.

Measurement of Line Width.—The high resolution and high dispersion enable the instrument to be used for evaluation of the widths of even quite narrow spectral lines. For example, interesting conclusions have been drawn about the temperatures in the upper atmosphere from measured line widths of auroral spectral lines.

Determination of Precision *Wave* Lengths.—The Fabry-Pérot interferometer is the standard instrument for accurate determination of the wave lengths of spectroscopic lines. By the use of three standard wave lengths (the cadmium lines 6,438.4916 Å, 5,085.8220 A, 4,799.9088 Å), each of which has been directly interferometrically evaluated against the standard metre, the spacing of the interferometer plates can. be derived with high accuracy. Then, from the measurement of the diameters of the fringes of the spectral lines under study, their wave lengths can be computed from the knowledge of this spacing, with an accuracy. in the best cases, of ± 0.001 A.

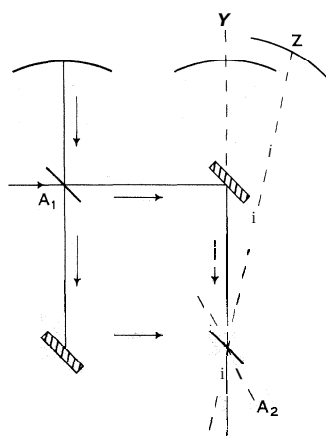


FIG. 14.— ARRANGEMENT OF W. J. BATES'S WAVE-FRONT SHEARING INTERFEROMETER (1947)

The *Evaluation of* the *Metre*.—J. R. Benôit, Fabry and Pérot (1913), combining the principles of the Brewster fringes with that of the Fabry-Pérot interferometer, redetermined the metre.

Multiple-beam Brewster fringes are produced in transmitted light by two Fabry-Pérot interferometers in series behind each other, their lengths being in the ratio 2:1. First the exact spacing in terms of the red cadmium line is found interferometrically for an interferometer with as near as possible a 6.25-cm. spacing. This is then matched, by Brewster fringes, against a 12.5-cm. etalon, then this against a 2j-cm., then this against a 50-cm. and finally the last is matched against an approximate 1-m. etalon. This etalon. the length of which is exactly known in wave lengths, can be compared with the standard metre quite rapidly, since only the difference is required.

Between Michelson's 1892 experiment and 1940, nine precision determinations were made by different laboratories; and the mean wave length for red cadmium was found to be 6.438 4696 ± 0.0010 Å, which by chance was exactly the value adopted by international agreement in 1907.

Refractive Index of Air.—The etalon gives the best values for the refractive indices and dispersions of gases. The exact metrical spacing of an enclosed interferometer is first found in *vacuo*. Then the new optical path is measured when air (or gas) is introduced. As typical of modern precision the refractive index for air (at 760 mm.. temperature 15° C. and 0.03% CO_2 content) for the red cadmium line is given by H. Barrel1 and J. E. Sears (1939) as 1.000276380.

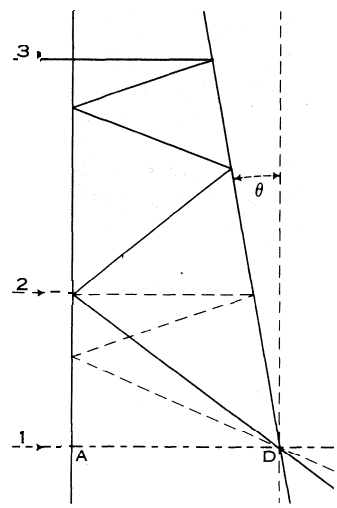


FIG. 15.—MULTIPLE-BEAM INTERFEROMETRY AS DEVELOPED BY S. TOLANSKY IN 1946

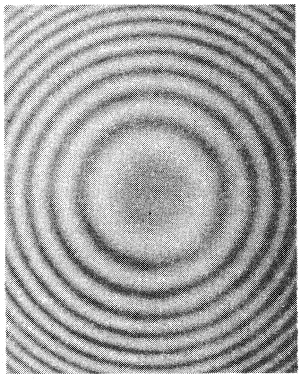
9. The Echelon and Lummer Plate Interferometers.—The echelon interferometer of Michelson and the Lummer plate interferometer, both species of multiple-beam interference instruments used specifically in spectroscopy, are discussed elsewhere (see SPECTROSCOPY) and need only be mentioned here.

III. MULTIPLE-BEAM INTERFEROMETRY

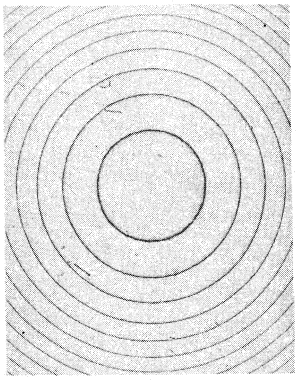
What is called multiple-beam interferometry is an important extension made by S. Tolansky (1946) of Boulouch's multiple-beam principle to include the case of wedge interference systems. The Fabry-Pérot interferometer was concerned with the circular fringes given by thick parallel plates. Such fringes arise from integration of light across the interferometer plates, hence the necessity for extreme flatness and extreme parallelism. Tolansky showed how the multiple-beam principle could be applied to thin-film localized wedge fringes; and thus succeeded in securing for topographical studies that same increase in power and sensitivity which the Fabry-Pérot interferometer had given to metrological and spectroscopic studies.

With highly reflecting plane surfaces inclined at a small angle, multiple reflections can lead to highly sharpened wedge fringes in accordance with the mechanism shown in fig. 1j.

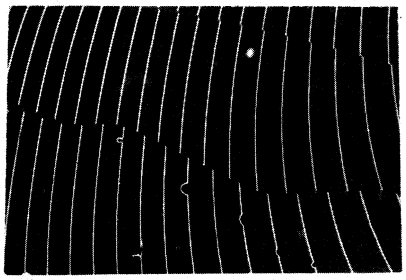
Three successive beams. 1, 2. 3, are shown meeting at the point D. The beams are not in arithmetical phase behind each other, for the nth beam lags behind the arithmetical progression by an amount $X = \frac{4n^3\theta^2 t}{3}$ in which AD = t. Only if X is appreciably less than $\frac{\lambda}{5}$ will the necessary condition for Airy summation hold, to produce very sharp fringes. Since effective values of n up to some 80 are involved, sharpening takes place only if t is very small, indeed of the order of one or two light wave lengths.



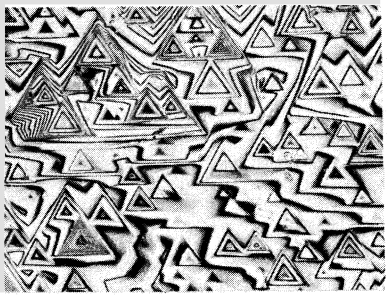
A



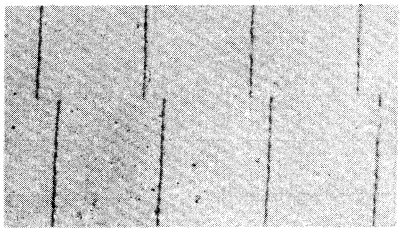
B



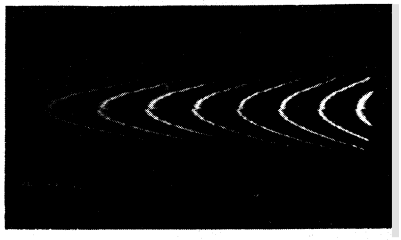
C



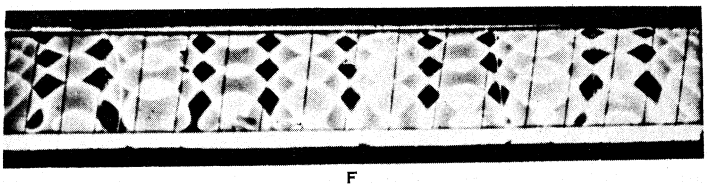
D



E

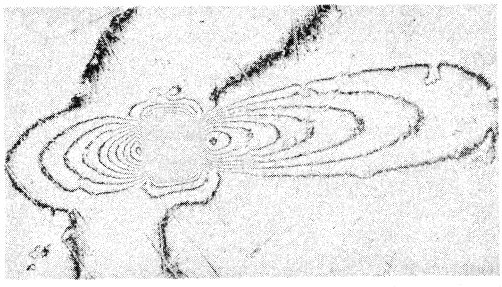


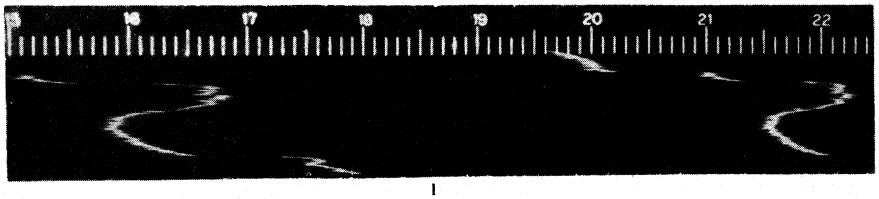
H



F

G





I

REPRODUCED BY PERMISSION OF LONGMANS GREEN & CO. LTD.

FIG. 16.— SOME APPLICATIONS OF MULTIPLE-BEAM INTERFEROMETRY (see TEXT)

In the Fabry-Pérot-type fringes the fringe shape is determined by the term $\frac{4R}{(1-R)^2}\sin^2\left(\frac{2\pi\mu t}{\lambda}\cos\theta\right)$ in which the only variable is t. In multiple-beam localized wedge fringes the same formula holds, but θ is constant and the variable is t. The fringe widths in the two systems obey a similar relation.

The surfaces to be studied are coated with a high reflector, placed very close together and illuminated from a small pinhole with strictly collimated monochromatic light at normal incidence. The resulting considerable improvement in fringe sharpness is shown in fig. 16. In (A) are shown Newton's rings obtained with two beams and in (B) the same secured with multiple beams. In the sections which follow, a selection is given from some of the studies made by Tolansky employing multiple-beam methods.

1. Some Applications of Multiple-Beam Interferometry.—*Microtopographies* of *Surfaces.*—A new high order of accuracy has been achieved in the study of surface microtopography. The fringes are contour lines of 2,500 Å height. Fringes are of the order of some $\frac{1}{50}$ wide, and displacements of $\frac{1}{5}$ of a fringe width are clearly measurable. Thus step heights of 10 Å can be recorded, a quantity of molecular dimensions. Indeed crystal lattice spacings of from 12 to 20 Å have been measured to within 1 Å.

Fig. 16(C) shows the fringe pattern at a cleavage step on mica; such pictures establish that the steps are small integral multiples of the lattice spacing. Many crystals reveal beautiful topographies; fig. 16(D) shows a complex microtopography on the octahedral face of a diamond.

Experimentation has established that vacuum deposition of silver by thermal evaporation leads to strict contouring by the silver of the surface features, even down to molecular dimensions.

Thickness of *Thin* Films.—The multiple-beam interferometer is widely used for the precise measurement of the thicknesses of thin films. The film is coated with an opaque layer of silver. extending over the film boundary so that a step appears in this thick silver film equal in height to the original film being measured. This step is then measured against a silvered optical flat with multiple-beam fringes in reflection. Film thicknesses as small as only 25 Å can be measured. Fig. 16(E) shows the fringe pattern given by a film 550 Å in thickness. The fringes are very narrow and the accuracy in the step measurement is high.

Oscillations of Piezoelectric Crystal Plates.—Quartz plate oscillators play an important part in precision electronic circuitry as frequency stabilizers and precision clocks. A most interesting application reveals the distribution of nodes and antinodes and the exact local values of amplitudes on such oscillators. The crystal surface, polished and silvered for interferometry, is one electrode! and a wire meshwork is the other. The silvered crystal rests on a silvered optical flat. When set into oscillation the initially straight line fringes take on a stationary pattern which reveals the distribution of the vibration, and the local fringe shape gives an exact measure of the amplitude. Fig. 16(F) snows a vibrating bar and fig. 16(G) a vibrating disk. Frequencies in both cases are several kilocycles. yet the patterns are completely stationary.

Fringes of Equal Chromatic Order.—Tolansky in 1946 developed a system of white-light multiple-beam fringes which have considerable power and are advantageous in specific instances. Their formation is shown in fig. 17. A white-light source A is imaged on a small aperture C and a parallel beam directed at normal incidence onto the silvered pair of interferometer surfaces E. The two surfaces must be very close together. but it is advantageous if they are near parallelism rather than wedged. With the achromatic lens F an image of E is projected onto G, the slit of a spectrograph, which thus selects a very narrow section of the surface under examination. Sharp multiple-beam white-light fringes form at H, each fringe being the locus of points for which $\frac{t}{\lambda}$ is constant. They have been named fringes of equal chromatic order.

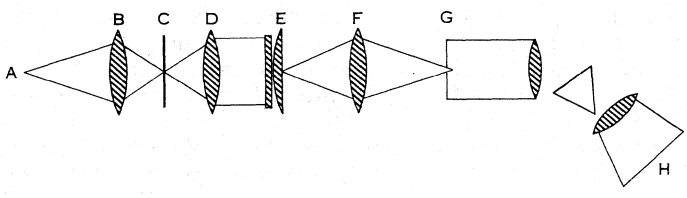


FIG. 17.— FORMATION OF WHITE-LIGHT MULTIPLE-BEAM FRINGES

For discontinuous steps, these fringes offer advantages. Examples are shown in fig. 16(H) which illustrates the fringes of equal chromatic order given by a silvered Newton's rings lens-plate combination. Fig. 16(I) illustrates the fringe pattern given by a very small surface depression with a depth of 4×10^{-6} cm. Each fringe is a contour line-profile over the same region on the object, but of different wave length. The separation between fringe pairs can be made very great. Magnifications of 500,000 times, with resolution of 10 Å, can readily be obtained. These great powers are in the up-down direction only.

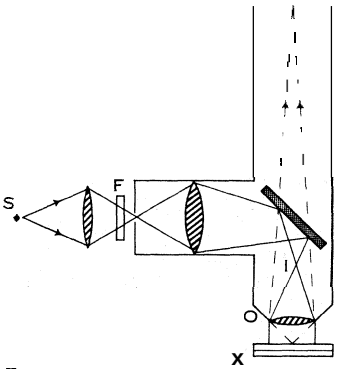


FIG. 18.—ARRANGEMENT WHEN A METALLURGICAL TYPE OF MICROSCOPE IS USED TO STUDY OPAQUE OBJECTS

Studies on *Opaque* Objects (Metals, *etc.*).—Many problems connected with surface flow, hardness indentation testing, crystal dislocation movements. electrodeposition, etc.. on metal surfaces have been studied with the multiple-beam interferometer. A metallurgical-type microscope must be employed with the arrangement shown in fig. 18. From a source S a point image I is formed at the back focal plane of the microscope objective O. The objective must illuminate the interferometer system with strictly parallel light at normal incidence and at the same time give a good microscopic image of the object X. As an example, fig 16(J) shows the distortions produced on a metal surface which has received a small micro-indent from a diamond pyramid, a procedure used in testing metal hardness. The distorted pattern is of crystallographic interest; for this indentation has been made on the surface of a single crystal of tin. The interference pattern indicates the character of the surface-flow distortion which results from the indentation. The asymmetry is even more marked than at first appears; for the extended horizontal lobes are elevations, while the smaller lobes at right angles to these are depressions. This shows that in one direction the surface "piles up." while at right angles to this it "sinks in." In fact, X-ray examination shows that these lobes lie along crystallographic axis directions. They reveal a differential directional hardness variation in the tin crystal. Such interferometric studies have already revealed much new information about surface-flow phenomena when materials are distorted.

BIBLIOGRAPHY.—The long article on interferometry by W. Feussner and L. Janicki in E. Gehrcke's Handhuch der Physikalischen *Optik,* 2 vol. (1927) is detailed and learned. C. Fabry's Les Applications des *interférences lumineuses* (1923) contains a great deal of value, especially on applications of the Fabry-Pérot interferometer. A. A. Michelson's *Studies* in Optics (1927) is a delightful exposition of Michelson's personal fundamental contributions. C. Candler's *Interferometers* (1951) contains much useful detail on instrumentation. An elementary introduction to the whole subject of interferometry is given in S. Tolansky, *Introduction* to *Interferometry* (1955). Spectroscopic interferometers are discussed in detail in S. Tolansky, High Resolution Spectroscopy (1942). The theory and practice of multiple-beam interferometry is given in S. Tolansky, *Multiple-Beam Interferometry* of *Surfaces* hnd *Films* (1948). (S. TY)

INTERGLACIAL STAGES, a series of comparatively warm and mild intervals, each several thousand years, between the equally prolonged times of extreme cold in the Pleistocene glacial period (see PLEISTOCENE EPOCH). For the stages of extreme cold the geologist A. Penck chose names from representative districts in the Alps: Günz, Mindel, Riss and Würm; of these, the Günz stage is the earliest; the Würm stage, the most recent. Penck chose these names because their order in

the alphabet corresponds to the chronological order of the four stages. while space is left between them for additional names, should additional stages of cold be defined.

The same names are conveniently used to indicate the intervening warmer stages. Thus the first mild interglacial stage is called the Günz-Mindel stage; the second, the Mindel-Riss stage; the third, the Riss-Wiirm. This cyclic alternation of climate through the Pleistocene period is accompanied by alternating arctic and temperate fauna and flora, while there is a further change, particularly of the fauna, due to the steady evolution of forms throughout the Pleistocene period. Thus in Europe during the colder stages the woolly mammoth and reindeer reached the south of France. while one of the interglacial stages was so warm that the lion and hippopotamus flourished in England.

In Sorth America there was a similar cyclic alternation of climatic conditions throughout the Pleistocene glacial period. but there are difficulties in the way of drawing definite parallels between the old world and the American stages. It is likely, however, that the earliest glacial stage in North America. which includes the pre-Kansan, Nebraskan and Albertan drifts, and which is called sub-Aftonian by American geologists, coincided with the Giinz of Penck. The earliest, or Xftonian. interglacial stage of North America would thus correspond with Penck's Günz-Mindel interval. In Sorth America, the Aftonian interglacial stage was marked by the presence of mastodons, three species of elephants, six species of horses, and the sabre-toothed tiger.

The second, or Kansan glacial stage in North America, corresponding to the Mindel ot Europe saw the extinction of some American camels and horses. It was followed by the Yarmouth interglacial stage. parallel to Penck's Mindel-Kiss, when the fauna included mastodons, mammoths, horses, tapirs, bison, deer and sabre-toothed tigers.

The third, or Illinoian, glacial stage in North America, corresponds to Penck's Riss. It was followed by the Sangamon interglacial stage; this was in its turn fourth, or Iowan, glacial stage. the record of which is not well defined. The fourth, or Peorian, interglacial stage followed; it presents similar difficulties.

The fifth. or Wisconsin, glacial stage appears to correspond to the European Würm. It was followed by the postglacial stage. which gradually merges into the present time. Elephants, mastodons, horses and the great sloths disappeared! the exact cause of their disappearance being unknown.

In the earlier or preglacial stage, Pleistocene vegetation was characterized by a commingling of warm temperate and cool temperate forms. During the alternating interglacial periods the record of plant life in the more northern regions indicates a succession of forest, barren ground, steppe, tundra and arctic types with each increase of glaciation. Upon the retreat of the glaciers this succession of plant types recurred but in reversed order. In some interglacial periods the climate was milder for the same latitudes than at the present time, so that numerous trees, for example, extended some hundreds of miles north of their present range. In the postglacial or late Pleistocene stage, which blends into the Recent, plant life assumed substantially the present status and distribution. Many arguments may be advanced supporting the view that the postglacial and recent constitute a part of an interglacial stage, as the time that has elapsed since the disappearance of the last great ice sheets from Europe and northeastern Sorth America is less than the duration of some of the former interglacial stages. The effect of glaciation upon the vegetation of Europe and North America, especially the former. was profound! not only with reference to the present distribution of the flora, but also as regards the extinction of old and the evolution of new types. In Europe the high mountain chains, which extend in an east-and-\vest direction, together with the Mediterranean, Black and Caspian seas, prevented the migration of the flora southward. In consequence an immense number of plants formerly components of the European flora, particularly that north of the Alps. was obliterated by glaciation. Numerous types of trees now found only in Sorth America and Asia were abundant in Europe in pre-Pleistocene and part of Pleistocene times. Among these were such important trees as the black walnut, butternut, hickory, magnolia, bald cypress and sassafras (*qq.v.*).

In North America the back-and-forth movement of plant life was not impeded, as in Europe, by high mountains and inland seas. The presence of the larch *(Larix laricina)* in Georgia, of the black spruce *(Picea mariana)* in Kansas and of the white spruce *(Picea glauca)* in Iowa, all far south of their present range, has been demonstrated. Likewise, the presence during a mild interglacial stage of a fig in fruit in British Columbia, and of the redbud *(Cercis)*, the Osage orange (*Maclura*), the papaw (*Asimina triloba*) and other warm temperate types as far north as Toronto. Ont., has been proved.

INTER-GOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION (IMCO), a specialized agency of the United Nations, came into existence on March 17, 1958, and was organized in Jan. 1959.

IMCO was established to promote international co-operation in maritime navigation and encourage the maximum use of safety measures; to encourage also the removal of discriminatory action and unnecessary restrictions by governments affecting international shipping; and to consider matters concerning unfair restrictive practices by shipping concerns.

It concentrated early on technical aspects of shipping such as safety at sea, pollution of the sea and tonnage measurement of ships. (M. H. H.)

INTERIOR, DEPARTMENT OF: see GOVERNMENT DEPARTMENTS.

INTERIOR DECORATION. In this article the history of interior decoration is arranged chronologically under the following headings: Egypt, Greece and Rome, Japan, India, Europe and United States. If it is read together with the article FURNITURE, arranged on similar lines, a picture can be obtained of the interiors of houses through the ages in different parts of the world.

ANCIENT CIVILIZATIONS

Egypt. — In Egypt the invariable material for houses was sun-dried brick. The roof was of reed-thatch and the floors of beaten earth. The interior walls were smoothed down with fine mud plaster and often covered with a white or coloured wash.

At the beginning of the historic period (1st dynasty, *c.* 4500 B.C.) rush or palm-leaf mats, woven in coloured patterns, were hung on horizontal rods across doorways to serve as doors or were hung on walls as decorations. They appear to have been used also as blinds at windows to keep the sun out, but the mechanism by which they were raised and lowered does not appear; it was probably of the simplest. Green-glazed tiles, 9 in. square, were used as a dado in an important building, perhaps a royal palace; they represent reed matting. Possibly the custom of decorating chambers in the tombs which were supposed to be frequented by the dead arose from the custom of decorating the rooms of the living.

In the 12th dynasty (*c.* 2500 B.C.) in the workmen's town of Kahun, the better-class houses had rooms decorated with a foot-high band of dark brown paint all round the bottom of the walls, not unlike a skirting board of modern times; above this was a dado, 4 ft. high, of vertical stripes in black, white and red. The upper part of the wall was colour-washed in a light shade of buff, on which, in a few cases, were brightly coloured frescoes.

In the palaces at Tell el Amarna (1375–58 B.C.) the interior walls were highly decorated with paintings of flowers and vines in their natural colours, with here and there scenes of animals, and the endless representations of Ikhnaton, Queen Nefertiti and their daughters. The decorations were in paint, often very delicate and beautiful; the naturalistic effect was enhanced by the inlay of the flowers and bunches of grapes moulded in coloured glazed ware, the grapes dark purple, the poppies red, the cornflowers bright blue and the large daisies with white petals and brilliant yellow centres.

The floors of the principal rooms were also painted, often with scenes of gardens and with ornamental ponds with lotuses in bud and blossom, fish swimming and numbers of water

birds on the banks. These painted floors are probably the origin of the mosaic pavements of later times.

As Egypt began to fall into decay after this period, the houses being of mud brick soon crumbled away and were reduced to utter ruin and their decorations perished with them.

See M. Murray, *The Splendour That Was Egypt* (London, New York, 1949). (M. A. M.)

Greece and Rome.—The Greeks and Romans delighted in colour and made effective use of it in the decoration of their houses and public buildings. Wall painting, a form of art. known to the ancient world since Mycenaean times *(see* AEGEAN CIVILIZATION; ARCHAEOLOGY: *Greek and Roman Orient (including Egypt-Indus)*. flourished in domestic contexts from the Hellenistic period onward. and many of the geometric and floral motifs developed at Pompeii and Herculaneum and in Rome itself spread throughout the empire and are found on many provincial sites. Scenes with human figures, animals, birds or fish also occur outside Italy, some of them. like the 4th-century Christian paintings from the villa at Lullingstone in Kent, Eng., obviously derived from the art of the Roman catacombs. The custom of decorating walls with thin sheets of marble and other coloured stones was also popular in Hellenistic and early imperial Greece and Italy; and, at a later date, wall decorations imitating these veneers in paint were no less widespread. In the 3rd and 4th centuries A.D. the use of actual marble for this purpose was revived, as, for instance, at Ostia, in association with floors of gaily coloured *opus sectile.*

Other methods of decoration, which became particularly fashionable in the 1st century B.C. and onward, when building in Rome was increasingly elaborate, include the use of slabs of terra cotta, either as individual plaques let into the walls or to form continuous friezes running round the rooms. These were ornamented with reliefs depicting gods, myths. pastoral scenes or episodes from the circus. Panels of fine stuccowork portraying the same themes were similarly used, and some particularly exquisite examples of Augustan work of this type were found in the Farnesine house in Rome. A house on the Palatine, probably of late republican date, shows griffins in white stucco on a red ground; while the vaults of ceilings of the early empire were often covered with small cameolike figures modelled on coloured backgrounds and occasionally gilded. Mosaics made of glass tesserae were used for vaults and apses, and decorated pavements, ranging from the early pebble mosaics of Delos to the later black-and-white or polychrome mosaics found all over the Roman empire, also formed part of these elaborate colour schemes *(see* MOSAIC).

Further touches of colour were added to a room by the curtains and furniture coverings. Mattresses. cushions and pillows were used with couches and chairs from the earliest times. No actual examples of these objects have survived. but they are frequently depicted on reliefs and in vase and wall paintings, where they are shown as provided with woollen or linen covers sometimes woven in very ornamental designs; the exceptionally thick mattresses popular in the and century A.D. often had very richly figured covers. Cushions and pillows were usually square or oblong in shape, and long, round bolsters were also used. The more luxurious were decorated with tassels and a fringe, or were covered in silk or cloth of gold. The stuffing seems to have consisted of feathers. straw, other vegetable materials or wool, described by Petronius as sometimes dyed scarlet or purple. Bedclothes included rush mats. skin rugs and loose draperies, and mattresses were occasionally embellished with valances. A painted stone funerary couch carved in a Ptolemaic tomb near Alexandria shows a mattress and pillows covered in a red material with broad yellow and narrow blue stripes and figures of women in gold woven in at some points. The main valance hangs down from behind a horizontal frame adorned with a frieze of gold cupids driving chariots drawn by stags, and it has a blue centre and a red border decorated with gold figures and red tassels. It may be assumed that such sepulchral couches had domestic prototypes.

Fragments of fabrics of wool, linen: cotton and Chinese silk have been found in tombs at Palmyra and a portion of a curtain or seat cover discovered at Doura-Europos bears rows of quatrefoil roses with petals shaded in dark red and pink, all outlined in tan on a green ground. Elaborate furnishings of this kind are mentioned by Horace, Propertius. Cicero and other authors, and further illustrated by such Pompeian mall paintings as the scene of the courtship of Venus and Mars in the house of Marcus Lucius Fronto, which shows a couch covered with purple, scarlet and dark green draperies with stripes and bands. of scarlet, yellow and purple. and a stool draped in red, gold and blue material with a golden fringe.

Objets d'art such as statues or statuettes of bronze or marble, painted vases and bowls and dishes of red-glazed pottery, silver, bronze or glass of various colours further enlivened Greek and Roman interiors. Lighting was provided by pottery or bronze lamps made in a variety of shapes. Sometimes these were placed or hung on elaborate bronze lampstands; fine examples of tall candelabra survive from Pompeii.

The statues and vases were displayed on shelves or placed on tables or on elaborate folding bronze tripods, the legs of which were decorated with busts and animal feet. When the tripod supported a tray or table top, the latter might be covered with a fringed tablecloth. Sometimes, however, the tops of the legs were provided with hooks which fitted under the rim of a bronze bowl or brazier; larger braziers and water heaters of bronze have come to light at Pompeii. These beautiful objects, when offset by the gaily coloured furniture and draperies and by the brilliant wall paintings and marble or mosaic floors, must have turned the interior of the dwelling of a well-to-do Hellenistic Greek or Roman into a truly gorgeous spectacle.

BIBLIOGRAPHY.—E. Wadsworth, "Stucco Reliefs of the First and Second Centuries Still Extant in Rome," *Menzoirs of the American Academy in Rome,* iv (Rome, 1924); A. hdriani, "La Necropole de Moustafa Pacha!" *Annuaire du Musée Gréco-Romain* (Alexandria, 1933–34, 1934–35); R. Pfister, *Textiles de Palmyre* (Paris, 1934–40); R. Pfister and L. Bellinger, *Excavations at Dura-Europos,* final report iv, pt. ii, "The Textiles" (New Haven, Conn., 1929–); D. K. Hill, "Roman Panther Tripods," *American Journal of Archaeology,* lv (Boston, 1951); G. Becatti, *Case Ostiensi del Tardo Impero* (Rome, 1950). (JN. L.)

THE ORIENT

Japan.—The interior of a Japanese house has probably changed much less than most in the course of 1,000 years. Almost the only difference is that the rooms are now divided by sliding doors, whereas in mediaeval times there were only single-leaf screens and curtains, and the wooden floors are pou entirely covered by mats. In these earlier buildings there were pivoted doors in the Chinese manner and windows of wooden grating that pushed outward instead of the sliding shōji, such as may still be seen in shrines and temples. There was a curtained dais for the most important person and separate mats on the wooden floor for others. Then as now there was a connecting corridor outside the rooms. The *Seiryoden,* or ordinary residence of the sovereign in the Kyoto palace, a simple suite in ancient style with its walls and standing screens decorated with pictures in the Chinese classic manner, is a surviving example of a 10th-century interior in which a present-day family could live quite comfortably.

It was in the late 15th century that the interior began to assume its present form. This was the result of the blending of the older court style with the more austere type of house favoured by the military caste, which was much influenced by Zen Buddhist architecture. Then in the later 16th century under the aesthetic autocrats Nobunaga and Hideyoshi came the rise of the tea masters. These connoisseurs of the "Way of Tea," which comprises the construction of the tearoom and its garden and the correct deportment in them, established hereditary families and schools and have ever since remained the established aesthetic advisers on most aspects of domestic architecture, interior decoration and garden planning. Their principles emphasized beauty with cheapness, asymmetry and economy of movement. Much of the simple grace of these interiors is due to them.

A survey of the interiors of a number of Japanese houses would probably convey the following impressions: that they all had a quiet harmonious and unostentatious delicacy, that any decoration was almost entirely constructional and that the residences of all classes were equally neat and pleasant and lacking in disorder

and vulgarity. Their decorative qualities derive from an infinite variety of detail in a setting that is completely standardized, for the ordinary rooms are multiples of the floor-mat unit of 6 ft. by 3 ft., the sliding doors 5 ft. 8 in. high by 3 ft. wide, the supporting pillars 33 in. to 4 in. square, set at 6 ft. intervals, and the ceiling boards 1 ft. to 1.5 ft. wide. All woodwork is unpainted and rarely lacquered. But there is a great variety in the fusuma or sliding doors which divide the rooms and which are covered with paper of many patterns or decorated with paintings or calligraphy. Thus the whole side of a room may present a landscape either in black and white or in colours, often on a silver or gold background, while a change of these fusuma will completely alter its appearance, and their removal throw two or more rooms into one. All rooms may be used as bedrooms, since the bedding is kept in spacious cupboards with other utensils, but the reception rooms provide more scope for decoration than the others, for there one end of the room is occupied by a tokonoma, an alcove with a canopy above it supported by a pillar of fine or uncommon wood, in which is hung the picture or set of pictures which, with the flower arrangement that usually accompanies it, is the only ornament. Both are changed frequently according to the season or taste. Next to it a writing table is often built in. Beside the tokonoma is usually a *chigai-dana,* an asymmetric arrangement of cupboards and shelves somewhat like a sideboard. Between the top of the fusuma and the ceiling is often a *ramma* or openwork frieze carved with patterns or landscapes in wood or bamboo. A framed tablet with a poem or painting on it may sometimes find a place there. Other walls are of plain plaster in subdued shades, mostly of gray or brown. The ceilings are usually of thin boards, slightly overlapping, upheld by bars about an inch square, the whole suspended from the roof or floor beams. In large apartments as in shrines and temples the coved and coffered "Chinese ceiling" with lacquered woodwork and pictures and patterns in the coffers is sometimes found. Fancy varieties made of bamboo and reeds and plaited wood are not uncommon. Occasional articles in these rooms, which otherwise have no furniture, may be a cabinet of blackwood or lacquer, a low writing table or a screen, either twofold or sixfold, the latter generally in pairs, decorated with landscapes on a gold or silver background and mounted in brocade, while a single-leaf screen sometimes stands in the entrance hall. These with other valuables such as scroll pictures, braziers, pottery, spare fusuma, books and curios are kept in a detached fireproof storehouse by the well-to-do and produced only occasionally to ensure a constant variety in the rooms. It is a principle that rooms that are only occasionally occupied may be more showy and fanciful than ordinary living rooms, and these are most often met with in hotels and restaurants and other places of entertainment. Just as much care is taken with the interiors of the bathroom and privy as with the other rooms, and the doors and windows and walls of these are usually of excellent workmanship. Those in famous restaurants are often wonderfully decorative. Bamboo has many uses in the Japanese house as pillars and window bars and ceiling material, and when split and flattened may take the place of boards. Some idea of the variety of the fitments may be obtained from the series of volumes of Illustrations of Architectural Details by Kenchiku Shashin Ruiju (Tokyo, 1916) that give 150 different examples of tokonoma and chigaidana arrangements, 100 of *ramma,* 100 of sliding doors, about 20 of ceilings and 50 of windows. These latter are of many shapes, round, square, bell-shaped, jar-shaped, gourd-shaped, diamond- and fan-shaped and purely asymmetric, and make a happy diversion in a blank wall.

There is little interior decoration in Chinese houses. The principal feature is the furniture, and the reader will find this treated in the article FURNITURE.

See also *A. L.* Sadler, *A Short History of Japanese Architecture* (Sydney, London, 1941); R. T. Paine and A. Soper, *The Art and Architecture of Japan* (Harmondsworth, 1955). (A. L. SR.)

India. — Words of Indian origin such as calico, chintz, palampore are in themselves an indication of India's importance in the history of interior decoration. Yet, Indians themselves have never been very conscious of this role, their own domestic interiors being of the utmost simplicity, with hardly more than a carpet or prayer mat to offset stone floors and plain white walls.

In fact it can be shown that India's role, although of great importance, was less revolutionary than is generally supposed. The painted calico hangings and bedspreads exported to Europe in bulk during the 17th and 18th centuries were mostly inspired by western examples in the first place. The usual practice was that the directors of the East India company in London sent out sample patterns to their agents in India with instructions that Indian calico painters and embroiderers should be commissioned to produce designs "after the same manner." It is even arguable that the well-known "tree of life" type of design was ultimately of English origin, for in 1669 (when this type first appeared in Indo-European textiles) the London directors of the company were writing to India: "Now of late, they are here in England come to a great practize of printing large branches for hangings of Romes, and we do believe that some of our calicoes painted after that manner might vent well, and therefore have sent you some patterns. . . ." The sample patterns were probably sent in a form similar to the many contemporary pattern books published in England for domestic embroiderers — in other words, as black and white drawings in quarto or smaller. Therefore, in making freehand enlargements, the Indian draftsman would have been compelled to elaborate according to his own imagination details of the flora and fauna with which he was not familiar. This perhaps explains why common European motifs appear in a very distorted form in many of the Indian designs — for example, the oak leaf, which the Indian copyist renders with exaggerated dentations, or the strawberry fruit, with unduly large seeds. In both cases the effect is exotic, and such motifs are hardly recognizable as European without prior knowledge of how they came into being. It was precisely this element of exoticism which gave Indian hangings and bedspreads such a wide appeal in Europe.

The demand for such goods reached its peak in the last quarter of the 17th century. In 1683 the directors of the East India company wrote enthusiastically to their agents in India that "you cannot imagine what a vast number of them [chintz] would sell here to content . . . 200,000 of all sorts in a year will not be too much for this markett, if our directions be punctually observed in the providing of them."

Competition with home industries led to agitation for stopping imports. In 1686 France introduced a ban, and England followed with the restrictive acts of 1701 and 1720. But in both countries the law was a dead letter and ways were found of evading it. Throughout the 18th century, Indian fabrics found their way into every fashionable English household, and it would be difficult to discuss the interior decoration of the period without them.

Toward the end of the 18th century, the traditional Indian methods of calico painting by resist and mordant processes gradually gave way to the cheaper print-block technique. This was accompanied by artistic degeneration, and in the 19th century Indian hangings and bedspreads were a poor shadow of the earlier tradition.

Two fine collections of the 17th- and 18th-century fabrics were preserved at the Victoria and Albert museum, London, and the Royal Ontario Museum of Archaeology, Toronto — the original private collections of G. P. Baker and Harry Wearne, respectively.

See G. P. Baker, *Calico Painting and Printing in the East Indies* (London, 1921); H. Clouzot, *Painted and Printed Fabrics* (New York, 1927). The latest research on the subject is mostly scattered in the form of articles. (J. C. I.)

EUROPE

Early Middle Ages. — In the earliest middle ages, after the collapse of the Roman empire, when nearly all the amenities of domestic life so highly developed by the Romans were lost to western Europe, interior decoration, as it is now understood, can hardly be said to have existed at all. They were times of incessant war and general insecurity, and above all else it was necessary for the owner of a house to be able to defend what he owned, and therefore in these times, and late into the mediaeval period, the larger and more important houses were strongholds rather than dwellings and were designed accordingly. For the same rea-

sons, a man who owned more than one house or castle and moved from one to the other found it necessary to take all his possessions with him, and so the interior fittings were limited in number and were as simple as possible.

The principal living apartment was a large hall with bare walls. open-beamed roof. narrow windows, at this period unglazed. and a floor of stone slabs, tiles or beaten earth. There was practically no furniture. Window curtains. if used, were suspended on hinged rods, swung away from the windows during the daytime. The doorways might have similar curtains. In earlier times the log fire burned in the middle of the floor, the smoke, somewhat uncertainly, finding its escape through a hole in the roof or left to disperse among the rafters. Later, large hooded stone fireplaces uere built into the wall; early English examples still exist at Stokesay castle in Shropshire, dating from the 13th century. Metal braziers on wheels, for local heating, were used during the late middle ages.

In the earliest times the whole community often lived and slept in the one hall, but slomly the house became divided up and separate rooms were provided for members of the family and for the use of important guests. At first one or more spaces in the hall mere curtained off by movable hangings, suspended from the rafters or from iron rods projecting from the walls. and separate apartments were thus temporarily provided

When recesses in the hall were curtained off, a first approach to separate sleeping rooms was made which eventually led to the building of proper bedrooms. Solars and cabinets or bowers for women's work and recreation were developed in this way. The kitchen was a low apartment with a depression in the middle of the floor for the fire, covered with a great iron grid for cooking upon.

The houses of those other than the nobility and wealthy classes, and particularly those of the serfs and peasantry, were far more primitively constructed and equipped. They were small, often circular, huts. lined with wattles, the floor being of bare earth, and with no interior decoration or fittings worthy of the name.

Later **Middle** Ages.—Such conditions, varying according to local circumstances, were generally prevalent in western Europe down to the close of the 12th century. Where eastern habits of life had already penetrated, as in Spain or Sicily, magnificent buildings were erected. A room in the palace at Palermo, Sic., is still known as that of the Norman king, Roger II. The walls are lined with marble; the lunettes and ceiling are encrusted with elaborate mosaics.

Changes were gradual and progressive, but a definite step forward was made about the 12th century. Most of the military leaders in France, and many in neighbouring countries, had by then taken part in the crusades, and they had learned something of the more luxurious mode of living in the middle east. Also during the folloaing centuries life gradually became more secure and the castle slowly evolved into the unfortified manor house. The accumulation of more elaborate household equipment, both decoration and furniture, began. and at the same time women began to take a more prominent share in the regulation of the household and the provision of daily needs. Curtains brought back from the east would be of thinner texture and were drawn back in folds rather than swung away on rods. Tapestries and various hangings relieved the bareness of the walls and gave additional uarmth to rooms; similar textiles were often draped over chairs and tables, and brightly coloured cushions were used. The wooden ceilings might be coffered, and sometimes painted in bright colours and gold. Where shutters nere provided for windows, glazing was not so necessary, though glass became commoner as the middle ages progressed. Many of the mediaeval rooms that still exist today give a falsely austere and stark impression of nhat they were like originally. In the later part of this period a certain degree of comfort, though crude by present-day standards, was attained, and the appearance of rooms, nith their hangings and painted decorations, their painted furniture and brightly woven cushions, would have been gay and cheerful.

Throughout this period the breaking up of houses into separate rooms, serving special purposes and providing greater privacy, continued slotily, though the hall still remained the hub of the life of any house. As time went on the hall continued to serve many purposes, but gradually the house became divided into an antechamber, hall and withdrawing chamber. There might also be a special guest room, as the one described in the 14th-century English poem, *Sir Gawayne and the Grene Knight*.

In the later middle ages the wardrobe was a separate room, with deep presses lining the walls. having cupboards above and lockers below. Here were stored the hangings, floor coverings, curtains, tapestries and linen of the establishment. besides the garments and other materials necessary for a large household. With the lack of shops this was the place to replenish supplies. It was also the workroom with tables and other provisions for tailors and needlewomen.

The kitchen was now provided with vast, low arched recesses in the walls, where the fire could be better regulated than in the middle of the floor. Rotating spits in stages. for roasting, had dripping pans below and there were adjustable hooks for suspending cooking pots over the fire. The floor, of stone or earthenware tiles in large houses, of bare earth in others, was covered with sawdust, as it was until recently in large kitchens. In time it became usual to spread the floor with rushes and with fragrant herbs, and later still the rushes were plaited into mats. Plain woollen cloth or furs were sometimes laid down. For ceremonial occasions. rich fabrics were spread before the royal throne. Oriental pile carpets were not used before the 15th century, and were rare in western Europe before the 17th.

Torches at first provided the principal lighting, and the fire gave light as well as heat. There might be a few sconces fixed to the walls, with prickets for candles. Standing candelabra of iron for many candles came into use, as well as small portable pricket candlesticks, and occasionally chandeliers, or lustres, hung from the rafters.

The use of ornaments and various articles of luxury grew during the times of the crusades, increasing in subsequent centuries as commercial relations with the near east became closer. The household plate, of gold or silver, was frequently displayed for decorative purposes and to impress visitors, on sideboards and cupboards. It was not unknown for these to be roped off to prevent the near approach of the acquisitive hand. Indoor provisions for washing and bathing must also be included among luxuries. A long trough with a row of taps in the courtyard served for most of the household. At times there was a tank or cistern with water continually running. A metal bowl, flat-sided, was sometimes fixed to the wall of a living room, with a swinging ewer or a small cistern with a tap over it and a towel on a hinged rod. Small convex mirrors were hung on the walls as early as the 15th century, such as the famous one in the portrait of Jan Arnolfini and his wife by Jan van Eyck in the National gallery, London, but hand mirrors, usually of polished metal, were the only sort in general use before that time.

An illustration in the celebrated manuscript in the museum at Chantilly. Fr., the *Très riches Heures du duc de Berry*, shows a striking picture of seignurial life in the first half of the 15th century. It represents King René seated at table. Behind him is a large hooded fireplace and he is protected from its heat by a circular screen of plaited rushes. The wall is covered with tapestry hung on hooks. The table is covered with a white cloth and there is rush matting on the floor.

In the Alpine lands, such as Switzerland, the Tirol and south Germany, the use of fir, pine and other soft local woods determined the form and ornamentation of much of the interior of houses there. Floors, walls and ceilings would be made entirely of wood, as they often are today. A bedroom from the Landesfürstliche Burg at Meran (Merano), south Tirol, is a remarkably well-preserved example of an interior in a house of some standing in the latter half of the 15th century. The old Swiss furnished interiors exhibited at the Historical museum in Basle, though only in one case dating back to the mediaeval period, illustrate much that has been said about earlier times. There are others in the museums of Berne and Zurich, covering the period from the 15th to the 17th centuries. Floors are of wood, walls

and ceilings are panelled and moulded. Sometimes there is inlay of harder and more ornamental woods. The mouldings are bold, but any carving is usually in slight relief because of the nature of the wood; the inlay is generally simple and geometrical.

The Castello d'Issogne, in the Val d'Aosta in northern Italy, is remarkable among surviving examples of the adaptation of the mediaeval domestic interior to the mild climate south of the Alps, where the Gothic style never took such firm roots as in northern Europe. It was built about 1490 by a member of the Challant family who held the post of governor of the Val d'Aosta. Though mediaeval in structure and appearance, it is not a stronghold, but a summer resort. It is built in a square with a tower at each corner. There is an inner courtyard, alongside of which is a kind of vaulted portico supported by pillars and open to the courtyard. This is used as a hall, with wooden linen-fold panelling and a fixed bench running along the wall. The lunettes above the panelling are filled with fresco paintings of scenes of daily life—the shops of a provision merchant, an apothecary, a tailor and a draper, and an outdoor market and soldiers in a guardroom. There is also a dining room, an armoury, a kitchen, a servants' hall and a chapel. The coffered ceilings are carved and painted.

Stokesay castle in Shropshire is one of the most complete remaining early domestic dwellings in England, a fortified manor dating in part from the 13th century. The large hall has a high open-beamed roof, the unglazed windows have wide stone seats and the floor is of beaten earth. An outside flight of stone steps leads to the solar, a private room for the owner of the manor, where there is a built-in fireplace. The house has other separate rooms and is an early example of the development of some form of privacy in the domestic arrangements of the English interior.

A notable early specialist in house decoration in England was Henry III, who rebuilt Westminster abbey. The Liberate rolls of his reign preserve all the orders he gave for the adornment of his various castles and manor houses. Larger windows, and especially rose windows, were built in halls, their painted glass adding to the rich colour decoration that the king liked and obtained at other times by painting "histories" on his walls, as in his Great chamber at Westminster. His queen had a figure of winter painted over her fireplace there and springlike flowers painted on the whitewash of her room at the Tower of London. Walls were frescoed with histories, including both biblical and classical scenes, and below them often was wainscoting with painted and decorated boarding. Wrought roofs or painted ceilings completed a rich domestic treatment, which was rare in 13th-century England, when walls were bare and hangings were the usual means of decoration used by the wealthier classes.

Flanders tapestries, known by the generic name of arras, were then the most favoured hangings. Solidly woven, they resisted the wear and tear of being moved frequently from one house to another. Tapestries were hung curtainwise from wood quartering set with tenterhooks, and such have been renovated at Tattershall castle where, except for such hangings, the brick structure of the walls was visible, as is also seen in a picture from an illuminated manuscript produced in Flanders for Edward IV (*c.* 1475) of Richard II feasting. There is no arras, but the king sits under a rich textile canopy, similar material also hanging in front of the musicians' stand. It was not as yet customary to have the walls lined with panelling, but wood was used for structural purposes as hall screens and room partitions. Also noteworthy is the great heraldically carved chimney piece at Tattershall, dating from about 1436.

In most features of interior decoration in the later middle ages England was strongly influenced by and followed the fashions of France and, through it, the Low Countries; and development both in furnishing and interior decoration lagged behind the more sophisticated French interiors and the solid comforts of houses in the Low Countries.

RENAISSANCE

The Renaissance, originating in Italy in the early years of the 15th century, provided a new style of interior decoration. This was created both by the new humanist approach to the world, and in this particular case to man's domestic background, and in practice by a new interest in the classical tradition, which had never been entirely lost in Italy and which now provided inspiration both for design and ornament. Traces of Roman greatness were to be seen in many places, though excavation was only undertaken with the aim of obtaining building materials from the ancient ruins. When a deliberate return to the classical style was made, the borrowing of the classical orders for example, it was not merely copied, but was adapted and enriched and used in novel arrangements.

The Italian Renaissance interior is characterized by the use of classical architectural features, which besides being incorporated in the more structural elements of the room, such as doorways, fireplaces and windows, were also used in other decorative mediums such as plasterwork, wood panelling and painted decorations. Besides the pillars, entablatures and heavy mouldings, a wealth of other ornament inspired by classical sources was employed in every decorative technique. Among the most familiar are the reclining *amorini*, floral garlands, caryatids, grotesque and lion masks, scrollwork, floral arabesques, cornucopia and trophies of arms.

The number of rooms increased and the larger palaces and houses achieved a richness of treatment and a spatial grandeur hitherto unknown in western Europe. Windows became larger, fine staircases were introduced and fireplaces and doorways were elaborately decorated, becoming key features in the scheme of a room. The fireplace by Benedetto da Rovezzano, now in the National museum, Florence, is characteristic, with its architectural design and its finely sculptured decoration.

The walls of great houses were often pictorially painted, the cornice and ceiling enriched with elaborate painted and gilded plasterwork. Subjects were drawn from classical mythology and from religious sources. In the Sala del Credo, one of the rooms in the Borgia apartments in the Vatican, the lunettes are decorated with paintings of the apostles, while benches of coloured marble fill the window embrasures. Sometimes, as in the Hall of Exchange in the Collegio del Cambio with its painted decorations by Perugino, the lower part of the wall is lined with wood panelling, frequently carved with pilasters and painted and gilded. Panelling decorated with intarsia, often reproducing startling effects of perspective, is found in Italy, a celebrated example being the room at the Palazzo Ducale, Urbino, where the effect of open cupboards full of books is created.

The interior decoration of France was first influenced by the Italian Renaissance in the reign of Francis I (1515–47). The French monarchs of the 16th century invited Italian artists to the court; they were employed in extensive undertakings and the forms that they introduced were generally followed. The chimney piece from Fontainebleau, with its elaborate arrangement of Renaissance motifs and its over-all imposing features, gives some idea of the dominance of Italian influence at this time. The same influence can be seen in the grander Renaissance interiors of Germany and Austria.

In the Low Countries and north Germany during the 16th century the ornament of the Italian Renaissance was borrowed and adapted to form an entirely individual style, such as may be seen in the pattern books of Vredeman de Vries and Wendel Dietterlin. Strapwork and raised faceted ornament were widely used, together with muscular, grotesque masked caryatids and distorted architectural features arranged in undisciplined designs. Chimney pieces, with overmantels carried to the ceiling, were embellished with marble columns and elaborate strapwork patterns, while similar ornaments flanked the doorways and enriched the ceilings. The great tapestries, for which the Netherlands had long been famous, afforded protection from the cold air, and oriental carpets were used as table covers, though not at this time spread on the floor.

In many areas of Europe the Italian Renaissance had little effect on interior decoration. In the Alpine lands, where wood was cheap and plentiful. traditional methods continued for a long time, wooden floors and ceilings and panelled walls, or partly panelled with plain plaster,.were the general rule. The mouldings

were bold, but carving was usually in slight relief. Often the woodwork was painted in bright colours.

In Scandinavian countries much domestic architecture continued to be of wood. Relief was afforded by painted linen hangings, sometimes depicting biblical scenes, and by brightly coloured cushions.

England.— The Italian style of decoration began to affect the English interior in about 1520. For the next 40 years or so English craftsmen borrowed from the repertoire of Italian ornament, at first inspired by and imitating the Italian artists and craftsmen employed by Henry VIII on royal works at Hampton court and Westminster, using such motifs as arabesque decoration, medallion heads and *amorini* on panelling and plasterwork, often mingling them with the traditional Gothic motifs. The Gothic style died hard in England, lingering in the remoter provinces and country districts well into the 17th century, in spite of Henry VIII's example and encouragement of the Italian style.

During the second half of the 16th century the individual Renaissance style of the Low Countries and Germany largely replaced the Italian style, becoming the dominant influence in the decoration of panelling and plasterwork of the English interior. Characterized by such features as intricate strapwork patterns, raised faceted ornament, grotesque masks, muscular caryatids and pilasters, the style of the north European Renaissance was fostered in England by the close religious. political and economic relations between England and the Low Countries, the influx of immigrant workmen and by the circulation of Flemish and German pattern books, which showed the full repertoire of this newly created style.

In adopting both the Italian and Flemish styles, the English craftsmen to some extent adapted and naturalized them, producing a new style peculiarly English—a style that can be seen in the plaster ceiling at Herrington, Dorchester, and in the decoration of the north drawing room at Levens hall, Westmorland.

During this period several methods mere used for covering and decorating the walls of rooms, oak panelling being one of the commonest. Until the middle of the 17th century the individual panels remained small, either regular in shape throughout a room or varying a little in shape and size. The height of the panelling also varied, sometimes covering the whole wall from floor to ceiling, sometimes only rising to about four or five feet, the rest of the wall being of plaster either covered with hangings or left plain. Both the Italian and the Flemish phases of influence can be recognized in the carved decoration of this panelling. The linen-fold ornament of the late Gothic period was at first combined with and later replaced by Italianate scrolled floral patterns, medallion busts and reclining cupids, while the areas of panelling were broken by pilasters headed by classical capitals, In the second half of the 16th century and during the Jacobean period the pilasters remained, but the carved motifs were borrowed from Germany and the Low Countries, strapwork and raised faceted ornament, like the decoration on the screens at Cuckfield place. Sussex, and Wollaton hall, Nottinghamshire, being particularly characteristic. The oak panelling mas also sometimes decorated with elaborate inlaid patterns, inspired by German work, using holly, bog oak, sycamore and other woods.

Screens continued to be used in halls even where they were only now of single-story height, as at Cuckfield where the screen is dated 1581. The majority were of oak, but in some larger houses stone was used, as at Wollaton hall and at Montacute, in Somerset. Similar decoration was used by the carver on these screens as on the wainscot of the room. During this period chimney pieces became the central decorative feature of a room. Made of wood, stone, plaster and marble, they were often the most elaborately decorated part of a room, as in the case of the plaster overmantel at Plas Mawr, Conway, Caernarvonshire, and the oak chimney piece at Levens hall. Westmorland.

The frescoing of walls still continued, and of the few remaining examples some show scenes taken from biblical and classical sources and incidents from local folklore. A good Elizabethan example depicting scenes from the story of Tobit was found at the White Swan inn at Stratford-on-Avon. Embossed, painted and gilt leather was less used in England than on the continent, but tapestries and such woven fabrics as velvet and damask for the wealthy and "sayes and bayes" for people of more modest means were widely used. These hangings still held premier place as wall coverings. The inventories of Henry VIII's palaces show the vast number of tapestries and various hangings possessed by kings and great men, as indeed does an inventory of Vyne, Hampshire, of 1541 which lists sets in almost every room of the house including the chambers of dependents. A cheaper substitute for tapestries was the painted cloth, produced in large numbers and depicting the same subjects as tapestries—histories from biblical and classical sources and decorative subjects passing from Gothic to Renaissance motifs, Nearly all of this "counterfeit arras" has perished. but a set displaying the acts of the apostles survives at Hardwick hall in Derbyshire.

Elaborate plaster ceilings were introduced during this period, consisting of narrow interlaced ribs forming geometrical patterns. There are interesting examples at Plas Mawr, where the same material forms the upper part of the chimney piece, the royal arms indicating a date in Elizabeth I's reign.

The most elaborate treatment was often found in those distinctive Elizabethan rooms, the long gallery and great chamber, which were frequently upstairs; greater height was obtained by using the roof space and forming a barrel-shaped ceiling. They exhibited not only the narrow ribbing of Elizabeth I's time, but also the broad bands with enriched soffits that came in under James I. One of the finest examples is at Herringston, near Dorchester, dating from about 1615.

The staircase developed considerably, for whereas in mediaeval times the winding newel form, sometimes of wood but more often of stone and never very wide or easy in gradient, had prevailed, under Elizabeth I it began to be placed around an ampler open space. Its decorative possibilities were recognized and it was enriched with newel posts and balusters and strings were given to it. The idea was developed during the following reign, and one of the finest, both in planning and execution, is the great stair at Hatfield, Hertfordshire, dating from 1610.

A feeling for classic reserve was now spreading and the late Renaissance period might have begun under Charles I but for the political upheaval that checked the zest for fine building. Inigo Jones (1573–1651), one of the few north European architects completely to absorb the spirit and the decorative repertoire of Italian Renaissance classicism, returned from Italy in 1615. He introduced the new style in the Banqueting house at Whitehall, London, and the Queen's house at Greenwich; and in spite of the obvious handicaps of the Civil War and the Commonwealth period his hand and that of his associate and kinsman, John Webb, are found at Wilton house, Wiltshire, and possibly at Forde abbey, Somerset. Also built under the Commonwealth was Coleshill, Berkshire, the earliest and one of the finest English country houses where classic form and Italian tendencies prevailed. Inigo Jones's principles were kept alive by a small band of followers, but his influence was not widespread in England until the beginning of the 18th century and the establishment of the Palladian school of architecture and interior decoration.

BAROQUE

Baroque, which started as an architectural development of the late Renaissance style in Rome in the late 16th century, affected interior decoration throughout Europe during the 17th and early 18th centuries. The use of painted panelling, marble, plasterwork, painted decoration and tapestries continued, and many of the Renaissance motifs were still used in the new style. But both their arrangement and execution were richer. heavier, bolder and more theatrical, reflecting a more sensual appreciation of both the spiritual and material worlds. Doorways, chimney pieces and. staircases were made more imposing than before, rooms were larger and the boldly modelled garlands, volutes, mouldings and scrollwork contained a dramatic quality that reflected the departure from the classical restraint of the Renaissance. The baroque style was borrowed by many European countries and adapted to suit national tastes, but by the second half of the 17th century France

had become the dominant influence in interior decoration, to such an extent that even Louis XIV's most violent enemies imitated the decoration of Versailles in the palaces of their own capitals.

In France the Italian influence of the 16th century was gradually assimilated, and the national style of decoration evolved soon spread its influence into neighbouring countries. The development of baroque in France can be divided into roughly three stages: the style of Louis XIII, that of Louis XIV and that of the final period of transition into the rococo style, now called the *régence* style, though in fact it began in about 1690 while Louis XIV was still on the throne.

The reign of Louis XIII. covering most of the first half of the 17th century, was itself a period of transition. The fame of his son and successor might suggest that the outlook of a great nation was then modified and enlarged by the force of a single personality, but it was the national spirit which created Louis XIV and his, times. Expansion in Asia and America and the growth in the national wealth were the causes that led to the building of Versailles and the Galerie d'Apollon of the Louvre.

The great *salon* now came into being, and the number of separate apartments was multiplied. A suite would comprise a vestibule, antechamber, dining room, *salon,* state bedroom, study and gallery. Stately and spacious staircases were provided. It was at this time too that the idea of a unified scheme of interior decoration, where the fittings of the room were designed in harmony with the furniture and vice versa, came into being. The interior economy of the modern house dates back largely to this period.

The Gobelins factory was founded in 1662 under Louis XIV for the production of fine furniture and furnishings for the royal palaces and the national buildings. Charles le Brun was appointed first director of the Gobelins. Among the many architects, artists and designers who provided designs and decorative schemes for the rooms of both Louis XIV's reign and the period of the *régence,* noteworthy for their influence are Jean Berain, Andre Charles Boulle, Jean le Pautre, Robert de Cotte and Jules Mansart.

The height of French baroque magnificence can be seen in the Galerie des Glaces at Versailles and the Galerie d'Apollon at the Louvre, both dating from the second half of the 17th century. There the vastness of the rooms combined with the lavish use of marble, plasterwork and painted ceilings, with the addition at Versailles of mirror glass, created an effect of overwhelming grandeur.

Toward the end of the 17th century, in the style known as *régence,* the heavy baroque motifs received a lighter, less geometrical and more fluent treatment, as can be seen in the work of Robert de Cotte at Versailles and the Hôtel de Toulouse. until almost imperceptibly the baroque repertoire of ornament was transformed into the delicate and refined rococo style of the mid-18th century.

England. — At the time of the Restoration the classical influence of Inigo Jones became mixed with the newly introduced continental baroque style, and the combination of these two elements can be seen in the decoration of the rooms of this period, their large simple fielded panels, which replaced the small sunken panels of the previous age, contrasting with the exuberant carved baroque decoration of the chimney pieces and doorframes, where garlands of flowers and fruit cascaded in decorative forms so closely associated with the style of the sculptor and carver, Grinling Gibbons. Plaster ceilings were enriched with similar floral decoration, such as the fine examples at Ham house, Surrey, or they were painted with allegorical scenes by such contemporary artists as James Thornhill or Antonio Verrio, who painted the ceiling in the great chamber at Chatsworth, Derbyshire. Ham house, though comparatively small, represents the height of luxurious interior decoration of the late 17th century, what John Evelyn called "the politer way of living, which was soon to turn to luxury and intolerable expense," and at Ham may still be seen many of the decorative innovations of that time, such as the practice of painting panelling in imitation of marble or wood graining and of gilding the mouldings. There also are tapestries, gilt and painted leather hangings, walls lined with silk damask and elaborate parquetry floors.

The craze for collecting blue and white oriental porcelain, Queen Mary being one of the leading collectors of her time, affected interior decoration, for many rooms were provided with carved brackets and alcoves for displaying porcelain. Designs for such rooms still exist by the refugee French architect and designer, Daniel Marot, who worked in England for William III. Imported oriental lacquer panels were also sometimes used for the panelling of rooms in accordance with the Chinese taste of the period.

In the last years of the 17th century and in the early 18th century the woodworker found his domain contracting. Through the influence of the grand tour and the establishment of the Palladian school of architecture under the patronage of Lord Burlington. Italian influence predominated, the work of Inigo Jones was studied and stone and stucco became more widely used. The influence of the architect spread from the outside of the house to the interior decoration and even, in the work of such men as William Kent. to the design of the furniture itself.

Where wooden panelling was used, it was set in a simple framework. Pine largely replaced oak, and it was painted green, blue, brown and other colours; walnut and mahogany were occasionally used for panelling. The increased use of stone, stucco and marble was begun by John Vanbrugh and continued by the Burlingtonian school of architects, as in the stone or marble halls of the new Whig palaces, such as Castle Howard, Yorkshire, and Blenheim palace, Oxfordshire, under Queen Anne, and Houghton hall and Holkham in Norfolk in the following reigns. In the large state rooms of such houses the walls were decorated with stucco garlands, masks and sporting *amorini,* often the work of Italian craftsmen, boldly modelled and painted and gilded. The doors and fireplaces were architectural in form, with elaborate entablatures and massive pediments. Walls were also hung with tapestry, velvet and damask, while hand-coloured wood-block printed papers provided an economical substitute *(see* WALLPAPER). Decorative painting also continued.

Stone treads and iron balustrades were introduced for staircases, although in this feature the joiner long retained the lead. Under Charles II the work had been solid, with heavy balusters or open panels elaborately carved under a broad handrail, as at Rolseley, Staffordshire. But in the 18th century staircases became lighter and more delicate, as at Beningbrough in Yorkshire; there in 1716 the joiner was still supreme, with the quality and quantity of the woodwork apparent in the many doorways and chimney pieces, shutters and framings, as also in George II houses like Godmersham park in Kent.

In the simpler houses of the early 18th century it was in the doorways and chimney pieces that the influence of the Palladian school was seen, for these copied the heavy architectural form of the grander houses and contrasted elegantly with the simple painted pine panelling. The proportions of rooms also improved and the large windows gave them increased lightness and a generally spacious effect.

ROCOCO AND NEOCLASSIC

In the rococo style, which quickly spread throughout the courts of Europe from Russia to Spain and from England to Italy, artists, architects, designers and craftsmen combined to create a style so light and delicate, so gay and so full of movement and colour that rooms such as those at Chantilly in France or the Amalienburg in Bavaria possess the quality of fairyland. The work of such designers as J. Meissonier and N. Pineau can be seen in mounted panelling with delicately modelled ornament of ragged C-scrolls, garlands of flowers decked with ribbons, sprays of foliage, shell motifs and leaf scrolls in asymmetrical yet subtly balanced arrangement, the background painted in soft colours, the detail gilded or silvered. Frequently the panels were painted by the best artists of the day—N. Lancret, C. Huet, F. Boucher—with imageries, scenes of the *fête champêtre* or idealized peasant life, groups and landscapes in the Chinese taste or designs of birds, flowers and foliage mingled with trophies of musical instruments, garden tools or symbols of science and the arts. Ceilings were similarly decorated with raised plaster ornament or were painted, the most famous painted ceiling perhaps being that at Würzburg by G. B. Tiepolo, who also decorated a ceiling in the royal palace at Madrid.

Tapestries were frequently used, notably Gobelin, Aubusson and Beauvais, woven after designs of such artists as Huet and Boucher. Walls were often mounted with panels of mirror glass which reflected the beauty of their panelled surrounds and the light of brilliant crystal chandeliers.

The neoclassic, known in France as the Louis XVI, style had in fact taken roots before the death of Louis XV. The tortuous and asymmetrical rococo decoration had already been severely criticized in France. Stimulated by the archaeological discoveries at Herculaneum and Pompeii and the publication of surveys of other classical remains in Greece and the near east, architects and designers in the 1750s and 1760s began to turn again to antique principles and ornament for inspiration. The sinuous forms of the rococo style were slowly replaced by a more restrained form of decoration, based on straight lines: right angles, ovals and circles, once again arranged in symmetrical design. Though the same decorating techniques were retained, new motifs culled from classical sources, and in particular from the grotesque wall paintings of Roman interiors, began to be used. Soon panelling is found decorated with a medley of palmettes, tripod stands, vases, classical figures, thyrsi, trophies of arms, lyres and arabesques. The panels are rectangular in shape and the mouldings refined. The decoration of the panels is flatter than before.

The introduction of the neoclassic style with its restraint and the preference for rectilinear design can be seen in the work of A. J. Gabriel in the Salle du Conseil at the École Militaire (1773) and in the Galerie Dorée in the Ministbre de Marine (1762–72), both in Paris.

For the fully developed style in the reign of Louis XVI, a small though outstandingly beautiful room is the boudoir of Madame de Sevilly, now in the Victoria and Albert museum. The exquisite carved, painted and gilt decorations of the panels, with classical figures and baskets of cascading flowers, are by J. S. Rousseau de la Rottière and the marble fireplace with muffled caryatids and delicate gilt bronze adornment is by C. M. Clodion. This room represents the height of French 18th-century taste and craftsmanship, providing a style that was copied with varying success in every corner of Europe.

England.— While in architecture the Palladian rule of taste continued to hold sway, during the 1740s the decorative style of the English interior began to be affected by the asymmetrical French rococo style which, in spite of strong Palladian opposition, gradually replaced the symmetrical baroque style, using the repertoire of *rocaille* motifs found in the designs of such French decorators as N. Pineau and J. Meissonier. The stucco and carved decoration became lighter and more fanciful and more tortuous in design. Though many baroque motifs were still used, they were more delicately modelled and the rococo style was characterized by elaborate patterns of interlacing C-scrolls combined with such naturalistic ornaments as flowers, foliage, shells and rocks, arranged subtly in asymmetrical yet balanced patterns. The plasterwork and carved panelling were often painted in light colours and the detail picked out in gold.

The music room from Norfolk house, St. James's square, London, now in the Victoria and Albert museum, London, designed by Mathew Brettingham and completed in 1756, is a fine example of rococo decoration in England. The carved wooden panels are enriched with delicate patterns of scrolled acanthus, shells and garlands of flowers, while the overmantel mirror and the main panels are mounted with fanciful trophies of musical instruments. The fine plaster cornice and ceiling are decorated with similar rococo devices. In smaller houses the new motifs were confined to the chimney pieces and doorcases, the remainder of the room being simply panelled or plastered.

Closely allied to the introduction of the French *rocaille* was the revival of the Chinese taste in a new rococo form, when architects and designers, in search of further novelty, turned again to the east for inspiration. An added stimulus was provided by the publication of books of travel and topography, notably J. B, du Halde's *General History of China,* published in Paris in 1736 and translated into English in 1741. In interior decoration the Chinese taste, with its bizarre ornamental repertoire of pagodas, mandarin figures, icicles and dripping water and exotic foliage and birds, reached the height of rococo invention and was particularly popular for bedrooms, where elaborate chimney pieces and doorcases were set against the background of imported or imitation Chinese wallpapers, and the beds and windows were hung with eastern textiles.

One of the most elaborate of these rooms was that at Claydon in Buckinghamshire, while a simpler version may be seen in the room from Wotton-under-Edge, Gloucestershire, now in the Victoria and Albert museum. There Chinese wallpaper combines with a delicate rococo overmantel which provides brackets for small pieces of oriental porcelain.

The Gothic taste, a further variation of the rococo, was peculiar to England at this time. The Gothic revival, starting as a literary movement in the poetry of the early 18th century, during the 1740s appeared in the more concrete forms of architecture and interior decoration. Both William Kent and Sanderson Miller had made essays in the Gothic taste before 1750, and by the middle of the century the fashion was widely popular and many houses, both large and small, were in part Gothicized, both inside and out. As with the Chinese taste, the products of this 18th-century vogue bore little resemblance to the original mediaeval models. Gothic details, originally worked in stone! were borrowed, adapted, often mingled with *rocaille* and Chinese motifs, and were executed in wood and plaster. At Strawberry Hill, Twickenham, Horatio Walpole, leader of the "true Goths," borrowed the designs of mediaeval tombs and turned them to designs for fireplaces and bookcases. Though this vogue fell out of general fashion in the 1760s, a few enthusiasts remained who carried the Gothic taste through until it was vigorously revived again in the 19th century.

About 1760 the rococo style, with all its vagaries of taste, began to give way before the neoclassic style, largely inspired and introduced by the Scottish architect, Robert Adam, whose work reflected the newly awakened interest in classical remains. Adam returned from Italy in 1758, where, strongly influenced by both Roman architecture and interior decoration, he evolved a new style based on classical precedent, composed of a medley of such classical ornaments as paterae, husk chains, the ram's head, the formalized honeysuckle and other motifs. In his interior decoration Adam was deeply influenced by the gay and delicate patterns of arabesques and grotesque ornament that he had seen in various classical remains in Rome, and which had already been copied during the Renaissance by Raphael and others. Adam strongly criticized the Burlington school for using heavy architectural features in their interiors, and replaced them with delicate ornament in plaster, wood, marble and painting. With Adam the despotism of the architect over the craftsman was complete. No detail of decoration or furnishing escaped him; his rapid and precise draftsmanship covered the whole scheme, from the over-all treatment of the walls and ceiling to the decorative details of the pelmets and grates. Even carpets were made to order, and often they repeated or echoed the design of the ceiling, bringing the whole room into harmony, as in the green drawing room at Osterley, Middlesex. Wood was never left unpainted, and although the joinery was still admirable, the enrichment was often in composition or pewter. There were specially designed temple-fronted bookcases and the plasterwork was often made a frame for the decorative paintings of such artists as Antonio Zucchi or Angelica Kauffmann. At this time cheaper and quicker methods of decoration began to be introduced; a considerable amount of the plaster decoration was cast from moulds and a composite imitation marble called scagliola was sometime3 used for floors and columns, while cheaper woods were disguised by marbling and graining.

The neoclassic style was further refined at the close of the century, the plaster relief decoration being simplified and lightened. The best of this style, strongly influenced by French decoration, can be seen in the work of the architect, Henry Holland, who enlarged Carlton house, London: for the prince regent and built Sothill in Bedfordshire. Holland, like Adam, was inspired by the classical monuments in Italy, where for some time he maintained a draftsman whose drawings of classical detail Holland incorporated in his plasterwork.

During the early years of the 19th century the neoclassic style of decoration continued, but with a strong archaeological bias which led to a more literal interpretation of classical remains. A Greek revival and an interest in the newly publicized Egyptian antiquities added new motifs to the architect's and designer's repertoire. The somewhat pedantic and archaeological style was given considerable publicity in the work of the wealthy amateur architect, Thomas Hope, who enlarged and decorated both his London home in Duchess street and his country house, Deepdene in Surrey, in the Greek and Egyptian taste, publishing in 1807 his *Household Furniture and Interior Decoration,* which further influenced contemporary taste.

19TH AND 20TH CENTURIES

In the last years of the 18th century and the early 19th century, both in France with the *directozre* and empire styles and throughout the other parts of Europe where decorative styles were influenced by France, the neoclassic taste grew more archaeological in inspiration, stimulated by a desire to imitate directly the styles of ancient Rome. Greece and Egypt. the last much publicized by the campaigns of Napoleon.

Toward 1825 the reaction came. Earlier fashions were again reverted to for a time but the original spirit was lost in the half-hearted imitation. The new wealth of industrial and trading communities gave rise to new ideas of material well-being, reflected in the comfortable Biedermeier style which arose in Germany, with thick curtains, festooned draperies, antimacassars, tassels and fringes.

Later there came a strong reaction to the fussiness and overcrowding of the 19th-century interior decoration. Particularly inspired by the work of Scandinavian designers and architects, a genuine attempt was being made in the 20th century to create an original and truly contemporary style, suited to the needs of contemporary life.

England. — During the first half of the 19th century the neoclassic style dropped out of fashion and there began a long period of imitative decoration. when past styles of all ages from all parts of the world were resuscitated and unhappily reproduced, the original spirit being lost and the detail coarsened, though on occasions the craftsmanship was highly skilled. In the continued Gothic revival, the flimsy wood, plaster and paper decoration entirely missed the Gothic spirit, also failing to capture the humour and whimsical charm of the Walpole Gothic, and these features were introduced as the trappings of houses designed to'serve entirely different habits of life. Thus, when the 19th century was reached, a plan that, in the disposition of parts, the shape of rooms, the height of ceilings, suited the habits and views of the day, might be decked out by the architect in what he pleased to think was Gothic, Tudor, Roman, Greek, French, Italian, Egyptian or Indian.

In less ambitious schemes of decoration, brightly coloured wallpapers with bold patterns were widely used, and the white plaster ceilings were relieved by modelled cornices and often some central feature, frequently in a coarsened rococo design, which made a background for the elaborate light fitting. Rooms became crowded with furniture, and fireplaces were often mounted with elaborate overmantels, fitted with mirror panels and a multitude of shelves and brackets for the display of Victorian knickknacks. Both furniture and fittings were draped in dark-coloured plush with heavy fringes.

William Morris, through his own firm, made a bold and valuable attempt to reassert some definite standards of taste and craftsmanship in interior decoration! producing, with the assistance of such artists and architects as D. G. Rossetti, Sir Edward Burne-Jones and Philip Webb, furniture, wallpapers and tapestries. But his influence was limited, for like his contemporaries he looked back, seeking inspiration from mediaeval craftsmanship, and in doing so refused to accept the possibilities of machine production, thereby failing to supply the leadership in a movement to bring together craft and the machine in his industrialized age.

In the 20th century there mas a violent reaction from the sombre and crowded interiors of the previous age. Rooms mere painted in light colours, interior features such as doors and fireplaces were flattened into the surface of the walls and furniture was reduced to the simplest minimum. Later, largely influenced by European and particularly Scandinavian taste, though simplicity and practicality still predominated, brightly painted colours and gay wallpapers were introduced, and once again the architect assumed a major responsibility in interior decoration with the necessity of built-in furniture.

BIBLIOGRAPHY.—England: R. S. Dutton, *The English Interior, 1500–1900* (New York, 1948; London, 1949), *The Victorian Home* (London, Toronto, 1954); M. Jourdain, *English Interior Decoration, 1500 to 1830* (London, 1950; New York, 1952); J. Lees-Milne, *The Age of Adam* (London, 1947; New York, 1948); A. L. Turner, *Decorative Plasterwork in Great Britain* (London, 1927); H. A. Tipping, *English Homes,* 9 vol. (London, New York, 1921–37); A. T. Bolton, *The Architecture of Robert and James Adam (1758–1794),* 2 vol. (London, New York, 1922). Austria: G. Adriani, *Die Klosterbibliotheken des Spatbarock in Österreich und Suddentschland . . .* (Graz, 193j); M. Zweig, *Zweites Rokoko . . . 1830–1880 . . .* (Vienna, 1924). Low Countries: K. Sluyterman, *Inte'rieurs anciens en Belgique . . .* (The Hague, 1913); F. R Yerbury (ed.), *Old Domestic Architecture of Holland* (London, 1924). France: T. A. Strange, *An Historical Guide to French Interiors, French Furniture, Wood-work and Allied Arts . . .* (London, 1903); M. J. Ballot, *Le De'cor au XVIII^e siècle* (Paris, 1930); Guerinet (publ.), *Intérieurs d'appartenzents, châteaux, etc.* (Paris, 1904); *Styles de France* (Paris, 1954). Spain: A. Byne and M. Stapley, *Spanish Interiors and Furniture,* 2 vol., new ed. (New York, 1930). Italy: A. Pedrini, *L'Ambiente, il mobilio e le decorazioni del rènascimento in Italia,* 2nd ed. (Florence, 1948), *Il Mobilio, gli ambienti e le decorazioni nei secoli XVII e XVIII in Piemonte* (Turin, 1953). Russia: G. K. Lukomskij, *Mobilier et de'coration des anciens palais impériaux russes* (Paris, Brussels, 1928). (J. E. LE.)

U.S. INTERIOR DECORATION

The story of the domestic interior in the U.S. and its decoration is inseparable both from its own architectural development and from the story of English architecture and decoration from which it was largely derived even long after the Revolution. Any discussion of U.S. decorative design must, therefore, constantly refer to the architectural ideas which prompted change on both sides of the Atlantic ocean.

Early Settlers' Homes. — Contrary to popular legend, the log cabin was not the earliest shelter of the first English settlers on the American continent. The turfed-over dugout hut of mud-chinked saplings, not unlike the Indian wigwam with the addition of a clay-daubed wooden chimney at one end, was probably the first home of the settlers in both Jamestown and Plymouth.

These primitive dwellings were speedily replaced by frame structures, copying the traditional small house of southeast England. At first a single room in plan, flanked by a massive chimney (where brick soon replaced wood and clay), the house was later enlarged by a second room on the opposite side of the chimney. The attic, later expanded into an overhanging second story, was reached by narrow winding stairs between the central entranceway and the chimney stack.

This development in New England is well represented by such vestiges as the Capen house, Topsfield, Mass. (1683). The interior clearly reflects the structure with its massive exposed oak corner posts, girders and joists and its huge open fireplace which served as the cooking and heating centre of the household. Inside walls were usually of undecorated lath and plaster, covering the studs and their clay or brick filling. Room partitions and the face of the fireplace wall were sheathed with horizontal or vertical boarding, frequently featheredged or moulded. Windows were small and originally of casement type. with small leaded panes in a wood frame. Small windows with low ceilings were needed to conserve heat in the severe winters. Floors of wide riven boards of pine, smoothed and sanded. replaced the beaten clay of the first shelters.

The furniture. with few exceptions, was simple and sparse. Though strictly utilitarian it reflected a desire for decorative warmth and dignity in its simplified carved and turned ornament and touches of earth colours.

By the end of the century homespun textiles were supplemented by imported decorative weaves in the houses of the more affluent, and mere used for curtains, table covers, bed hangings and seat pads. Richly coloured damasks and velvets gave relief and accent to unpainted wood and plaster surfaces even in puritan New England, and probably to a greater extent among the less austere New

York Dutch and the comparatively wealthy tobacco planters of Virginia.

While utensils of crude pottery and wood served the needs of most people. pewter and. to a surprising extent, vessels of silver were among the possessions of the well-to-do. A remarkable quantity of fine silver was produced in the last half of the century by silversmiths such as John Hull, John Coney and Jeremiah Dummer of Boston and Cornelius VanderBurgh and Jacob Boelen of New York. Although based mainly on English models, the work of these craftsmen shows a distinctly individual feeling for form and proportion and a craft skill matching that of their English contemporaries.

In the early dwellings south of New England, brick and stone tended to replace wood as a building material, though much small timber construction must have been used which has now largely disappeared. In the Hudson region the traditional cottage of the Flemish and Huguenot settlers, long and low with steep pitched roof and extended eaves, became the typical farmhouse. At the same time, the narrow Dutch town house of brick with its stepped gable ends gave New Amsterdam, even after the English occupation, an appearance completely different from that of the Ehglish settlements to the north and south.

In the Dutch houses windows tended to be larger and ceilings higher. The early fireplace, with its tiled surround. surmounted with a deep hood, was flush with the wall instead of deeply recessed. Such traditional Dutch features as the horizontally divided door, the monumental cupboard or kas, the built-in bed, tiling and dishes of Delft ware gave the early New York interior an individuality which withstood English influence until well into the following century.

Similar national characteristics must have distinguished the early Swedish settlement on the Delaware, where the log cabin of pioneer tradition may have appeared for the first time later in the century. But the Snedish contribution was only temporary because the settlement was speedily absorbed by both the Dutch and the English. The early settlements of the English in east Jersey were mainly founded by migrants from New England who brought with them the typical central-chimney house and interior arrangement, but before the end of the century largely abandoned them for the Flemish type of house in the neighbouring Hudson region. The first settlers in Pennsylvania, arriving in Philadelphia at the end of the century, brought the type of town dwelling devised for the rebuilding of London after the great fire of 1666, and their story belongs to the following century.

In Virginia and the south, scant evidence remains of the early 17th-century house. Bacon's castle in Surry county, Va., with its projecting two-story porch in front and rear stair tower. built in brick about 1660, is all that remains of what must have been several such colonial versions of the small English Jacobean manor. From surviving evidence and deduction it is believed that panelled walls, carefully designed beamed ceilings and ornamental plasterwork in colour gave the larger Virginia houses interiors of much more deliberate decorative effect than those of the north. While the milder climate made loftier ceilings and larger rooms possible, it is unlikely that the ordinary early dwelling differed from its northern contemporary save in its greater use of brick and in placing chimneys at the ends instead of at the centre of the structure.

Among the wealthy the principal articles of furniture were undoubtedly English imports, but the more humble settler probably had to make shift with articles of the simplest sort. Few things survive from this period, so little is known about it. Certainly the scattered or rural character of the southern settlements and their concentration on tobacco planting failed to encourage the early development of skilled crafts found in villages and towns of the northern communities.

Pre-Revolution Homes.—During this period the late mediaeval tradition of design and decoration was gradually replaced by the formalism of the full Renaissance style. Inigo Jones (1573–1651) and Sir Christopher Wren (1632–1723) had initiated and established the new architectural mode in England in the first and second halves of the 17th century. By 1720 these innovations, as reflected in the Queen Anne style with its strong mingling of Dutch and Flemish elements, had already crossed the Atlantic.

In New England the traditional two-story "salt box" was at first modified in detail rather than size by the substitution of a double-hung sash for the casement and the replacement of sheathing by panelling and trim of more or less formal design. Houses of the 17th century were often so "modernized." The parlor of the Samuel Wentworth house, Portsmouth, N.H., now in the Metropolitan museum in New York city. is an instance.

Wren's influence is increasingly evident throughout the period in the effortto achieve symmetrical design around an accented central feature and, particularly in the interiors, in greater insistence on classic ordonnance in the positions of openings and the arrangement of panelling. Panelling, usually of pine in the north, was generally painted. Relatively deep and strong tones—red, blue, green, brown and yellow—were used either singly or in combination. producing an effective background for the walnut furniture of the period.

Additional colour was introduced by a more elaborate use of woven and embroidered textiles, in upholstery as well as draperies. Though woven carpets for floor coverings were rare even at the mid-century, their effect was frequently achieved by stretched canvas painted with allover repeat patterns.

At this time throughout the colonies furniture became more plentiful and varied. Chairs without arms took the place of stools, the cabriole largely replaced the turned leg and small drop-leaf tables replaced the fixed-frame type. Bedroom furniture became differentiated with the development of the high chest (highboy) and dressing table (lowboy), and later the case-top desk or secretary became the principal ornament of the living room. Tall mirrors with crested tops replaced the small square Jacobean looking glasses, and portraits and prints came into more general use, sharing the wall space with bracketed wall lights or sconces. Artificial light still came mainly from small wick and grease betty lamps, but tallow and wax candles held in sconces, in adjustable metal and wood floor stands or in candlesticks of brass or pewter and occasionally in brass chandeliers were used by the wealthier.

Though domestic comfort was improving, north of Virginia the large formal house or mansion remained a rarity until about 1750. In the south the wealth of the slaveholding planter permitted closer fidelity to the early Georgian manor house type. Great houses of two or threestories with side dependencies became numerous. Stratford in Westmoreland county and Westover in Charles City county, built about 1725–30 by the Lee and Byrd families, are early examples of the type. The elaborately panelled rooms of these mansions were furnished according to the latest London fashion. Probably only later in the century were these products of the London shops mingled with pieces from the cabinetmakers of Philadelphia, New York and Boston. Between 1750 and the Revolution this Georgian phase reached its highest development in the colonies. Though generally smaller and lacking the forecourt and dependencies of the southern mansion, the larger houses of the north, such as the Wentworth-Gardner house in Portsmouth, mark perhaps the most distinctive achievements of colonial design and decoration by their apt translations into wood of brick and stone Georgian forms.

In the middle Atlantic colonies, particularly in Philadelphia which by 1760 had assumed urban leadership in the colonies, a type of domestic design midway between that of New England and Virginia had developed. There the English rococo decorative style publicized by Thomas Chippendale in his Director of 1754 received its most competent and original interpretation. This is well seen in Philadelphia interiors such as those of the Powel house (1768) and in the work of cabinetmakers such as Thomas Affleck and Benjamin Randolph. By this time, mahogany, with its fine grain, receptive to carving and high finish, had largely replaced walnut as the principal cabinet wood. Inspired by this material and the challenge of London design both these Philadelphia craftsmen and their northern contemporaries, particularly John Goddard and Job Townsend of Newport, R.I., brought their art to the highest level of perfection.

During the third quarter of the 18th century. the panelled interior attained its greatest colonial elaboration. North of Virginia

a fully panelled room was exceptional; wood panelling was reserved for the chimney breast and its flanking recesses or cupboards. In Virginia and the south full panelling remained the rule. Both north and south, however, the mantel and its overmantel were emphasized as a decorative unit and the baroque broken pediment became the usual crowning feature of overmantel and doorway. Painted woodwork remained popular, but with softer and lighter tones. tending toward white and gray. Plaster wall surfaces were also painted. Block-printed and painted wallpapers were frequently used in the main rooms and there are indications that fabric wall hangings were used also.

Plaster ceilings completely concealed the floor beams by the second quarter of the century, and after 1750 these were frequently decorated with ornament in low relief in the French or rococo manner and hung with many-branched chandeliers of crystal. Floors of hardwood, occasionally parquetry, were more frequently covered with patterned rugs of European or oriental origin.

During the 18th century the textile resources of the colonists had been enlarged by imports of printed cottons or chintz in the Indian taste, and these silk brocades and damasks largely replaced the linen and woollen weaves of earlier days. Upholstered furniture, wing chairs and sofas and elaborate draperies increased still further the richness of the fashionable interior.

The craft of the silversmith continued to develop in the 1700s. North of Virginia even the smaller communities supported silversmiths of ability. Judging from the quality and amount of work that survives from Boston, New York, Newport and Philadelphia, a phenomenal amount of silver plate must have been produced and distributed among even the moderately well-to-do. Like the furniture, this silver mainly followed the Queen Anne style and depended upon elegance of form and line rather than ornament.

As in Europe, the growth of tea and coffee drinking encouraged production of suitable silverware and the import of English and oriental porcelains which required corner and wall storage cupboards. Demand was also created for a variety of small movable tables and stands for tea and coffee services.

During this century the German settlers in Pennsylvania added their traditional art style to the dominantly English tradition of the colony. The effects of this were more visible in folk arts than in formal decoration. It was to this style and its development after the Revolution that the first American decorative glass of Henry William "Baron" Stiegel and Frederick Amelung must be credited, as well as most of the decoration on early American pottery.

Classic *Movement After the Revolution,* 1785–1835.—Even after the Revolution English decorative influence remained dominant in the new republic in spite of greatly increased contacts with French thought and ideas. Although many leaders like Thomas Jefferson wished to see a complete break with the English-dominated past, the Georgian forms of colonial days persisted in common usage till 1800 or after. By 1785, however, the reaction in Europe against the rather heavy classic style called free Palladianism and its rococo and baroque elaborations began to affect design in the United States.

Jefferson, largely under French influence. became the Ieader of one aspect of the new movement in the south. This combined practical planning with a literal classicism resting on the direct study of ancient monuments. While Jefferson's interest in strict classic form was felt particularly in architecture, the decorative phase of the movement both north and south was dominated by the freer and more personal interpretation of classic motifs based on the work of the Adam brothers in England, before and during the Revolution. This was the principal influence in the designs of Charles Bulfinch of Boston and his followers and was popularized about 1800 in the builders' pattern books of William Pain and Asher Benjamin.

The houses of Boston, Salem and Portsmouth built around 1800–10 by or under the influence of Bulfinch and Samuel McIntire of Salem are the best examples of the changes wrought by rhe fine scale and delicate precision of their Adam-inspired designs. producing what has become knowp as the early federal style. In the houses of the time the circle, the ellipse and the octagon were introduced as occasional variations in the plan, and the flying or freestanding staircase became a feature of the entrance hall.

In interior decoration wood panelling was practically abandoned or was restricted to the area below the chair rail. Decorative emphasis was concentrated on the mantel and overmantel, the doors and window frames and the cornice. all usually of wood and enriched with delicate repeat ornament either carved or applied. Rich colour in draperies and upholstery was set off by wall surfaces and decoration in light tones, grayed tints or white. Block-printed wallpapers with classical motifs were frequently used or replaced by stencilled decorations in the simpler homes.

In general. geometric forms and their objective embodiment in the urn, swag, patera and wreath were favoured. The taste for lightness and attenuation which verged on dryness was reflected in the furniture. The designs of George Hepplewhite and Thomas Sheraton influenced by Louis XVI and *Directoire* forms found American versions around the turn of the century in the work of Samuel McIntire of Salem, John Seymour of Boston, Duncan Phyfe of New York, Henry Connelly of Philadelphia and the cabinet shops of Baltimore and Charleston. At first, light woods and finishes and decorative inlays were preferred, but by 1820 French empire influence substituted dark ruddy mahogany, carved and gilded ornament and heavy, often ill-proportioned forms considered more in keeping with classic taste.

The new classicism, particularly in its Adam phase, was also expressed by the silversmiths, one of whom was Paul Revere, whose patriotic activities have given him a prominence somewhat unfair to his able colleagues. This silver is identified by its general use of the urn form, relieved occasionally by the cylinder, and by a simple elegance of silhouette enriched only with surface chasing. After 1820 the early federal style waned and Jeffersonian classicism was modified by the introduction of Greek and even Egyptian detail, constituting the so-called Greek revival. Accompanied by furnishings and draperies in the heavier Sheraton-empire taste, the classic pattern established in the 1820s became the basic style in building and decorative design until about 1850, and constituted for the time a national style without parallel in Europe. In its later decorative aspect the Greek revival became a fashion rather than a style. As such it marks not only the end of the 18th-century classicism but the beginning of the romantic movement.

Romantic Movement and the Battle of the Styles, 1835–1925.—The ordered symbolism of the Roman classic style had been envisioned by Jefferson as a proper expression of the American. national ideal; but by 1835 its restraints had grown tedious. Social and economic changes already initiated by the Industrial Revolution encouraged reaction. This found more or less romantic and emotional expression in a series of style revivals ill-adapted to actual conditions.

The Greek revival, stimulated by the Greek struggle for national independence, was diluted almost immediately by the antiquarian romanticism of the "Gothic." "Tuscan" and "country cottage" fashions. These offered opportunity to the undercurrent of practical utilitarianism, repressed or thwarted by the classic formula, and also gave a fertile field for the novel or exotic in decorative taste fostered by a wealth-induced appetite for comfort and display. By the middle of the century the last vestiges of order in early Victorian romanticism had disappeared under a plethora of decorative motifs and objects easily and inexpensively produced by machine. Colour became confusedly drab or brilliant, and generally out of character as a result of the introduction of uncontrolled chemical dyes and the magic of the Jacquard loom. Increased travel and ease of communication made American styles hardly distinguishable from those of Europe.

This decorative salad of classic and mediaeval motifs was supplanted by the revival of 18th-century forms which temporarily triumphed in the "second rococo" of the 1850s when rosewood and walnut took the place of mahogany, This was succeeded by fashions based on the 17th century and the later Renaissance until the Centennial exhibition of 1876 brought to America the "craft" mediaevalism advocated and industrialized by Charles Eastlake, and a new series of more literal style revivals including that of colonial times. These were in turn infiltrated by the orientalisms of the

"aesthetic" movement of the later 19th century.

In the first quarter of the present century this confused costume ball culminated for the wealthy in the fashionable antiquarianism of the authentic period interior and, for most people, in its diluted reflection, adapted to the thinner purse, provided by the wholesale decorator and manufacturer of period reproductions. The decorative picture covering these 90 years of enormous technical and financial development is too confused and complex for further analysis here. Almost from its beginnings, however, a body of criticism and rational experiment was developing both in Europe and America which was to find effective expression in the early 1920s amid the social and economic upheavals following World War I.

Functionalism and the Contemporary Mode, After 1925. —The struggle between the symbols of a traditional past and a rational acceptance of a society based on mechanized industry came into the open in the interval between the World Wars of 1914 and 1939. 4 full acceptance of new industrial techniques and an earnest desire to reconcile their free play with the needs of a society impoverished spiritually and materially by war was the basis of the co-operative efforts of the Bauhaus group established in Dessau, Germany, in the early 1920s.

This brought to a head the numerous reform movements of the late 19th and early 20th centuries. Its philosophy was a psychological and material essentialism, cathartic and analytical in its methods. which on one hand shocked the conservative into immoderate fury and on the other converted its radical adherents into equally uncompromising iconoclasts.

Though many of the ideas used by the Bauhaus movement were inspired by the subtle simplicities of the Japanese tradition and by the innovations and writings of the Chicago architect, Louis Sullivan, German functionalism hardly affected American design until its leaders found refuge in the United States from nazi oppression. The movement was brought to public attention in the middle 1930s by the need for new stimuli in the trough of economic depression, by the educational campaigns of the Museum of Modern Art in New York city, and by the re-establishment of the Bauhaus teachings in the Institute of Design in Chicago.

In the decade following the Paris exhibition of 1925 progressive thought in American design was principally influenced by the less radical productions of the French luxury crafts, based on a modified art *nouveau,* and the Swedish success in combining and developing its craft traditions in co-operation with industry. This influence was, however, confined to a relatively small and semi-professional coterie, while the market as a whole continued to concentrate on traditional forms, producing and adapting them at various levels of quality and taste. By 1935 the functionalist movement spearheaded by the adherents of the Bauhaus program had gained a substantial following among the younger architects and designers. During and after World War II their efforts, combined with those of the museums and the more progressive schools and periodicals, had gained the interest of a considerable portion of the wealthier and the manufacturers who catered to them.

The functional or contemporary program involved a complete break with the past and its ornamental motifs and meant the reawakening of a natural response to form, proportion and line and the visual and tactile values in materials. This closely paralleled contemporary interest in abstract as opposed to representational art. It also involved a scientific study of human needs and behaviour, correlating these with psychological responses to physical stimuli of all kinds, and so co-ordinated the interests of art and science. The uncompromising application of such an intellectualized program proved immediately impracticable, but its bold challenge to the conventional resulted in a notable change in the home.

The most obvious changes in the domestic interior were: first, its rapid mechanization; second, its redistribution of interior space; and third, its elimination of formal barriers between indoors and outdoors. These developments were accompanied by radical changes in decoration and the design and use of furniture and fittings. Equipment for heating and lighting, sanitation and the preparation of food, all devised essentially during the 19th century, were brought to a high degree of mechanized efficiency taking full advantage of advanced production methods. These utility units were designed to obtrude as little as possible by an insistence on simplicity of form, colour and texture. Convenience and economy became principal considerations in fitting utility units into living space instead of hiding them in otherwise unused areas in the arbitrary traditional room arrangement. The kitchen, particularly in the modest house, received careful study for visual appeal as well as operating efficiency. In mechanical equipment the mid-20th-century house began to be an efficient machine for living. Electric power, liquid fuels, flexible controls of temperature, ventilation and lighting and countless labour-saving devices became the new household gods.

Reconsideration and correlation of the space requirements of living areas broke down traditional room divisions. Decoration became concerned with the functional requirements of a living area. Because it served more than one function, a living area was frequently irregular in plan and impossible to treat as a unit in the traditional formal manner. Changes of colour, texture and materials consequently became the chief resources of decorative design, taking the place traditionally given to ornament. The new interior was in harmony with the times through its invitation to movement, both actual and implied. Earlier attempts at the functional mode suffered from, too much anxiety over simplicity and unity, and consequently became monotonous and cold. Difficulties in the handling of such abstractions as colour and texture without formal limits are so great that the temptation to follow set formulas was all too prevalent.

The demands of space tended to keep movable pieces of furniture to a minimum and encourage the use of built-in units. An earlier overemphasis on straight lines and angles was countered by greater use of curved and moulded forms in furniture design. As the average house, usually of a single story, became smaller and more efficient in its use of enclosed space and as the desire for outdoor living grew, there was a tendency to replace at least one of the enclosing walls of both living and bedrooms with glass. With a properly oriented plan this had the advantage of providing each room with a living mural as well as better light and it also extended the apparent space. Bringing the outside in has a most liberating effect, but it also creates certain practical and psychological problems. This "international style," an outcome of the functionalist movement of the 1920s and 1930s in its direct approach to needs and materials, was in complete opposition to the concepts of the Renaissance which had dominated western design for the preceding 400 years.

BIBLIOGRAPHY.—An annotated and classified working bibliography covering the main publications in this field up to and including 1947 will be found in Meyric R. Rogers, *American Interior Design* (New York, 1947). *See* also Mary E. Gould, *The Early American House* (New York, 1949); T. T. Waterman, *The Dwellings of Colonial America* (Chapel Hill, *N.C.,* 1950); and George Nelson (ed.), *Living Spaces* (New York, 1952). (M. R. Rs.)

PRACTICAL SUGGESTIONS

Styles in interior decoration have always been influenced by those trends immediately preceding, and the decorator's main efforts therefore are devoted to interpreting them discriminately and to designing original interiors based on historical period inspiration.

Traditional Style. — There was a time when whole rooms were reproduced in their entirety from some French château or Italian villa. But the contemporary interior decorator is more likely to be concerned about the minor details of a period when planning for a particular effect.

In decorating a house or an apartment there is probably no more interesting, if difficult, style to work with than the complex and highly decorative effect loosely described as 18th century. Varying renditions of the epoch come and go, changing with the decades. In recent years 18th-century styles were interpreted with rare antiques, costly panelling or expensive fabrics as the chief identifying motif. This style was also achieved more economically but as effectively by using colourful backgrounds with simple furniture and accessories.

Good interior decoration in the traditional style expresses the

period from a contemporary viewpoint without sacrificing its gracious quality and livableness to functionalism. Yet all the rooms are modern in the sense that they have convenient and efficient arrangements of furniture, are bright and refreshing with crisp colour schemes and are finely conceived.

Modern Style.—Decoration in the contemporary or modern manner calls for the same simple lines, good proportions and well-chosen woods or other mediums of decoration that apply to selection of materials for the traditional styles. Furniture and accessories must complement and harmonize with their background. Only with the greatest care, and only by those informed in period tradition can a successful combination of traditional and modern styling be accomplished. Modern furnishings against a period background can be absurd unless the background has been treated in a free manner; but period furnishings gain in effectiveness if set against a modern background. Whether traditional or modern in style, every interior should be somewhat functional through the use of modern materials; otherwise it tends to express an anachronism.

Asymmetry, which is the outstanding characteristic of contemporary design, is likely to be prevalent in any plan. Windows do not have to be equally spaced, and if they sometimes are found that way they do not affect interior decoration materially. Design develops easily from the function and general plan, and there is generally much integrity in the decoration that is produced. The contemporary designer regards the entire project as an entity in which there should be an easy and consistent flow from one room into another, instead of having each room a distinct, separate unit for living. Partitions rarely form an obstacle to design, and many times are disregarded in the scheme altogether or are used as foils to convey contrasting colours from one room into another.

Whatever may be said of modern decoration, its merit lies in function—utilitarian, simple of line and suited to contemporary living—rather than in stylistic connotation The determining factor in its measurement is not merely architectural background, nor the furniture set against it, nor mere colour, but rather a co-ordination of all these factors.

First Steps in Decorating.—The first step in decorating is to ascertain the functions of the various rooms and apportion each, depending upon its importance in the scheme, a relative share of the allotted budget in the estimate

The second step is to formulate a plan. Interior decoration is a pictorial space conceived as a four-dimensional plenum which maintains itself with reference to any point in the interior. This means that the component parts of the room are interdependent, and the relationship is maintained not by cramming the room with objects, but by use of colour harmony and pleasing co-ordinated arrangement of furniture and decorative objects.

The plan confined solely to one floor, as in the split-level and ranch-style houses, presents a problem which necessitates meticulous care in arrangement to include living comforts and service conveniences. The plan should provide an air of spaciousness in order to relieve any feeling of crowding, and one group of furniture should not interfere with another. Much of the attractiveness of the rooms depends upon draperies and carpets—even expensive furniture and textiles lose their effectiveness in bad groupings and inharmonious colour schemes. Strive for simple, straightforward, formal groupings without pictures, sofa pillows. small mirrors and incidental furniture. Add these things later, and eschew all fussy arrangements in order to defeat any chance of crowding.

Do not neglect the decorative possibilities of halls and passageways, settees and benches and console groupings uith accompanying pictures and lamps, placed in strategic positions—either to break a long wall or to form a focal point at the end of a corridor—will contribute much charm.

Proportion.—Few rooms are perfectly proportioned, and one can seldom dictate the proportions except nhen building Therefore if a room is too long, too small and high or too narron, or with doors and windows in the wrong places. nothing can be done about it except to employ decorating tricks to correct the awkward lines. The same solution applies to too-large furniture that daarfs the rest of the furniture in the room.

A cornice and a chair rail, with dado painted a different colour from the rest of the walls, will make a room seem lower, as will a ceiling painted a darker colour than the walls. To make it seem higher, employ vertical lines in the design of the wallpaper and the curtains and continue the colour of the walls over the cornice and ceiling, or paint the ceiling white. A sheet of mirror extending to the ceiling on a long wall of the narrow room will tend to widen it; so will the ends of the room painted a darker colour than the wide walls.

If windows are too narrow, hang curtains outside the window trim so that the folds are against the wall instead of the glass. For two windows too close together, hang the curtains beyond the window trim at the ends and the inner curtains in a continuous panel, as for any other window, and they will look like a wide single window. For the too-short window, a valence can be fastened on the wall above the window, low enough to conceal the window top.

Scale.—After colour, next in importance is scale. The proper scaling of furniture is frequently overlooked in the scheme because of its subtlety. It is important not only in the relationship of one object to another. but in each group of furniture to the room as a whole. Scale can be altered by the position of objects. Thus a too-large sofa between too-small tables looks larger and the tables appear even smaller. The commonest mistake is in acquiring furniture that is too large, therefore. be doubly sure that every purchase is properly scaled for the room into which it is to go. Even the patterns on fabrics and wallpaper must be considered.

Developing the Background.—The background of an interior is comprised of the walls, ceiling and floor. Of these, the walls present more problems than any other factor in the decorative ensemble, and the manner in which a decorator employs wall coverings is evidence of his ability. As background they rate highly in every scheme because they constitute a major, decorative area.

One of the most dependable sources for colour in the room, besides paint. is wallpaper; and the prodigious number of patterns available enable the decorator to choose exactly the texture of paper and the scale and character of design required for any individual scheme. Good wallpapers last for generations, and if backed with muslin they can be taken down, stored and used again and again.

Striped wallpapers possess intrinsic style. They also add to the apparent height of the wall, and if used horizontally they tend to loner the ceiling.

Pictorial papers are of three types: panoramic scenic, foliage and figured. They derive their importance in the decorative scheme from studied design and colour distributed over large areas.

The usefulness of friezes and elaborate border papers cannot be emphasized too strongly. Effects otherwise unattainable are possible with borders, panels and architectural papers showing simulated cornices, mouldings, pilasters and panelled wainscoting. Striking results are attained by pasting them to painted walls and allowing them to contribute the only pattern in the room. Border papers can also be used to outline the windows and doors and can be placed above the baseboard and the dado and at the intersection of the wall with the ceiling.

Fabric patterns are particularly adaptable as wall coverings. especially when it is desirable to have walls and draperies match exactly. The richer examples, such as flock and brocade, are of course applicable only to formal rooms. When applied to the wall and varnished, the verisimilitude of the marble papers to actual marble is astonishing. Two colours of marbled wallpapers can be combined for a pleasing effect by having the dado one colour and the wall above divided into panels of another colour.

An essential element in the background of any interior is the floor. Wood excepted. which can be patterned in beautiful parquetry of period design, floorings can be of tile, brick. stone, rubber, linoleum, cork, asphalt and the vinyl products, to mention a few. All these materials can be developed individually in ways which are decorative in themselves or which form backgrounds for rugs.

Furniture Arrangement.—In arranging the furnishings of a

room, begin with a centre of interest—such as fireplace, window or TV set—then set up secondary groupings of furniture according to their function, and keep all traffic lanes clear. The well-planned living room will be furnished to accommodate several different centres of activity—such as a record player, a grouping of table and chairs for cards or games, a bookcase, sofa and companion upholstered chairs for conversation and a desk and chair for writing—and will mix formality and informality in a way that pleases a variety of tastes.

There are four steps to observe in arranging furniture. Start with a floor plan of the room, drawn to scale, with all deficiencies of the room indicated (such as windows too close together, doors that open in instead of out or a chimney breast that juts too far into the room). Establish a centre of interest, such as a fireplace, window or breakfront cabinet, and work out from there by placing sofas near the fireplace or window and adding chairs and accompanying tables for lamps. Add supplementary groupings, such as a table and chairs for games, or a television set. Finally, check all groupings for efficiency: a desk and chair near a nindow for writing; a television set that can be heard and seen from every angle; and end tables near chairs, coffee table at the sofa and accompanying chairs. etc. Study and game areas should have a permanent place in the living room.

In order to keep the furniture arrangement flexible, keep large items parallel with walls, never cater-cornered. Disregard corners, except in small rooms developed in the modem style, and concentrate upon furniture groupings centred around larger items, such as a sofa or break-front cabinet against the wall. Never have a chair or a picture unrelated to a grouping—a print too small to go over a sofa should be used elsewhere or not at ail, and every chair should have a table or other item of furniture beside it.

The single all-purpose room will require individual treatment. First, divide the area with the dining table at one end nearest the kitchen and sitting-sleeping area at the other; curtain off, if possible, an alcove for privacy and late desk work; and lay a bold rug to accent the seating area. Two walls can be painted white or some other light colour, the other two painted a colour to blend with the decorative scheme. Furniture should be of multiple-use types, and there should be at least one comfortable upholstered chair.

Creating Colour Schemes.—Creating a colour scheme requires much sureness in order to prevent later disappointment. Yet the use of colour need not be a complicated operation, although the creation of every successful colour scheme presupposes a thorough knowledge of the primary colours, red, blue and yellow, the secondaries, green (blue with yellow), orange (red with yellow) and purple (red with blue), and their various values. such as blue-green, yellow-green, etc., in combinations ranging from the deepest shade (made by adding black) to the palest tint (made by adding white). Interior decorators generally select a colour in a rug or fabric and plan the other colours in the room around it. This is called the basic colour. With any basic colour. different contrasting effects or harmonies are possible.

A monochromatic scheme will result with all hues keyed to a single colour, such as red with pink and rose; a related colour scheme is the result of combining hues with a single related colour, such as red with orange and yellow, or coral with peach and cream; opposite or directly contrasting colours are called complementary colours, and include red opposite green, blue opposite orange and yellow opposite purple.

Generally speaking, a predominant quantity of cool colours, such as blue, green or gray, is never specified for a room with a northern exposure; there the colours should be light and warm, such as yellow, red or orange. Nor will warm colours be specified for a room with a warm exposure; there the hues should be cool and neutralized. There are exceptions, of course, for in cities one frequently sees blue rooms. green rooms, yellow rooms and red rooms irrespective of their exposures. In such instances masses of muted hues in fabrics and accessories are employed in the decorative scheme to balance the predominating colour of the background. The cool colours have a tendency to increase the apparent size of a room, just as the warm colours seem to diminish the size. Red (warm) and blue (cool) are outstanding examples, and yellow may be considered an exception because of its diffusive light quality under all conditions.

Accenting colours, either harmonizing or contrasting ones, are most important in completing a colour scheme, because without them a scheme will be flat. They lend emphasis. Care must be exercised in their use, however, else they may become a very disturbing element. Too many accents create confusion instead of pointing up a decorative scheme.

In developing a colour scheme for a room, the following course is recommended: instead of selecting a sample of fabric or wallpaper in the customary manner, and scheming with several related colours chosen from it, reduce the number of colours to two or three, emphasizing contrasts and sharpening the decorative pitch. Thus instead of employing the usual five or six colours, one dominating colour is selected and two related colours are used. This plan is infinitely simpler and more effective, and the problem of pattern and scale are reduced to a minimum.

Small rooms seem crowded and oppressive if the walls are dark or too bright. Pale blue or green gives a feeling of spaciousness, and the ceiling in the same colour increases the roomy effect. To make a big high-ceilinged living room acquire a more intimate air, paint the walls in a bright rosy shade and the ceiling in a deeper colour. This will give the illusion of less height and provide a warmer atmosphere. Apartment dwellers can make rooms appear larger by painting walls and woodwork the same colour, and by relating colours of different rooms so they seem to flow one to the other. Painting one wall a pale shade in a different colour from the rest will add length to a room that is boxy. For the room that lacks sunshine, a generous application of yellow paint will give it a sunny effect. Red should be used sparingly in the kitchen, since it is a "hot" colour and tends to emphasize the heat of cooking.

Specify background colours which are fresh and clear, whether pale or dark, subtle or vivid hues are planned. Aim for clarity rather than depth, and colours can include watermelon pink, subtle beige, lemon yellow, emerald green, blue, gray, deep brown, black or white. Colours should express a vital quality of elegance rather than opulence, and one working in this tempo will find that fabrics, floor coverings and furniture finishes all follow the same trend.

Always include the ceiling in the colour plan. It can be in contrast with the walls or match the wallpaper or rug. If the floor is wood, have it stained dark brown, then waxed and polished. The light-oak shellacked floor is never recommended.

The most helpful element in the creation of a successful colour scheme is illumination. The colour combination which in daylight seems so beautiful can at night be utterly spoiled if the illumination is not carefully planned; and nothing is more discordant in a subtle arrangement of pastels than strong shadows which have the power of actually subordinating the colours. Correct illumination, it will be found, is indistinguishable from the use of colour.

Lamps and Lighting.—Light sources should be subordinate in visual importance to the things they are intended to illuminate, except in rare instances where the light source itself is to be the dominant decorative motif. Unless concealed or counterlighted so that they are not apparent, light sources have extremely high attention value and readily dominate the decorative scheme, thereby detracting from the background and furnishings of the room. Generally speaking, lamps used for reading and writing must be relatively tall and equipped with shades wide enough to direct light on the reading plane.

Lamps should be used sparingly. Have them mounted with rubber-insulated wire, which will not fray and tends to disappear against wood better than does silk. The variety of portable lamps is as limitless as it is interesting. They range from simple pottery units with parchment shades to expensive ones fashioned of porcelains or rare metals and semiprecious stones combined with shades of the finest workmanship. Before the lamp is decided upon, it should meet the following requirements: Is the lamp appropriate for the room in which it is to be used? Is it of the same

character in design and colour as the other furnishings in the room? Is it suitable in type for the use to which it is to be put? Finally, what is the size of the table upon which the lamp is to stand? Because a lamp is a source of light. it attracts more interest than does any other object and is therefore always placed near a wall where it can be absorbed by the background, rather than in the centre of the room.

The shade is as important as the lamp base, because it is not only a decorative feature but controls the flow of light as well. For this reason it should, like the lamp base, be studied in relation to its purpose and position in the room. Uniformity of colour and styling is always to be observed. and all conflicting shapes and colours must be assiduously avoided. It is also essential that all lamp shades be kept at the same height in the room, to prevent any jumpy effect. Shades should always be severely tailored and simple of line, with ornament confined to a border band of gold or colour or a small bow. Lamp shades should be selected so that the completed lamp looks as though it had been conceived of as a lamp rather than as a vase with a shade affixed to it.

A ceiling fixture controlled by a wall switch is sufficient in a hall, because halls usually serve merely as passageways. But more adaptable lighting is essential in other rooms of the house. Floor lamps are never advisable except where close. bright illumination is required—at a piano, bridge table or sewing stand. Indirect lighting from floor lamps, although designed to eliminate glare, is not satisfactory because light is thrown on the ceiling in a manner that is objectionable in a perfectly planned interior.

Concealed lighting is appropriately termed architectural illumination and is employed as something with which to build and decorate. This versatile lighting, capable of infinite variations with fluorescent lamps, is employed to supplement the usual fixtures and portable lamps, and its decorative possibilities are limitless because it is inexpensive and easy to use. Used directly or indirectly. it is frequently employed in a simple manner with striking results. It can be confined entirely beneath a surface of enclosed glass to emphasize an architectural plane, or it can be spread, in a similar manner, behind a cornice or a frieze to illuminate an entire room.

The Small House.—The trend toward less complicated living is marked by some of the most interesting examples of interior decoration to be seen, particularly when it comes to making the smaller house or apartment attractive.

The results, decoratively speaking, can be as effective and interesting as they are low in cost. How to evoke a setting for enjoyable living and comfort in a small area. and at a minimum cost without sacrificing either beauty or good taste is the problem. In such cases original ideas are as important as money. A new window treatment, smart use of a mirror or two, colour used in just the right way—these are the little things that will lift a small house or apartment out of the ordinary.

The value of details in the scheme is infinitely greater when there are several of them, for what makes the room successful is the cumulative effect of these essential parts. In decoration, as in mathematics, the total is the sum of its component parts. Consider the dramatic qualities of natural woods, the pleasing effect of plain areas as backgrounds for dramatic settings, the sparkling beauty contributed by mirrors and glass, the decorative value of growing plants, the dramatic effect of jet-black metal or brass in the scheme or the interest created by an antique or two set against a modern background.

In the small house or apartment the chief decorative interest can be successfully centred in vivid colour; a scheme of geranium red and white carried throughout, for example, can be a jewel of decoration in a small setting. Blue and green. apricot and white, pink and brown and lilac and green are other colour combinations that prove delightful. In any case, furnishings for the small house or apartment should be kept to an absolute minimum.

Decorating on a Budget.—There are three low-budget ways to decorate, as regularly practised by decorators. First, economize by specifying inexpensive materials of limited durability, with the expectation of either replacing them as they wear out or finally substituting better materials when the budget permits it. The second way is to consider furnishing as an investment, beginning with expensive but long-wearing materials at the outset and avoiding the redecorating expense. There is much to recommend both practices.

For example, if the house or apartment is rented or leased, or alterations in the decorative style are desired with the changing seasons, it will be expedient to recommend the first plan for draperies and wall coverings; otherwise it is seldom satisfactory unless budget limitations will permit only minimum investment. Conversely, if the background of the room is fixed in architectural style as to xoodwork, fireplace and mantel, doors and windows, the decoration should be of equally enduring character consistent with it. Only then will such anachronisms as Georgian furniture combined with modern architecture be averted.

Progressive assembling is the third method of decorating an interior with a minimum initial outlay of money. A system of discriminating purchasing is recommended for either the simple or the luxurious interior, and acquiring fine things on a gradual scale—the furniture and floor coverings one season, the draperies and accessories the next—is recommended in preference to a complete installation of mediocre furnishings.

Furniture is one of the items with which the decorator can make but few. if any, economies so far as actual construction is concerned. Buy furniture of a high standard. The only way to save is to reduce the number of pieces.

Frequently one or two important items of furniture, such as a sofa. commode or large table, can be the nucleus for incidental pieces that are added later. This economy of buying fewer items is recommended because it is not necessary to include as much furniture in a room as heretofore. It should be remembered that furniture cannot be easily discarded for a passing style, and that many items lose their decorative effect because they are not placed advantageously in the room.

Above all, provision should be made for adequate floor coverings, although this item does not lend itself easily to the budget. Floor coverings should be submitted to many tests for quality and viewed with an eye to their wear and future adaptability to changing styles.

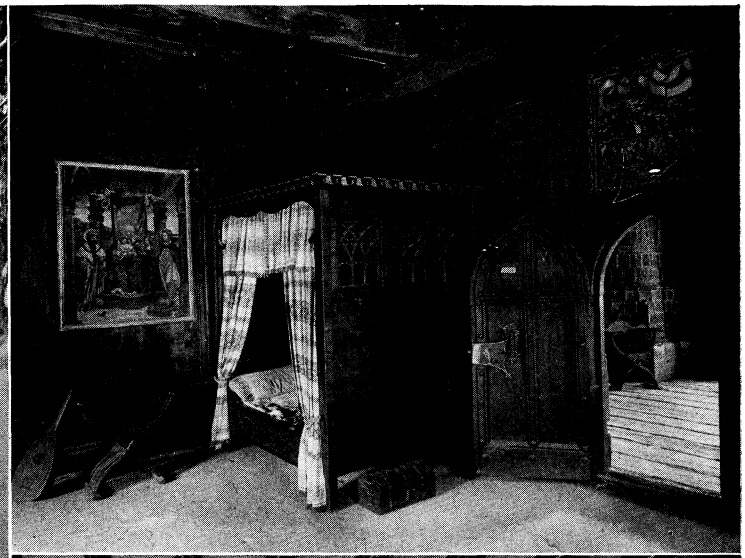
Textiles supply vitality to the decorative scheme, and the most effective may to achieve a desired effect with the minimum outlay of money is with drapery and upholstery fabrics. These can be changed from time to time to meet the exigencies of the season, and such transformations do not require much money if the fabrics are selected for enduring qualities of weave and design.

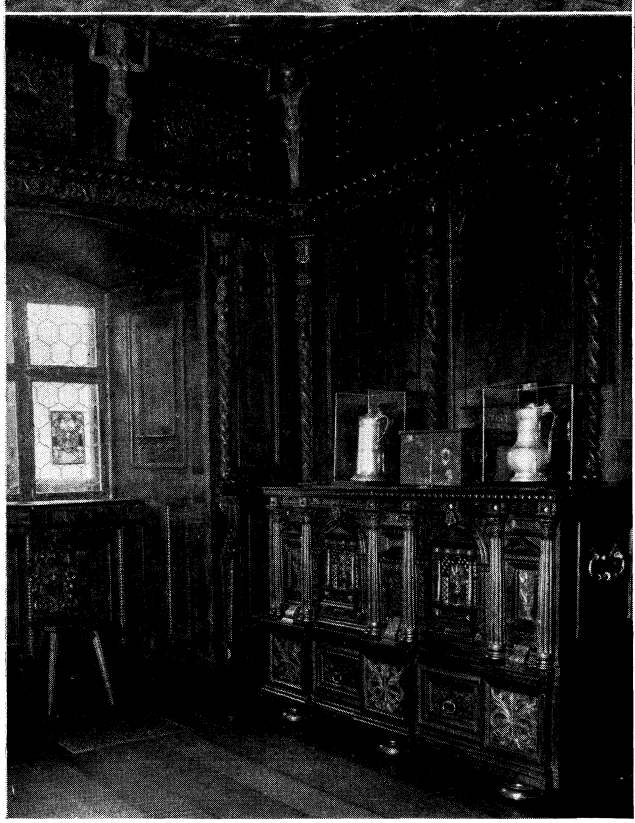
To lay the foundation for future enjoyment of a decorative scheme, spend money for decoration which is basically worthwhile and of permanent value. Economize on the things that can be replaced in a scheme: hang unlined curtains, use slip covers instead of upholstery coverings which can be supplied later. **A** sofa can be selected, for example. in a temporary sateen covering and be made the dominant note of the colour scheme. Maple or limed-oak wood finishes look well with simple curtains and no draperies, and nith upholstery and rugs of moderate cost. These relatively inexpensive woods permit use of accessories scaled correspondingly low in price.

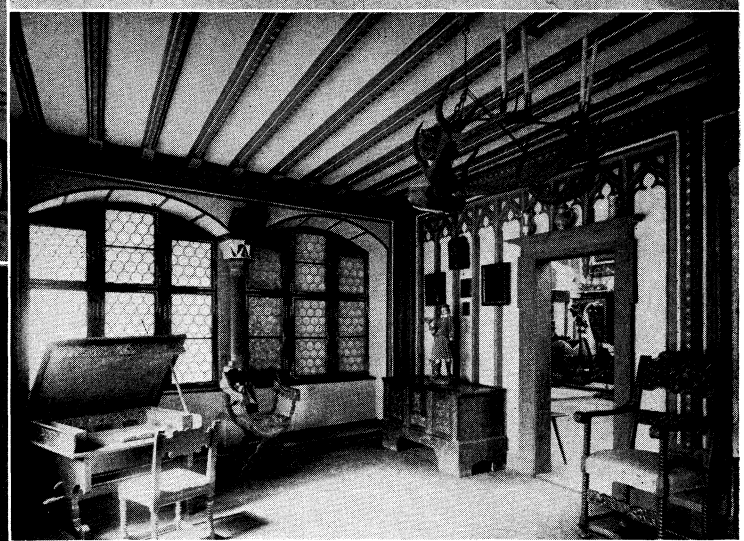
Decorative Window Treatments.—Any attractive room can be made more attractive with appropriate curtains and draperies for its windows, and window shades can also add to the decorative effect in many instances. The variety of window treatments is legion, drawing upon every period of interior decoration.

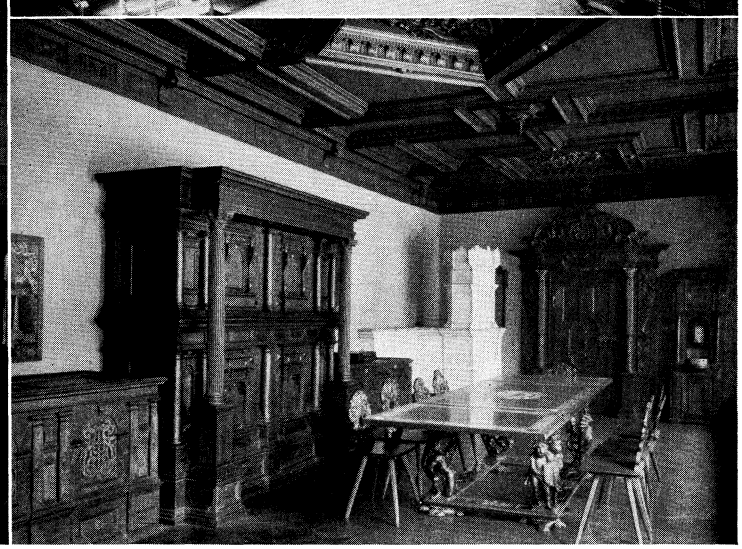
The three periods of early American artistic expression—from the earliest New England styles through the first quarter of the 18th century; from 1725 to the early republic; and the Federal, 1785 to 1830—are exemplified chronologically by the series of decorative curtain treatments exhibited in the American wing of the Metropolitan Museum of Art in New York city. They clearly delineate the changing styles of window curtains in interiors of the respective periods and are valuable for use in traditional schemes.

The earliest example introduces a style of window treatment that was already in fashion in England when the first permanent









BY COURTESY OF (CENTRE RIGHT, BOTTOM RIGHT) THE DIRECTOR OF THE HISTORICAL MUSEUM, BASLE, (BOTTOM LEFT) THE METROPOLITAN MUSEUM OF ART, NEW YORK; PHOTOGRAPHS, (TOP LEFT) BROGI, (TOP RIGHT) KUNSTANSTALT STENGEL AND COMPANY G.M.B.H.

EUROPEAN INTERIORS OF THE MIDDLE AGES AND RENAISSANCE

Top left: Room in the royal palace, Palermo, Sicily, known as the apartment of King Roger II; an interior of the Norman period (12th century) showing the influence of the earlier Saracen rulers of the island

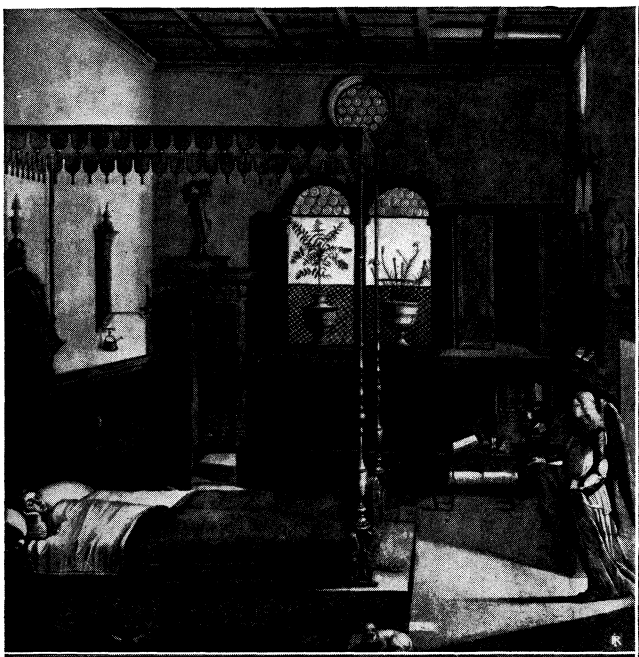
Top right: Bedroom with walls and ceiling of wood, from the Landesfürstliche Burg at Merano, Bolzano, Italy; 15th century

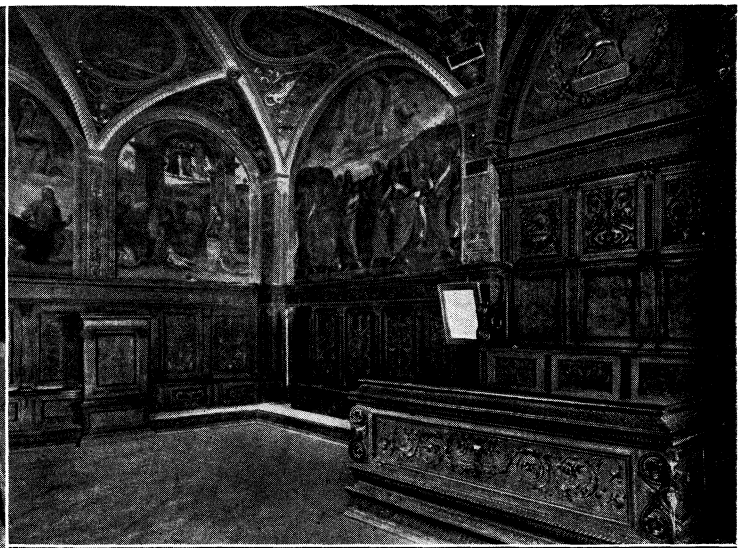
Centre right: Room from the House of the Cardinal, 1540, reconstructed in the historical museum at Basle, Switz.

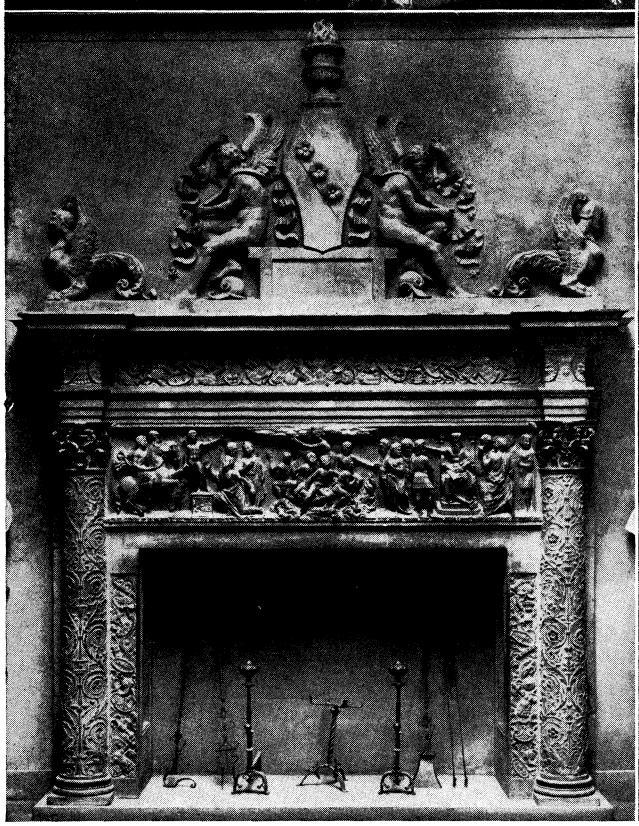
Bottom left: Room with wood floor and carved and panelled walls and ceiling, from a house in Flims, Switz.; 17th century

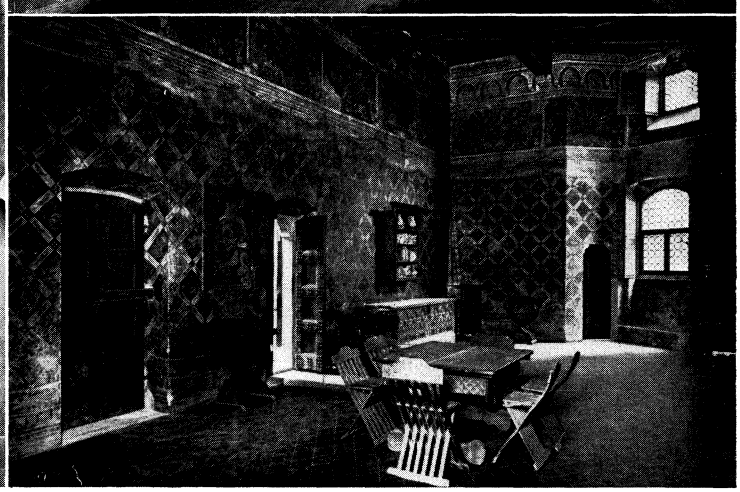
Bottom right: Room from the Speisshof in Switzerland, about 1580, reconstructed in the historical museum, Basle

IhTERIOR DECORATION









PHOTOGRAPHS, (TOP LEFT, CENTRE RIGHT, BOTTOM LEFT) ANDERSON, (TOP RIGHT, BOTTOM RIGHT) ALINARI

ITALIAN INTERIORS OF THE RENAISSANCE

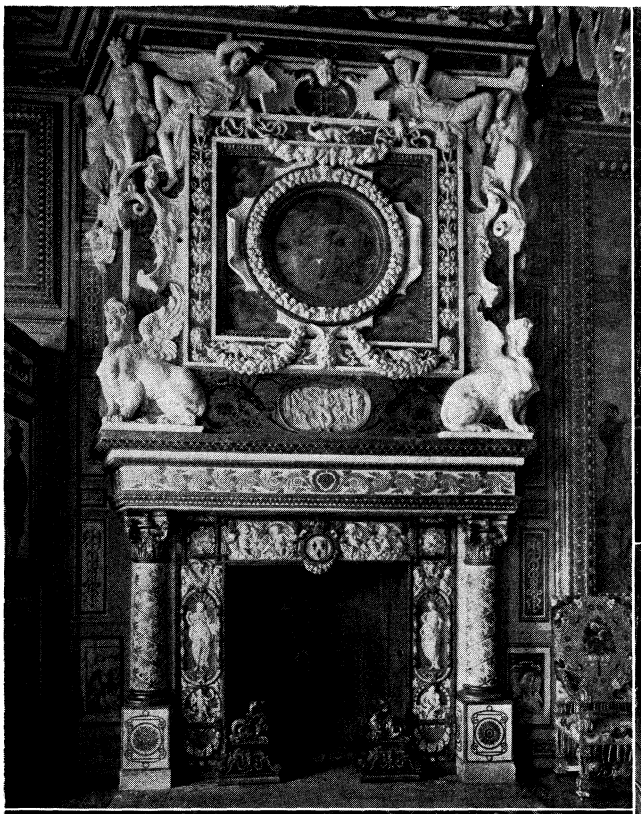
Top *left:* "St. Ursula's Dream," by Vittorio Carpaccio (*c.* 1465–c. 1522), in the Academy, Venice, showing an Italian interior of the late 15th century. The bed is uncurtained; the windows have leaded lunettes

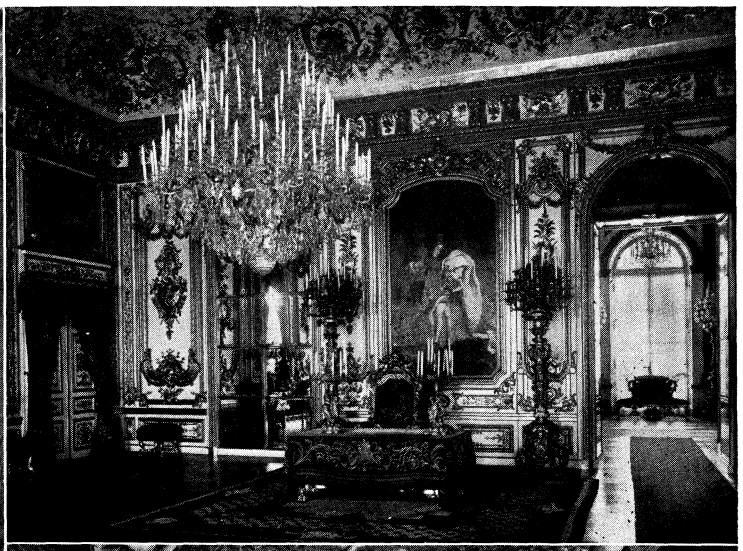
Top right: The Hall of Exchange in the Collegio del Cambio (Banker's guild), Perugia, panelled and frescoed after the Italian manner of the 15th century. In the right foreground is a desk of carved and inlaid walnut. The frescoes are by Pietro Perugino (c. 1450–1524)

Centre right: A room in the Boroia apartments of the Vatican, known as "Sala del Credo." The walls are painted, and benches of coloured marble fill the window embrasures; 15th century

Bottom left: Fireplace by Benedetto da Rovezzano (1474–1552), in the national museum, Florence

Bottom right: A room in the Davanzati palace, Florence. The lower sections of the walls are painted in imitation of hangings. The furniture dates from the 15th and 16th centuries





BY COURTESY OF (CENTRE RIGHT) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (BOTTOM LEFT) BY PERMISSION OF KING GEORGE VI, COPR., WALTER BOURKE; PHOTOGRAPHS, (TOP LEFT) LEVY AND NEURDEIN, (TOP RIGHT) EWING GALLOWAY, (BOTTOM RIGHT) BURTON HOLMES FROM EWING GALLOWAY

EUROPEAN INTERIOR DECORATION OF THE 17TH–19TH CENTURIES

Top *left:* Mantelpiece in the palace of Fontainebleau, Fr.; period of Francis I (1494-1547)

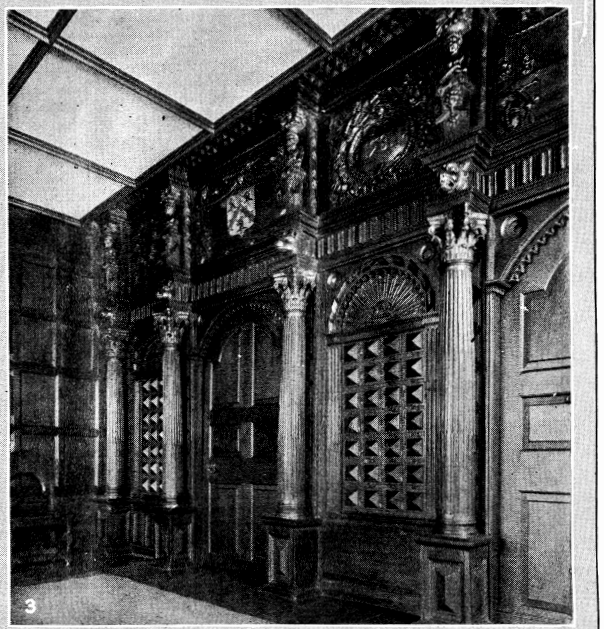
Top *right:* Interior of Herrenchiemsee castle erected in Bavaria by Louis II (1845–86), after the French Louis XIV style

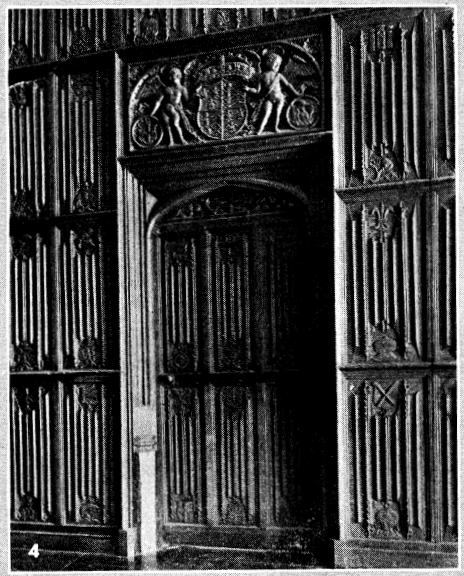
Centre right: Bedroom from the Palazzo Sagredo, Venice, about 1718. Later in the Metropolitan Museum of Art, New York city. The bedstead is carved and gilded; the ceiling is attributed to Gasparo Diziani

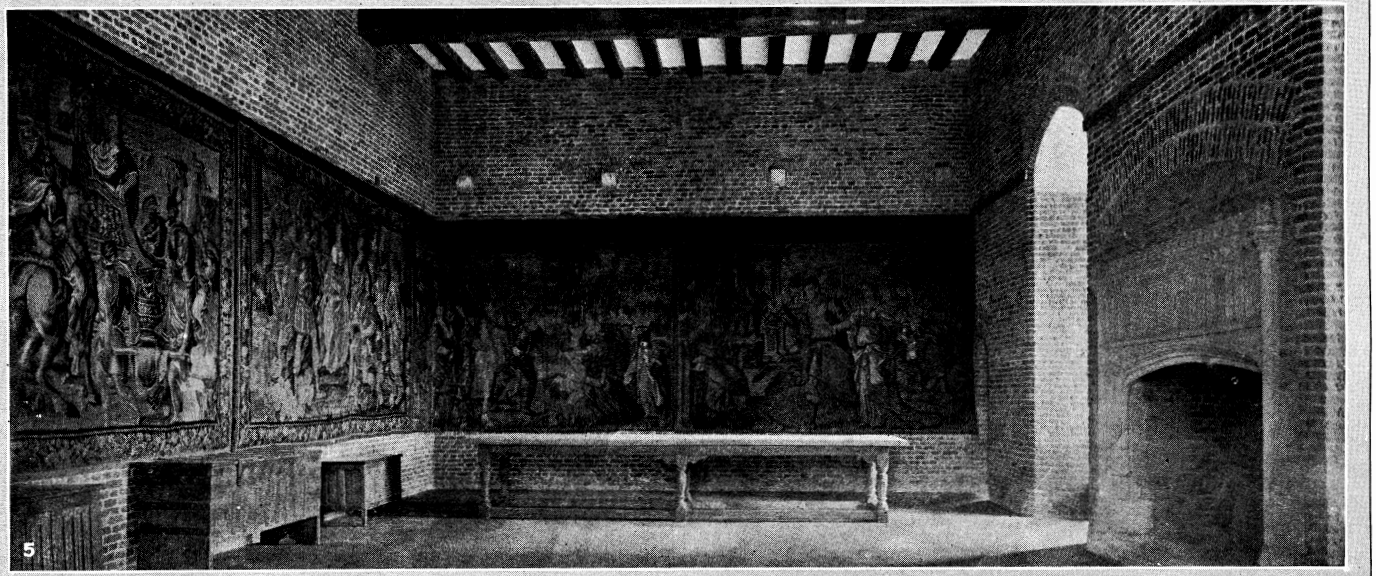
Bottom left: State bed with hangings of rose damask, made for George, prince of Wales, in 1715

Bottom right: Salle du Conseil at Fontainebleau, built under Charles IX and decorated under Louis XIV and Louis XV

INTERIOR DECORATION



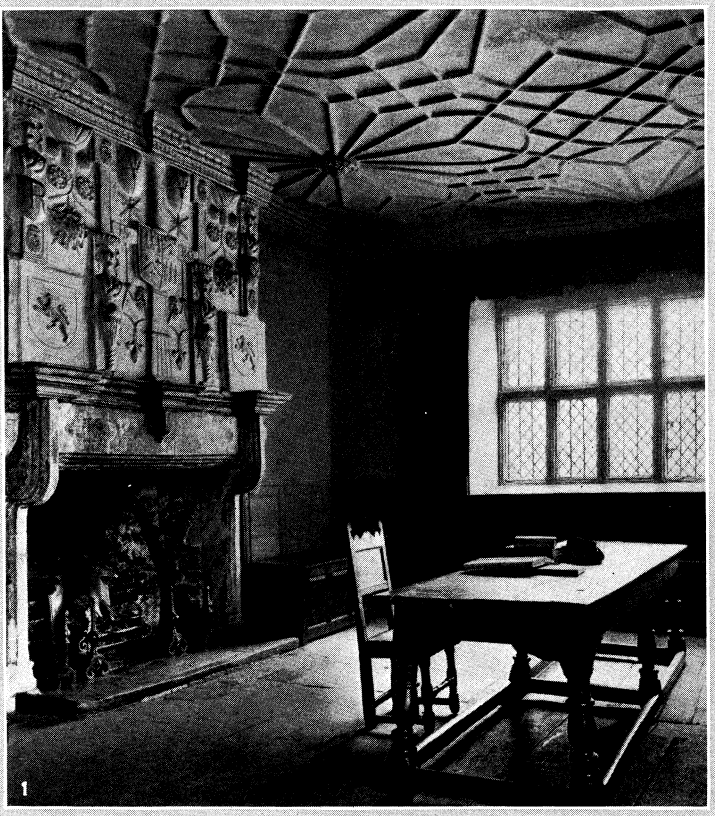


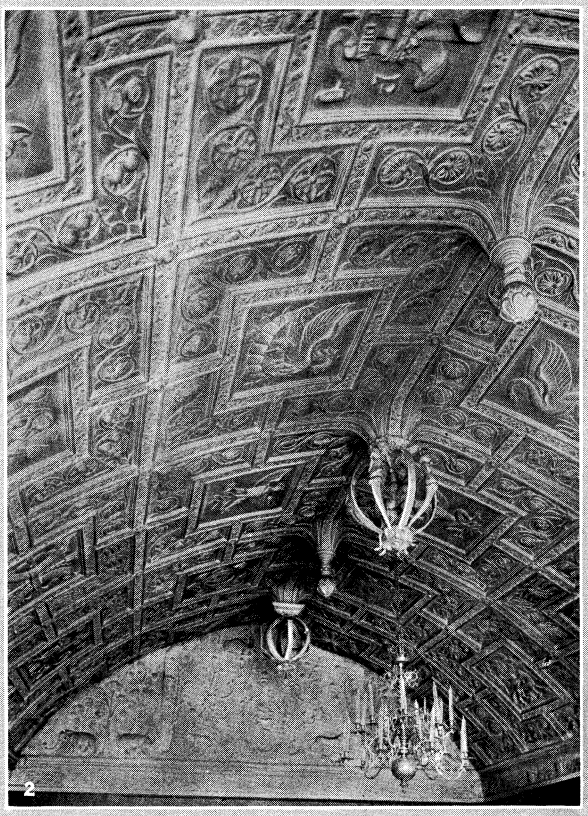


BY COURTESY OF COUNTRY LIFE, LONDON, FROM TIPPING, "ENGLISH HOMES"

ENGLISH INTERIORS OF THE 15TH AND 16TH CENTURIES

1. "Richard II. Feasting," from *Les Chroniques d'Angleterre*, an illuminated manuscript of about 1475; showing architectural treatments and decoration of the period
2. Marble chimney piece in the gallery at Cobham, executed by Giles de Whitt of the Low Countries, 1599
4. Gallery door at the Vyne, Hampshire; carved in Gothic linen fold with various heraldic devices. About 1515
5. A room (restored) in Tattershall Castle, Lincolnshire, built about 1438 by Baron Cromwell, Lord High [illegible] Gothic chests and table of the late 16th century

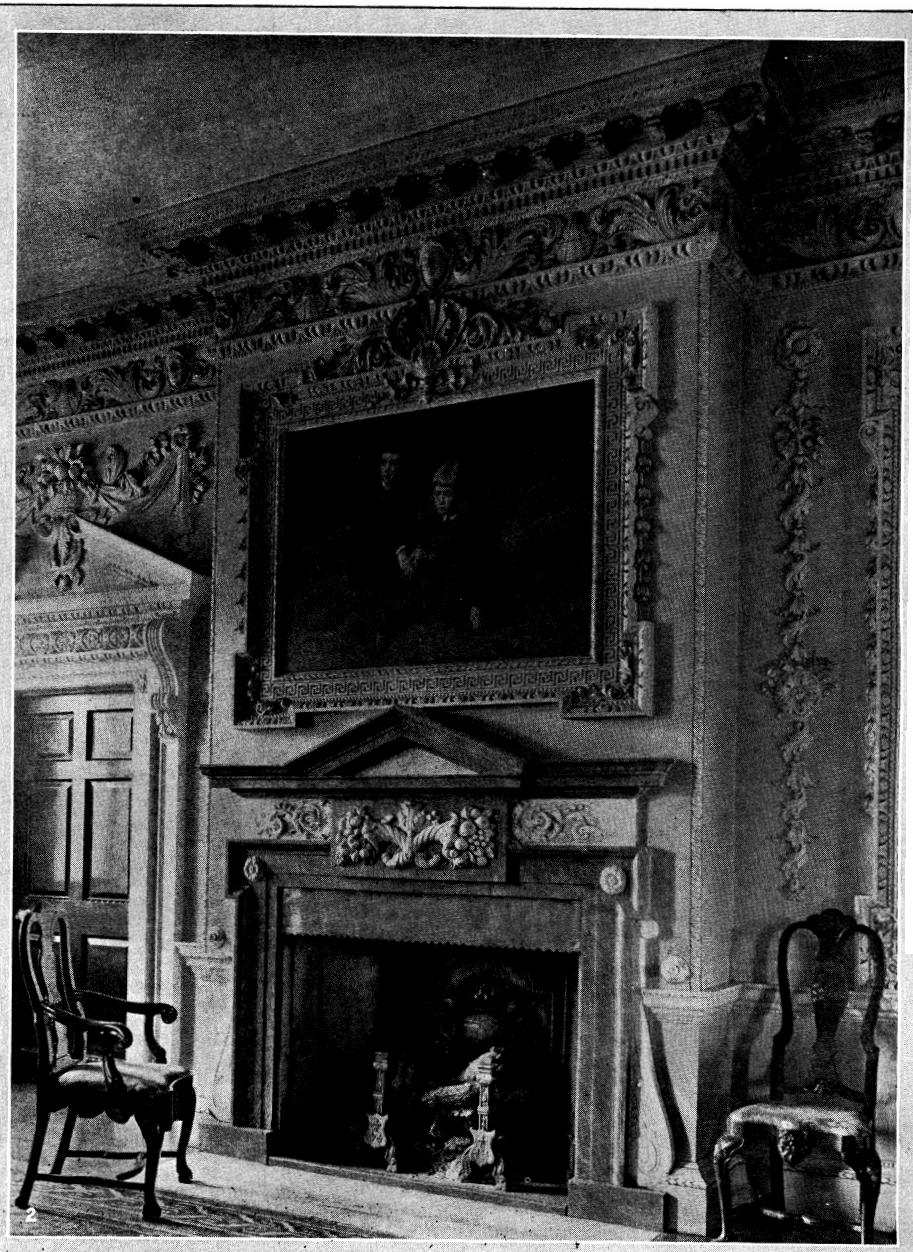




BY COURTESY OF COUNTRY LIFE, LONDON, FROM TIPPING, "ENGLISH HOMES"

ELIZABETHAN AND JACOBEAN INTERIORS

1. The hall at Plas Mawr, Conway, Caernarvonshire, an admirable example of an Elizabethan interior. The patterned ceiling is a product of the school of plasterwork that flourished during the last auarter of the 16th century; the upper part of the chimney piece is also plaster
2. Ceiling in the great chamber at Herringston, Dorchester, dating from about 1615. It is barrel shaped and worked with an elaborate pattern of fioral scrolls, heraldry, beasts and birds. The pendentals are a feature of the period
3. Stone hall screen at Wollaton hall, Nottinghamshire, a residence erected in 1580 by Sir Francis Wiiloughby. Elizabethan
4. The large or north drawing room at Levens hall, Westmorland, showing three-decker chimney piece, plasterwork ceiling and north window with roundels of painted glass. The family heraldry is carved in the compartment above the fire arch; Queen Elizabeth's arms in the centre panel of the top compartment, and the date 1595 in that to the right. The family heraldry also provides the motifs of the six painted window ovals

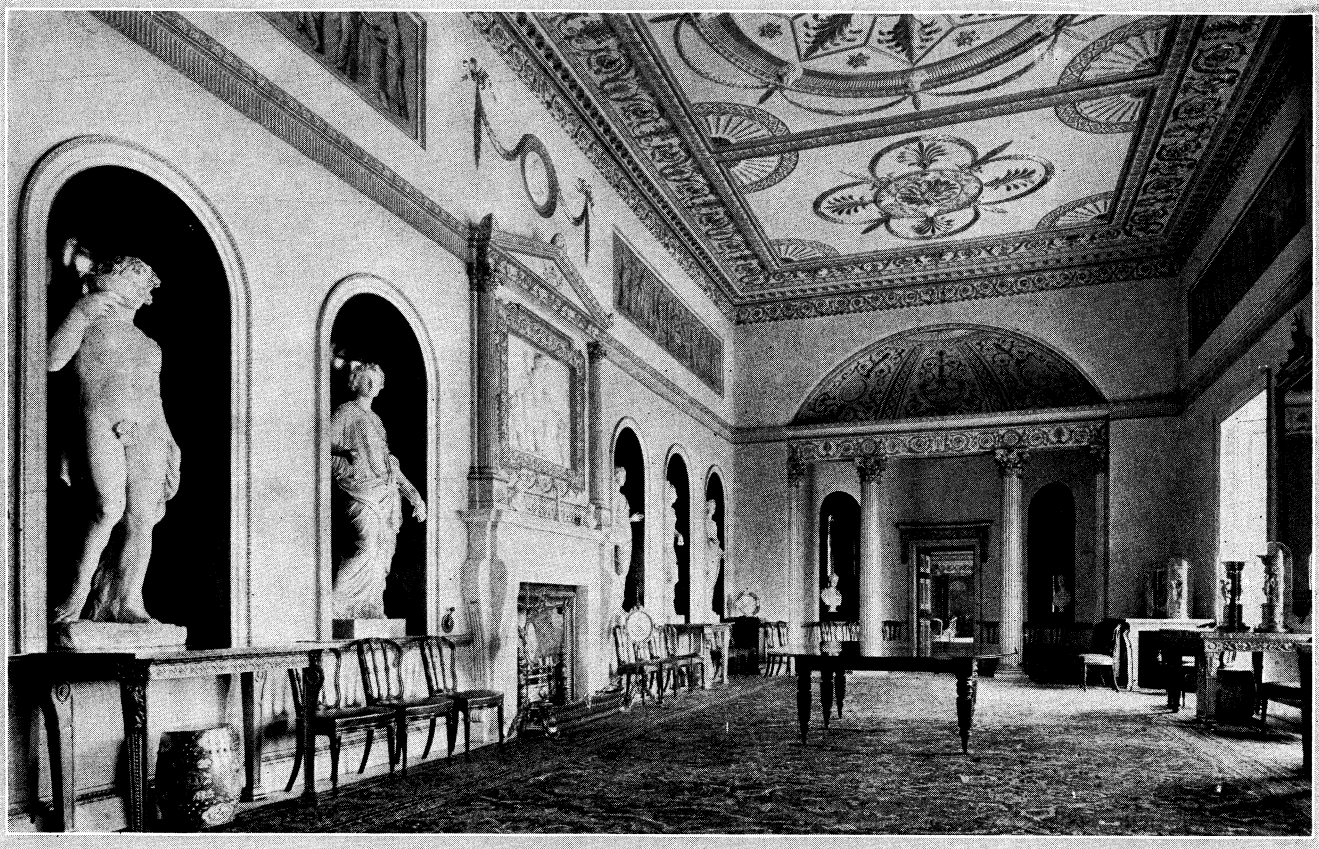


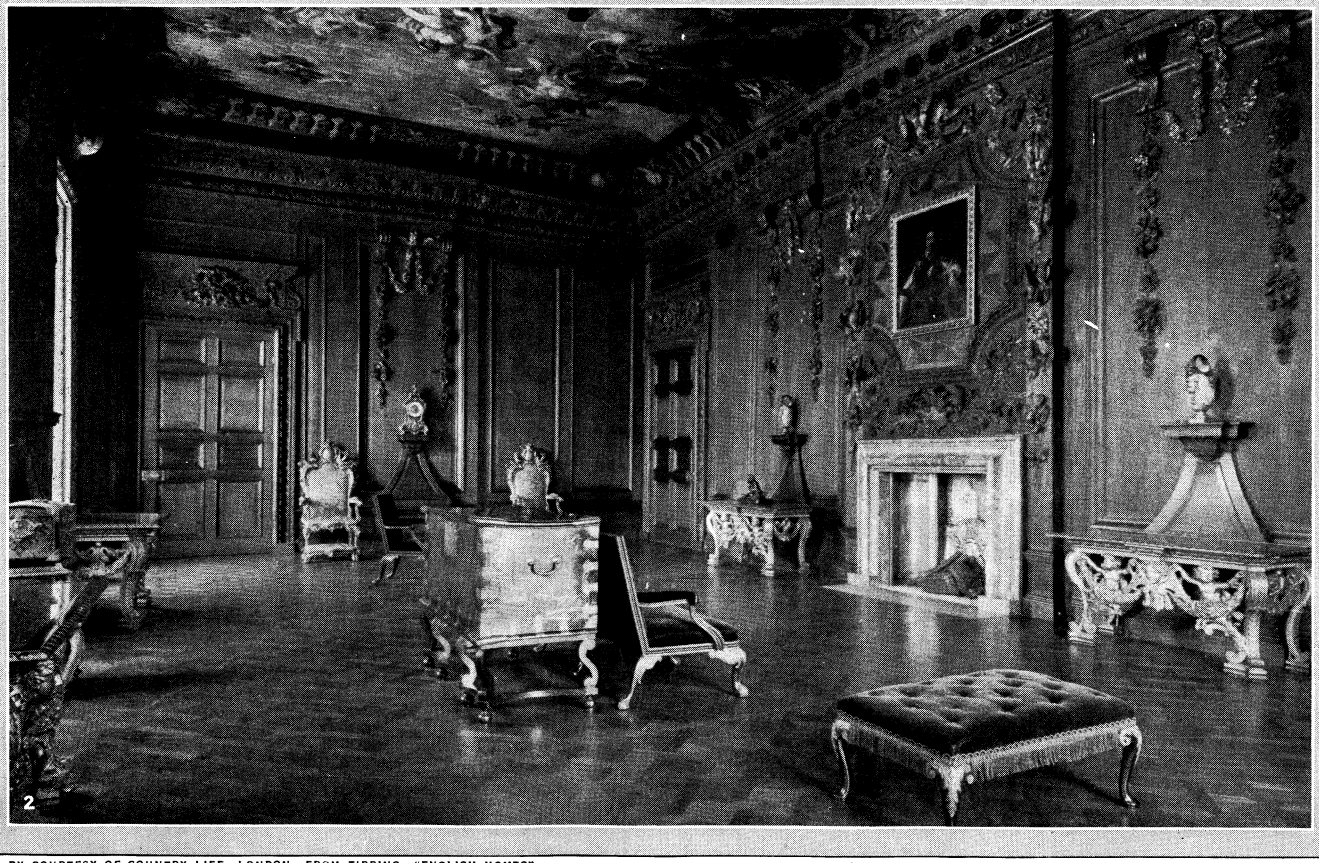
BY COURTESY OF COUNTRY LIFE, LONDON, FROM TIPPING, "ENGLISH HOMES"

EARLY GEORGIAN INTERIORS

1. South side of the stone hall at Houghton, Norfolk. *c.* 1725. The room, surrounded on three sides by a gallery, is of white Whitby stone, with stucco ceiling and mahogany windows and doors

2. Chimney piece of dark veined marble with frieze and sculptured ornament of Carrara marble, at Godmersham Park, Kent. *c.* 1732. Design of the picture frame resembles that of the other wall panels and the window cases





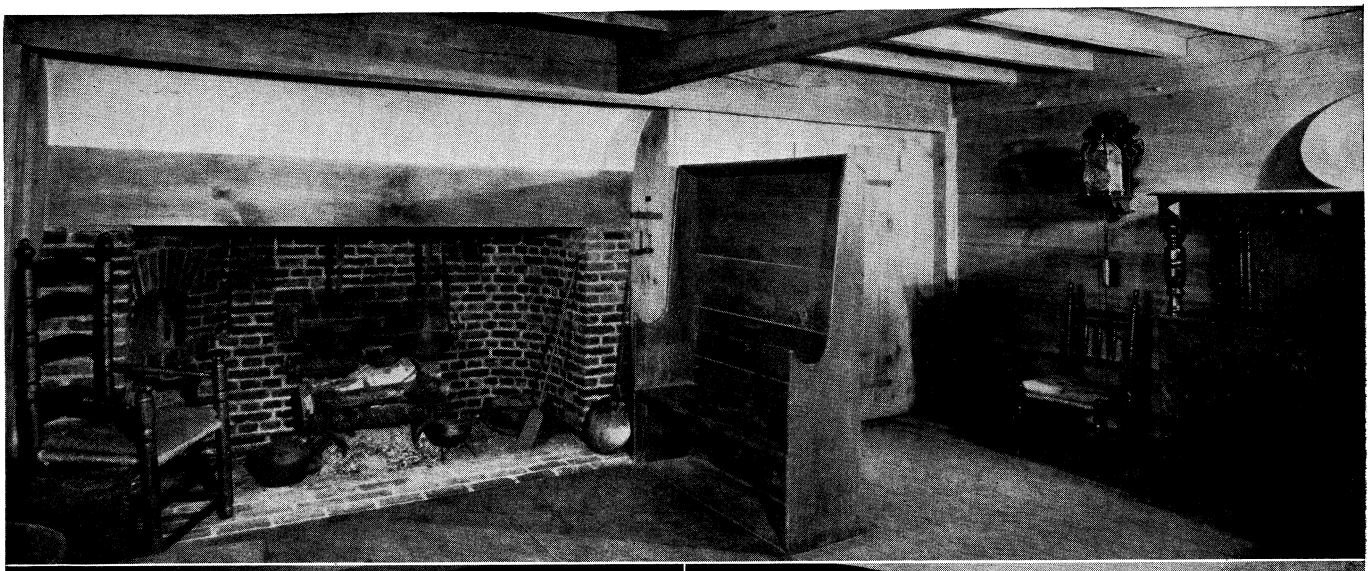
BY COURTESY OF COUNTRY LIFE, LONDON, FROM TIPPING, "ENGLISH HOMES"

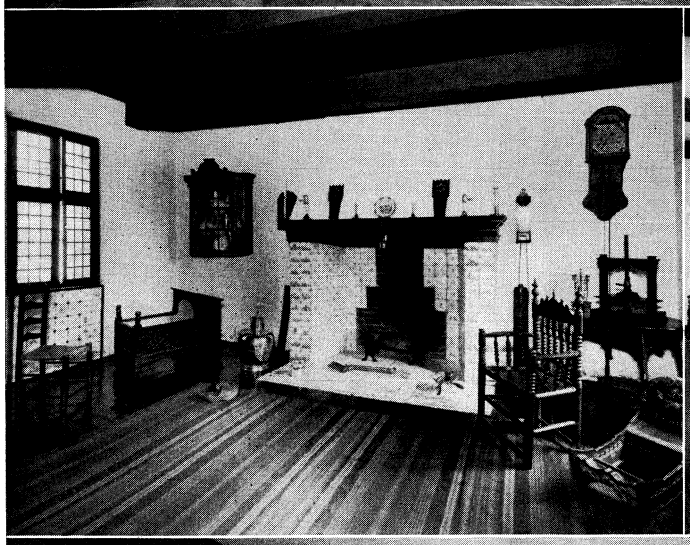
ENGLISH INTERIORS — SYON HOUSE AND CHATSWORTH

1. View of the great dining room at Syon House, Middlesex, looking east, showing the niche system (introduced to add to the sense of width), the columned apse and the enriched ceiling. The chimney piece is of white marble, and the room is painted yellow with gilded enrichments. Designed about 1762 by Robert Adam

2. The great chamber at Chatsworth, Derbyshire. Late Stuart style. It is wainscoted from floor to ceiling, and the more important panels decorated with carvings in Grinling Gibbon's manner by Lobb, Davis and Watson in 1692-3. The ceiling was painted by Verrio, the famous contemporary Italian artist

INTERIOR DECORATION

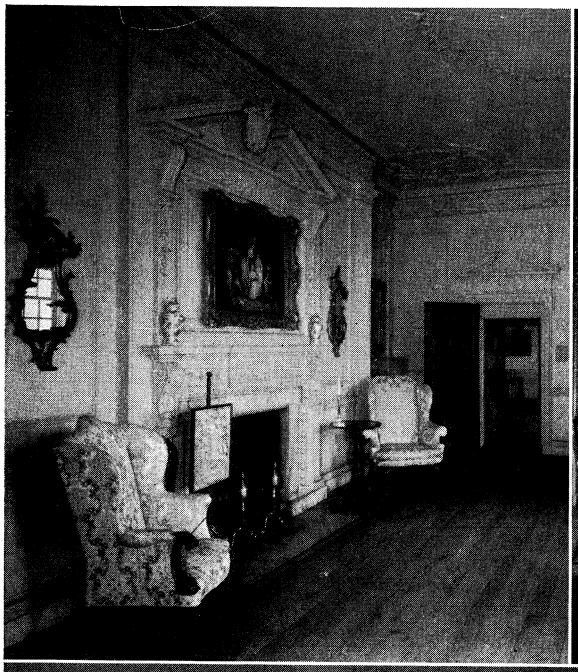


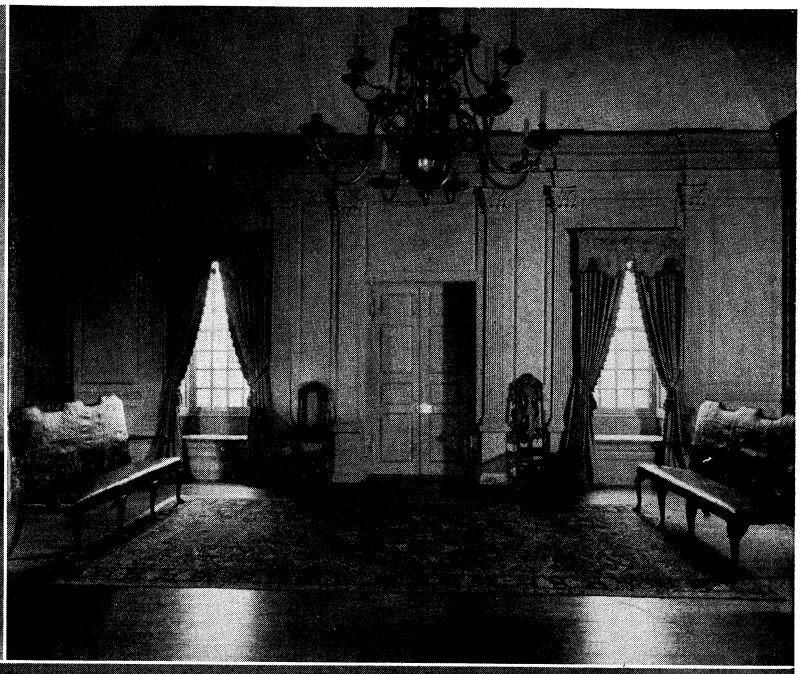


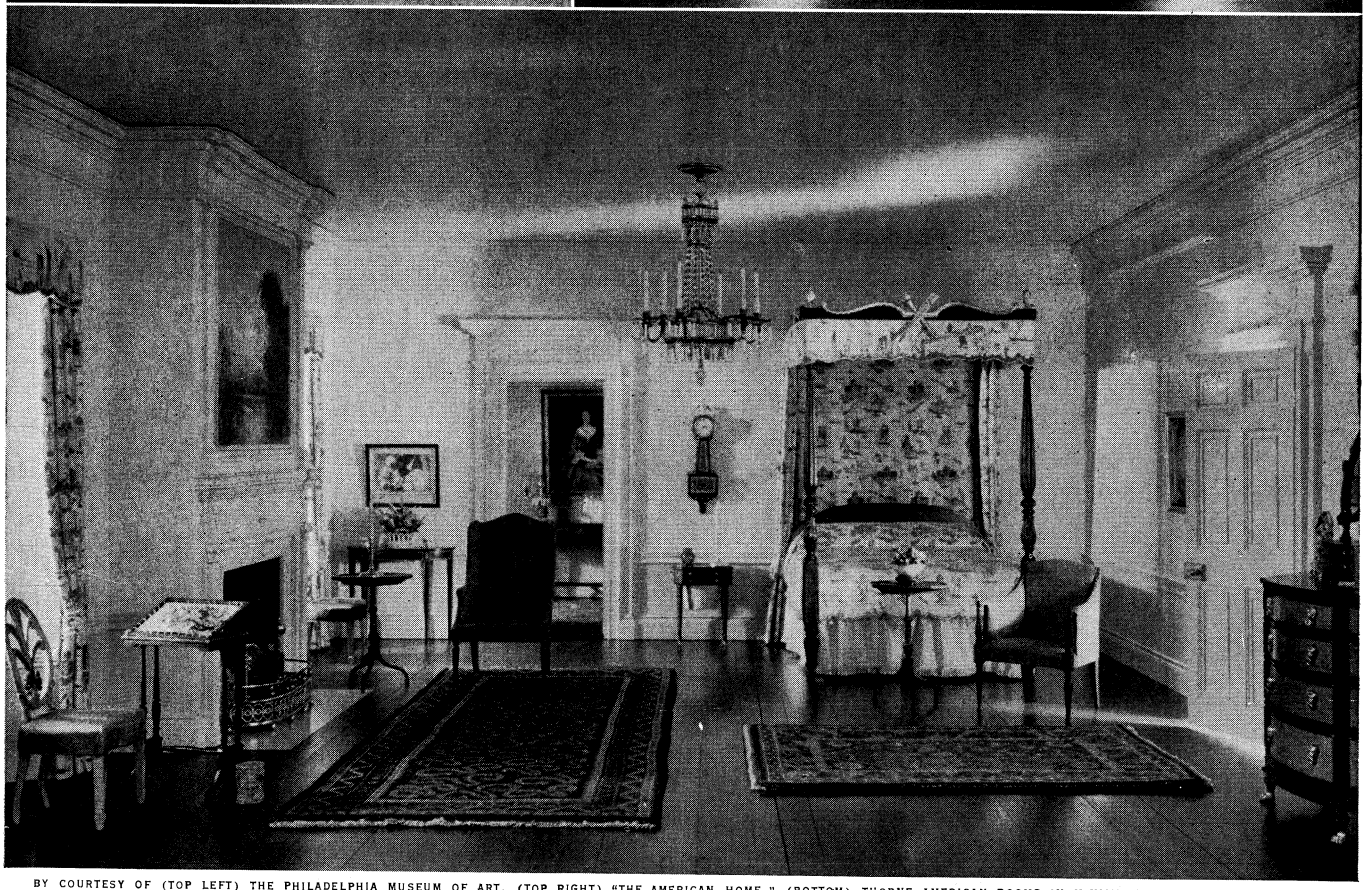
BY COURTESY OF (TOP. CENTRE RIGHT) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (BOTTOM) THORNE AMERICAN ROOMS IN MINIATURE. THE ART INSTITUTE OF CHICAGO: PHOTOGRAPH, (CENTRE LEFT) BROWN BROTHERS

EARLY UNITED STATES INTERIORS

Top: Reproduction of the Capen house kitchen, Topsfield, Mass., 1683
Centre left: Fireplace wall of the Van Courtlandt house, New York city, a 17th-century interior showing Dutch influence
Centre right: The Samuel Wentworth house, Portsmouth, N.H., built in 1671, panelled about 1710
Bottom: Drawing room of the Jeremiah Lee mansion, Marblehead, Mass., 1768







BY COURTESY OF (TOP LEFT) THE PHILADELPHIA MUSEUM OF ART, (TOP RIGHT) "THE AMERICAN HOME," (BOTTOM) THORNE AMERICAN ROOMS IN MINIATURE, THE ART INSTITUTE OF CHICAGO; PHOTOGRAPH, (TOP RIGHT) F. M. DEMAREST

18th-CENTURY UNITED STATES INTERIORS

Top **left:** Fireplace wall, drawing room of the Powel house, Philadelphia. Pa.. 1768
Top right: The great hall, Stratford house, Westmoreland county, Va., about 1725–30
Bottom: Bedroom, Oak Hill, Peabody, Mass., about 1800

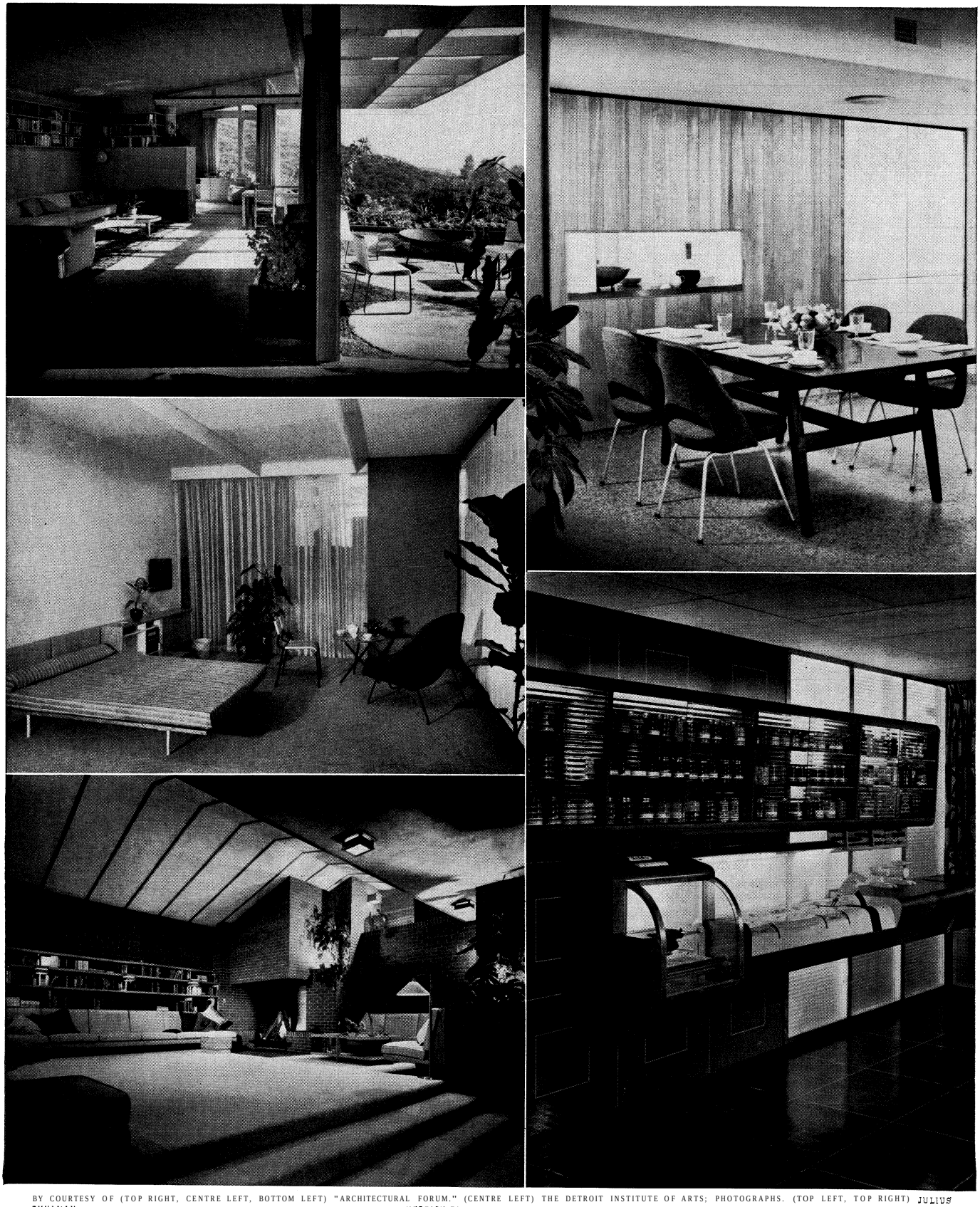
INTERIOR DECORATION

BY COURTESY OF THORNE AMERICAN ROOMS IN MINIATURE, THE ART INSTITUTE OF CHICAGO

U.S. INTERIORS OF THE 19th CENTURY

Top: Drawing room, Andalusia, Bensalem township, Pa., remodelled about 1834–36

Bottom: Victorian parlour, New York city, 1850–75



BY COURTESY OF (TOP RIGHT, CENTRE LEFT, BOTTOM LEFT) "ARCHITECTURAL FORUM." (CENTRE LEFT) THE DETROIT INSTITUTE OF ARTS; PHOTOGRAPHS. (TOP LEFT, TOP RIGHT) JULIUS SHULMAN, (BOTTOM LEFT) COPYRIGHT, EZRA STOLLER, (BOTTOM RIGHT) HEDRICH-BLESSING

CONTEMPORARY U.S. INTERIORS

Top **left:** Living room by Ain, Johnson and Day, showing relationship of interior and exterior design

***Top** right:* Dining room arranged with table near opening into kitchen: Kazumi Adachi, architect

Centre left: Bedroom designed by Florence Knoll

Bottom left: Brick-lined living room by Frank Lloyd Wright

Bottom right: Kitchen from the Libbey-Owens-Ford "House *of* Tomorrow." All cooking equipment is built in and can be recessed to provide additional counter space when not in use

settlements were made in New England. The valence of worsted embroidery on linen marked a transition beta een the use of heavy, solid needlenork and the use of lighter, printed fabrics. Later examples of this latter phase are the curtains printed in a Jacobean pattern, those nith the pattern outlined in one colour and the remainder printed in by hand; and the toiles de *Jouy* The development of draperies in richer fabrics, including plain silks, damasks and brocades. began about 1756. The shaped valance, or pelmet, appeared at the same time, and this charming style was never abandoned for the various festooned adaptations that were so greatly esteemed during the first years of the 19th century.

A note of individuality is often given the roller shade by substituting glazed chintz or gaily striped awning material for the customary fabric. With shaped or plain end it is a perennial favourite for small houses, and affords a source of much colour. This type of shade is lovely with ruffled sheer curtains, and no draperies are needed nith it; an individual trick is to use a shaped valance, made of the same material as the shade. with sheer curtains and a plain coloured or white fabric for the side curtains, or no side curtains at all. A cool summery effect can be obtained with sheer starched or nylon curtains that are edged with a bright binding or with deep pleated ruffles, a treatment that is sufficient for informal sitting rooms. A more sophisticated window treatment for the formal room can be realized with bouffant Austrian shades that may be raised or lowered by traverse cords attached to the shades.

Contemporary enough for any modern whim, Venetian blinds—either vertical or horizontal—are equally correct in rooms of either English or French late-18th-century derivation. They form an ideal accompaniment to the formal French empire, English regency or early American interior, and are informal enough to be used in French provincial and colonial treatments. The advantages of Venetian blinds are many. Not only are they smart and trim, but, uhen made of plastic, are durable as well and can be easily detached for cleaning.

In informal settings, or on stair landings and in halls where wall space is less of a problem than it is in the more lived-in rooms of the house, the use of indoor shutters, both louvered and panelled. is of definite value. The panels are often painted in attractive motifs or decorated with applied flower prints. This type of decoration is by no means confined to small-house interiors; painted antique doors in the rococo style used at French windows offer as great an effect of richness and formality as could be desired.

Terraces and Outdoor Rooms.—A sunroom or breezeway in the smaller house—a transition room between the house and the garden—must have about it a suggestion of fresh air and the outdoors, an atmosphere of both garden and interior, yet also appear gayer and less formal than the inside.

This room, detached from the main part of the house, and its many windows with light streaming in will permit a freedom in decorative treatment inappropriate to any other room. This atmosphere can be emphasized by bringing in things from the outdoors: small trees, flowers, vines and water. However, the interior decoration should be related to that in the other rooms as concerns style and the type of furniture.

A terrace need not necessarily be joined to the house to be an outdoor room. Any pleasant spot or area of turf can constitute the location, because furniture is available to withstand the vagaries of weather. Provided there is a view—if not of a garden or trees, then of a high trellis with vines—the first consideration for any terrace is an awning to offer shade and to make the terrace livable at all hours of the day. It may be a portable device or be fastened directly to the house, or shade can be effected aith decorated fabric roller shades, bamboo curtains or Venetian blinds.

The fact that so many meals are served on the terrace means that the outdoor room must have chairs and tables that can be shifted to give the appearance of a well-set dining table at night. For out-of-door use. furniture must be either weatherproof or easy to move about and take up or down steps; it must not fall over or blow away in a breeze, nor be too heavy for a woman to move. Cushions must either be waterproof or easily carted indoors. And ash trays must be windproof, the best being deep ones filled with sand.

A small copper-lined cabinet is useful on the terrace to hold an electric hot-water heater for preparing tea; and it might also have a compartment in which to dump cushions, books and magazines to keep them dry. There should be a little wall fountain, also, from which to rinse teacups and to obtain fresh water. Or a little house, part of a grape arbour or tool house, might have a closet for bottles and glasses and even a small electric refrigerator. A portable screen might also prove useful, and there should be a chest for garden tools. If benches are located some distance from the house it is well to have a box for brushes and rags to flick away any dirt.

Floors for terraces and open porches are usually of bare stone, linoleum (if indoors) or tile; and if of plain cement, they are frequently coloured.

Kitchens.—The actual layout of a kitchen depends on the room itself. but if three sides of it are properly equipped the sink will be at one end under a window, flanked by two work surfaces; the stove will be on one side with additional work space, all equal in height; and across from it will be the refrigerator. Cabinets should be fitted in, above and below the various units, completing the compact arrangement.

Ignoring the universal black and white stove and refrigerator is an impossibility, therefore colour and decorative schemes must be worked out from the cabinets, wall and floor coverings and ceiling. Even wood cabinets lend an atmosphere of attractiveness when used in natural grains or when painted. Walls can have any decorative treatment, since numerous wall coverings are washable, and paints offer an excellent chance to unify a particular colour scheme; steel and other tiles can be installed that contribute sparkling brilliancy. and glass is a favourite. Linoleum, vinyl, rubber and asphalt tiles are favoured floor coverings because of their resiliency and sound-deadening effect, as well as easy cleaning.

Paint the kitchen ceiling either dark or light to contrast with the walls. Lighting fixtures can be used in such flexible mays that a kitchen can be planned in terms of the best light for efficient work. Steel domes over recessed windows can contain indirect light bulbs, for example, to give reflected illumination; cabinets can light up indirectly from within when the doors are opened; and lights can be placed under shelves to prevent glare. Daylight can flow in through glass bricks, which let in more light than windows.

Trim lines. air, light and sunshine should be part of the decoration of the kitchen. A snack bar with leather-covered high stools can be set before a long window or about a counter-table partition, or one-arm lunch chairs will lend a unique note. Decorative accessories on glass shelves set in front of the light will enhance the general scheme.

Children's Rooms.—Because few people can afford to replace furniture every few years, it is sensible to buy children's furniture with an eye to the future. The pieces should be selected with emphasis on adaptability as well as charm and comfort. Cribs are available that can later be transformed into beds, while chests can be fitted together to make cabinets and desks to fit the needs of the older child.

Because the furniture is for the child's use, it should be designed and scaled proportionately. Much of the infant's and younger child's furniture is painted or enamelled in the somewhat lifeless pinks and blues, and stencils of the familiar nursery rhyme characters are found on many pieces as well as on the walls of the room. Such designs are all right if the furniture can be scraped and refinished when the child outgrows his nursery fancies. A better choice would be vivid, primary colours which, child psychologists claim, hold more interest for the very young and will later appeal also to the older child.

The needs of the child's room should not be overlooked. It must have adequate shelf space, a place for each toy; the old wooden box into which the toys were dumped in a heap is gone forever. The child's toys should be easily accessible. Furniture should be scaled to his size. There should be space enough to leave

toys where they are when the play hour is ended; there should also be plenty of table space for drawing and a sandbox for constructing model villages. etc. Action toys are of little value if there is insufficient space in which to manipulate them.

The wall colour of the child's room should be light, and decoration should not be used to the detriment of space that can be utilized for maps, bookshelves, a blackboard and cases to house small collections of shells and stones. Washable wallpapers are not only practical. but ha e decorative, charming designs as well. A small blackboard installed on one of the walls will ward off any tendency toward infant mural decoration. Linoleum, in appropriate colours and patterns, is always good for the floor in a child's room; if rugs are used, small washable throw rugs are practical.

Accessories deserve careful consideration. Vases with fresh flowers. china animals and lamps may enhance the attractiveness of the child's room, but they are hazardous and so have no place in the scheme. Wall brackets can take the place of vases, and pictures are better than china animals. A clock in the nursery is a necessity. and indirect wall lighting is more practical than lamps (which can be pulled off tables).

Bathrooms.— In the selection and arrangement of bathroom fixtures much depends upon the size and shape of the room. Where small space or unusual design makes the use of a conventional tub impractical. a receptor bath which is more or less square in shape makes an ideal installation. Developments in tubs stress low height, straight sides and large flat bottoms, all in the interest of saiety as well as structural beauty. Wide. comfortable seats on the rims on some of the tubs make them ideal for foot-bathing. Lavatory and toilet units can match the style of the tub. Some lavatories are very sleek with their slender chromium legs; others emphasize practicality with cabinet bases for storing towels or medicines. Bathroom fixtures are available in a wide range of colours and. where space permits, the installation of the small basin for oral hygiene or shaving is a great convenience.

Because bathroom fixtures can be had in various sizes and shapes. decoration is largely a matter of arrangement. In cases where one bathroom must serve an entire family, effective partitioning can be done with walls of glass blocks or tiles to separate the toilet from the rest of the room. Separate shower units with watertight walls and doors of laminated plastics, tile or glass and with a vent at the top of the door to permit steam and heat to escape are extremely practical and easily installed.

Although the bathroom has emerged from its "laboratory" garb of austere white, there is one essential item that must be retained: adequate lighting. At the lavatory or dressing-table mirror, over the tub or in the shower unit, good lighting is necessary. Manufacturers of cabinets and dressing-table mirrors have incorporated frosted tubular lighting fixtures in their units to ensure compact design and proper illumination. Of paramount importance are the electrical outlets for the bathroom; there should be a sufficient number conveniently located for using the electric razor, vibrator and other appliances.

Besides tile, linoleum and rubber composition wall coverings, there are various types of glass bricks and panels, opaque or translucent. or glass may be used in the form of large mirrored surfaces which tend to increase the apparent size of the room. Water-repellent fabrics for curtains and washable wallpapers, figured or plain. are not only beautiiul but their use is advisable in cases where the over-all cost must be kept at a minimum.

Closets.—The closet composed entirely of sections of drawers, cabinets, shelves and sliding trays is extremely practical and smart. This kind of closet is not only suited for linens but can be used for wearing apparel. The ideally lighted closet has automatic lights that go on when the door is opened and off when it is shut. In choosing backgrounds for closets, painted walls to match the colour of the room are the simplest and most durable. Sometimes, to give a smart bandbox effect, a striped wallpaper or one with small nosegays or allover pattern makes an attractive background for hangers, hat stands, boxes and dress bags in plain colours. Colours in the wallpaper design may be effectively brought out in the colour of fabric and binding used in closet accessories.

There are all sorts of bags for use in the closet: garment bags for dresses: suits or fur coats, shoe bags with a pocket for each shoe and laundry bags. Ctility boxes come in all sizes and shapes, and are made to harmonize with other accessories of the closet ensemble. Racks, too, are an important part of the closet and it is important to note whether rods and bars are placed at a proper distance from the floor. These can be had in chromium?stainless steel, brass or painted wood. Various types of tie holders are also available in metal or plastic materials.

Hatstands are a convenience and lengthen the life of the hats by decreasing cleaning and blocking bills. The stubby or short stands with a rather broad base and top are the most practical because they do not topple over when one removes a hat. Hangers are of wood, metal or plastics. sometimes covered with velvet, satin or other fabric and often scented. Size and shape of the hanger are important considerations, in order to give proper support to the garment.

Pictures.— Pictures can be valuable in securing an atmosphere of repose if they are hung in a balanced scheme and any unbalanced arrangement, restless to the eye, is avoided. The fundamental rule—hang pictures at eye level and' at a fairly uniform height around the room—still holds, for it creates an effect of order and repose. But any variation that gives a fresh and harmonious effect will still be in good taste.

The fashion for pictures hung in groups, frequently covering an entire wall. is enjoying a revival in interest. When pictures of different sizes are hung in a line, they should be hung so that the centres are all on a line regardless of the tops and bottoms of their frames. Small pictures are always grouped together, the supporting nails concealed behind the frames; larger pictures should be hung from two parallel wires when support is necessary, and not from a single wire forming a triangle above the picture.

Pictures are wall decoration; forming an architectural part of the wall, and should not be scattered aimlessly about; for this reason the only place where pictures may be placed stepwise is the stairway wall. And pictures are always hung flat, never tipping forward.

Many a good painting has been ruined by the wrong type of frame. Be certain that the frame does not attract more attention than the picture; this can be the guide for successful framing.

(H. V. A.)

INTERLAKEN, a Swiss town (1,864 ft.) in the canton of Bern. situated on the flat plain (Bodeli) between the lakes of Brienz (east) and of Thun (west). It is built on the left bank of the Aar, and grew up around the religious house of Austin canons, founded about 1130 and suppressed in 1528.

Interlaken is much frequented in summer, partly because of the glorious view of the Jungfrau (13,642 ft.) which it commands to the south, and partly because it is the best starting point for many excursions, as to Schynige Platte, Lauterbrunnen, Grindelwald, Mürren and Jungfraujoch. The lines serving these places all start from the eastern railway station (that from Thun reaches the western or main railway station), whence steamers depart for the Giessbach falls, Brienz and Meiringen, on the way to Lucerne or to the Grimsel pass. In 1950 the population of Interlaken was 4,368 (mainly Protestant and German speaking). Opposite Interlaken is Cnterseen (population 3,448), which was built in 1280 by Berthold von Eschenbach.

INTERLUDES. Early Tudor dramas, performed indoors and before a select circle by professional minstrels (lusores) or amateurs (such as Thomas More in his youth) in the pauses of some other entertainment (banquet). Interlude may also mean simply a "play between persons" (ludus inter personas), hence stage play in general. Most interludes were of a nonreligious and even farcical nature. However, in the 15th and 16th centuries some plays were called interludes which are today classed with the morality genre. Allegorical machinery such as associated with the moralities is not absent in *A* Goodly Interlude of *Nature* by Henry Medwall (*q.v.*) and in his revival of the old *débat,* Fulgens and Lucres (c. 1497). Medieval abstractions prevailed in *A* New Interlude and a Mery of the Nature of the *IIII* Elements (*c.* 1517) attributed to John Rastell (*q.v.*) and in John Redford's

Wyt and Science (ante 1548). Rastell's son-in-law, John Heywood (*q.v.*) brought the interlude genre to perfection in his "newe and very mery interludes" called *The Play* of *the Weather* and *The Foure PP (c.* 1520).

BIBLIOGRAPHY.—E. K. Chambers, *The Mediaeval Stage* (1903); *A.* **W.** Reed, *Early Tudor Drama* **(1926)**; *A.* **W.** Pollard, *English Miracle Plays, Moralities and Interludes,* 8th ed. **(1927)**; F. Boas, *An Introduction to Tudor Drama* (1933); *A.* **P.** Rossiter, *English Drama from Early Times to the Elizabethans* (1950). **(A. M. N.)**

INTERMETALLIC COMPOUNDS. The formation of intermetallic compounds cannot in general be interpreted according to the laws of ordinary chemistry; progress in the theory of the solid state and the structure of crystals, however. enables the main factors involved to be understood. During the period following the application of microscopic techniques to metallurgical problems and the application of phase-rule principles to metallic equilibrium. much research was devoted to systems consisting of two or more metals. The phase rule, which was based on thermodynamics, enabled the number of distinct phases or types of material which could coexist in such systems to be related to the temperature and pressure at which the systems were studied (see THERMODYNAMICS). It became possible to construct for these systems "equilibrium diagrams." that is, diagrams summarizing the temperature ranges and composition ranges over which various metallic phases of the systems were stable at atmospheric pressure. It was quickly realized that metals were able to dissolve in each other, not only in the liquid state but also in the solid state, particularly at high temperatures. Further. it was found that many metals formed well-defined solid compounds with each other. For example. magnesium will dissolve tin to a maximum of about 15% by weight in the solid state. Magnesium and tin also form a stable intermetallic compound, which is of substantially fixed composition and has the formula Mg_2Sn. The melting point of this compound is higher than those of either of the component metals, and its properties are very different from those of either magnesium or tin. The data available for this metallic system may be summarized in the form of the equilibrium diagram shown in fig. 1. At temperatures above the curve ABCDE. all compositions consist of a homogeneous liquid mixture of the two metals. At compositions and temperatures within the. area AFG, the system consists of a homogeneous solid solution of tin in magnesium. At temperatures and compositions within the area GFHI, however. the alloys consist of two phases—the solid solution of tin in magnesium and the compound Mg_2Sn. Similarly: alloys in the area KIJL consist of two phases—the compound and the solid solution of magnesium in tin. Only at the precise composition represented by the line CHIK do the alloys consist entirely of the intcrmetallic compound. The areas ABF and BCH represent compositions and temperatures at which the homogeneous liquid is in equilibrium with the solid solution and the compound respectively. while in areas CDI and DJE the liquid is in equilibrium with the compound and the tin-rich solid solution respectively.

Naturally the attempt was made to interpret compound formation between metals in terms of the valency conceptions of chemistry (see VALENCE). This met. however. with only partial success. Although the iormation of Mg_2Sn. for example. could be explained in terms of ionic attraction between doubly charged positive magnesium ions and tetravalent negative tin ions, other cases. such as Cu_2Mg and $CuMg_2$, defied such an interpretation. The accumulation of data with respect to intermetallic compounds showed that it is only in a comparatively limited number of cases that the laws of ordinary chemistry can be applied. In the greater number of cases. factors other than chemical bond iormation are dominant. Advances in the theory of the solid state, and particularly of the metallic state. have elucidated some of these factors. In addition, the application of X-ray crystal structure determination techniques has revealed the ways in which atoms may be arranged in solid crystals and a satisiactory classification of intermetallic compounds became possible. At the same time, theoretical work tended to emphasize that there is no sharp dividing line between the various types; the problem of fitting unlike atoms together in such a way that the assembly forms a regular three-dimensional framework in space (or space lattice) must be viewed as a whole. The stability of the arrangement will depend on a number of factors. Where these factors oppose each other. classification is difficult, and many cases of behaviour intermediate between those of the well-defined compound types are known.

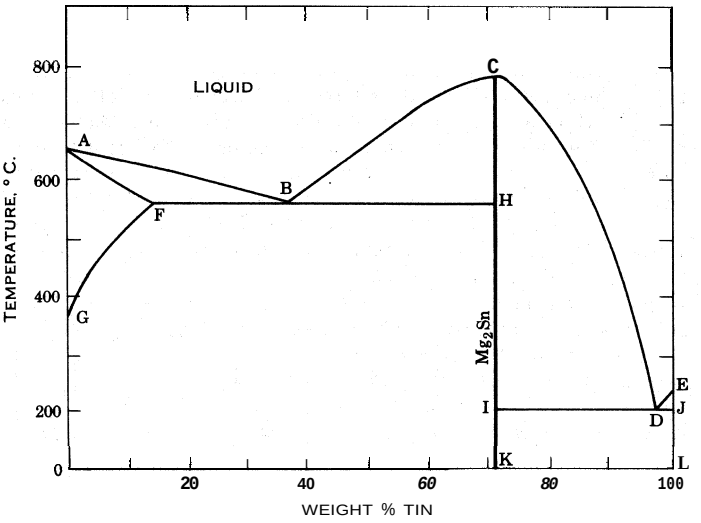


FIG. 1.— EQUILIBRIUM DIAGRAM OF THE MAGNESIUM-TIN SYSTEM

The discussion of the main types of intermetallic compounds observed may well begin with the compounds in which the normal valencies of the component metals are satisfied. These are only found when the electrochemical characteristics of the metals differ considerably. Just as the electropositive metals of the alkali and alkaline earth groups of the periodic table form stable compounds (salts) with the electronegative elements of the halogen group, they tend to form stable intermetallic compounds with the more electronegative of the metallic elements. There is a general tendency. therefore. for metals of the alkali and alkaline earth groups (*e.g.,* sodium, potassium, rubidium, beryllium, magnesium, calcium) to form stable compounds with silicon, germanium, tin and lead in the fourth group of the periodic table, and arsenic, antimony and bismuth in the fifth group. Selenium and tellurium also form the electronegative component in such compounds. In general, in compounds of this type, the normal valencies of the component metals are satisfied. A typical selection of compounds is found in the alloys of magnesium. With silicon. germanium; tin and lead, one stable compound is found in each case.

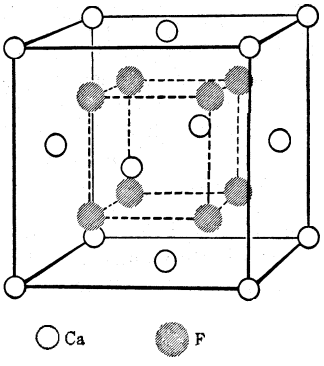


FIG 2 —FLUORSPAR STRUCTURE

Alternatively, in the case of alloys with arsenic, antimony and bismuth. the compounds Mg_3As_2, Mg_3Sb_2 and Mg_3Bi_2 are formed, while with selenium and tellurium, the compounds MgSe and MgTe occur. In each case the normal valencies of the components are satisfied. The compounds have very limited ranges of homogeneity (a reflection of the high affinity between the metals), are very brittle and tend to have high melting points. They are. if not insulators. very poor conductors of electricity. The stability decreases as the atomic number of the electronegative element increases within any one group of the periodic table. in agreement nith the usual tendency for the elements of any one group to become progressively more positive in character as the number of the period to which they belong increases. This is reflected in the progressive decrease in melting point on passing from Mg_2Si (melting point

1,102° C.) to Mg_2Pb (m.p. 553° C.), and from Mg_3Sb_2 (m.p. 1,228° C.) to Mg_3Bi_2 (m.p. 823° C.). These compounds are also characterized by high heats of formation, which are of the order of several kilocalories per gram atom. In general, the greater the stability and the heat of formation, the greater also the electropositive nature of the first metal, and the greater the electronegative nature of the elements of the fourth, fifth or sixth group of the periodic table.

It is significant that compounds of this type have crystal structures which are very closely related to those of true salts. Thus Mg_2Si, Mg_2Ge, Mg_2Sn and Mg_2Pb are anti-isomorphous with calcium fluoride, the arrangement of atoms in the structure of which is shown in fig. 2; the term "anti-isomorphous" means that the crystal structures of the compounds are such that the positive component (Mg) occupies the type of position in the framework or lattice which is occupied by the negative component in the salt. Similarly, the compounds with arsenic, antimony and bismuth are anti-isomorphous with certain of the oxides of the rare-earth elements, while MgS and MgSe and many other tellurides and selenides possess the same type of structure as sodium chloride.

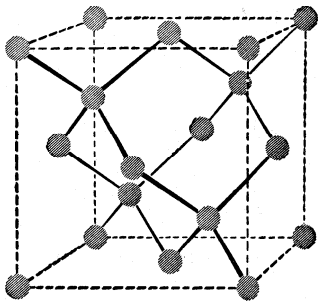


FIG. 3.—DIAMOND STRUCTURE

These compounds may thus be regarded, from one point of view, as the extension of the ordinary ionic structure into the realm of intermetallic structures where one component is electropositive and the other electronegative.

There are examples of a somewhat analogous type of compound to be found among the sulfides! selenides, tellurides and arsenides of metals such as zinc, cadmium and mercury, where the electrochemical differences are less marked than in the systems previously considered. Many of these compounds crystallize in the lattices characteristic of the two naturally occurring forms of zinc sulfide, which are both simply related to the lattice of diamond (fig. 3). Each atom in these compound structures is tetrahedrally surrounded by four atoms of the other component. Diamond takes up this structure by each carbon atom sharing one of its four valency electrons with each of four neighbouring atoms; the bonding force is covalent (electrons shared), and there are four valency electrons per atom in the structure. In the intermctallic compounds which have the zinc sulfide structures, there are again four electrons per atom, as, for example, in CdS, AlP and MgTe. It is very probable that such compounds are not essentially ionic in nature, but are held together by covalent bonds.

There is. houever, another large class of intermetallic structures which cannot be simply related to ordinary chemistry. These tend to occur in cases where the electrochemical characters of the components do not differ greatly. They often have considerable ranges of homogeneity. are metallic in their general properties and are metallic conductors of electricity. The compositions over which they are stable frequently include compositions corresponding to simple atomic ratios, but these ratios rarely bear any relation to the usually accepted valencies of the components. Thus, intermediate phases occur in the copper-tin alloys at compositions in the region of Cu_5Sn, $Cu_{31}Sn_8$ and Cu_3Sn. At first sight. there appears to be little reason why such peculiar atomic ratios represent stable structures. Systematic work on many alloy systems formed by copper, silver and gold uith elements of various valencies, however, enabled phases of this type to be classified. with striking results. In many of these systems, the primary solid solution is followed, as the concentration of the solute is increased, by a phase the structure of which is body-centred cubic (see fig. 4); the phase may be stable at room temperature or only at high temperatures. Taking copper as a typical solvent metal, and zinc, aluminum and tin as solutes of valencies 2. 3 and 4 respectively. there are body-centred cubic phases in the regions of the compositions CuZn, Cu_3Al and Cu_5Sn respectively. The common characteristic in each case is a ratio of three valency electrons to two atoms. Both the compositions of the phases and the structure they assume are therefore governed by the valency electron/atom ratio. The same principle holds for many other body-centred cubic phases in this class of alloy. In the alloys of copper and silver with elements of various valencies. homogeneous phases with a complex structure (the "y" structure) based on a deformed body-centred cube are very frequently found at a ratio of valency electrons to atoms of 21/13. Examples of this type, which tend to be brittle and silvery in colour, are Cu_5Zn_8, Cu_9Al_4 and $Cu_{31}Sn_8$. A further class, all members of which possess a close-packed hexagonal structure, tends to occur at a valency electron to atom ratio of 7/4, as. for instance, in the cases of $CuZn_3$, Cu_3Sn and Ag_5Al_3. It is of interest to note that alloys of transitional metal solvents with similar solute metals also form intermediate phases of the same type. Thus, the phases which occur close to the compositions CoAl, NiAl and FeAl are body-centred cubic in structure! while the phases Co_5Zn_{21}, Fe_5An_{21} and Ni_5Zn_{21} have the "γ" structure. It will be noted that the electron/atom ratios for these phases are the same as in the corresponding copper alloys if the transitional metal atoms are regarded as contributing no valency electrons to the structure, a behaviour which is connected with their peculiar electronic structure. This class of intermediate phase, the formation of which is governed by the number of valency electrons per atom, is usually known as the electron compound class, and occurs in the absence of any marked electrochemical difference between the components and where the atomic sizes of the components do not differ too widely. This class is of great theoretical interest, and its occurrence has been interpreted in terms of the modern electron theory of metals. Broadly speaking, the occurrence of electron compounds is caused by the tendency of a metallic structure to assume such an arrangement that the relatively free (*i.e.*, nonionic) electrons possess the lowest possible energy; this condition is satisfied at electron/atom ratios of 3/2, 21/13 and 7/4 by the body-centred cubic, "γ" and close-packed hexagonal structures respectively. As stated above, these phases frequently have considerable homogeneity ranges, unlike normal valency compounds, and the precise details of the way in which a phase of the fundamental electron/atom ratio can tolerate an excess or deficit of one kind of atom depends on subsidiary factors, such as the atomic size difference involved. It is clear, however, that, in agreement with theoretical expectations, the homogeneity ranges decrease as the valency of the solute increases.

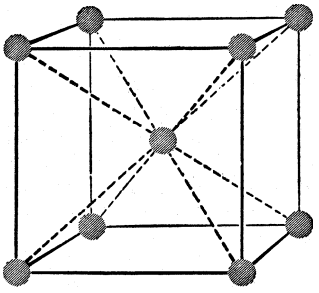


FIG. 4.— BODY-CENTRED CUBIC STRUCTURE

It is important to note that electron compounds are found in ternary alloy systems. Thus the typical "γ" structure is obtained in copper-zinc-aluminum alloys if the composition is so adjusted as to maintain the required electron/atom ratio of 21/13. A further point of interest is that, although the arrangement of the atoms on the lattice points in many electron compounds is entirely at random, in others an ordered arrangement exists. The copper-zinc β phase shows both types of behaviour. At high temperatures, the copper and zinc atoms are distributed quite at random on the lattice points, and there is no distinction between the atoms at the cube corners and the cube centre of fig. 4. At low temperatures, however, the zinc atoms occupy the cube centres and the copper atoms the cube corners (or vice versa). This behaviour depends on factors, such as atomic size, which are distinct from electronic considerations.

The two types of intermediate phases so far considered indicate that, where size and electrochemical differences are not marked, electronic factors tend to control the occurrence of compounds, while a pronounced electrochemical difference leads to the formation of normal valency compounds. Certain details of the occurrence of the electron compounds, such as the existence of ordered arrangements, show that atomic size differences must be considered as another factor which may become predominant

in certain cases. It is known. for instance. that several intermetallic compounds crystallize in the body-centred cubic structure (*e.g.*, NaTl. LiIn. LiZn) without any possibility of an electron/atom ratio of 3/2 being established. In these cases, the effect of size relationship is predominant, and the formation of a large and interesting group of phases is governed primarily by this factor. Among the most interesting are the interstitial compounds, in which it is possible to fit very small atoms into the interstices of a metal lattice. which may be deformed but is left otherwise essentially unchanged. Compounds of this type are met with in the hard. high-melting horides, carbides, nitrides and hydrides of many metals, and the skeleton of the metallic structure accounts for the metallic properties shown by many of these compounds. 4 large number are based on the face-centred cubic structure (fig. 5). Very small atoms, such as hydrogen. may he inserted into the centres of the small cubes of fig. j, so that each is surrounded by four symmetrically suited metal atoms: several hydrides possess this structure. The somewhat larger nitrogen and carbon atoms are in general too large to form stable structures of this type with most metals. Such atoms, however. can be inserted into the spaces between metal atoms which occupy the corners of the large cube in fig. 5, and are then symmetrically surrounded by six metal atoms; this type of structure is often observed in carbides and nitrides. Other types of interstitial compounds are known, but in most cases can be understood in terms of the insertion of a small atom into spaces in the metallic lattice which are large enough to accommodate them without too much strain, but not so large that the small atom would be loose in a hole too large for it. The structures are thus determined essentially by the atomic size relationships.

Analogous behaviour is often shown in cases where the atomic size difference is considerable, but not large enough for interstitial compound formation. For instance, the compounds $NaPb_3$, $CaPb_3$, $SrPb_3$, $CaTl_3$, $CaSn_3$ and $CeSn_3$ all crystallize in the structure of fig. 6. In each case the relationship between the sizes of the larger and smaller atoms is similar and the structure appears to be based on geometrical convenience — the structure of fig. 6 is a stable manner in which atoms. the sizes of which differ in a particular way, can be packed together. This clearly suggests that other structures will be found to be characteristic of different size ratios, and this is fully borne out in practice. Thus an approximately constant atomic size ratio is shown in the series of compounds Cu_2Mg, W_2Zr, KBi_2 and Au_2Bi, all of which crystallize in the same type of structure; and it may be noted, in confirmation of the principle that the relative atomic size is the main factor, that the structure of KBi_2, where the bismuth atom is the smaller, is the same as that of Au_2Bi, where the bismuth atom is the larger. The class of body-centred cubic structures quoted above (NaTl, LiIn, LiZn) are also governed primarily by size relationships. Where, in the systems XB and CD. the ratio of the atomic sizes of A and B is closely similar to that of C and D, compounds of the same general type and crystal structure may be expected. Such compounds have narrow ranges of homogeneity because of the difficulty of satisfying the geometrical conditions except at one, particular, simple atomic ratio. For the same reason, ternary cornpounds of a corresponding type are relatively scarce. Some, however, are known.

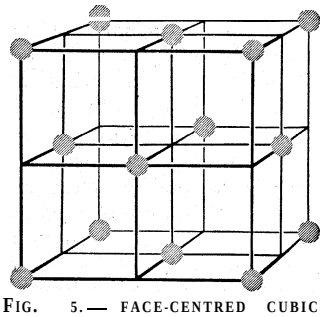


FIG. 5.— FACE-CENTRED CUBIC STRUCTURE

A particularly interesting group of compounds, in which both size and electronic factors are involved. is illustrated by certain compounds formed between magnesium and zinc. copper or nickel. Thus, in $MgZn_2$, $MgCu_2$ and $MgNi_2$ the ratio of atomic diameters lies between 1.13 and 1.1j, and in each case the smaller atoms may be regarded as situated on a close-packed lattice from which each large Mg atom has replaced two small atoms. There is a close similarity between the three lattices, which are built up from similar atomic planes arranged in a different order. As a consequence of the arrangement of planes. $MgCu_2$ has cubic symmetry, while $MgZn_2$ and $MgNi_2$ are hexagonal. the axial ratio of the latter being twice that of the former. Which of these structures is taken up depends on the number of valency electrons per atom. This is seen most clearly by considering the ternary phases which are isomorphous with these binary structures. Thus, the addition of aluminum to $MgCu_2$ increases the electron/atom ratio and leads to the appearance of a compound with the $MgZn_2$ type of structure, while the addition of silver to $MgZn_2$, which decreases the electron/atom ratio! gives a compound with the $MgCu_2$ type of lattice. These compounds form examples of a type in which the occurrence and general structure are decided by the size and number of electrons per atom.

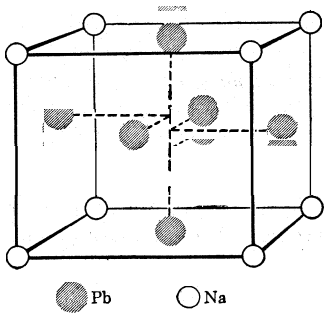


FIG. 6.—$NaPb_3$ STRUCTURE

It is possible, therefore, to interpret the formation and nature of intermetallic compounds in terms of three main factors: atomic size relationships, normal valency of components and the ratio of valency electrons to atoms. Although, in this article, only the main types which occur when one or another of these factors predominates have been considered, it will be realized that there must be cases where two or more of the factors are of equal importance. In such cases: more complex compounds may occur, but a discussion of these is beyond the scope of the present article.

Similarly, cases exist where intermetallic compounds of different characteristics crystallize in structures which are essentially the same, or vary only slightly. Thus cobalt sulfide, CoS, crystallizes in a structure in which the metal atoms may be regarded as occupying, in a regular manner, interstices in a close-packed hexagonal arrangement of nonmetal atoms.

The compound AuSn adopts the same type of structure, but with a much smaller axial ratio; it is considered that direct interactions between the gold atoms may be responsible for the difference.

The existence of intermediate types, which can be considered from different points of view, does, however, emphasize that the problem of intermetallic compounds must be considered as a whole, without too rigid an insistence on subdivision into types. The classification is a matter of convenience rather than a consequence of the existence of completely different types of compound.

BIBLIOGRAPHY.—G. Hägg, "Gesetzmassigkeiten im Kristallbau bei Hydriden, Boriden, Carbiden und Nitriden der Ubergangselemente," *Z. fur physik. Chentie (B)*, 12, **33**; **C. H.** Desch, *The Chemistry of Solids* (1934), *Metallography* (1937); U. Dehlinger, "Gitteraufbau metallischer Systeme," *Handbuch der Metallphysik*, vol. i (1935); Robert Crispin Evans, *Crystal Chemistry* (1939); *W*. Hume-Rothery and G. V. Raynor, *The Structure of Metals and Alloys*, Institute of Metals "Monographs and Reports Series," no. 1, 3rd ed. (1954).

(G. V. R.)

INTERMEZZO. An interlude or entr'acte of a light and pleasing character serving as a contrast between the acts of a more serious drama or tragedy, and, in its developed form, continuing as an independent piece in this manner throughout the whole work, two entirely independent works, one serious and one light, being thus presented in alternate instalments. Giovanni Battista Pergolesi's famous La *serva padrona* mas such an intermezzo as originally produced. Nowadays the term is more generally applied to a short piece introduced between the larger movements of a symphony or sonata or to an independent short composition.

INTERNAL-COMBUSTION ENGINES. In an internal-combustion engine a fuel-air mixture is burned in such manner that the hot gaseous products of combustion exert a force on moving parts of the machine, thereby doing useful work and generating power. These engines comprise one group of what are known as heat engines, so named because they derive their power either

directly or indirectly from a thermal-energy-releasing reaction, such as combustion.

In the internal-combustion engine the products of combustion act directly on pistons or turbine rotor blades, whereas the external-combustion engine employs a secondary working fluid that is interposed between the combustion chamber and the power-producing elements. All heat engines other than the internal-conibustion engine are similar in principle to the steam engine and boiler combination in that the fuel with which they operate is burned in a furnace that is external to the engine; a portion of the energy liberated by combustion is transferred through boiler or heat-exchanger walls to a secondary working fluid, such as water; and the liquid is converted into steam under a high pressure that is created by the expansion accompanying vaporization. The steam is then conveyed through pipes to an engine or turbine in which the pressure of the steam acts upon pistons or turbine runners whose motion causes a shaft to rotate and produce power.

The fundamental principle of the steam engine is to produce a high-pressure working medium by utilizing the expansion accompanying the vaporization of a liquid; the internal-combustion engine utilizes the large volume of high-temperature combustion products which, when confined, become a high-pressure gaseous medium.

History. — Attempts to devise engines of various types were made in pre-Christian times. The steam engine. however. became the first successful power plant when James Watt carried the ideas of earlier experimenters to a satisfactory degree of practicability during the 18th century. The internal-combustidn engine followed as an improvement over the steam engine.

Unlike many products of the mechanical age, the internal-combustion engine cannot be attributed to any one inventor. The piston, for example, is thought to have originated about 150 B.C., and mas used by metalworkers in pumps for blowing air. The problem of preventing leakage between the piston and cylinder wall led Watt to employ rope yarn impregnated with mutton tallow as a packing in 1764. Brass sealing rings were fitted to steam-engine pistons in Scotland several years later. thus originating the metal piston rings with which internal-combustion engine pistons have aln-ays been equipped.

The internal-combustion engine of the mid-20th century was the outgrowth of more than 100 years of study and experiment. It was made possible by a gradual accumulation of knowledge of thermodynamic principles. mechanical skill! availability of materials and experience. The development was inspired by an early recognition of the inherent disadvantages of steam power plants, their low thermal efficiency, great weight and bulk and inconvenience of operation, all of which defects are largely traceable to burning the fuel in a furnace separate from the engine. The greater desirability of a self-contained power unit was evident. A remarkable development resulted from the application of engines to automobiles and aeroplanes. (This development is even more remarkable in that the gasoline engine is inherently poorly suited for vehicle propulsion and must have intricate clutch and transmission devices to adapt it to this application. The steam engine can be started under full load, but the internal-combustion must be set in motion by a cranking device before any load can be applied to it, and its performance is greatly affected by the speed at which it runs.)

The events leading to the development of a practical internal-combustion engine probably start with the attempt of the Abbé Jean de Hautefeuille in 1677 to pump water to a higher level by the combustion of gunpowder in direct contact with the water. The vacuum formed by cooling the hot gaseous products of combustion was used to lift the water. Christian Huygens in 1680 and Denis Papin in 1690 experimented unsuccessfully with similar devices. Robert Street obtained a patent in England in 1794 describing an internal-combustion engine employing a piston and a system of levers. In 1801 Lebon proposed in France that the charge be compressed before burning. but he did not build an engine. W. Cecil experimented in England with an engine operated by exploding hydrogen-air mixtures and employing the vacuum acting on a piston as the products of combustion were cooled. Tests of this engine as reported in 1820 provide the first record of operation of a gas engine.

Actual production and sale of the gas engine began in 1823 when Samuel Brown started to build a vacuum-type gas-burning engine. The role of Brown in the development of the internal-combustion engine was similar to that of Newcomen in the steam-engine field. Their engines were heavy and crude but contained many of the essential elements of later more successful engines.

The most competent early study of the thermodynamic aspects of the internal-combustion engine was that of Sadi Carnot in France. He published a pamphlet in 1824 in which he outlined not only the fundamental internal-combustion engine theory. but even that of the diesel engine. Although he did not experiment with actual engines, his *Reflections on the Motive Power of Heat* undoubtedly influenced the thinking of many other experimenters.

One of the first engines to use pressure resulting from combustion rather than vacuum from cooling of the products was built by W. L. Wright in 1833. The first engine in which the charge mas compressed before burning was built by William Barnett in 1838 and he was granted a patent which included this idea. He also built an engine of the two-stroke-cycle type with an external charging pump, an arrangement that was adopted many years later for diesel engines. By a two-stroke cycle is meant that the cycle necessary to operate the engine is completed in one up- and one downstroke of the piston or one turn of the crankshaft, in contrast with the four-stroke cycle that requires two full turns of the crankshaft. All machines have operating cycles consisting of a series of events which, when repeated over and over again, periodically return all of their parts to their exact original condition.

Barnett also devised an ingenious igniting cock that provided a pilot flame for igniting the charge and a relighter to rekindle the pilot light after it was extinguished when the oxygen in the cylinder was consumed in burning the charge. This method of ignition was applied to many engines before electrical ignition was developed. Another method of ignition, the hot plug, was introduced by Alfred Drake in 1843.

Until 1860 most of the contributions made were in the form of ideas. Few engines mere built, and not many of those ever ran; but practical difficulties were gradually overcome and production facilities improved until it was possible to combine the various accomplishments into a practical engine. In 1860 J. J. E. Lenoir, a Frenchman, placed an engine on the market that gave reasonably satisfactory service operating on illuminating gas. There was nothing new or original in the Lenoir engine; in fact it was essentially a converted double-acting steam engine with slide valves to admit gas and air and to discharge exhaust products. It operated on a two-stroke cycle and, although it developed very little power and utilized only about 4% of the energy in the gas, several hundred were sold over a period of years.

In 1861 G. Schmidt proposed that the fresh charge be compressed by pumps to a pressure of three atmospheres before introduction to the engine cylinder. He stated that this would lead to a great expansion of the products of combustion and permit a greater transformation of heat energy. Schmidt was, therefore, one of the early proponents of the theory that compression should precede combustion. although his method of accomplishing the increase in pressure pointed toward the idea of supercharge rather than to the compression-type cycle.

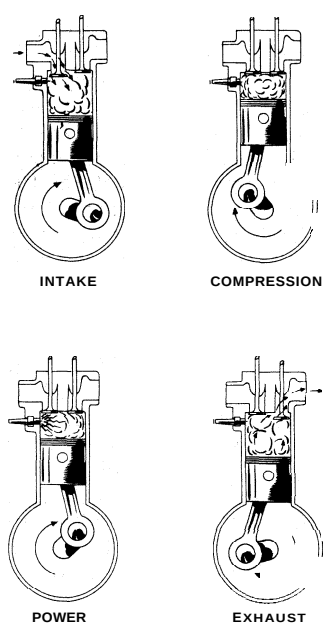
The operating cycle of the modern automobile engine originated with Alphonse Beau de Rochas, who published his theory in Paris in 1862. He first stated the conditions necessary for maximum economy as: (1) maximum cylinder volume with a minimum cooling surface; (2) maximum rapidity of expansion; (3) maximum ratio of expansion; and (4) maximum pressure of the ignited charge. He then described the sequence of operations whereby this maximum economy could be attained as: (1) suction during an entire outstroke of the piston; (2) compression during the following instroke; (3) ignition of the charge at dead centre and expansion during the next outstroke (the power stroke); and (4) forcing out the burned gases during the next instroke.

Although he did no practical experimental work and never built an engine, Beau de Rochas's statement of factors affecting

economy and performance appears as one of the most significant steps in the development of the internal-combustion engine. The four-stroke cycle that he described is the same as that used in modern automobile engines. Because his work mas entirely theoretical. Beau de Rochas has not been given the credit for originating the basic principle of the four-stroke-cycle engine; the name of Nikolaus Otto is commonly associated with that achievement.

The firm of Otto and Langen started production of a free-piston engine in Deutz, Ger.. in 1867. Engines of this type had previously been built by Barsanti and Matteucci, but the Otto and Langen engine was superior in mechanical design and workmanship. It employed a vertical cylinder. open at the top and fitted with a heavy piston, below which the combustion chamber was formed. The gas and air charge mas drawn into the cylinder during the first half of the upstroke. The charge was then ignited electrically and the piston lifted by the explosion. The velocity attained by the piston and the fact that upward motion mas opposed only by friction caused the piston to continue its upward travel after the pressure on its underside had been reduced to a partial vacuum. Atmospheric pressure acting on the top of the piston. the vacuum underneath and the weight of the piston caused it to descend immediately. The motion of the piston was transmitted to the engine shaft and heavy flywheel by a toothed rack extending downward and meshing the teeth of a gear on the shaft. This gear turned freely on the shaft during the upward piston stroke, but a free-wheeling clutch engaged on the downward stroke and applied a turning effort to the shaft. The engine was very noisy, of small power capacity, and the rack-and-pinion mechanism unsound mechanically. but it consumed less than half as much fuel per unit of power produced as did the Lenoir engine and succeeded commercially because of this greater economy.

In 1876 Otto and Langen applied the Beau de Rochas principle in the design of a new engine that became known as the Otto silent engine. This was the first four-stroke-cycle engine employing compression and operating on the basic principle of the modern automobile engine. In spite of its great weight and low economy by modern standards, nearly 50,000 engines with a capacity of about 200,000 h.p. were reportedly sold in 17 years. Its immediate success led to the rapid development of a wide variety of engines of the same basic type. Manufacture of the Otto engine in the United States began in 1878, following the granting of a U.S. patent to Otto in 1877.



BY COURTESY OF GENERAL MOTORS CORP

FIG. 1 — THE STROKES OF THE FOUR-STROKE CYCLE

The four-stroke-cycle principle. as introduced by Otto and followed by a majority of the internal-combustion engines built since, is illustrated in fig. 1. The piston first descends on the intake stroke, during which the inlet valve is held open by the valve mechanism. The valves shown in the figure are of the commonly used poppet or mushroom type. The fresh charge is inducted into the cylinder by the partial vacuum created in the cylinder by the descent of the piston. The piston then ascends on the compression stroke with both valves closed and forces the charge into the smaller space of the combustion chamber where it is ignited by an electric spark as the end of the stroke is approached. The power stroke follows with both valves still closed and gas pressure acting on the piston crown because of the expansion of the burned charge. The exhaust stroke then completes the cycle with the ascending piston forcing the spent products of combustion past the exhaust valve that is now held open by the valve train. The cycle then starts to repeat itself with the closure of the exhaust valve, opening of the inlet valve and descent of the piston. The cycle thus requires four strokes of the piston — intake, compression, power and exhaust — and two revolutions of the crankshaft for its completion.

The disadvantage of the four-stroke cycle is that only half as many power strokes are completed as in the two-stroke cycle and only half as much power would be expected from an engine of a given size at a given operating speed. The four-stroke cycle, however, provides more positive scavenging and charging of the cylinders with less loss of fresh charge to the exhaust.

Although the two-stroke cycle was employed by all of the early noncompression engine builders, its application to the compression-type engine by a modification of the Beau de Rochas theory did not come until 1878, when Sir Dugald Clerk of Scotland produced his engine. The Clerk engine employed a second cylinder and piston connected to the power cylinder and crankshaft of the engine. This cylinder acted as a pump to precompress the air charge sufficiently to force it into the power cylinder and to drive the products of combustion of the previous charge from the cylinder through exhaust ports in the cylinder wall, so located that they were uncovered by the descending piston as it approached the end of the power stroke. The crank for the compressor piston led the power crank by 90° and began to build up air pressure at about the same time that the exhaust ports were uncovered and exhaust gases allowed to escape from the cylinder. Air transfer from the compressor cylinder through an automatic. spring-closed inlet valve in the power-cylinder head started immediately after the exhaust flow started. and the replacement of the spent products of combustion by the next fresh air charge was completed when the compressor piston ended its delivery stroke shortly after the exhaust ports were covered by the piston rising on its compression stroke in the power cylinder. Compression was followed by ignition and the expansion or power stroke. The compression and power strokes of the four-stroke cycle were thus unchanged, but a transfer process at the end of the power stroke and the beginning of the compression stroke replaced the inlet and exhaust or pumping strokes of the Beau de Rochas cycle. Every outstroke of the power piston was a working stroke in this engine and there was a power impulse in every turn of the crankshaft. If the scavenging and recharging had not been less effective than the pumping strokes of the four-stroke cycle, the engine would have developed twice the power of a four-stroke engine of similar size and speed.

The two-stroke principle was further simplified by Joseph Day, who produced an engine in 1891 employing the underside of the power piston and an enclosed crankcase as an air compressor, replacing the separate pumping cylinder for supplying charge to the engine. This type is illustrated in fig. 2. The crankcase is completely enclosed except for a passage leading to transfer or inlet ports in the cylinder wall and an automatic inlet valve permitting inward flow from the carburettor but preventing return flow from the crankcase.

During the compression stroke the ascending piston creates a partial vacuum in the crankcase which enables outside atmospheric pressure to force a fresh charge of fuel and air in through the carburettor. The charge trapped in the crankcase by the closure of the automatic inlet valve is compressed slightly by the downward movement of the piston on its power stroke. As the piston approaches the end of the stroke, the exhaust ports are first uncovered, permitting the spent products of combustion to start to leave the cylinder. Later the inlet ports communicating with the crankcase are uncovered, thus admitting the compressed fresh charge into the cylinder. A deflector on the piston crown directs the entering charge upward to minimize the possibility of its escaping from the cylinder by mingling with the exhaust gases and to cause it to sweep these gases toward the exhaust ports on the opposite side of the cylinder. The incoming charge thus scavenges the cylinder by pushing the spent products from the previous cycle ahead of it as it flows upward from the crankcase. The rising piston recovers the cylinder-wall ports and then compresses the charge into the combustion chamber, where it is ignited by the spark plug in the cylinder head. The piston moves downward under the force of the expanding products of combustion and a power

stroke is executed. The two strokes of the working cycle are compression (which is accompanied by induction of the next fresh charge into the crankcase) and the power stroke, during which the next charge is precompressed in the crankcase. The transfer of fresh charge from the crankcase to the cylinder is divided equally between the last portion of the power stroke and the initial part of the compression stroke. This modification of the Clerk engine became very popular and for many years mas the simplest and least expensive type of engine available. Later the blower-scavenged two-stroke engine superseded the crankcase-compression type in practically all fields of application except outboard marine engines and other very small portable types that still use crankcase compression for simplicity.

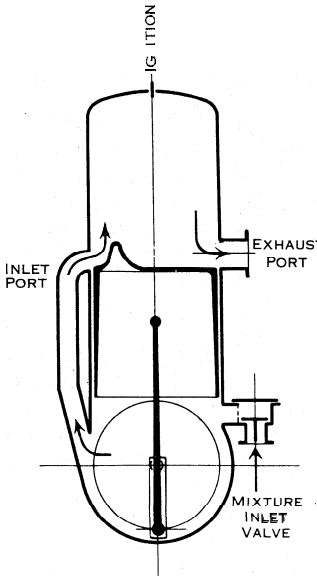
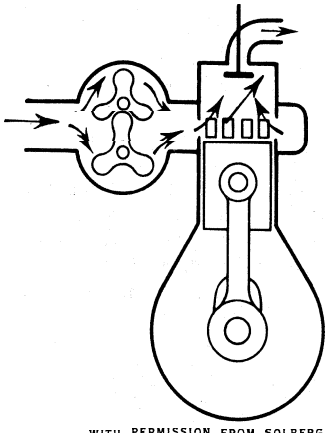


FIG. 2.— TWO-STROKE-CYCLE INTERNAL-COMBUSTION ENGINE WITH CRANKCASE COMPRESSION

Fig. 3 illustrates diagrammatically the modern two-stroke-cycle engine of the uniflow type, wherein the fresh charge is forced into the cylinder through circumferential ports by a positive-displacement rotary blower of the Roots type. The exhaust gases leave the cylinder through poppet valves in the cylinder head. thus eliminating the return flow of the previously described two-port type and reducing the loss of fresh charge by short circuiting to the exhaust outlet. The cycle of this engine differs from that of the simpler type only in the method of placing the fresh charge under pressure to cause its flow into the cylinder. All modern two-stroke diesel engines employ blowers of some type, but with a variety of port and valve combinations.

Carburettor engines operating on the two-stroke cycle lack the fuel economy of the four-stroke engines because some of the fuel escapes with the exhaust gases and does not remain in the cylinder to be used. This loss can be avoided in two-stroke spark-ignition engines only by equipping them with fuel-injection systems instead of carburettors and injecting the fuel directly into the cylinders after scavenging is completed. Such an arrangement is attractive as a means of attaining high power output from a relatively small engine. Development of the turbocharger for this application held promise of further improvement.



WITH PERMISSION FROM SOLBERG, CROMER AND SPALDING, "ELEMENTARY HEAT POWER," 1952, JOHN WILEY & SONS, INC.

OF BLOWER-SCAVENGED TWO-STROKE-CYCLE ENGINE WITH UNIFLOW SCAVENGING

Ignition of the charge by the high temperature attained by very high compression, hinted at by Carnot in 1823, became a practical reality in 1897 after five years of effort by Rudolf Diesel and his associates. An original attempt to use pulverized coal as fuel was abandoned and the diesel engine, as finally developed, burned nonvolatile liquid fuels such as kerosene and heavier paraffin fuels. The diesel engine differs from spark-ignition engines in that air alone is inducted into the cylinders, compressed to such an extent that a temperature exceeding the ignition requirement of the fuel is attained. and the fuel is injected into the combustion chamber where it self-ignites and burns. The carburettor and ignition system are eliminated, and improved economy results from the use of lower-grade fuels at higher compression ratios than are attainable with spark ignition.

The **Gas** Turbine. — Continuous rotation is concededly superior to reciprocating motion in mechanical devices. and the imperfections of the reciprocating-piston-type engine are largely traceable to the noncontinuous motion of many of its parts and the cyclic interruption of combustion. The fundamental principle of the gas turbine was known before that of any other type of heat engine, historians having recorded that a toy gas turbine was built by Heron of Alexandria, Egy., in 130 B.C. Nevertheless, practical development of the gas turbine did not take place until the 20th century. John Barber had been granted a patent in 1791 on a gas turbine that was essentially similar to modern types: F. Stolze designed a unit in 1872 that comprised a multistage axial compressor and reaction turbine, devices used in modern gas-turbine plants.

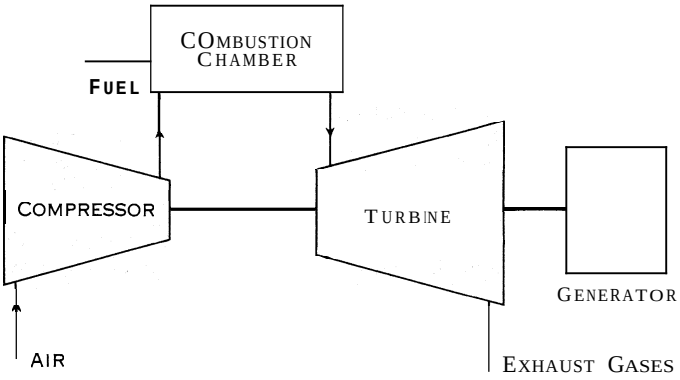


FIG. 4.— DIAGRAM OF SIMPLE GAS-TURBINE POWER PLANT

Various patents were granted during the late 19th and early 20th centuries, but no record exists of a gas turbine operating until 1902 when Sanford A. Moss converted a De Laval steam turbine during his graduate studies at Cornell university, Ithaca, N.Y. Although his turbine actually ran, it did not develop enough power to drive the air compressor which supplied the air for combustion. The large power requirement of the air compressor was to remain a problem in the development of the gas turbine.

The gas turbine is a simple power plant. An air compressor supplies air at about three to six times atmospheric pressure to a combustion chamber in which the fuel is sprayed into the air and continuous combustion maintained. The resulting large volume of high-temperature gaseous products then expands through the turbine unit to atmospheric pressure. The compressor and turbine rotors may be on the same shaft. The excess of power developed in the turbine unit over that required to turn the compressor rotor (somewhat less than half of the turbine output) is delivered to a generator. propeller or other load. The gas-turbine power plant is shown diagrammatically in fig. 4.

Continuous efforts have been made since the start of the 20th century to eliminate certain practical defects in the gas turbine. The most important barrier was the unavailability of materials to withstand the high temperatures that result if the cycle is carried out in the optimum manner dictated by theoretical considerations. Fuel and air mixtures in proportions approaching the chemical requirements of the fuel, such as are used in reciprocating-piston engines, result in combustion temperatures on the order of 4,000° F. These temperatures can be tolerated by the metal parts of the piston engine because they are maintained for only a tiny fraction of a second and the remainder of the cycle is at relatively low temperatures. Combustion in the gas turbine is continuous and the combustor walls, connecting passages and turbine blades are continuously exposed to the peak temperature of the cycle. Common practice is to supply large excesses of air so that the temperature attained by the diluted products of combustion does not exceed about 1,500° F. Efficiency is reduced in two ways by this practice: the cyclic efficiency, which is dependent upon the peak temperature attained, is lower; and the power consumed by the compressor in supplying the larger than theoretically needed amount of air is increased.

Improved compressor design increased the efficiency at which the air is supplied to the combustor, and improved metallurgy greatly increased the allowable temperature at which turbine blades and other parts may operate. Further improvements in charging efficiency may be made by multistaging the compressor and by using intercoolers between stages. 'Improvement in energy utilization may also be effected by placing a heat exchanger in the turbine exhaust line that will transfer heat from the exhaust gases to the air as it enters the combustor. This process, a feeding back of leftover energy through the system, is called regeneration. By the second half of the 20th century, it appeared to offer the greatest promise of improvement in gas-turbine economy. A further practical problem arises from the fact that, for high capacity and efficiency, the rotative speed of the turbine runner should be extremely high. on the order of 25,000 to 30.000 r.p.m. The cost and noise of gears to harness the turbine to its load at such speeds necessitates a compromise with performance by reducing runner speed. Fuel economy attained with the gas turbine is poor by comparison with that of the piston engine, but some of the more restrictive fuel specifications are eliminated. The application of the gas turbine to jet-propelled aeroplanes is a favourable one because the considerable energy in the large mass of high-temperature exhaust gases forms the propelling jet and is not wasted as it is in the simple gas turbine.

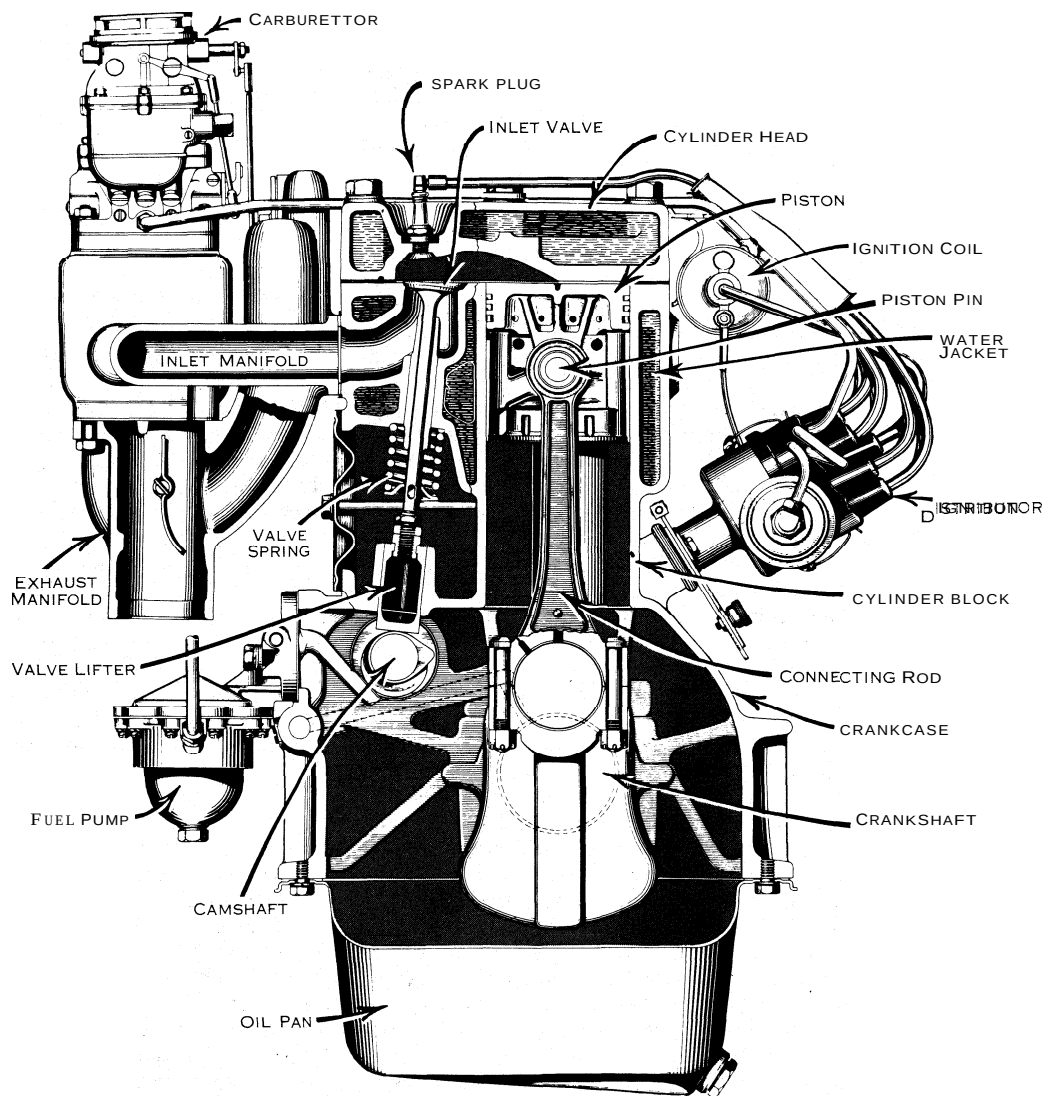
Engine Types.—A wide variety of internal-combustion engines resulted from the requirements of the extensive range of possible applications. Although these various engines differ radically in size. weight per unit of power developed, arrangement of components and details of operation! they are basically similar. The only exception is the gas turbine, which is fundamentally diiferent from the reciprocating-piston engine. The only clearly defined separation into groups having similar design and operating characteristics is consequently the classification as reciprocating-piston types and gas turbines. Classification of reciprocating engines into sharply defined groups is difficult because of overlapping of characteristics.

The greatest differences between engines are those that adapt them to various applications; *i.e.*, automotive: aviation, marine and stationary. with a wide range of special types included within each. Of these. the automotive is most important because of the number of engines in use and the total power developed. This group includes all engines used to propel land vehicles ranging from passenger automobiles to railway locomotives, with intermediate truck, tractor and bus types.

Perhaps the most striking of the differences that arise between two types of engines because of their intended applications are those that distinguish the locomotive diesel from the aeroplane engine. The most widely used locomotive diesel engine is a 16-cylinder vee-type engine weighing approximately 31,000 lb. and having a rating of 1,500 h.p. One of the best of the World War II aeroplane engines was also a 1,500-h.p. unit, a 12-cylinder, vee-type engine weighing about 1,200 lb. The locomotive engine is two and one-half times as long as the aeroplane engine and weighs more than 25 times as much—a contrast that seems to indicate inefficiency in the locomotive engine. Such, honever, is not the case. Both engines are of excellent design. The locomotive engine is a heavy-duty type designed for millions of miles of operation, much of the time at full throttle, and its crankshaft turns at less than one-third the speed of the aeroplane engine shaft, whereas the military aviation engine is designed for high specific output with a useful life of perhaps 700 hours. Both are used for transportation, but in widely differing vehicles.

The stationary power plant engine is usually even heavier than the locomotive type of the same cylinder dimensions and develops less power per unit of size and weight because of its durability and very low crankshaft speed. Intermediate between these two extreme types, aviation and stationary. are motor-vehicle engines of a wide variety, some of which are designed to operate at very high crankshaft speeds in order to reduce their size, cost and weight. It is evident that the important apparent differences between engines are largely traceable to the use for which they are intended.

Differences in operation of engines also permit grouping together certain types that have functional similarities. The most important differences result from: (1) whether the operating cycle is



REPRINTED WITH PERMISSION FROM SOLBERG, CROMER AND SPALDING, "ELEMENTARY HEAT POWER," 1952, JOHN WILEY & SONS, INC.

FIG. 5.—CROSS SECTION OF L-HEAD AUTOMOBILE ENGINE

completed in two or four strokes of the piston; (2) whether the charge is ignited by an electric spark or by compression temperature; and (3) whether the fuel burned is gas. gasoline or fuel oil. Such differences are also superimposed on those that adapt the engines to their intended use. thereby multiplying the specification items necessary to define each type. For example. a stationary power plant engine may be a diesel or compression-ignition type, operating on the two-stroke cycle, and burning a heavy fuel oil. or it might be a spark-ignition engine. burning natural gas on the four-stroke cycle. When viewed from even a short distance, these two engines appear to be very much alike because of the predominant effect of both being stationary power plant engines, but close examination reveals important mechanical and functional differences.

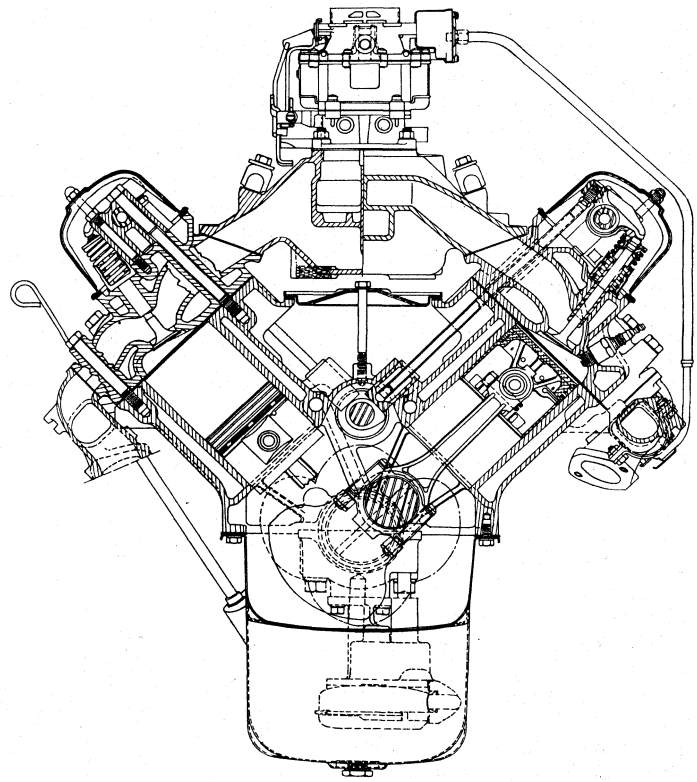
Engine Structure.— The following description of general engine construction is intended to indicate the essential components of an engine and to introduce and clarify the nomenclature of the various parts. The four-stroke-cycle automobile engine is used as the basic type. Fig. 5 shows a cross section of a typical cylinders-in-line automobile engine with the important parts indicated

The main structural member of all automotive-type engines is the cylinder block, which usually extends upward from the centre line of the bearings that support the crankshaft to the junction with the cylinder heads The block serves as the structural framework of the engine and carries the mounting pads by which the engine is supported in the chassis. Large stationary power plant engines and marine engines are built up from a foundation or bedplate and have upper and lower crankcases that are separate from the cylinder assemblies. The cylinder block of the automobile engine is an alloy-iron casting with appropriate machined surfaces and threaded holes for attaching the cylinder head, main bearings, oil pan and other units. The crankcase is formed by the portion of the cylinder block below the cylinder bores and the stamped metal oil pan that forms the lower enclosure of the engine and also serves as the lubricating oil reservoir or sump.

The cylinders are openings of circular cross section that extend through the upper portion of the block with interior walls bored and honed to form smooth, accurate bearing surfaces. The cylinders of heavy-duty engines are usually fitted with removable cylinder liners made of metals more wear-resistant than that used in the block casting Two arrangements of cylinders are in common automotive use—the vertical or in-line type and the vee type. The in-line engine has a single row of cylinders extending vertically upward from the crankcase and aligned with the crankshaft main bearings. The vee type has two rows of cylinders, usually forming an angle of 60° or 90° between the two banks. V-8 engines are usually of the 90° type. Fig. 6 shows a cross-sectional view of an automobile engine of the high-speed valve-in-head V-8 type. Large stationary-, marine- and locomotive-type engines with 12 cylinders commonly have 60° vees because of their firing interval, whereas 16-cyiinder engines similarly have their cylinder banks at 45°. The conventional angle between the planes of the cylinder banks is 360° divided by half the total number of cylinders.

A passage is bored lengthwise of the engine for the camshaft which operates the valves. and a gear or chain compartment for the camshaft drive from the crankshaft is formed between the front or rear extremity of the block and a cover plate. A so-called bell housing is formed at the rear of the cylinder block to enclose the flywheel and provide for attachment of a transmission housing. Water jackets are formed around the cylinders with suitable cored connecting passages for circulation of the coolant.

The design of the cylinder block is affected by the location of the valves of the four-stroke-cycle engine and by the provision of cylinder ports in the two-stroke-cycle type, The overhead-valve engine that largely replaced the L-head type has its valves entirely in the cylinder head. and no portion of the valve system is carried in the cylinder block except the camshaft and the cam followers or valve lifters that bear against the cams. The cylinder block of the L-head engine is extended to one side of the cylinder bores, as shown in fig. j, with the valve seats and passages for inlet and exhaust, together with the valve guides, formed in this extension of the block. The cylinder head then becomes merely a water-jacketed cover, providing threaded locations for the spark plugs and with its underside so profiled that a combustion chamber of the desired size and shape is formed above each cylinder bore. The depth of the combustion chamber in the L-head engine is increased above the valves and the space is thinned out above the piston at the side opposite the valves to permit control of combustion of the last portion of the charge to burn. The shape of the



BY COURTESY OF STUDEBAKER-PACKARD CORP.

FIG. 6.— TRANSVERSE SECTION OF A V-8 ENGINE

space forming the combustion chamber when the piston is at its closest approach to the cylinder head and the volume contained therein in relation to the piston displacement volume of the cylinder are extremely important in their effects upon the performance of the engine (Theoretical considerations influencing combustion-chamber design are discussed later.) The cylinder head of the valve-in-head engine is narrower and deeper. and carries the valve seats, valve guides and valve ports.

The size of the combustion chamber relative to the volume displaced by the piston establishes the compression ratio of the engine. The piston displacement of a cylinder is the volume swept by the piston during one stroke and is equal to the cross-sectional area of the cylinder multiplied by the length of the piston stroke. The larger volume above the piston at the lowest point in its stroke divided by the combustion-chamber volume when the piston is at its upper extremity of travel is called the compression ratio of the engine. The larger volume is the sum of the piston-displacement volume and the combustion-chamber volume. The compression ratio may thus be expressed as the ratio of the sum of the piston-displacement volume and the combustion-chamber volume to the combustion-chamber volume. This ratio establishes the fraction of the original volume of the charge as inducted that the charge occupies at the end of the compression stroke and also the resulting compression pressure. Compression ratio will be shown later to be the most important factor affecting the theoretical efficiency of the engine cycle. Because increased compression ratio has long been recognized as the most basic way to improve efficiency, the development of the automobile engine has followed a steady trend toward higher compression ratios.

The pistons are cup-shaped cylindrical castings of iron or aluminum alloy. The upper, closed end, called the crown, forms the lower surface of the combustion chamber and receives the force

applied by the combustion gases. The outer surface is machined to fit the cylinder bore closely and is grooved to receive several piston rings that are provided to seal the gap between the piston and the cylinder wall. The rings are larger in diameter than the cylinders and gaps are provided so that they can be compressed into the cylinder bore. The rings in the upper piston grooves are plain compression rings that prevent the combustion gases from blowing past the piston. The lower rings are vented oil rings that distribute and limit the amount of lubricant on the cylinder wall. Piston pin bosses are cast in opposite sides of the pistons and hardened steel pins fitted into these bosses pass through the upper ends of the connecting rods. The piston pins are frequently clamped in the eyes of the connecting rods although floating pins (prevented by spring clips from contacting the cylinder malls) are used by some manufacturers.

A forged steel connecting rod of I section connects the piston to the throw of the crankshaft and converts the reciprocating motion of the piston to the rotating motion of the crank. The loner. larger end of the rod is bored to take a precision bearing insert that is lined with babbitt or other bearing metal and closely fitted to the crankpin. Vee-type engines usually have opposite cylinders staggered sufficiently to permit the two conriecting rods that operate on each crank throw to be side by side. Some larger engines employ fork-and-blade rods with the rods in the same plane and cylinders exactly opposite each other

The crankshaft functions with the connecting rods in converting the up-and-down motion of the pistons to a rotary motion. Each connecting rod in an in-line engine or each pair of rods in a vee-type engine is attached to an offset portion of the crankshaft called a throm. Each throw consists of a crankpin with a bearing surface. on which the connecting rod bearing insert is fitted. and tno radial cheeks that connect it to the main journals that turn in the main bearings that are supported by the cylinder block. Sufficient throns are provided to serve all the cylinders, and the angles between them equal the angular firing intervals between the cylinders The throws of a six-cylinder. four-stroke-cycle crankshaft are thus spaced 120° apart; those of an eight-cylinder engine are go° apart because half of the cylinders fire in each turn of the crankshaft. The location of each throw in the various radial directions along the shaft depends upon the firing order of the cylinders. Firing sequence is chosen to distribute the power impulses along the length of the engine to minimize vibration. Consideration is also given to the fluid flow pattern in the manifolds. The standard firing order for a six-cylinder engine is 1–5–3–6–2–4, which illustrates the practice of alternating successive impulses between the front and rear halves of the engine whenever possible. Balancing is further improved by adding counterweights to the crankshaft to offset the eccentric masses of metal in the crank throws and thus neutralize centrifugal forces.

The crankshaft design also establishes the piston stroke because the radial offset of each throw is equal to half the stroke imparted to the piston. The ratio of the piston stroke to the cylinder bore diameter is an important design consideration. No logical basis for the establishment of this ratio existed in the early years of engine development, and a range from unity to one and one-half was used by the different manufacturers. As engine speeds increased, however, and it became apparent that friction horsepower increased with piston speed rather than nith crankshaft rotating speed a trend toward short-stroke engines started. Strokes were shortened to as much as 20% less than the bores.

Other advantages are gained by short strokes, such as providing more cylinder-head surface for valves in proportion to piston displacement and decreasing the height of the engine. Engines with lon stroke-bore ratios have showed slightly greater horsepower, principally because of reduced friction losses.

Cylinder Charging — All internal-combustion engines function by converting heat released by burning a fuel into mechanical energy or power. Certain processes must be carried out to make possible this conversion of chemical energy into power. The first is the introduction of the combustible charge to the cylinder. One hundred or more cubic feet of air must be pumped into an engine per hour for each horsepower developed in order to supply the oxygen needed for combustion. The engine must first function as an air pump as the first step in its operation. Cylinder charging includes ridding the cylinder of the spent products of combustion of the previous cycle to make room for the next charge. This is done by direct pumping on the exhaust stroke of the four-stroke-cycle engine and by pushing out the exhaust gases ahead of the fresh-air charge pumped in by the scavenging pump or blower of the two-stroke-cycle engine.

The pumping mechanism of the four-stroke engine consists of an exhaust valve that is held open during the upward stroke of the piston that follows the power stroke and an inlet valve that is held open during the next downstroke. The intake and exhaust valves remain open for longer periods than the corresponding piston strokes in order to provide time for opening and closing the valves. and to utilize the inertia effects of the high velocity at which the gases flow The opening and closing points of both valves are therefore displaced somewhat from the dead centre points at which they theoretically would occur.

The exhaust valve is timed to open at approximately 50° before the piston reaches its bottom dead centre on the power stroke. This occurs well before the power stroke is completed in order to provide a blow-doan period to release the gases from the cylinder and reduce the pressure approximately to exhaust-manifold pressure by the end of the power stroke. Some useful work near the end of the power stroke is lost by this early valve opening. but a greater amount of negative work during the exhaust stroke is avoided by not requiring the piston to ascend against back pressure.

The exhaust valve remains open about 15° after top dead centre. thus allowing the kinetic energy of the outflowing mass of exhaust gases to reduce the pressure within the combustion chamber below atmospheric pressure and thereby decrease the weight of exhaust gases remaining in the cylinder to dilute the next charge The partial vacuum created by the outrushing exhaust gases is also useful in permitting the inlet valve to be opened early and the flow of fresh charge into the cylinder started sooner.

The inlet valve opens about 15° before top dead centre to take advantage of the pulling effect at the end of the exhaust period. About 30° of valve overlap results from the early inlet opening and delayed exhaust closure. The overlap period helps to scavenge the combustion chamber and results in a larger fresh charge entering the cylinder.

The inlet valve is not closed until 50° or more after bottom dead centre to utilize the kinetic energy of the rapidly moving charge. The optimum inlet closure point depends upon the speed at which the engine is to operate. low-speed engines having much earlier closure than high-speed types. The greater the departure of ali valve events from the dead centre points, the higher the speed at which the power of the engine will reach its peak. So-called racing cams are designed with all opening events earlier than normal and all closing events, especially inlet closure, later than in conventional timing. This causes the engine to develop its maximum power at a higher speed and therefore at an increased amount. but low-speed performance is impaired.

The extent to which the cylinder is filled with fresh air depends upon the speed of the engine, the size of the flon passages. valve size. lift and timing, as well as other fluid dynamics factors. The effectiveness of the charging process of the four-stroke engine is expressed as volumetric efficiency, which is defined as the weight of fresh air inducted per cycle in per cent of the weight required to fill a volume equal to the piston displacement at outside temperature and pressure. The volumetric efficiency of an automotive engine usually rises to a peak of slightly more than 80% at about half the rated speed of the engine and then decreases considerably at higher speed. This change in air charge per cycle with engine speed is reflected in proportionate changes in the torque or turning effort applied to the crankshaft and causes the power that the engine is capable of delivering at iull throttle to reach a maximum as engine speed increases At speeds above this peaking speed the air charge inducted per cycle falls off so rapidly that less power is developed than at lower speeds. The inability of the engine to induct a full charge of fresh air for each cycle at high engine speeds is thus the factor that limits the power output of the engine.

Supercharging is resorted to because of the power limitation caused by inability of the engine to maintain its charging effectiveness at high crankshaft speeds and also at high altitudes where the lower density of the atmosphere decreases the weight of air inducted Supercharged engines differ from naturally aspirated engines in that a pump or blower is provided to raise the pressure of the air supplied to the cylinders, thus increasing the weight of charge that flows into the cylinder By this means the approximately 50% loss in power suffered by unsupercharged aeroplane engines at 20 000 ft. altitude can be largely restored It is also possible to more than double the power of an engine of given size and weight by supercharging.

Supercharging is more applicable to compression-ignition engines than to spark-ignition types because of its effect on combustion. Increased charge density and temperature, resulting from supercharge, increases the tendency for combustion knock or detonation in the spark-ignition engine and necessitates an undesirable decrease in compression ratio or the use of a fuel of higher antiknock quality. The diesel engine, however, benefits from supercharge because of improved ignition of the charge. Four-stroke-cycle diesel engines therefore are commonly supercharged as a means of increasing their specific output and improving their competitive position with the two-stroke diesel and spark-ignition engines on the horsepoaer per unit of weight basis.

The supercharging blower may be geared to the crankshaft, in which case the power consumed in driving it is added to the friction loss of the engine. The turbocharger employs a gas turbine operated by the exhaust gases from the engine to drive a centrifugal blower. thus using principally the kinetic energy of the exhaust gases that is otherwise wasted The turbocharged engine not only gains increased power capacity, but also operates at improved fuel economy. Turbochargers are used extensively to supercharge the larger four-stroke-cycle engines and have found some application on two-stroke-cycle diesel engines. Aeroplane engines are usually supercharged both by geared blowers and by turbochargers in order to provide the large pumping capacity needed to overcome the effects of high altitude.

Performance. — The performance of an engine is expressed in terms of power. speed and fuel economy relationships. The three quantities are evaluated from data taken in a dynamometer test A dynamometer is a laboratory device that applies a controllable load in the form of resistance to the turning of the engine crankshaft, and also provides a means of measuring the turning effort or torque that is exerted at the shaft coupling The resistance to turning imposed by the dynamometer may be so adjusted by the operator that the desired engine speed is established at any throttle position. It is thus possible to run the engine at the load corresponding to full throttle, or any fraction thereof, at various speeds throughout its operating range, to maintain these operating conditions continuously and to measure the precise loads and speeds at which each run is made. Additional test equipment permits measurement of the exact quantity of fuel consumed as well as the duration of the runs Certain types of dynamometers also permit the engine to be motored and the power required to drive it determined. From the data taken the power-speed-economy relationships can be calculated, performance plotted and much information regarding the suitability of the engine for its purpose derived. More thorough tests are sometimes conducted to determine the durability of the engine, quietness and smoothness of operation, accelerating ability, cooling requirements. fuel limitations, air consumption, etc.

The power produced by an engine is expressed in horsepouer, a unit established by James Watt as a means of rating his steam engines. He tested several horses to determine the rate at nhich they could work and decided that 33.000 ft. lb. per minute was a liberal unit, representing appreciably more work than an ordinary horse could do for a short time. A foot-pound of work is equivalent to lifting a mass of one pound (thereby producing a force of one pound) a distance of one foot. According to Watt's unit, a horsepower represents the work done in one minute by some force (expressed in pounds) acting through some distance (expressed in feet) such that the product is 33,000.

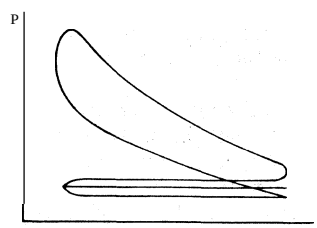
When the power developed by an engine is measured by means of a dynamometer or similar braking device, it is called brake horsepower or shaft horsepower. This is the power actually delivered by the engine and is therefore the capacity of the engine that the user can obtain. Engineers are also interested in the power developed in the combustion chamber of the engine, which is greater than the delivered power because of friction and other mechanical losses. This power loss, called the friction horsepower, can be evaluated by motoring the engine with a suitable dynamometer when no fuel is being burned. The power developed in the cylinders can then be found by adding the friction horsepower to the brake horsepower. This quantity is the indicated horsepower of the engine, so called from an instrument known as the engine indicator, which is used to measure the pressure acting on the pistons and thus calculate the power developed in the cylinders. The engine indicator draws a diagram of the cycle as carried out by the gases in the cylinder. It traces curves of pressures acting on the piston versus volume changes in the cylinder caused by piston motion during the strokes that correspond to one cycle.

Fig. 7 shows a pressure-volume diagram for an internal-combustion engine. From this diagram it is possible to evaluate the mean height and thus the average pressure which, if it acted constantly on the piston for one stroke. would produce a motivating force equal to that produced by the actual varying pressure during an entire cycle. It is thus possible to find the net force in pounds that would act on the piston during one power stroke if this average pressure is expressed in pounds per square inch and multiplied by the area of the piston in square inches. This pressure is called the mean effective pressure of the cylinder and is defined as the constant pressure which, if acting on the piston for one stroke, would do the same amount of work as was done by the actual varying pressure in the entire cycle. This quantity can be used to calculate the power developed in the cylinder by substituting in the equation

$$\text{indicated horsepower} = \frac{PLAN}{33{,}000}$$

where P is the mean effective pressure in pounds per square inch, L is the length of the stroke in feet, A is the piston area in square inches and N is the number of cycles completed per minute. The product PA is the force in pounds acting on the piston and, when multiplied by L, becomes the work done per cycle in foot-pounds. Multiplication by N then yields the work in foot-pounds per minute and division by 33,000 gives the horsepower.

Friction horsepower resulting from the mechanical imperfections of the engine is caused for the most part by friction between cylinder walls and pistons and by the work done in pumping the charge into and out of the cylinders. In addition to these large mechanical losses, smaller amounts of power are spent in operating the valves, driving the cooling fan, generator, ignition system and the oil and coolant pumps.



BY COURTESY OF O. C. CROMER

FIG. 7.— ENGINE INDICATOR DIAGRAM FOR FOUR-STROKE-CYCLE INTERNAL-COMBUSTION ENGINE (SEE TEXT FOR FURTHER EXPLANATION)

Mechanical efficiency is defined as the brake horsepower in per cent of the indicated horsepower. Friction horsepower increases rapidly with increased piston speed, but is fairly independent of load. The mechanical efficiency of an engine, therefore, increases with increased load at constant speed but decreases with increased speed at constant throttle and is usually between 70% and 90% within the normal operating speed range.

A hypothetical quantity called brake mean effective pressure (b.m.e.p.) is obtained by multiplying the indicated mean effective pressure of an engine by its mechanical efficiency. This is a commonly used index quantity expressing the ability of the engine, per unit of cylinder bore, to develop useful pressure in the cylinders and thereby deliver power. If the power delivered by an engine is increased by any change other than an increase in speed or cylinder dimensions, its b.m.e.p. increases proportionately. The

b.m.e.p., therefore. reflects any improvement in power output and permits a comparison of effectiveness of engines differing in size that cannot be made from their poner outputs alone.

Horsepower is calculated from dynamometer data by measuring the quantity known as torque that is applied to the dynamometer in restraining the rotation of the crankshaft of the engine. Torque is defined as rotating effort or the tendency to turn something about a centre and, quantitatively, is equal to the product of a force in pounds and the perpendicular distance in feet from the centre of rotation to the line of action of the force. Torque is expressed in units of pound-feet, and careful distinction must be made between this unit and the foot-pound used in measuring work. Work may or may not be done by the application of torque. If the torque applied is insufficient to overcome the resistance to turning, then no work is done, but, if the torque causes rotation, work is done per turn equal in amount to the product of the force acting and the circumference of the circle to which the force is tangent.

Dynamometer data include the length of the dynamometer arm, which is the torque arm or radius, R, in feet, of the torque circle, the reaction of the scales, W, in pounds, which is the force actmg, and the number of turns made by the crankshaft of the engine per minute. n. By Watt's definition. the brake horsepower developed may be calculated by substituting the quantities defined above in

$$\text{brake horsepower} = \frac{2\pi RWn}{33{,}000}$$

This equation may be simplified by dividing the denominator by 2π and substituting torque, t, for RW, which results in the equation

$$\text{brake horsepower} = \frac{tn}{5{,}252}$$

The brake mean effective pressure of an engine may be calculated from the dimensions of the engine and the brake horsepower as determined from dynamometer data. The equation for indicated horsepower in terms of mean effective pressure. piston area, stroke and cycles completed per minute may be converted to brake horsepower by substituting b.m.e.p. for indicated mean effective pressure. This substitution is possible because b.m.e.p. bears the same relationship to m.e.p. as brake horsepower does to indicated horsepower. If b.m.e.p. is expressed by P_b, the equation becomes

$$\text{brake horsepower} = \frac{P_b LAN}{33{,}000}$$

Transposing to get an expression for b.m.e.p.

$$\text{brake mean effective pressure} = \frac{33{,}000 \text{ b.h.p.}}{LAN}$$

The power determined by a test of an automobile engine is affected by such test conditions as atmospheric pressure, temperature and humidity; exhaust back pressure; and the number of accessories, such as the fan, generator, etc., that are attached to the engine. Automobile manufacturers in the United States adopted a standard code of rating tests for establishing the advertised horsepower of their engines. The conditions specified by this code are favourable to the engine and yield higher horsepower ratings than would be developed by the engines in normal operation. This practice establishes another, slightly smaller horsepower unit for engine rating purposes. In 1906 the Royal Automobile club in Great Britain adopted an approximate horsepower rating based upon an assumed piston speed of 1,000 ft. per minute and a b.m.e.p. 67 lb. per square inch. The rating is expressed by the equation

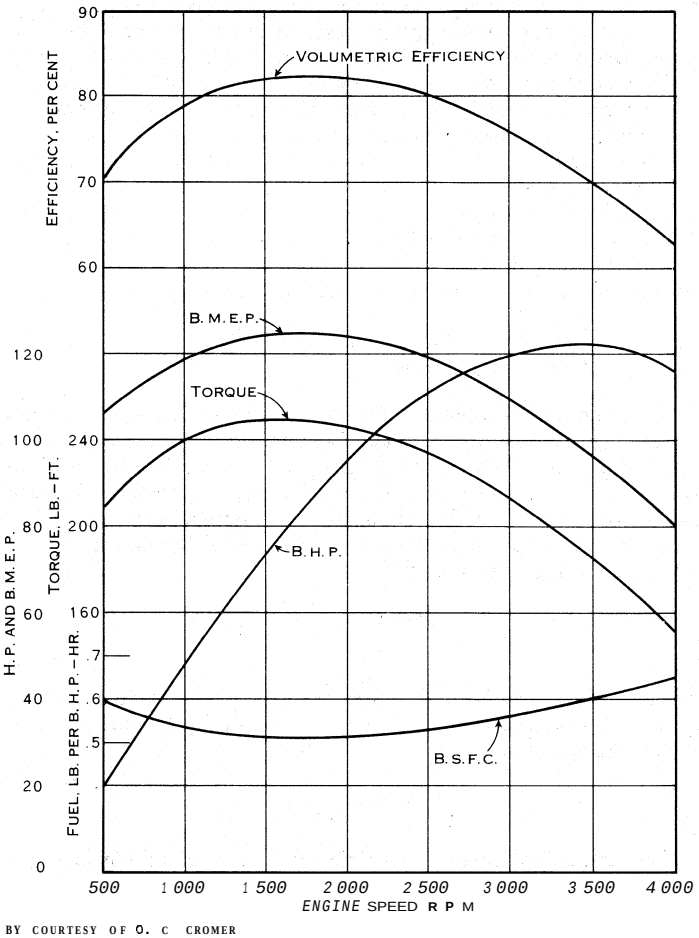
$$\text{horsepower} = \frac{B^2N}{2.5}$$

where B is the cylinder bore in inches and N is the number of cylinders. The same formula was adopted in the United States by the Association of Licensed Automobile Manufacturers and became known as the ALAM rating. Both piston speeds and brake mean effective pressures of modern engines are much higher, and it is not unusual for the manufacturer's rating to exceed the horsepower calculated by this formula by a factor as large as five. This formula is widely used as a basis for licenses and taxes.

The horsepower unit in continental Europe, where the metric system is used, is slightly smaller than Watt's unit. It evaluates a horsepower as work done at the rate of 4,500 kilogram-metres per minute and is 98.6% as large as the English and American unit.

In order to effect a comparison of engines of differing size, it is customary to divide the horsepower developed by the piston displacement, thus arriving at the power per unit of cylinder size. Either the engine speed or the mean effective pressure must be increased in order to increase the power per cubic inch of piston displacement. Because it is difficult to maintain effective cylinder charging and low friction losses at high speed, high specific power output as expressed by this unit represents a desirable design achievement. The usual range is from one-half to seven-eighths of a horsepower per cubic inch of piston displacement for automobile engines and much less for slow-speed engines.

The fuel economy of an engine is expressed in units of pounds of fuel per brake horsepower per hour. This quantity is found by weighing the fuel burned during a test run at constant operating conditions, converting the weight to pounds per hour and dividing by the brake horsepower that the engine was developing during the test. The rate of fuel consumption evaluated by this unit is called the brake specific fuel consumption of the engine (b s.f.c.). The fuel economy of an automobile engine is usually best at about half its rated speed and three-quarters or more load. Lighter or heavier



BY COURTESY OF O. C CROMER

FIG. 8.— PERFORMANCE CURVES FOR TYPICAL AUTOMOBILE ENGINE

loads and higher or lower speeds cause the specific fuel consumption to increase.

Performance curves are drawn from test data for a variable-speed engine by plotting power and economy against engine revolutions per minute. Fig. 8 is a set of such performance curves for a typical automobile engine. These curves show that both the torque and the b.m.e.p, curves follow the changes in cylinder-charging ef-

fectiveness that are reflected in the volumetric efficiency curve. The brake horsepower curve is also seen to reach a peak at the speed above which the torque and b.m.e.p. are decreasing more rapidly than the speed is increasing.

Theoretical Cycles.—Improvements in engine performance were brought about by studying and analyzing the results of tests. The engine indicator diagram is capable of theoretical analysis when simplified by substituting conventional standard processes of thermodynamics for its irregular and unsystematic curves. The indicator diagram of fig. 7 then appears as a summation of four processes as shown in fig. 9, the diagram of the ideal Otto style.

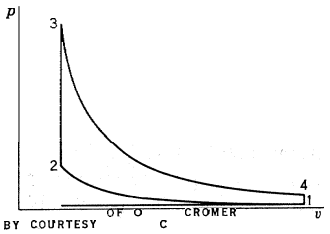


FIG 9 — THEORETICAL OTTO-CYCLE PRESSURE-VOLUME DIAGRAM (SEE TEXT FOR FURTHER EXPLANATION)

The lower loop of the indicator diagram found by the intake and exhaust strokes is eliminated by the assumption that, ideally, both of these strokes are carried out at atmospheric pressure. Further simplifying assumptions are that air is the working fluid throughout the cycle and its properties are those of atmospheric air. The cycle then starts with atmospheric conditions at the point 1. The processes 1–2 and 3–4 both follow the theoretical paths for adiabatic compression and expansion resulting from the assumption that no heat is transferred to or from the working fluid during the process. The pressure at each point along these curves is established by the perfect gas relationship PV^K, a constant, wherein P is the absolute pressure of the air, V the volume occupied by a unit mass of air and K is the ratio of the specific heat at constant pressure to that at constant volume. which may be taken as 1.4 for atmospheric air. The process 2–3 and 4–1 are carried out at constant volume, since it is assumed that energy is gained by combustion from 2 to 3 instantaneously and that rejection of energy to the exhaust from 4 to 1 is also instantaneous.

The theoretical or ideal Otto cycle may be analyzed by evaluating the energy quantities in the equation for efficiency, η :

$$\eta = \frac{\text{net work}}{\text{energy supplied}} = \frac{Q_{\text{in}} - Q_{\text{out}}}{Q_{\text{in}}} = \frac{Q_{2-3} - Q_{4-1}}{Q_{2-3}}$$

Thermodynamic relationships permit the evaluation of Q between 2 and 3 in terms of specific heat and the temperatures at the two points, and similarly for Q between 4 and 1. An expression in terms of the temperatures at the four corners of the cycle diagram is thus obtained. Further application of thermodynamics yields a simpler and more useful expression in terms of the maximum and minimum volumes of the cycle

$$\eta = 1 - \frac{1}{\left(\frac{V}{V_2}\right)^{K-1}}$$

The ratio V_1/V_2 is the compression ratio of the cycle or engine. Substituting r, the compression ratio, for V_1/V_2 makes the theoretical efficiency equation

$$\eta = 1 - \frac{1}{r^{K-1}}$$

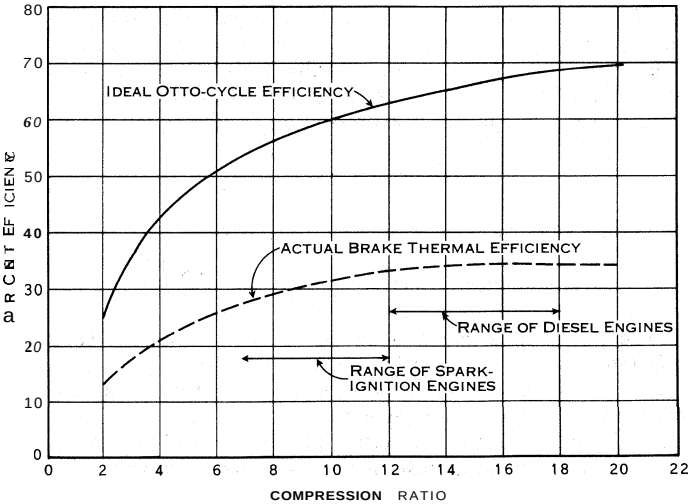
The theoretical Otto-cycle efficiency is the thermal efficiency of the cycle and is equivalent to the fraction of the energy supplied that is converted into work. No losses other than those inherent in the cycle are involved and only a perfect engine operating on that cycle could attain such high efficiency. The practical losses introduced by the imperfections of the engine include its failure to burn the fuel completely and to duplicate the cycle processes exactly; also the heat transferred from the engine, the friction losses and other ways in which energy is dissipated by the real engine. The thermal efficiency of the actual engine is calculated from test data and is much lower than the theoretical efficiency, perhaps only half as large.

The brake thermal efficiency of an engine is the fraction of the energy supplied in the fuel that is present in the brake horsepower delivered by the engine. The heating value of the fuel must be known in order to evaluate the energy supplied. Fuel is tested for heating value by burning it in a calorimeter that transfers the heat released by burning a known weight of the fuel to a known weight of water. Each degree that each pound of water is heated through 1° F. temperature rise is called a British thermal unit (B.Th.U.). The number of British thermal units released by the combustion of a pound of fuel is its heating value Q_H. For gasoline this value is about 20.000 B.Th.U. per pound. The power developed by the engine can also be expressed in British thermal units because 1 B.Th.U. has been experimentally found to be equivalent to 778 ft.lb. of work. A horsepower delivered continuously for one hour is thus equivalent to 2,545 B.Th.U. Since brake specific fuel consumption is the pounds of fuel burned in one hour to deliver one horsepower, brake thermal efficiency may be expressed as

$$\text{brake thermal efficiency} = \frac{2{,}545}{\text{b.s.f.c.} \times Q_H}$$

The curves of fig. 10 show the theoretical Otto-cycle efficiency and the approximate brake thermal efficiency of an engine operating on the Otto cycle for compression ratios from 2 to 20. The approximate ranges of the compression ratios of spark-ignition engines and diesel engines are also indicated. The upper portion of the spark-ignition engine range is attainable only by engines operating with natural gas or extremely high-octane fuels.

The cycle described by Diesel in his 1893 patent differs from the Otto cycle only in that energy is supplied more slonly, at a rate such that the increase in volume during combustion exactly compensates for the tendency for the pressure to rise. Energy is thus supplied at constant pressure instead of at constant volume as in the Otto cycle; and combustion in an engine following this cycle occurs more gradually during the early part of the power stroke instead of instantaneously at the dead centre point and the path 2–3 is horizontal instead of vertical. The analysis of the Diesel



REPRINTED WITH PERMISSION FROM SOLBERG, CROMER AND SPALDING, "ELEMENTARY HEAT POWER," 1952, JOHN WILEY & SONS, INC.

FIG. 10.— CURVESSHOWING EFFECT OF COMPRESSION RATIO ON THEORETICAL OTTO-CYCLE EFFICIENCY AND APPROXIMATE BRAKE THERMAL EFFICIENCY

cycle is not as simple as that of the Otto cycle and the expression for its efficiency is more complicated, usually being expressed as

$$\eta = 1 - \frac{1}{r^{K-1}}\left[\frac{r_c^K - 1}{K(r_c - 1)}\right]$$

wherein r_c is the cutoff ratio or ratio of expansion during combustion V_3/V_2. The value of the bracketed factor is greater than unity for any practical cutoff ratio and the subtractive term is consequently greater than that of the Otto-cycle expression, $\frac{1}{r^{K-1}}$. The efficiency of the Diesel cycle is thus lower than that of the

Otto cycle for the same compression ratio by an amount that increases with the energy input. An engine operating on this cycle would then be more efficient at a light load than at a heavier load.

The value of K in theoretical efficiency expressions is higher for air than for fuel vapours. It can be shown by calculating the value of K for various air-fuel ratios that the efficiencies of both the Otto and Diesel cycles are higher when air alone is considered as the working fluid and decrease progressively as fuel is included in the charge. It is evident from this study that lean mixtures are theoretically more efficient than those containing more fuel.

A practical consideration. however. enters here because combustion in the spark-ignition engine is slowed down as the mixture is leaned beyond the maximum-economy ratio. causing the combustion process to depart from the constant-volume process of the Otto cycle and tend toward the less efficient constant-pressure process of the Diesel cycle. The compression-ignition engine is inherently a lean-mixture engine; however. and its combustion is not retarded by excess air. The higher efficiency of the diesel-type engine is attributable both to its higher compression ratio and its higher air-fuel ratio than those used with spark ignition. High-speed diesel engines follow the Otto cycle.

These theoretical analyses indicate three factors affecting efficiency. First, the compression ratio should be as high as is practical; second, combustion should be as rapid as is practical; and third! the air-fuel ratio should be high. These criteria favour the Diesel principle of compression ignition because the compression ratio of this engine is not limited by detonation and preignition as it is in the spark-ignition engine, and it can operate at high air-fuel ratios without impairing combustion. As shown by the curves of fig. 10, the important gains in efficiency from increased compression ratio were made when ratios were increased from about 4 to 7; further increases above 12 result in proportionately less theoretical improvement and very little actual gain in thermal efficiency.

Charge Requirements. — Combustion of any fuel requires that a certain amount of oxygen be made available to permit the proper chemical reaction to occur. The amount of oxygen necessary to support the combustion of fuel may be readily calculated if the chemical ingredients of the fuel are known. It is customary to assume that gasoline is a mixture composed of many hydrocarbon coinpounds that average approximately the same as octane! C_8H_{18}. With this simplifying assumption it is possible to write the combining equation for gasoline and air as

$$C_8H_{18} + 12.5\ O_2 + 47.5\ N_2 \rightarrow 8\ CO_2 + 9\ H_2O + 47.5\ N_2$$

Multiplying each term of this equation by the molecular weight of the substance results in the folloning equation in pounds

$$114\ C_8H_{18} + 400\ O_2 + 1{,}330\ N_2 \rightarrow 352\ CO_2 + 162\ H_2O + 1{,}330\ N_2$$

For one pound of fuel

$$1\text{ lb. } C_8H_{18} + 3.51\text{ lb. } O_2 + 11.66\text{ lb. } N_2 \rightarrow 3.09\text{ lb. } CO_2 + 1.42\text{ lb. } H_2O + 11.66\ N_2$$

$$1\text{ lb. } C_8H_{18} + 15.17\text{ lb. air} \rightarrow 16.17\text{ lb. products of combustion}$$

In this final form it is indicated that 1 Ib. of gasoline reacts with slightly more than 1 j lb. of air to form products of complete combustion. These equations represent the proportion for perfect combustion in which the fuel and oxygen are both entirely consumed by the reaction. The imperfections of the combustion chamber as a chemical retort. incomplete mixing of the fuel and air, insufficient time to permit the reaction to go to completion and other unfavourable factors prevent perfect combustion and cause both combustible material and oxygen to be present in the products formed.

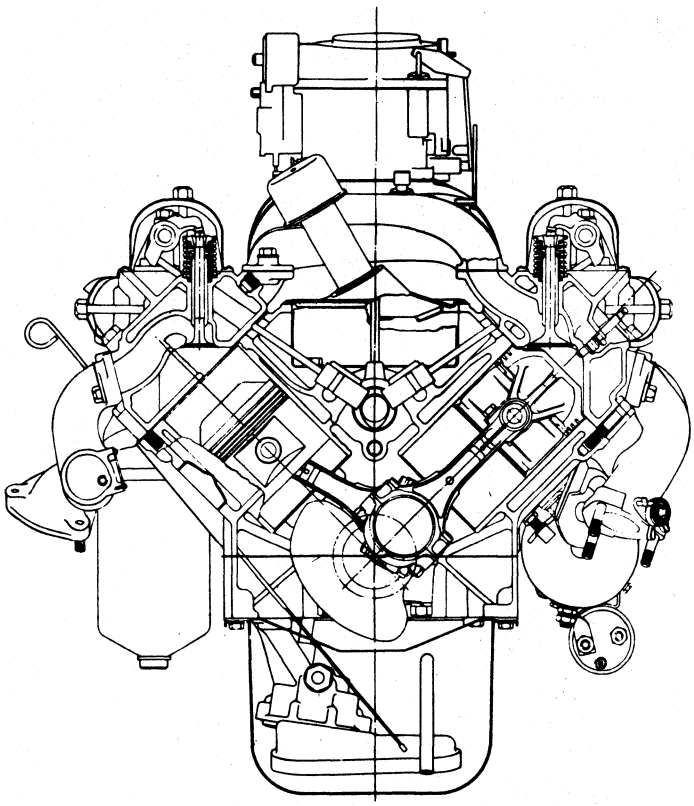
The 1 j to 1 ratio of pounds of air to pounds of gasoline. although chemically correct, is not the best proportion for a gasoline engine charge. Experiment proved that a slightly lean mixture. about 16 to 1, is more economical than the chemically correct ratio. The excess air contributes to completeness of combustion by requiring less perfect mixing in order fcr the fuel to contact sufficient oxygen, but less power is developed because less chemical energy is present in the smaller amount of fuel contained in the leaner mixture. Further leaning of the mixture is uneconomical because the burning rate of the charge is decreased. A somewhat rich mixture, about 12 to 1. is more powerful than the cheniically correct ratio. This is true because the additional fuel introduces a greater amount of chemical energy to the combustion chamber and, although the deficiency in oxygen decreases the combustion completeness slightly, the net energy release is increased. Further enrichment reduces the power output by decreasing the burning rate.

Combustion. — Combustion in the spark-ignition engine originates at the spark plug where the high temperature of the electric spark ignites the tiny portion of the charge in the immediate vicinity of the spark-plug gap. In burning, this first particle of fuel presents a somewhat spherical surface of flame to the layer of charge surrounding it, causing it to ignite and expose the next layer to an igniting flame. As the charge is exposed to this flame front, layer by layer, the inflamed sphere grows until it spans the combustion chamber. The flame front then advances radially across the chamber and, if undisturbed. progressively ignites and burns the remainder of the charge. Normal combustion, then, is a progressive burning at a rate dependent upon the density of the charge, the speed at which the flame front advances and the area of the flame surface. Although the entire process is completed in a small fraction of a second, there is no instant during the burning time when any sizable portion of the charge is burning. Energy is thus released at a uniform rate that is not violent.

As each portion of the charge burns, it releases its chemical energy; its products of combustion attain a very high temperature and the volume of space occupied by the products increases. This expansion of the burned portion of the charge compresses the unburned portion by crowding it into a smaller part of the chamber than it originally occupied. A compression of this sort is accompanied by an increase in temperature as well as in pressure and density. It is possible that the temperature and density attained by the last portion of the charge may be so great and the time of exposure be sufficient to cause the entire remaining charge to self-ignite simultaneously with explosive violence. Such almost instantaneous combustion causes a high rate of pressure rise in that part of the chamber and sets up a high-frequency pressure wave within the gases. The resulting vibration of the chamber walls produces a knock that is called detonation. When detonation occurs, the engine is noisy and the temperature of the combustion chamber rises rapidly, accompanied by a loss in power. Only the last portion of the charge, that farthest from the spark plug, is involved in this combustion irregularity, and it will not occur if the fuel is able to resist self-ignition under the conditions to which it is exposed until it is burned in the normal manner by the arrival of the flame front. Detonation can be avoided by improvements in the fuel to make it more resistent to self-ignition or by improvements in the engine that lessen the severity of the condition to which the charge is exposed before it burns. Control of combustion thus requires a knowledge of fuels and the effects of combustion-chamber design.

Fuels. — Gasoline is a mixture of many hydrocarbon compounds, each of which differs from the others in such characteristics as boiling point or volatility, inolecular structure, density and ignition behaviour. To suit the needs of a modern engine a gasoline must have the volatility, as indicated by its boiling-point range. for which the fuel system of the engine was designed, and antiknock quality, as indicated by its octane number, sufficient to avoid detonation under normal operation. Other specifications must also be met, but. volatility and octane number are the most important. Starting quality: vapour-locking tendency, rapidity of warm up, acceleration, crankcase dilution, power and completeness of combustion are some of the performance factors affected by volatility. The octane number of a gasoline determines whether knock-free operation is possible in a given engine. The size of the molecules and the structural arrangement of the carbon and hydrogen atoms within the molecules principally determine the octane number of a gasoline.

The hydrocarbon compounds of which petroleum fuels are composed have three distinct molecular patterns, straight-chain, branched-chain and ring. Larger molecules are frequently combinations of these basic forms, such as double rings or rings with side chains. Physical chemists have found that the ease with which these molecules enter into chemical reactions, such as combustion,



BY COURTESY OF GENERAL MOTORS CORP.

FIG. 11.—TRANSVERSE CROSS SECTION OF A V-8 ENGINE

is affected by both the size and structure of the molecules. Large straight-chain molecules react most readily, whereas small compact molecules are most resistant to chemical reactions. The size of the molecules and, to a lesser extent, their structure also affect the volatility of the fuel. The smallest molecule, that of methane, has the lowest boiling point, —259° F., and it is so volatile that it exists as a gas at atmospheric conditions. It is also the most inert of the hydrocarbons and therefore has the highest antiknock quality. Cetane is an example of the opposite extreme. It has a long straight chain with 16 carbon atoms, enters into reaction with oxygen at relatively low temperature and has a boiling point of 536° F. Intermediate compounds, of which gasoline is composed, have molecules with from 5 to 12 carbon atoms and a boiling point range from about 100° to 400° F.; the molecules are largely of branched-chain and ring structure that vary considerably in chemical activity.

The octane-number rating of gasolines for antiknock quality is based upon the effect of molecular structure on the knocking tendency of a fuel and the effect of increased compression ratio on the knocking tendency of an engine. A special single-cylinder test engine with adjustable compression ratio is used to compare the knock intensity of the gasoline under test with that of blends of two reference fuels that are used as a standard.

Isooctane, a branched-chain hydrocarbon of high antiknock quality, is blended with normal heptane, a straight-chain hydrocarbon that knocks severely, in varying proportions by volume. The engine is operated on the gasoline and the compression ratio adjusted until a knock of a standard intensity, as established by the test code, is indicated by a knock meter. Reference blends of octane and heptane are then successively substituted for the gasoline at the same compression ratio, in proportions that are varied until the same knock intensity is again indicated. The per cent of octane in the reference blend that causes the same knock intensity as mas caused by the gasoline is taken as the octane number of the gasoline.

A fuel that has the same knocking tendency as isooctane is a 100-octane fuel and one that behaves the same as normal heptane is a 0-octane fuel. An 80-octane fuel has the same antiknock quality as a mixture of 80% isooctane and 20% normal heptane. It should be noted that no quality of the gasoline other than its knocking tendency is indicated by its octane number.

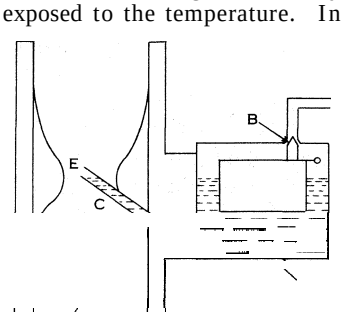
The petroleum chemist devised refining techniques whereby gasoline molecules of compact structure and desirable antiknock characteristics are produced. In this way it became possible to improve greatly the antiknock quality of gasoline and also produce much larger amounts of gasoline from the crude oil. Additives, principally tetraethyl lead, also contribute to the knock resistance of gasoline.

For many years gasoline and other volatile portions of the crude oil were distilled off and thrown away for want of a market, but the advent of the automobile made it desirable to increase the yield of gasoline from crude oil to meet the demand. Only 20% of the crude could be made into gasoline originally and up to 1914, and its octane number was only 50. By 1922 improved refining processes and the addition of tetraethyl lead had increased the yield to 30% and the octane number to 6j. Thermal cracking, whereby large molecules too low in volatility for gasoline are broken up, came in 1925, increasing the yield to more than 40% and the octane number to 7j. In 193j the cracking process was improved by the use of catalysts to raise the octane number to 85. Higher octane ingredients are made by converting certain highly volatile constituents into gasoline, making 100-octane fuel possible and nearly 45% yield from the crude oil. *(See* also PETROLEUM)

Combustion Chambers.— While the petroleum industry was improving gasoline, the engine manufacturers were improving combustion and fuel utilization of the engines. Modern gasoline engines resulted from the mutual adaptation of fuels and engines to each other. The knowledge that higher compression ratio increases thermal efficiency and power output encouraged engine designers to increase compression ratios progressively as rapidly as the fuel limitations and the engine requirements could be matched by co-operative endeavour.

Combustion control in the spark-ignition engine is largely a matter of avoidance of preignition and detonation. Preignition is self-ignition of the charge before the spark occurs and is one of the extreme effects of increased compression ratio. Detonation is a self-ignition effect, but it occurs after most of the charge has burned normally and as an effect of the combustion and expansion of the first portion.

The tendency for a mixture of gasoline vapour and air to self-ignite increases with the temperature of the charge, its density and the length of time that it is exposed to the temperature. In high-compression engines the temperature and density attained by the charge before ignition are much higher than in low-compression engines. The problem in attaining smooth, normal combustion becomes one of burning the charge by the normal flame front before it ignites spontaneously. Much depends upon the resistance to self-ignition or octane number of the fuel, but the severity of the conditions to which the charge is exposed before and during combustion can be lessened by careful design of the combustion chamber and the induction system. as well as by improved cooling of surfaces that are contacted by the charge. The time element in self-ignition is important and can be controlled and shortened in several ways.



BY COURTESY OF O. C. CROMER

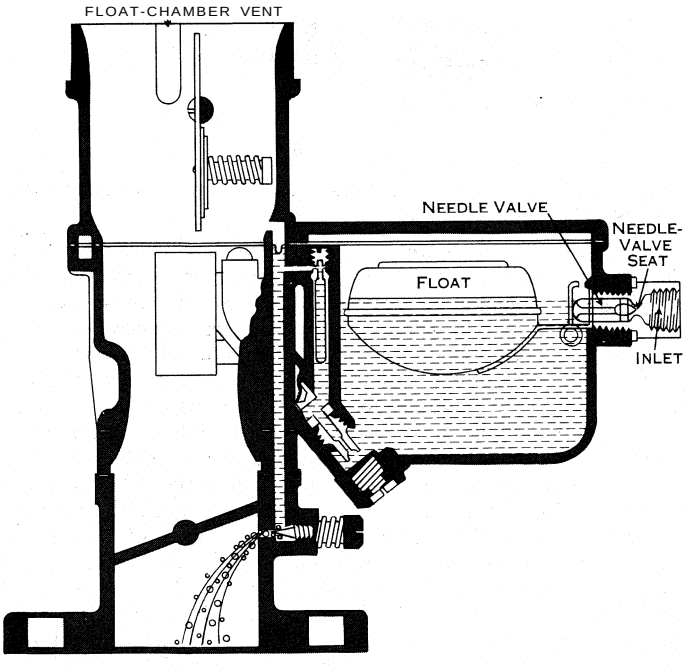
FIG. 12.— DIAGRAM OF SIMPLE ELEMENTARY CARBURETTOR (SEE TEXT FOR FURTHER EXPLANATION)

The more compact the combustion chamber is made the shorter the distance that the flame front must travel in order to burn all of the charge. Locating the spark plug more centrally shortens the flame travel to the most extreme boundary of the chamber. Increased engine speed causes more rapid combustion. All of these time-shortening factors are employed in reducing the octane requirements of engines.

The L-head engine was the first to which the principle of turbulence, charge concentration near the spark plug, shortened flame travel and quench area remote from the plug were applied. Sir Harry Ricardo conceived the L-head combustion chamber design shown in fig. 5 shortly after World War I, and it was widely adopted for engines of this type. The squish turbulence, created by the close approach of the far side of the piston to the cylinder head, feeds most of the charge that would otherwise have been last to burn into the flame front and permits the remainder to be kept cool by proximity to the metal walls. As compression ratios are increased, however, reduced depth of the passage from the valves in the L-head engine to the cylinder bore restricts the flow of charge between the valves and the cylinder, causing decreased power at high speeds. Manufacturers were forced to adopt the valve-in-head design, in which the charge flows directly into the cylinders from the valves, for engines with compression ratios higher than eight.

Two types of high-compression combustion chambers were developed for valve-in-head engines, the wedge type and the hemispherical type. All practical designs may be considered as modifications of these two types. The combustion chamber shown in fig. 6 is of the wedge type and employs the same basic design principles of combustion control as were expressed by Ricardo. The spark plug is located at a deep section so that as much charge as possible can be burned initially and tapers away to a region thinned out to gasket thickness as a quench area and to promote squish turbulence.

Fig. 11 shows a cross section of a V-8 engine in which a modified hemispherical-type chamber is used. The spark plug is centrally located for short flame travel and charge concentration near

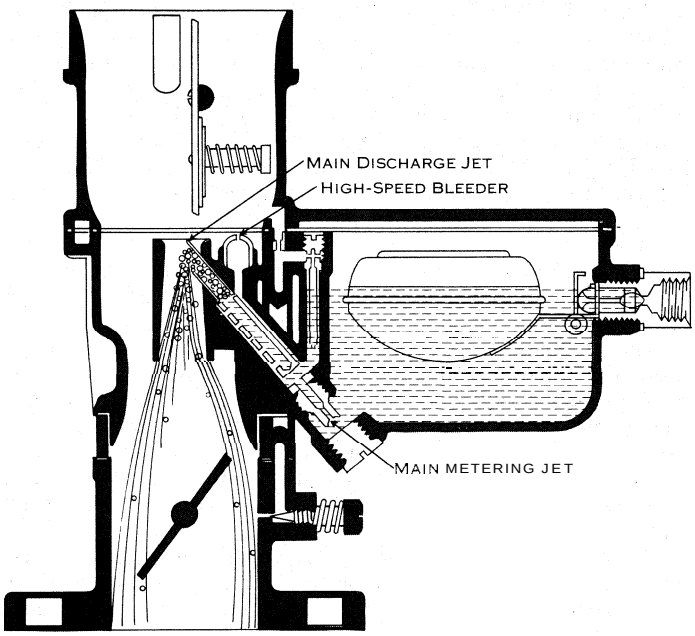


BY COURTESY OF BENDIX AVIATION CORP.

FIG 13.— SECTIONAL VIEW OF A CARBURETTOR SHOWING FLOAT MECHANISM AND LOW-SPEED CIRCUIT

the plug. The piston is crowned to form shallow regions around the periphery of the chamber where combustion ends and to cause motion of the charge toward the spark plug.

Carburetion.— The gasoline carburettor is a device that proportions fuel into the air stream as it flows into the intake manifold. A simple carburettor is shown diagrammatically in fig. 12. Gasoline is maintained in the float chamber A by the float-actuated valve B at a level slightly below the outlet of the jet C. Air flows downward through the throat, past the throttle valve D and into the intake manifold. A venturi is formed by the reduced



BY COURTESY OF BENDIX AVIATION CORP.

FIG. 14.— SECTIONAL VIEW OF A CARBURETTOR SHOWING MAIN METERING SYSTEM

throat diameter at E, and acceleration of the air through this smaller passage causes a decrease in pressure below atmospheric proportional to the amount of air floaing. This decrease in throat pressure when air is flowing causes the atmospheric pressure on the surface of the gasoline in the float chamber to exceed that at E, resulting in fuel flow from jet C into the air stream. Any increase in air flow caused by change in engine speed or throttle position will increase the pressure differential acting on the fuel and cause more fuel to flow.

The volume ratio of air to fuel established by the throat and fuel jet sizes will be maintained with increased charge flow, but the weight of fuel per pound of air increases because the air expands to a lower density as the throat pressure decreases at higher rates of charge flow. This inherent enriching tendency necessitates the inclusion of a compensating device in a practical carburettor. Carburettor design is further complicated by the need for an enriching device to provide a maximum-power ratio at full throttle, a choke to facilitate starting a cold engine. an idling system to provide the special needs of light-load operation and an accelerating device to supply additional fuel while the throttle is being opened.

Fig. 13, a sectional view of a typical automobile engine carburettor, shows the throttle in the idling position and indicates the flow of fuel through the idling circuit which draws fuel from the top of the float chamber and delivers it past an idle adjusting screw to a point in the carburettor outlet just below the throttle valve. When the throttle valve is closed a high vacuum exists on the manifold side of the valve which causes the idling circuit to function.

As the throttle is opened the vacuum at the idle fuel outlet is so reduced that no fuel flows from it and it is supplied only by the main jet. The small air flow at the venturi when the throttle is closed is insufficient to cause fuel to flow from the main jet, but it comes into operation as the throttle is opened.

Fig. 14 shows the carburettor functioning normally with the throttle more fully open and fuel flowing through the main metering jet and into the air stream at the main discharge jet. The high-speed bleeder shown is a device that admits air into the fuel passage as a means of preventing enrichment at increased rates of

charge flow.

Only the idling and main-fuel circuits are shown in these two views. Accelerating, full-throttle enriching devices and other components are present but not visible.

Modern automobile carburettors are further complicated by the provision of two or four throats, commonly called barrels instead of one. as a means of improving charge distribution to the cylinders and better adapting them to the large range of quantity of charge that they must supply from idling at lon engine speed to full throttle at maximum speed. A dual carburettor has two throats, each of which supplies half of the cylinders. A four-barrel carburettor is in effect a small dual carburettor at less than half throttle and a large carburettor when the throttle is more fully opened and the other two barrels cut in.

Gasoline-injection systems were available for aeroplane engines of high power output before World M7ar II and were extensively used by the armed forces The performance of engines with this equipment was excellent. but the much greater cost of fuel-injection systems as against carburettors limited their application to large expensive engines. Efforts to simplify and cheapen fuel-injection equipment without impairing performance yielded multicylinder pumps that could compete in cost with the four-barrel carburettor Gasoline-injection equipment has been designed of a variety of types ranging from distributor systems employing a single pump for all of the cylinders to multipump types.

The principal advantages of gasoline injection over the carburettor are: (1) improved fuel economy because of more accurate fuel and air proportioning; (2) greater power because of elimination of charge heating: (3) elimination of inlet icing; and (4) more uniform distribution of charge to all of the cylinders because the fuel is delivered directly to each cylinder.

The SU fuel-injection pump, developed in England, is representative of the direct gasoline-injection systems available for engines of moderate size. An injection nozzle is located just outside each intake valve to which fuel is supplied at pressures up to zoo lb. per square inch in metred quantities while air is entering the cylinder. The basic metering principle of the system is to vary the amount of gasoline delivered to each cylinder in accordance with three functions of the engine — speed, manifold pressure and temperature of the air in the inlet manifold. This is known as speed-density metering and assumes that the rate of air flow to an engine is very nearly proportional to its speed and the density of the air as it enters the cylinders.

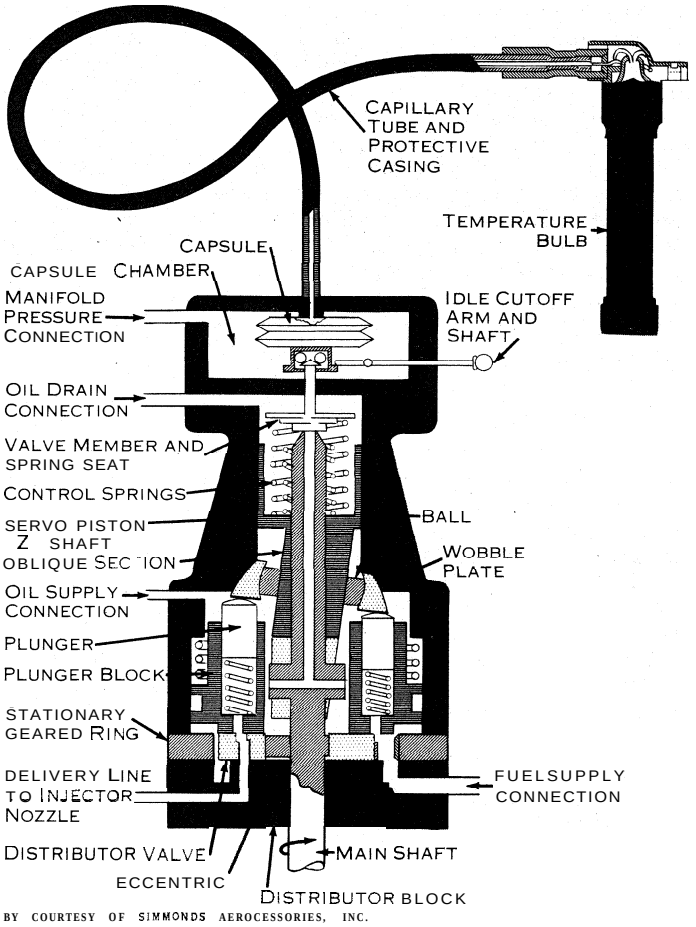
A cross section of the SU fuel-injection pump is shown in fig. 15 with the important parts identified. Pump bores, each with a closely fitted plunger, are spaced in a circle about the central drive shaft with their axes parallel with the shaft. The plungers are held against a wobble plate by springs and receive their reciprocating motion from the angle through which the wobble plate rocks as the main shaft rotates. This angle, in turn, depends upon the axial displacement of the servo piston and its oblique extension through the wobble plate. Upward motion of the servo piston displaces the wobble plate laterally. causing its ball-section upper surface to assume a more level position in its socket, thereby shortening the strokes of the plungers.

The axial location of the servo piston is established by the intake-manifold pressure in the capsule chamber above the piston and the gas pressure nithin the capsule created by the temperature bulb located in the manifold.

When the throttle at the entrance to the inlet manifold is opened the manifold pressure rises, compressing the capsule, moving the pin shaft upward and opening the oil supply so that pressure is applied under the servo piston. The wobble plate is then tilted at a greater angle and pumping capacity increased. Higher manifold pressure causes the piston to assume a higher position and higher air temperature lowers it, resulting in an amount of fuel delivered proportional to the air density.

There are half as many pump barrels and plungers as there are cylinders in the engine and the pump shaft turns at crankshaft speed. A distributor valve between the pump barrels and the delivery lines to the injectors is moved so that the fuel is delivered to half of the cylinders during one turn of the shaft and to the other half on the next turn. Thus each pump delivers fuel alternately to two cylinders that fire one crank turn apart. Fuel flows to each injector nozzle for 180° of crankshaft rotation. timed to occur within the period of inlet-valve opening. Fuel flow into the pump chambers on the plunger upstrokes is also controlled by the distributor valve.

Ignition. — Two types of electric ignition systems are used,



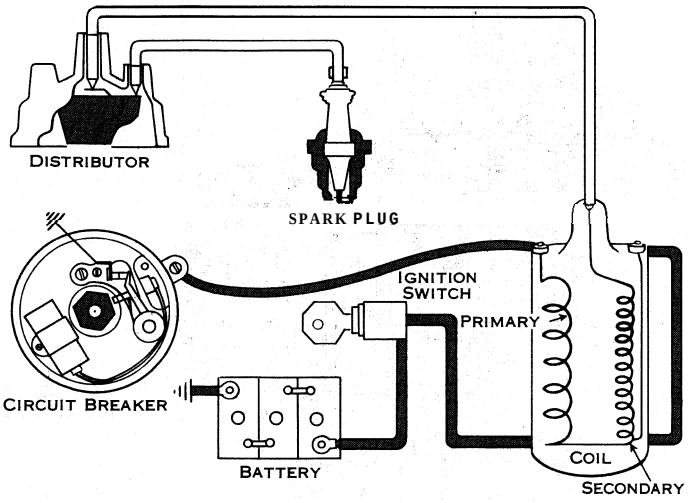
BY COURTESY OF SIMMONDS AEROCESSORIES, INC.

FIG. 15. — SECTIONALVIEW OF SU GASOLINE-INJECTION PUMP FOR SPARK-IGNITION ENGINES

the magneto and the battery and coil systems. They are similar in principle but the magneto is a self-contained device requiring only the spark plugs and connecting wires to complete the system, whereas the battery and coil system comprises several separate components. Fig. 16 shows the components of a six-cylinder battery, coil and distributor system and the electrical circuit. The circuit consists of a primary side, which starts with the 6- or 12-v. battery, one terminal of which is grounded while the other leads through a switch to the primary winding of the coil, comprising relatively few turns of heavy wire, and then to the circuit breaker where it is again grounded. Current flows through the primary circuit when the switch is closed and the points of the circuit breaker are in contact. Rotation of the circuit-breaker cam opens and closes the primary circuit. The secondary circuit starts with the secondary winding of the coil, comprising several thousand turns of very fine wire, one end of which is connected to the primary winding while the other leads to the rotor of the distributor which acts as a rotary switch, selecting which of the spark plugs is placed in the circuit. Each spark plug is connected to one of the outer terminals of the distributor to receive an electrical impulse in proper sequence.

When the breaker points are in contact, a current flows through the primary winding of the coil. creating a magnetic field which threads the turns of the secondary winding. Separation of the breaker points by the cam opens the circuit and causes the mag-

netic field to collapse rapidly, an action which induces a voltage across each turn of the coil. A total voltage as high as 20.000 is built up in the secondary winding at the instant that the breaker points open and applied to the rotor of the distributor. This rotor is in phase with the circuit-breaker cam so that it establishes a circuit to one of the spark plugs just before the breaker points



BY COURTESY OF INTERNATIONAL HARVESTER CO.

FIG 16.— DIAGRAM OF BATTERY AND COIL IGNITION SYSTEM FOR AUTOMOBILE ENGINES

separate and then moves on to the terminal leading to the next spark plug in firing sequence.

A considerable voltage is also induced in the turns of the primary winding when the breaker points open, causing a spark to occur at the points just as they are separating. This spark tends to burn and pit the breaker points. so a capacitor or condenser is connected across the circuit breaker to absorb the energy and protect the points from burning.

A spark plug consists of a threaded steel shell that screws into the cylinder head and an insulator that contains a central electrode. A gap of $\frac{20}{1.000}$ to $\frac{40}{1.000}$ in. is provided between the central electrode and the ground electrode attached to the shell of the plug. The central electrode extends through the insulator to receive the secondary wire from the distributor, and the circuit is completed from the ground electrode through the metal of the engine to the battery and thence to .the coil. The voltage established at the coil must be sufficient to jump the spark-plug gap against the resistance of the compressed charge.

The spark must be precisely timed to occur at the proper point in the cycle of the engine; the timing is established by the gear train connecting the breaker cam to the camshaft and thence to the crankshaft. The optimum time for the spark to occur varies both with the load on the engine and with its speed, necessitating an advance mechanism to control the timing with changes in operating conditions.

A centrifugal flyweight device advances the spark timing as the engine speed increases and a vacuum device advances the timing as the throttle is closed, utilizing the increase in intake manifold vacuum as load decreases.

Lubrication. — The purpose of lubrication is to interpose an oil film between the parts that have relative motion, thus substituting the fluid friction between the molecules of the lubricant for the mechanical friction that would quickly destroy the rubbing parts. The lubrication system must continuously replace the oil films that separate the parts.

The lubricant employed is refined from the heavy nonvolatile fractions of crude oil after the fuels are removed. The viscosity or body of the oil must be appropriate for the needs of each engine and the oil must be of a type suitable for the severity of its operating conditions. Oils are made more resistant to deterioration by additives that reduce oxidation, inhibit corrosion and act as detergents to disperse deposit-forming gums and solid contaminants.

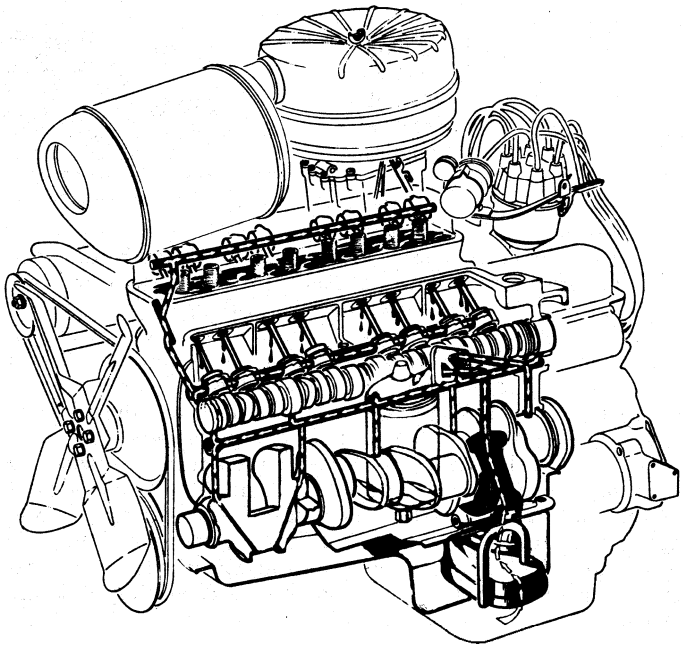
A system of SAE numbers, from 5 to 70, is used by refiners to designate the range within which the viscosity of an oil falls; the lower the number, the lighter the body of the oil. Oils of SAE 30 and lower are classified according to their rates of flow at 130°; the higher viscosity oils are tested at 210°. The letter W after the number indicates that the oil is rated at zero temperature and is, therefore. suitable for winter use. Multi-rated oils. such as 10W-30, contain additives that oppose the tendency of the oil to thicken at low temperature. thus making the same oil satisfy both summer and winter requirements.

Automobile engine lubricants are also classified according to the severity of the operating conditions for which they are suitable by the code letters ML, MM, and MS stamped on the container. The ML grade is recommended only for light-duty service. MM for moderately severe conditions, and MS for severe conditions requiring a heavy-duty oil These oils differ principally in the types and quantities of additives included.

Oil filters, if regularly serviced, are capable of removing solid contaminants from crankcase oil. There is. however, a possihility that chemical reactions may form liquids that are corrosive and damaging to the engine. Depletion of the additives that give the oils needed properties also limits their useful life.

The lubrication system is fed by the oil sump that forms the lower enclosure of the engine. Oil is taken from the sump by a pump, usually of the gear type, and delivered under pressure to a system of passages or channels drilled through the engine parts. In some instances a full-flow filter is interposed between the pump and the main oil passage extending the length of the engine. In other engines bypass filters bleed off a small quantity of oil continuously from the system and return the filtered oil to the sump.

Oil is supplied under pressure to all of the crankshaft and camshaft main bearings. Adjacent crank throws are drilled for oil to flow from the supply at the main bearings to the crankpins. Leaking oil from all of the crankshaft bearings is sprayed on the cylinder walls, cams, and up into the pistons to lubricate the piston pins. Additional passages intersect the cam follower openings and supply oil to hydraulic valve lifters when used. A spring-loaded pressure-relief valve maintains the pressure at the design value. Fig. 17 shows the lubrication of a typical V-8 engine.



BY COURTESY OF GENERAL MOTORS CORP.

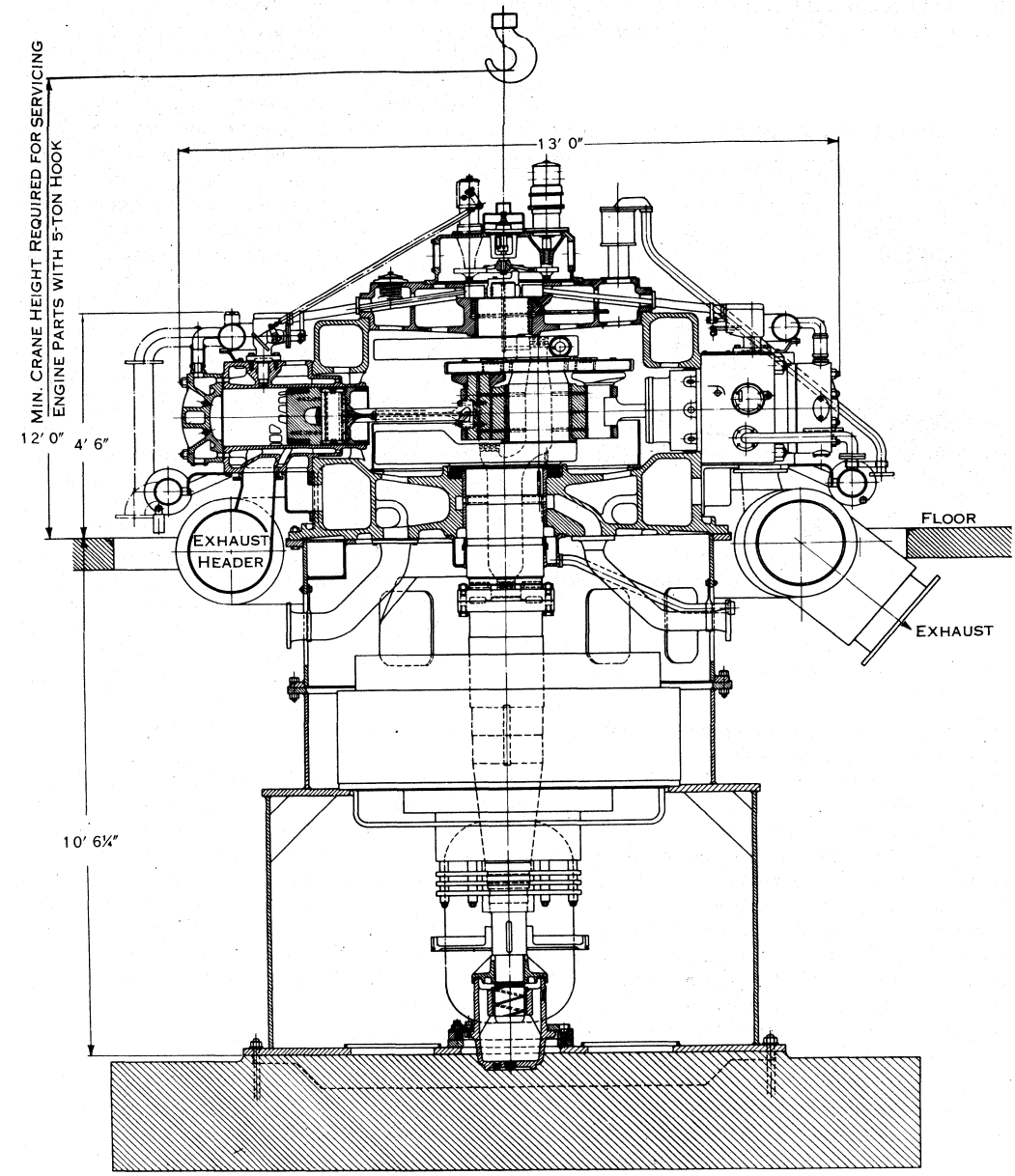
FIG. 17.— LUBRICATION SYSTEM OF AN AUTOMOBILE ENGINE

Gas Engines. — Gas is burned in two distinctly different groups of engines — large stationary power plant types and automotive types used in trucks, buses and tractors. Stationary gas engines

are used extensively in geographical regions where natural gas is available at a lower price per British thermal unit than must be paid for any other type of fuel. An additional advantage of 'natural gas used with spark-ignition engines is that it is more resistant to self-ignition than other fuels. permitting higher compression ratios to be used with higher efficiency and greater fuel economy. Low-cost power is the important factor in these engines. and brake thermal efiiciency of more than 40% is reported, more than is claimed for any other type prime mover.

Large stationary power plant engines were originally of the cylinders-in-line type, hut space requirement and engine cost considerations led to the development of vee-type and horizontal radial type engines. Two major engine manufacturers build radial gas engines in the United States.

Fig. 18 shows a cross section of a radial engine with a vertical crankshaft directly connected to a direct-current generator. The engine room is located on the floor above the ground floor where the generators are carried on the foundation which supports the entire power plant. This is a two-stroke-cycle engine with 12 cylinders of 14-in. bore and 16-in. stroke, developing up to 2,125 h.p. and 1,500 kw. at 400 r.p.m. Scavenging and charging are through two sets of ports in opposite sides of the cylinder walls and poppet valves are eliminated.



BY COURTESY OF NORDBERG MANUFACTURING CO.

FIG. 18 — SECTIONAL VIEW OF A RADIAL SPARK-IGNITION GAS-BURNING ENGINE

The salient features of the radial engine are high power output per unit of floor space, low weight, high mechanical efficiency because of few bearings. single-throw crankshaft and perfect balance. Operation on natural gas with spark-ignition at a compression pressure of 275 lb. per square inch and a maximum cylinder pressure of 650 lb. per square inch is possible because of the high antiknock quality of the fuel and the lean mixtures used. Gas is supplied at 20 lb. per square inch to mechanically actuated gas inlet valves located above the inlet ports in the top surfaces of the cylinders that admit the fuel into the stream of scavenging air brought in from headers below the floor. Two spark plugs at the top and bottom of each cylinder head fire at slightly different angles before top dead centre. A unique feature of this engine is the restraining linkage that prevents rotation of the single master bearing to which the inner ends of the connecting rods are pinned.

Automotive gas engines obviously cannot operate on natural gas because of the large volume of gas that would have to be carried. These engines burn propane-butane mixtures that are liquefied hy compression to about 185 lb. per square inch. These gases are important by-products of petroleum refinery operation and are available on the market as liquefied petroleum gases (LPG). Gases with similar liquefying characteristics also are taken from the ground at petroleum wells. The supply of these gases is large in proportion to the demand and, particularly in oil-producing regions. they are priced below the cost of gasoline.

The necessity of storing LPG in steel bottles or cylinders designed to withstand 250 lb. per square inch is a serious handicap attending its use; nevertheless its excellent combustion characteristics for spark-ignition engines make it attractive. High antiknock quality, high energy content or heating value per pound and high volatility, which facilitates mixture formation, give LPG excellent performance characteristics. The high antiknock quality permits compression ratios several units higher than are practical uith gasoline, resulting in higher thermal efficiency and fuel economy.

The fuel system that must be installed requires, in addition to the heavy steel container, pressure regulators. a vaporizer heated by the engine coolant and a gas carburettor. The fuel is supplied to the vaporizer as a liquid and is prevented from freezing because of the refrigerating effect of its vaporization by the heat received from the coolant. The LPG carburettor is simpler than the gasoline carburettor because special compensating devices are unnecessary.

See also AIRCRAFT PROPULSION; AUTOMOBILE; DIESEL ENGINE.

BIBLIOGRAPHY.—Peter M. Heldt, *High-Speed Combustion Engines* (Nyack, *NY.*, London, 1946); Lester C. Lichty, *Internal-Combustion Engines,* 6th ed (New York, London, 1951); Edward F. Obert, *Internal Combustion Engines,* 2nd ed. (Scranton, Pa, 1950); Sir Harry R. Ricardo, *The High-Speed Internal Combustion Engine,* 4th ed (Burbank, Calif, London, 1953); H L. Solberg, O C Cromer and A R Spalding, *Elementary Heat Power,* 2nd ed. (New York, London, 1952). (O. C. C)

INTERNATIONAL, THE. The term "international" is used by many groups with an international membership, such as the international associations of trade unions. Politically, however, the term has been fastened upon international organizations devoted to the transformation of the "capitalist" into a "socialist" world order.

The First International. — The idea of an international revolutionary association was first entertained by the French Jacobins of the 1790s. Before the revolutions of 1848 there were already several organizations, such as the French Alliance des Justes (directed by Louis Auguste Blanqui), the Italian Giovane Europa (directed by Giuseppe Mazzini) and the German Bund der Kommunisten (led by Karl Marx and Friedrich Engels), aiming at creating a revolutionary International. None of them, however, achieved that aim, though political co-operation between various national movements during the revolutions of 1848 was quite close.

The first successful attempt was made in 1864 when, under the prompting of several strong British trade unions. with the organizational and theoretical guidance of Marx and Engels, the International Working Men's association, known as the First International (1864–72), was founded. Its importance at the time was much overrated. Most of the British unions and important sections of the budding continental labour movement (the Blanquists in France, the Lassalleans in Germany) held aloof. Apart from fighting against the importation of strike breakers from abroad, the First International achieved nothing tangible and had no real influence upon the growth and ideological development of labour movements in the bigger countries. The unfolding of its banner did, however, do much in stimulating the emergence and growth of Socialist labour organizations in Spain, Italy, Belgium, the Netherlands and Scandinavia.

The International served as an important forum of debate, and its annual or biennial congresses became the platform where Marx's centralist socialism and the anarchism of the Russian Mikhail Bakunin clashed. When, in March 1871, the Paris Commune was formed, Marx. in a pamphlet written on behalf of the International, interpreted the Paris revolutionary government's policy as identical with his own principles. This raised violent objections both from the British unions, unwilling to be accomplices of violence, and from the Anarchists, uho regarded Marx's interpretation of the Commune as an usurpation. At its Hague congress in 1872 the First International split between Marxists and Bakuninists. The latter, actually controlling the majority of the membership, lost by a narrow margin because the Italian section, entirely Bakuninist, had broken with the International before the congress. The Bakuninists thereupon created their own Anarchist International. which adopted the official name of the International Working Men's association and continued to exert a fluctuating but at times considerable influence on the labour movements of southern Europe and of Latin America (also, to some extent, on those of the C.S., Australia, the Netherlands and Scandinavia) until it finally collapsed at the end of the Spanish Civil War (1936–39).

Marx moved the offices of his fragment of the First International to New York city. It expired soon after, on July 15, 1876, in Philadelphia.

The Second International, to 1920.—The Second International was formed at a congress in Paris in 1889 and at once adopted a statute leaving an ample measure of independence to the affiliated national parties, thus securing a much wider range of adherents than the First had had. Since in the meantime the labour movements of nearly all European countries had grown in size and experience and could very well stand on their own feet, the real influence of the Second International was perhaps even smaller than that of the First. Yet, since contact between Socialist and Labour movements of various countries was quite considerable during that period, membership of the International was valued by practically all European Socialist and labour parties as a certificate of their being bona fide representatives of labour interests. Thus the International, by threatening nonrecognition or expulsion of dissident groups, could prevent splits and occasionally enforce a merger of various labour groups within one country (as in France in 1904).

As the First, so the Second International became a debating platform for the various tendencies in international socialism: for orthodox Marxists such as August Bebel and Jules Guesde, for less rigid "revisionists" and "reformists" such as Jean Jaurès and Eduard Bernstein and, somewhat later, for a new extreme left represented primarily by Nicolai Lenin and by Rosa Luxemburg.

World War I.—In the decade preceding World War I the International had entertained a vigorous agitation against armaments and against the danger of war; at its Stuttgart congress of 1907, on a motion of Lenin and Luxemburg, it had even pledged itself to exploit any possible war for revolutionary purposes. These too-ambitious aspirations proved futile when, in Aug. 1914, by far the greater part of the Socialist movements in the belligerent countries supported their several governments. The attitude to the war was sharply debated in all parties throughout the years 1914–18; but only the German Social-Democratic party split over the question of supporting the war, in 1916–17. In 1915, however: the Swiss and Italian Socialist parties. which were pacifist in their majority, summoned "internationalists" from belligerent and neutral countries to a conference at Zimmerwald, Switz., which created a liaison office and issued a manifesto in favour of the class struggle and of the peace movement. Another conference of the same groups followed in 1916, at Kienthal, Switz.

Bolshevism and *the Vienna* International.—Lenin, who took part in both these conferences but failed to influence them, had before the war founded the Bolshevik group among the Russian Marxists and developed a doctrine hostile to the self-determination of the proletariat and stressing almost exclusively the need for a small group of dedicated professional revolutionaries. In 1914 he concluded that all other Socialist parties had "betrayed" their revolutionary programs and with them the proletariat and that the only safeguard against a repetition of this collapse was the extension of his concept of a revolutionary vanguard party to the whole world.

Already in Sept. 1914 he had launched the slogan of a "Third Communist International" and, in opposition to the pacifism of the Socialist left wing, the program of "transforming the imperialist war into civil war." He did not find much of an audience for these ideas until, in Nov. 1917, he had captured power in Russia; but even then the civil war in his own country at first prevented him from effectively controlling any section of the western European labour movement. The great strikes of Jan. 1918, which shook the Central Powers to their roots. were inspired by sympathy with the Soviet system but not in any sense directed from Moscow. The "Soviet republics" of Hungary (March–July 1919) and of Bavaria (April 1919), while invoking the Russian model, were not in any specific sense attached to Moscow.

When the war was over, the Socialists tried to rally, but the antagonism between patriots and pacifists could not at first be overcome. The patriots, supported by the German Socialist right wing and by the British, Belgian, Dutch, Swedish and Danish Socialist and labour parties, simply rebuilt the Second International. The pacifists, in 1920, at a congress in Vienna, Aus., founded an International mainly supported by the German left wing, by the Eritish I.L.P. (Independent Labour party) and by the Austrians, the Swiss and the French.

The Third International, or Cornintern. — The Cornintern, that is, the Communist or Third International, founded in Moscow at a conference in March 1919, was at first entirely unrepresentative of anything except the Bolshevik regime in Russia. Grigory Zinoviev, one of Lenin's oldest supporters, was elected its first president. The most important non-Russian section, the German Spartacusbund, was in ruins at the moment of the Comintern's

first congress, since its leaders, Karl Liebknecht and Rosa Luxemburg, had been murdered and its ranks shattered in consequence of an ill-timed attempt at capturing power two months before.

The Congress *of 1920.*—In 1920, however, with the Russian civil war over. the Comintern could carry through a frontal attack against the Vienna International. Continuing their old feud against the Zimmerwald majority and invoking the experience of their own victory, the Russian Communists challenged the pacifists to join the ranks of the Comintern. while at the same time laying down 21 stringent conditions for admission. These were so framed as to make access impossible to most of the pacifist leaders, in order that the masses which might join should come directly under Moscow's control. Indeed. the acceptance of control from the Executive Committee of the Comintern (E.C.C.I.), which mas itself actually controlled by the Russian Politburo, was stipulated among the 21 conditions. which also provided for periodical purges, for the creation of a secret *Apparat* side by side with the official party (even where the latter enjoyed perfect democratic freedom) and for measures to disrupt the armed forces of all "capitalist" countries; great stress moreover was laid on work in the colonial and backward areas. as Lenin expected the world revolution not to be purely proletarian,but to emerge out of an alliance of proletarian revolutionaries in the west with national revolutionaries in the east. These 21 conditions were submitted to the second world congress of the Comintern (July 1920) and there accepted. The German Independent Social-Democratic party (the pacifist left wing of the German labour movement), the French Socialist party and, as iar as possible, other Socialist parties were then split, for and against the 21 points.

The Vienna International, shattered by these divisions, was merged with the restored Second International in 1923. The Communists in many European countries, especially Germany, France, Italy, Bulgaria and Norway, had become a mass party.

Yet this favourable position could not be maintained for long. In March 1921 (only a few months after the splitting oi the German Independents), the German Communist party, by Moscow's orders. was involved in an absurd rising (interspersed with criminal acts') and collapsed amid the indignation of its own members. The French Communist party, in a slightly more protracted process. disintegrated under inner dissensions.

The Italian and Norwegian Socialist parties, originally accepted into the ranks of the Comintern without a split, were split under the 21 points soon aiter; and in both cases Moscow kept only a small fraction of its original adherents. A congress for the eastern nations, held at Baku. U.S.S.R.. in Sept. 1920 and mostly attended by Moslems. had at first seemed to hold out splendid prospects; but its effects evaporated in the unfavourable Moslem milieu almost without leaving a trace. By 1922 the Comintern found itself reduced to insignificance.

The *United* Front.— In the meantime. however, the tactics of frontal attack on western governments and Socialist parties alike had been replaced by the tactics of the United Front. endorsed by the third world congress in the middle of 1921. Under this policy any merging with the Socialist parties was to be sternly rejected, but at the same time offers of co-operation on specific points (*e.g.*, wages. taxes and the defense of democratic rights) were to be made. The Communists' suggestions were in each case framed to appear quite moderate but were in iact incompatible with the allegiance of the Socialist parties to a free democracy.

Germany became the model country for the new tactics. which were quite successful there since they involved a temporary renunciation of revolutionary verbiage and a new interest in the practical problems of working-class life. Trade-union work (also highly developed in the British Communist party) and municipal activities became the chief support of Communist propaganda, and the parties effectively adopting the new tactics again gained in membership. In the political field the tactics of the United Front led to the strengthening and radicalization of a left wing within the Social-Democratic parties (especially in central Germany) ready to co-operate with the Communists against their own party leaders. The chief drawback, at first, appeared to be that the new tactics carried disruption into the Communist parties themselves, which, while exerting pressure upon the Socialists, were now also exposed to pressure from them.

Negotiations with Socialists involved compromise. How far could a Communist go in that direction? Several parties, notably the French and the Italian, refused to apply the new tactics in earnest; in others, for example the German, a left wing grew to fight against them.

Triumph of Stalinism.— With Lenin dying. the first serious symptoms of internecine struggle within the Soviet Communist party appeared and rapidly intermingled with the antagonisms existing in the Comintern. The latter came to a head when the German Communist party, in 1923, banking on the effects of the French occupation of the Ruhr and of runaway inflation, prepared a rising which, they expected, would be supported by the left-wing Socialists. That help was refused at the last moment, the plan for a rising foundered, the Communist ministers who had joined the Socialist provincial governments of Saxony and Thuringia were ejected by the military, the party itseli was prohibited for a short period. and its influence again collapsed, dragging into limbo the prestige of the United Front tactics. The right wing of the German party was removed from leadership by the infuriated members, who replaced it with left extremists, and in Moscow every group attempted to exploit the defeat. which had shattered all hope of ending the isolation of the U.S.S.R. Zinoviev half supported the left wing, which helped him to defeat L. Trotsky; and the fifth world congress of the International, in the middle of 1924, endorsed a more extremist policy.

But Zinoviev's tactics were short-sighted, as the victorious left wing of the German and also of the French, Czechoslovakian and other Communist parties soon turned against the policy, then propounded by the rising J. V. Stalin, of "socialism in one country" —a policy that left no importance to the Comintern. Soon the left extremists turned anti-Soviet too. thus providing a splendid argument for Stalin against Zinoviev. In the summer of 1925 the German left extremists were removed from their leading positions by Moscow; in Dec. 1926 Zinoviev had to resign the presidency of the Comintern; and in 1927, when Zinoviev and Trotsky had joined hands against Stalin, almost the whole left wing was expelled in all Communist parties as "Trotskyite."

Comintern developments now ran parallel to Soviet developments. The Chinese Communist party had risen to great influence in the revolutionary Kuomintang government by tactics closely patterned on those of German communism in 1923. But the divisions between right and left. which had torn the German party, also paralyzed the Chinese. In 1927, largely through acting on orders irom Stalin (who supported the right wing), it suffered a crushing defeat. just at the time of Stalin's campaign against Trotsky and Zinoviev.

When Trotsky and Zinoviev had been expelled. however, Stalin turned against the international right wing, led by N. I. Bukharin, who had replaced Zinoviev as the Comintern's president. Bukharin had to give this position up (actually at the sixth world congress in 1928, formally in the spring of 1929) and was for a short time replaced by V. M. Molotov. The latter, however. soon ceded control to Dmitry Manuilskiy, a second-rank Bolshevik, who was appointed not president but only secretary-general. Bukharin's supporters all over the world were simultaneously expelled irom their parties, except those who, like the Italian Palmiro Togliatti and the German Gerhart Eisler, capitulated before Stalin. The Comintern was now wholly Stalinist, wholly totalitarian.

The First Five-Year-Plan.—The U.S.S.R.'s first five-year plan opened a new era of leit extremism which had to be closely copied by the Comintern. All vestiges of contact with the Socialists were now removed, the latter were denounced as "Social-Fascists," the trade unions were split and the Communists began a show of co-operation not with the Socialists but with the Nazis and other groups of the extreme right. In most countries, both west and east, these tactics almost at once reduced the Communist parties to nullity; hut in Germany, shaken as the country was by economic and political crisis, the party achieved considerable electoral successes, though far below those of the Nazis. When the Nazis came to power, the German Communists were crushed, almost

without leaving a trace of their former mass influence.

The Popular Front.—After the end of the first five-year plan a more "liberal" attitude prevailed for a short time in the U.S.S.R.; and this, combined with the failure to come to an understanding with Germany. prompted the plan to gain control over the international policy of the western democracies, beginning with France, by setting the local Communist parties on a road which would give them direct political influence. This necessitated a plausible pretense of having renounced the idea of world revolution, and this in its turn involved a return to the United Front policy of the early '20s, without any of the inhibitions, restrictions and internal feuds which had hampered it originally. Offers of co-operation were now no longer limited to the Socialists but extended also to the "bourgeois" left and centre. Thus the class struggle ceased to be the basic doctrine of international communism; and programs and slogans became strictly pragmatic, so that not infrequently the Communists appeared much more moderate than the Socialists. The bloc thus created in France was baptized the "Popular Front." The seventh and last world congress (1935) endorsed that policy and elected Georgi Dimitrov president, while Manuilskiy remained the real manager.

The basic hypocrisy of such a policy stood in the strongest possible contrast to the genuine revolutionary fanaticism of the early days and, involving an exceedingly flexible opportunist kind of manoeuvring. could only be carried out by men unquestioningly obedient to orders. Such groups of leaders of the various Communist parties were now for the first time available; the last group of convinced left extremists had been weeded out from the national leaderships in the transition from the first five-year plan to the "liberal" phase. and the remaining leaders (Maurice Thorez in France, Ernst Thalmann—until his arrest by the Gestapo—in Germany. Togliatti in Italy. etc.) were docile.

The bloc of left and centre groups formed under the Popular Front policy in France gained an ample electoral victory in June 1936 and was able to form a government. The Communists. however, who through that policy had risen from nullity to very large influence, refused to participate in the government and, from its very inception, harassed it by organizing strikes, by promoting an inflationary financial policy and by undermining the Socialist organizations. A particularly grave difficulty was created for the French Popular Front by the outbreak of the Spanish Civil War.

This war was not planned by the Communists: they were at the time quite insignificant in Spain; and any such planning would not have tallied with the long-term approach to power characteristic of the Popular Front policy. Once the war had started, however, the Communists made every effort to gain control of the Republican camp, using as a means of pressure the military help sent by the L.S.S.R.

Characteristically, once they had got hold of a large part of the police forces. they turned their efforts against the revolutionary left wing of the movement, the Anarcho-Syndicalists. left-wing Socialists and Trotskyites. whom they crushed. They played a key role in building up the new army and administration, thus securing further power; but in view of the very sharp turn to the right that simultaneously took place in the U.S.S.R. (where the "Old Guard" was exterminated) and the international complications that a Communist victory in Spain would have created, it is doubtful whether the Communists ever wanted fully to win the war. In its later stages they found themselves involved in sharp antagonisms with the moderates of the Republican camp, who resented foreign domination and a totalitarian police regime. Ultimately all other groups of that camp, together with the most important military leaders. rose against the Communists in March 1939 and enforced capitulation before Gen. Francisco Franco.

The French Communists. meanwhile, had vainly attempted to push France into direct intervention in Spain. Divergences about foreign policy and currency inflation: however, undermined the Popular Front government until, after repeated reshuffles, it collapsed in April 1938. In Nov. 1938 the Communists drove the Confédération Générale du Travail into a general strike, which failed miserably and led to the virtual collapse of the C.G.T. The Popular Front had ended in complete failure, but the French Communists had immensely enhanced their strength and influence—the first lasting success achieved by international communism.

World War II.—By this time Stalin had already lost interest in any kind of co-operation with free countries or with democratic parties and was preparing his pact with Adolf Hitler. One of the implied or, at any rate, unpublished stipulations of that pact seems to have been that the Communist parties abroad would support the Nazi cause.

This, in the case of the German Communist party in exile, went to the point of overtly anti-Semitic and almost overtly pro-Nazi propaganda, while simultaneously the British and the French Communists (the latter from underground) fiercely attacked the Allied effort in the first years of World War II. When Hitler invaded one western country after another, the Communists joined in the Nazi appeals for co-operation with the invader. Everywhere they tried to gain control of the national trade-union movement and of the largest possible section of the government machine.

That policy wore thin during the last months before Hitler's attack on the U.S.S.R. and was dramatically reversed at the moment of the Nazi invasion. The western Communists now adopted, as the Chinese under Mao Tse-tung had done since 1937, the slogan of the democratic struggle against fascism. In a repetition of the Popular Front phase, the Communists, under cover of their newly discovered "patriotism," continued trying to infiltrate governments and political parties and to undermine governments and all the non-Communist political leaderships—with, however, considerably more camouflage than ever before. These dispositions, together with the U.S.S.R.'s skilful foreign policy, undoubtedly helped to create that atmosphere of uncritical goodwill toward the Soviet regime which was a major factor in bringing about a postwar settlement very favourable to Stalin.

The main field of Communist action was, however. in territory occupied by the enemy. The Communists, almost everywhere superior to any competitors in underground organization, successfully infiltrated some of the other resistance movements (*e.g.*, in France) and defeated others in a sanguinary civil war within the war (*e.g.*, in Yugoslavia). In China they used guerrilla warfare to subdue vast territories which, at the moment of Japan's capitulation, were withheld from the recognized government's control. These tactics laid the foundations for Mao Tse-tung's later ascendancy in China and at least contributed to Tito's in Yugoslavia; and after the war it became clear that the Communists had considerably strengthened their position in France and in Italy, though in these two countries the presence of U.S. and British armies had counteracted their influence over the guerrilla warfare. In the far east, moreover, the guerrilla phase, even outside China, had greatly increased the Communists' influence and prestige.

In eastern Europe, on the other hand, the Soviet armies installed congenial governments even where no guerrilla warfare had prepared the ground.

On May 22, 1943, the Comintern, which at the beginning of the war had been removed to Ufa in the Urals, was officially dissolved. Actually, its offices continued to exert their old functions and returned to Moscow. Yet the return home of all the emigration leaders weakened the *Apparat:* in the last years of the war and in the early postwar period Moscow's control, if never absent. was weaker and more intermittent than ever before. This led to the emergence of new factions of an international character; extremists such as Tito and the Frenchman André Marty stood for immediate Communist revolution. while moderates such as Togliatti advocated a much more circuitous strategy. The extremists are supposed to have been backed by Andrei Zhdanov, second man of the Moscow Politburo, but Stalin seems to have sided with the party of caution. After attempts at direct capture of power had failed in Belgium and in Greece in 1944, the Communist parties everywhere adopted a "patriotic-democratic" line and in most continental countries joined in government coalitions.

The Corninform.—The "patriotic-democratic" policy broke down with the breakdown of co-operation between the eastern and

western powers. At a conference at Wilcza Gora in Poland in Sept. 1947, under the guidance of Zhdanov. a new official centre of international control. described as the Communist Information bureau or Cominform, was set up. Officially, it comprised only the Communist parties of the U.S.S R , of the eastern European countries and of France and Italy; in fact its jurisdiction was both farther-reaching and ampler in function than was admitted. Its formation initiated a phase of direct revolutionary aggression in many countries. The Communists everynhere left the national governments; revolutionary strikes took place in France and in Italy; in Feb 1948 a coup d'état in Prague completed the process of imposing Communist regimes on all countries originally occupied by the Soviet army: and the civil war in Greece. which had been simmering since 1946, suddenly took a grave turn. But in June 1948 the dissidence of Tito, nho had been one of the promoters of the Cominform. broke the backbone of its policy. Its offices were transferred from Belgrade, Tugos., to remote Bucharest, Rum.. and Zhdanov died in Aug. 1948. Thereafter the Cominform seemed to be confining itself to the issuing of anodyne propaganda, and Moscow's control over international communism was apparently directed from the Kremlin.

This statement, however, needs a qualification. Mao Tse-tung had risen to prominence in his own right, not, as all other Communist leaders had done, through Stalin's investiture; and it is clear that he never submitted to control of the ordinary type from Moscow. His conquest of China (1948–50) made him a world influence, and simultaneously he raised a claim to advise and control the Communist movement in all the colonial. semicolonial and backward countries. This did not eliminate Moscow's influence over any section of eastern communism, but whereas in the nest that influence was exclusive. in the east the claims of Moscow and of Peking had constantly to be adjusted behind closed doors.

In the west, on the other hand. Moscow's control was hampered by the severe internal antagonisms besetting the Kremlin leadership in the years immediately preceding Stalin's death. These antagonisms paralyzed activity and interfered with the purge of "Titoists." The sensational purge trials in Hungary, in Bulgaria and in Czechoslovakia and the less sensational purges in other Communist parties after Tito's defection may well have been connected with developments inside the Kremlin (the trial of Rudolf Slansky in Prague was clearly a signal for the anti-Semitic campaign which very shortly after resulted in the notorious case of the Jewish doctors in the U.S.S.R.). When Stalin at last died (1953). further divergences of policy seemed to be discernible among Communist parties not only in the non-Communist world but even in the U.S.S.R.'s satellite countries. (Fz. B.)

The Socialist International. — After its reconstitution the Second or Socialist International, which with the Vienna International had been merged in 1923, never again attempted to define principles for the policy of its affiliated parties within their several countries. Nonetheless, it made frequent pronouncements on international policy. backing the various peace policies between World Wars I and II. It also campaigned against the totalitarian regimes of right and left. With Hitler's victories in Europe its organization collapsed. Afterward it was reconstituted by gradual stages. The first meeting of Socialist parties, held in England in 1946, set up a Socialist information and liaison office. To this was added a consultative committee, which in 1947 developed into the Committee of the International Socialist Conference, or Comisco, comprising one representative of each member party. This organization. consisting of Comisco and periodic conferences but usually referred to simply as Comisco, continued until 1951, u-hen it was decided to reconstitute the Socialist International.

The rehirth took place at the eighth postwar international Socialist conference, held at Frankfurt-on-Main. Ger., in July 1951. A declaration of the "Aims and Tasks of Democratic Socialism" was adopted. together with a statute of the International which determined the structure of the organization. The main structure consisted of three institutions: congress. council and bureau. All member parties and associated organizations were to be represented at the congress. which should meet at least once every two years. Each member party might send six delegates to the congress, but each delegation had only one vote. In addition to making political decisions. the congress was empowered to amend the constitution of the International and to decide upon the admission or expulsion of members. This power to determine its membership was the only sanction at the International's disposal.

The council was to be as representative as the congress but a smaller body, the number of delegates being limited to two from each party. It was to meet two or three times a year and had the power to take political decisions. In both the council and the congress every effort was to be made to reach unanimity. Decisions taken by a majority vote were not binding on, the minority. Each member party of the International was to retain its autonomy. The International was thus not a supreme authority but an instrument of co-operation between Socialist parties.

The bureau was to be a small body of 12 members, which could not be fully representative of the International's membership. Its functions were therefore administrative. It was to arrange the meetings of other organs of the International and to supervise the work of the permanent secretariat in London.

Directly associated with the Socialist International mere the International Socialist \Vomen's secretariat, the International Union of Socialist Youth and the Socialist Union of Central-Eastern Europe (composed of Socialist parties in exile). all represented at meetings of congress and council with the right to speak but not to vote. A press centre established in Paris served as an agency for Socialist newspapers and convened a number of experts' conferences to examine general problems requiring specialist knowledge, such as industrial democracy or policy for the underdeveloped areas of the world.

The general rule was that there should be one vote from each country. but an exception was made for Japan. where the Socialist party split after its admission to the International. In 195j the International comprised Socialist, Social-Democratic or Labour parties from Argentina, Austria, Belgium. Bulgaria (exiles), Canada, Czechoslovakia (exiles), Denmark, Estonia (exiles), Finland. France. Germany. Great Britain. Greece, Hungary (exiles). Iceland. India. Israel, Italy, Jamaica. Japan, Latvia (exiles), Lithuania (exiles). Luxembourg, Malaya, the Netherlands. New Zealand, Norway, Poland (exiles), the Saar, Spain (exiles). Sweden. Switzerland. Trieste. the United States of America (non-voting observers), Uruguay and Yugoslavia (exiles), as well as the International Jewish Labour Bund and the World Union of Zionist Socialist Parties. In Jan. 1953 at Rangoon an Asian Socialist conference was formed, on the model of the old Comisco. comprising parties from Burma, India. Indonesia, Israel. Japan. Lebanon, Malaya and Pakistan. (S. RE.)

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT: see INTERNATIONAL MONETARY FUND; BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL.

INTERNATIONAL CHAMBER OF COMMERCE. A world forum of private enterprise, the I.C.C. was founded in 1919 by business leaders from Belgium, France, Italy, the U.K. and the C.S. The organization works for world trade expansion through advocacy of broad international economic policies, reduction of trade barriers and provisions for a central clearinghouse for the exchange of views among businessmen.

The I.C.C. engaged in the economic work of the League of Nations and in 1946 was granted the highest consultative status with the Economic and Social council of the United Nations. Permanent liaison with the United Nations was established through the international headquarters at Paris. Fr., and its special offices in New York, N.Y., and Geneva, Switz. Permanent contact also is maintained with numerous other international organizations.

The congress. or general assemhly of members, which determines the general policy of the I.C.C.. meets biennially in a major world city. Congresses have been held in Paris, Lisbon, London, Vienna. Washington and other world centres. The governing body is the council on which each national committee is represented. Usually the council meets in Paris two or three times a year. In the interval between council meetings, the president,

elected for a two-year term, has the advice of an executive committee The secretary-general heads the international secretariat, which includes specialists in leading fields of business and international relations. National committees are the essential links between international headquarters and domestic business communities.

The range of work of the I.C.C. falls into four broad categories: (1) economic and financial policy; (2) transport and communications; (3) production. distribution and advertising; (4) law and commercial practice. Major objectives in the 1950s included a campaign for return to currency convertibility; a code of fair treatment for private foreign investments; elimination of double taxation; co-ordination of transport; simplification of trade formalities; statements on tariff policy; a convention on the enforcement of international arbitration awards; a code of standards of advertising practice; and similar matters. From 1923 the I.C.C. maintained a court of arbitration which provided an inexpensive and quick method for settlement of disputes which might arise among businessmen in connection with commercial transactions.

In 1954 membership extended into 57 countries, of which 30 had organized national committees in five continents. (R M. LI.)

INTERNATIONAL CIVIL AVIATION ORGANIZATION. The ICAO was established by the Chicago Convention on International Civil Aviation in 1944 to foster development of safe, regular and efficient international civil aviation. The principal body of the organization is the assembly, meeting annually until 1956 and thereafter at longer intervals. A permanent council of 21 contracting states is elected by the assembly every three years. Subordinate to the council were the Air Navigation commission (12 technical experts nominated by states); the Air Transport committee and the Joint Support committee (limited membership from council-member states); and the Legal committee (open to all contracting states). The headquarters of the permanent bodies and secretariat were established in Montreal, Can., with five regional offices in Bangkok, Thailand, Cairo, Egy., Lima, Peru, Mexico City and Paris.

Technical activities of the ICAO comprise establishment of regional plans giving details of specific facilities and services required in each region; and of international technical specifications related to airports, air traffic, telecommunications, meteorology, charts, operations, airworthiness and personnel. Such plans and specifications originate in regional and technical meetings, convened from time to time, whose recommendations are reviewed by the Air Navigation commission and approved by the council.

Economic activities channeled through the Air Transport committee include studies and recommendations concerning international airmail; exchange of commercial rights in air transportation: charges for airports and air-route facilities; publication of statistical data; and establishment of specifications on facilitation of air transport (simplification of forms and procedure for immigration, customs, health and quarantine). Joint-support activities of the ICAO relate to agreements for joint financing of ground or water facilities (such as North Atlantic Ocean Station vessels) by member states. See also AERIAL LAW. (WR. B.)

INTERNATIONAL COURT OF JUSTICE, the principal judicial organ of the United Nations. which succeeded the Permanent Court of International Justice after World War II. For generations eminent statesmen, private persons and various organizations — national and international — have devoted much time and energy to efforts looking to the peaceful settlement of disputes between nations. Various methods of settlement have been advocated and at times resorted to. such as the use of good offices by other states, commissions of inquiry and conciliation, arbitration and judicial settlement.

Arbitration as a form of judicial settlement has been used by states over a long period of time — not generally but frequently. Many bilateral and a number of multilateral treaties and conventions providing for arbitration have been concluded from time to time, some relating to then-existing disputes and others relating to disputes or categories of disputes which might arise in the future. Of the multilateral conventions providing for arbitration those which stand out are the Conventions for the Pacific Settlement of International Disputes concluded at the first and second peace conferences held at The Hague in 1899 and 1907. The convention of 1899 contains provisions on the use of good offices and mediation. international commissions of inquiry and elaborate provisions designed to regularize arbitral procedure. It also provides for the establishment by the signatories of a panel of jurists called the Permanent Court of Arbitration (although in no sense a court) to which each state, party to the convention, should appoint four members, and from which governments desiring to arbitrate might choose competent arbitrators.

Although many international arbitrations both before and following the Hague conventions constitute landmarks in the process of peaceful settlement of disputes, and the tribunals in such cases made notable contributions to an international jurisprudence, it was recognized that with all its virtues a system in which reliance is placed on ad *hoc* tribunals, as distinguished from an established court of justice. was not all that might be desired. The situation, as visualized by him. was epitomized by Elihu Root, the U.S. secretary of state, who, in instructions to the U.S. delegation to the second Hague conference, observed that the principal objection to arbitration rested not upon the unwillingness of nations to submit their controversies to impartial arbitration, but upon an apprehension that the arbitrators would not be impartial. He instructed the delegates to try to have the Permanent Court of Arbitration developed into a permanent tribunal composed of judges "who are judicial officers and nothing else, who are paid adequate salaries, who have no other occupation and who will devote their entire time to the trial and decision of international causes by judicial methods and under a sense of judicial responsibility."

The 1899 convention was revised, but as revised it fell far short of the pattern outlined by Root. It did not provide for judges "who are judicial officers and nothing else" and who would "devote their entire time to the trial and decision of international causes." Rather it continued the system of a panel of jurists from which arbitrators might or might not be chosen for particular cases.

However, the 1907 conference prepared and recommended to the powers represented at the conference a draft convention to establish a court of arbitral justice composed of judges to be elected for fixed periods of service and on a salary basis. But the project was not adopted by the states and the court was never established. Xevertheless the draft had its influence on subsequent developments.

Permanent Court of International **Justice.**—The next notable step in the process of developing an international judiciary was taken by the League of Nations in 1920, when, pursuant to article 14 of the covenant of the League, it took steps to establish the Permanent Court of International Justice.

Article 14 provided:

> The Council shall formulate and submit to the Members of the League for adoption plans for the establishment of a Permanent Court of International Justicc. The Court shall be competent to hear and determine any dispute of an international character which the Parties thereto submit to it. The Court may also give an advisory opinion upon any dispute or question referred to it by the Council or by the Assembly.

In Feb. 1920, the council appointed a committee of jurists to prepare a plan which it could submit to members of the League for adoption. The members of the committee were: Mineitciro Adatci (Japan), Rafael Altamira Y Crevea (Spain), Raoul Fernandes (Brazil), Baron E. E. F. Descamps (Belgium), G. F. Hagerup (Norway), Albert Geouffre de la Pradelle (France), B. C. J. Loder (Netherlands). Lord Phillimore (United Kingdom), A. Ricci-Busatti (Italy) and Sen. Elihu Root accompanied by James Brown Scott (United States).

The committee, following meetings at The Hague in June and July of that year, submitted to the council a draft scheme which, with certain modifications. was adopted by the council, and with still further amendments was approved by the assembly on Dec. 13, 1920. The text was attached to a protocol of Dec. 16, 1920, for signature and ratification by the members of the League.

By Sept. 1921, the requisite number of states, a majority, had given their approval and the draft became the statute of the Permanent Court of International Justice.

The statute prescribed the qualifications for the judges, the method of election and tenure of office, the court's jurisdiction, its mode of procedure, etc. The first court. consisting of 11 judges and 4 deputy judges, was elected by the council and the assembly on Sept. 14–16, 1921. Later, in 1930, the assembly elected 15 judges and 4 deputy judges. Still later, following the coming into force in 1936 of amendments to the statute, the deputy judges were eliminated and the court was composed of 15 judges elected as theretofore by the council and the assembly.

The court held its first meeting at The Hague. its seat, on Jan. 30, 1922 It held annual meetings thereafter until its work was interrupted by World War II. Its last meeting, an administrative one, was in Oct. 1945.

During its existence it rendered 23 judgments and gave 27 advisory opinions. The court was open to members of the League and also to states mentioned in the annex to the covenant. The conditions under which it should be open to still other states were to be laid down by the council. Acceptance of the jurisdiction of the court was not compulsory. States were free to bring their disputes to the court or not as they might see fit. However, they were privileged, under the optional clause of article 36 of the statute, to declare, either when signing or ratifying the protocol to which the statute was adjoined, or at a later moment, that they recognized as compulsory ***ipso facto*** and without special agreement, in relation to any other state accepting the same obligation, the jurisdiction of the court in any or all of certain specified categories of disputes. Such declarations might be made unconditionally or on condition of reciprocity on the part of several or certain states or for a certain time. During the existence of the court some 29 states accepted the compulsory jurisdiction in varying forms and for varying periods of time. During this same period 47 states signed the protocol of 1920, to which the statute was annexed, and all but 8 ratified it.

The United States did not become a party to the statute of the Permanent court, although efforts to have it do so were made in turn by Secretaries of State Charles E. Hughes, Frank B. Kellogg and Henry L. Stimson, supported by Presidents Warren G. Harding and Herbert Hoover, as well as by many private citizens who felt that such a tribunal held great potentialities for peaceful settlement of international disputes. A senate resolution for adherence that came to a vote on Jan. 29, 1935, failed to obtain the requisite two-thirds vote, and no further action to have the United States become a party to the statute was taken. Yet throughout the period of the court a U.S. jurist was on the bench.

Judges of the Permanent Court.—During its existence, the court had on the bench the following named judges who served respectively for the periods indicated:

Rafael Altamira (Spain), 1922–45
Dionisio Anzilotti (Italy), 1922–45
Ruy Barbosa (Brazil), 1922–23
A. Sánchez de Bustamante (Cuba), 1922–45
Viscount Finlay (United Kingdom), 1922–29
Hans Max Huber (Switzerland), 1922–30
B. C. J. Loder (Netherlands), 1922–30
Mineitciro Adatci (Japan), 1931–34
W. J. M. van Eysinga (etherlands), 1931–4j
T. G. Guerrero (El Salvador), 1931–45
Demétre Negulescu (Rumania), 1931–45
E. Rolin Jacquemyns (Belgium), 1931–36
Michal Rostworowski (Poland), 1931–40
Walter Schiicking (Germany), 1931–35
John B. Moore (United States), D. G. G. Nyholm (Denmark), 1922–30
Yorozu Oda (Japan), 1922–30
C. A. Weiss (France), 1922–28
E. da Silva Pessôa (Brazil), 1923–30
Charles E. Hughes (U.S.), 1928–30
Henri Fromageot (France), 1929–45
Sir Cecil Hurst (U.K.), 1929–45
Frank B. Kellogg (U.S.), 1930–35
F. J. Urrutia (Colombia), 1931–42
Charles De Visscher (Belgium), 1937–45
Wang Chung-hui (China), 1931–36
Åke Hammarskjöld (Sweden), 1936–37
Manley O. Hudson (U.S.), 1936–45
Harukazu Nagaoka (Japan), 1935–42
Cheng Tien-hsi (China), 1936–45
R. W. Erich (Finland), 1938–45

The deputy-judges were:

F. V. N. Beichmann (Norway), 1922–30
Demétre Negulcscu (Rumania), 1922–30
Wang Chung-hui (China), 1922–30
Mihailo Yovanovich (Yugoslavia), 1922–30
R. W. Erich (Finland), 1930–36
J. Caeiro da Matta (Portugal), 1930–36
Mileta Novakovich (Yugoslavia), 1930 36
Josef Redlich (Austria), 1930–36

The court was authorized by the statute to elect its president and vice-president for three years. The presidents were: Loder (Netherlands), 1922–24; Huber (Switzerland), 1925–27; Anzilotti (Italy), 1928–30; Adatci (Japan), 1931–33; Sir Cecil Hurst (U.R.), 1934–36; Guerrero (El Salvador). 1937–45. The vice-presidents were: Weiss (France), 1922–28; Huber (Switzerland) 1928–30; Guerrero (El Salvador), 1931–36; Sir Cecil Hurst (U.K.), 1937–45.

Establishment **of** International Court of Justice.—Following World War II and the advent of the United Nations, the League of Nations mas dissolved and with it the Permanent Court of International Justice. But that court was not dissolved until the new one—the International Court of Justice—had been established. By this time the nations, including the United States, were thoroughly convinced that a court of justice must have first rank in any organization for the maintenance of peace. This explains why the court was featured in the charter of the United Nations and why the statute was unanimously approved by the U.S. senate. Article 92 of the charter states:

The International Court of Justice shall be the principal judicial organ of the United Nations. It shall function in accordance with the annexed Statute, which is based upon the Statute of the Permanent Court of International Justice and forms an integral part of the present Charter.

Article 93 states that all members of the United Nations are ***ipso facto*** parties to the statute and states not members may become parties on conditions to be determined in each case by the UN general assembly upon recommendation of the Security council. The court consists of 1j judges, no two of whom may be nationals of the same state, elected by the general assembly and the Security council. They do not have life tenure as do members of the supreme court of the United States, for example, but are elected for periods of nine years and are eligible for re-election.

The seat of the court is at The Hague, but it may hold sessions elsewhere whenever it considers it desirable. Its first session was held at The Hague in April and May 1946.

It is a continuing body. The statute provides that it shall remain permanently in session, except during judicial vacations. It is also an autonomous body. It elects its president and vice-president, appoints its registrar and provides for the appointment of such other officers and clerical staff as may be necessary. The president and the registrar are required to reside at The Hague.

The Judges.—The judges, who must possess certain specified qualifications, do not represent the states from which they are chosen. They represent the entire international community of states. They are not selected by the governments of their states or even nominated by them; they are nominated rather by the national groups in the Permanent Court of Arbitration referred to above, or. in the case of states not represented on the Permanent Court of Arbitration, by national groups appointed for that purpose by their governments, the purpose being to remove the nominations as far as possible from political considerations.

Comparable safeguards were placed around the election of the judges. The statute provides that in such elections the general assembly and the Security council shall proceed independently of each other, and that at every election the electors should bear in mind not only that the persons to be elected shall individually possess the qualifications required "but also that in the body as a whole the representation of the main forms of civilization and of the principal legal systems of the world should be assured." Those candidates who obtain an absolute majority of votes in both the general assembly and the Security council are to be considered as elected. Further procedure is provided for the situation where, after the first meeting for the purpose of the election, one or more seats remain to be filled.

The judges receive annual salaries reasonably commensurate with their status. But they must be prepared to accept certain inhibitions; *i.e.*, they must refrain from all activities incompatible with their judicial functions. Specifically, they are forbidden to exercise any political or administrative function, or to engage in any other occupation of a professional nature; they are not permitted to act as agent. counsel or advocate in any case, and no member may participate in the decision of a case in which he has previously taken part as agent, counsel or advocate for one of the parties, or as a member of a national or international court, or a commission of inquiry, "or in any other capacity."

The purpose of the statute is to have at all times a court that is entirely free from bias or any preconceived notion as to the merits of any case coming before it. Each member is required, before taking up his duties, to "make a solemn declaration in open Court that he will exercise his po ers impartially and conscientiously." In order to facilitate the proper exercise of their judicial functions the members, when engaged on the business of the court, enjoy diplomatic privileges and immunities. Members are bound to hold themselves permanently at the disposal of the court.

While nine judges constitute a quorum, the statute requires that the full court shall sit except when it is expressly provided otherwise. The court may dispense with the sitting of one or more judges "according to circumstances and in rotation," provided the number of available judges is not thereby reduced below 11. In practice, the full court sits in all cases except where a judge is disqualified by reason of some previous connection with the case or is prevented by illness or other serious reasons from attending.

No judge may be dismissed unless in the opinion of all the others he has ceased to fulfill the required conditions.

Vacancies resulting from death or otherwise must be filled by the same method as that laid don-n for the first election. A member elected to replace a member whose term of office has not expired holds office for the remainder of his predecessor's term.

Obviously, since there are only 15 judges. cases are sometimes presented by states which have no national on the court. While the statute provides that judges of the nationality of each of the parties retain their right to sit in the case before the court, it also provides that, if the court includes upon the bench a judge of the nationality of one of the parties, the other party may choose a person to sit as judge; also that if the court includes upon the bench no judge of the nationality of either party each of the parties may choose a person to sit as judge. This privilege is frequently exercised. *Ad hoc* judges receive compensation for each day on which they exercise their functions.

Competence. — Since the function of the court is to pass judgment upon disputes between states, only states may be parties in cases before the court. It is open to all states parties to the statute and to such other states as comply with conditions laid down by the Security council, which conditions must not, in any case, place the parties in a position of inequality before the court.

At the time that the statute was being drafted, there was strong sentiment on the part of certain states, particularly the smaller ones. for giving the court compulsory jurisdiction; *i.e.*, making it possible for any state to bring an action against any other state without the latter's consent. This, it was argued, was warranted by the more than 20 years of satisfactory experience with the Permanent court. The opponents of this view felt that some states were not yet ready to accept compulsory jurisdiction, and that to try to force it upon them might cause them to decline to accept the statute at all. They favoured the adoption of the optional provisions in article *36* of the statute of the Permanent court. This was agreed upon, and that article became article *36* of the new statute. Under it parties to the statute may at any time file with the secretary-general of the United Nations a declaration accepting compulsory jurisdiction. A large number of states have done so.

The declaration mentioned may be made unconditionally or on condition of reciprocity on the part of other states, or for a certain time.

It was further provided in article 36 (paragraph *5)* that declarations made under the old statute conferring jurisdiction on the Permanent court which were still in force should be deemed, as between the parties to the new statute, to be acceptances of the compulsory jurisdiction of the new court.

The Anglo-Iranian Oil company case *(Great Britain* v. *Iran)* involved a declaration by Iran in 1933 under article *36* of the statute of the Permanent court. Although the court held that it did not have jurisdiction, it was only because it found that the declaration did not cover that particular case (judgment. July *22,* 1952; I.C.J. Reports [1952] p. *93).*

The court's jurisdiction was still further extended by article 37 of the statute, which stipulates that whenever a treaty or convention in force "provides for reference of a matter to . . . the Permanent Court of International Justice, the matter shall, as between the parties to the present Statute, be referred to the International Court of Justice."

The advisory opinion given July 11, 1950 (I.C.J. Reports [1950] p. *128).* on the international status of South-West Africa, and the judgment rendered July *1,* 1952, in the Ambatielos case *(Greece* v. *Great Britain; ibid.* [1952] p. *28)* are examples involving article 37 of the statute.

States which have not accepted compulsory jurisdiction may not be sued without their consent. A state may give its consent by entering into an agreement with another state or otherwise indicating its willingness to submit the dispute to the court, *See* the judgment of March *25, 1948,* in the Corfu channel case *(Great Britain* v. *Albania; ibid.* [1948] p. 15).

In 1954, the United States filed with the court two applications instituting proceedings against the Soviet Union and Hungary, respectively, and in 1955 like action was taken against Czechoslovakia and the Soviet Union, respectively, each complaint relating to certain aircraft incidents; also in 1955 Great Britain filed two applications instituting proceedings against Argentina and Chile, respectively, concerning sovereign rights in the antarctic. None of the defendant states had accepted compulsory jurisdiction, and on being informed of these actions by the registrar of the court, each in turn specifically declined to submit the dispute to the court. In consequence, the court was under the necessity of issuing orders removing the cases from its list.

The statute declares it to be the duty of the court to decide disputes in accordance with international law. It applies: *(1)* international conventions establishing rules recognized by the contesting states; *(2)* international custom, as evidence of a general practice accepted as law; *(3)* the general principles of law recognized by civilized nations; and *(4)* it may look to judicial decisions and the teachings of the most highly qualified publicists of the various nations as subsidiary means for determining rules of law. It may also decide cases *ex aequo et bono* (that is to say, on the basis of equity), if the parties agree. In the absence of such an agreement it must apply rules of law.

Procedure. — The official languages of the court are French and English; either may be used by the parties. Written pleadings and oral arguments presented in one language are translated by the court's staff into the other. The judgments and opinions are in both languages.

Cases are brought before the court either by the notification to it of a special agreement concluded by the parties or by the unilateral action of one of them through a written application addressed to the registrar. The proceedings are in two parts, written and oral. The written proceedings usually consist of two pleadings on each side and supporting documents. Oral arguments by counsel follow the written proceedings.

The court may also hear witnesses and appoint commissions of experts to make investigations and reports when necessary. Both these procedures were followed in the Corfu channel case *(Great Britain* v. *Albania)* decided April *9,* 1949.

The deliberations of the court are in private, but the judgments, which are by a majority vote, are read in open court. Any judge may file a separate opinion if he does not agree in whole or in part with the decision. Few decisions represent the unanimous opinion of the judges. The judgment is final and without appeal.

The question is frequently asked as to how decisions of the

court are enforced. This also troubled the minds of some of the delegates at the United Nations Conference on International Organization, held at San Francisco, Calif., when the statute was under consideration. To meet their wishes there was incorporated in article 94 of the charter an undertaking on the part of each member of the United Nations "to comply with the decision of the . . . Court . . . in any case to which it is a party," and a further provision that:

If any party to a case fails to perform the obligations incumbent upon it under a judgment rendered by the Court, the other party map have recourse to the Security Council, which may, if it deems necessary, make recommendations or decide upon measures to be taken to give effect to the judgment.

It should be remarked, however, that by the late 1950s there had been no known instance of the failure of a party to a case before the court, or before its predecessor, the Permanent Court of International Justice, to carry out a decision of either court. In the case of the Anglo-Iranian Oil company, *supra,* Iran declined to observe an order issued by the court, July j, 1951, under article 41 of the statute, indicating interim measures of protection to be taken by the parties pending final decision. But this is not to be regarded as an exceptisn to what has just been stated since such orders do not amount to judgments. They merely indicate provisional measures which the court considers ought to be taken to preserve the rights of the parties.

Advisory Opinions.— The court is authorized by article 65 of the statute to give advisory opinions on any legal questions at the request of whatever body may be authorized by or in accordance with the charter of the UN to make such a request.

Article 96 of the charter provides that such opinions may be requested by the general assembly or the Security council; also that they may be requested by other organs of the United Nations and specialized agencies, when authorized by the general assembly. Such requests must be laid before the court by means of a written request containing an exact statement of the questions, accompanied by all documents likely to throw light upon them. From this point on, the procedure before the court is somewhat analogous to that followed in contentious cases; that is to say, the registrar gives notice of the request to all states entitled to appear before the court, and the court or the president of the court fixes time limits within which the states wishing to do so may submit written statements or be heard orally at a public sitting to be held for the purpose. States and organizations presenting written or oral statements are allowed, within a specified time, to comment on those submitted by others.

Advisory opinions, like judgments, are delivered in open court.

Article 13 of the statute provides that the members of the court shall be elected for nine years and may be re-elected, but in order to avoid the necessity of electing an entirely new court at the end of each nine-year period and to ensure that there shall be on the bench at all times a majority of experienced judges, it was further provided that of the judges elected at the first election, the terms of five should expire at the end of three years and the terms of five more should expire at the end of six years; also that the judges whose terms were to expire at the end of the said periods of three and six years should be chosen by lot to be drawn by the secretary-general of the United Nations immediately after the first election had been completed.

The first election was held on Feb. 6, 1946, at the London meeting of the general assembly and the Security council. Fifteen judges were elected.

The procedure provided in article 13 was applied and five judges drew three-year terms and five others drew six-year terms.

On its 12th anniversary (Feb. 6, 1958) the court was constituted as follows:

Green H. Hackworth (United States), president
Abd-el-Hamid Badawi (Egypt), vice-president
J. G. Guerrero (El Salvador)
Jules Basdevant (France)
Bohdan Winiarski (Poland)
Helge Klaestad (Norway)
E. C. Armand-Ugon (Uruguay)
Feodor I. Kozhevnikov (U.S.S.R.)
Muhammad Zafrulla Khan (Pakistan)
Sir Hersch Lauterpacht (United Kingdom)
L. M. Moreno Quintana (Argentina)
Roberto Córdova (Mexico)
V. K. Wellington Koo (China)
Ioannis Spiropoulos (Greece)
Sir Percy Spender (Australia)

Former presidents and vice-presidents were: Guerrero and Basdevant (1946–49); Basdevant and Guerrero (1949–52); Sir Arnold McNair and Guerrero (1952–55).

Former members were:

Alejandro Alvarez (Chile), 1946–55
Isidro Fabela (Mexico), 1946–52
Milovan Zoričić (Yugoslavia), 1946–58
Charles De Visscher (Belgium), 1946–52
Sir Arnold McNair (United Kingdom), 1946–55
Sergei B. Krylov (U.S.S.R.), 1946–52
John Erskine Read (Canada), 1946–58
Hsu Mo (China), 1946–56
José Philadelpho de Barros e Azevedo (Brazil), 1946–51
Levi Carneiro (Brazil), 1951–55
Benegal Rau (India), 1952–53
Sergei A. Golunski (U.S.S.R.), 1952–53

See also ARBITRATION, INTERNATIONAL. (*G. H. H.*)

INTERNATIONAL DATE LINE: *see* DATE LINE.

INTERNATIONAL EDUCATION: *see* EDUCATION, INTERNATIONAL.

INTERNATIONAL FINANCE CORPORATION, an international investment institution, closely affiliated with the World bank (*see* BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL) was founded in July 1956. Its purpose was to further economic development in its member countries by investing, without government guarantee, in productive private enterprises in association with private capital and management.

Membership was opened to all members of the World bank and by the early 1960s the corporation capital amounted to nearly $1,000,000,000. The corporation's investments in more than 25 projects throughout the world, particularly in Central and South America and Asia, covered a wide range of industrial activities including manufacturing, milling, mining, smelting and refining.

INTERNATIONAL GEOPHYSICAL YEAR, commonly known as IGY, is the designation of the 18-month period July 1, 1957–Dec. 31, 1958, during which an intensified program of geophysical research was conducted throughout the world. The magnitude of the effort is suggested by the fact that it included: co-operation among more than 70 nations, participation by several thousand scientists and observers and operation of several thousand scientific stations reaching from pole to pole.

The IGY was directed toward a systematic study of the planet earth and its cosmic environment. Even as a single planetary body, the earth is far from static. Earthquakes, large and small, subject it to noticeable stresses and strains, and not only the oceans and seas but the land itself is subject to tidal pulls. Moreover, the processes at its surface are in continual flux. Energized by the sun's heat, water passes from the solid state in glaciers and snow fields to a liquid form in seas and rivers and then becomes a vapour in the atmosphere. Great atmospheric and oceanographic circulation systems transport heat energy between the tropics and the high latitudes, equalizing the energy balance of the earth: the tropics receive more energy from the sun than can be reradiated, while the polar regions radiate to space more energy than received directly from the sun.

The sun plays a critical role in the events associated with weather and climate, for it serves as the driving engine of the winds and currents in the seas and the atmosphere. But the sun also plays a dominant role in the upper atmosphere, the region from 20 to some thousand or so miles above the earth. Invisible particles and radiations stream to the earth, affecting the ionosphere and the earth's magnetic field and causing the brilliant northern and southern lights. Many of these particles and radiations come from the sun; some of them, including most cosmic rays and radio naves. come from the vast stretches of interplanetary space and distant stars and nebulae. The earth is thus an integral part of the universe whose forces, particles and radiations establish the conditions of human life and activity. These conditions are dynamic in nature as events vary in the universe and as the earth rotates about its axis. moves about the sun and is carried with the solar system in a vast trajectory about the centre of our galaxy.

To understand these phenomena and processes better, to obtain thereby a better mastery of man's planetary environment and to gain new insights into the nature of the cosmos, world-wide ob-

servations and measurements are needed. The IGY included 11 fields of geophysics: aurora and airglow, cosmic rays. geomagnetism, glaciology, gravity, ionospheric physics, longitude and latitude, meteorology, oceanography, seismology and solar activity. Each of these fields is planetary in nature and some are interplanetary. Each field requires measurement at many points on or above the earth's surface if a relatively complete view of the field is to be obtained, and because many of the fields are interrelated. simultaneous studies permit the establishment of correlations and relationships among the many phenomena and processes. Because no one nation could undertake so extensive an effort nor overcome problems of national boundaries, the IGY was necessarily a cooperative effort among scientists of many nations.

History and Organization.— The idea of international cooperation in geophysical investigations is not new, for the IGY had two antecedents in the polar years of 1882–83 and 1932–33. Both of these endeavours were largely concerned with studies of the high northern latitudes. During the first International Polar year 12 stations were established by 11 nations in the arctic for studies of surface weather conditions. geomagnetism and the aurora borealis. Perhaps the most significant result of this effort was the mapping of the auroral lights, which showed that these lights occurred most often and vividly in a circular belt about the north magnetic pole and some 1,200 mi. below it. The success of the first International Polar year led to an expanded effort 50 years later during the second International Polar year. Some 20 nations organized expeditions, and the number of observation stations in the northern latitudes was considerably increased. For example, about 90 meteorological stations were available in the arctic and 30 geomagnetic stations in latitudes above 60° N. In addition to the three fields investigated in the first International Polar year, studies of ionospheric physics were included in the second International Polar year. Using a device then relatively new, which transmitted short pulses of radio energy to the ionosphere and received the reflected signals, physicists gained new insight into the behaviour of the electrified layers between 40 and 200 mi. above the earth. Another new instrument at that time was the radiosonde, a balloon-borne instrument for measurements of pressure, temperature and humidity, which transmits its data to ground by radio. Appreciable advances were made, using radiosondes, in the understanding of arctic weather and its relationship to weather in lower latitudes.

The impetus behind the IGY had several sources. aside from the examples of the two polar years. Advances in instrumentation during the three decades following the second International Polar year had made possible sensitive and quantitative measurements. High-altitude balloons extended the range of radiosondes to some 100,000 ft. and special balloons could carry cosmic ray instruments even higher. Rockets were successfully used in the decade following World War II for direct exploration of the atmosphere up to heights of 250 mi. Automatic high-speed computers, capable of analyzing the vast quantities of data that characterize most of the fields of geophysics, were becoming available. These and many similar devices suggested that considerable progress could be made in studying geophysics on a broad basis. As early as 1950 informal discussions were held by geophysicists looking to a third polar year. Proposals to this effect were considered by two international scientific organizations: the International Scientific Radio union and the International Union of Geodesy and Geophysics.

In view of the instrumentation advances, the existence of some good networks of stations, as in meteorology, geomagnetism and ionospheric physics, and the increased recognition of the planetary nature of geophysical problems, the proposal for a third polar year was broadened to encompass the whole earth and its cosmic environs. Accordingly, the parent body of international scientific organizations—the International Council of Scientific Unions—sanctioned the broader study of the International Geophysical year and established a special committee (Comité Spécial de l'Année Géophysique Internationale) for the IGY consisting of scientific representation from the unions concerned with ionospheric and radio physics, astronomy, geodesy and geophysics, physics and geography, and the World Meteorological organization. The officers of this committee were Sydney Chapman (president), L. V. Berkner (vice-president) and Marcel Nicolet (secretary-general). The first meeting of the special committee, commonly known by its abbreviation as CSAGI, took place in Brussels. Belg., in July 1953 and was followed by a series of general assemblies and regional conferences. At the general assemblies in particular, the criteria for the IGY program were established by scientific delegates from all parts of the world.

The criteria were essentially four in number. First. fields of geophysics were to be studied where data were needed from many points on or above the surface of the earth in order to get a planetary view of a particular field—for example, meteorology, geomagnetism and ionospheric studies. Second, special projects were to be undertaken which would yield results of value to the former studies, such as rocket exploration of the upper atmosphere. Third, advantage would be taken of expeditions to remote places to conduct studies in other fields. In large part seismology and gravity measurements mere introduced into the program to capitalize upon opportunities opened up by the IGY in the antarctic, the arctic basin and at sea. Finally, epochal measurements were to be made for posterity. Such measurements, as of snow and ice in glaciers, repeated at intervals over many years, could indicate long-range trends in climate.

Within each country the pattern of planning and operations developed on somewhat similar lines. National committees were established by scientific organizations to plan, direct and execute their contributions to the over-all effort, and these groups solicited support from their governments and private institutions. In Great Britain, for example, the Royal society established an appropriate committee of experts. In the United States, the National Academy of Sciences assumed responsibilities for the United States effort, which received contributions from many public and private organizations, including the National Science foundation (through which congress appropriated $43,500,000 by Dec. 31, 1958, for research aspects) and the department of defense (which contributed extensive logistics and technical support, particularly in arctic, antarctic, rocket and satellite operations).

More than 70 nations co-operated in the IGY; 66 national groups were formal participants: Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Bulgaria, Burma, Canada, Ceylon, Chile, China (Taipei), Colombia. Cuba, Czechoslovakia, Denmark, Dominican Republic, East Africa, Ecuador, Egypt, Ethiopia, Finland, France, German Democratic Republic, German Federal Republic, Ghana, Greece, Guatemala, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Democratic Republic of Korea, Malaya, Mexico, Mongolian Peoples Republic, Morocco. Netherlands, New Zealand, Norway, Pakistan, Panamá, Peru, Philippines, Poland, Portugal, Southern Rhodesia, Rumania, Spain, Sweden, Switzerland, Tunisia, Union of South Africa, Union of Soviet Socialist Republics, United Kingdom, United States, Uruguay, Venezuela, Democratic Republic of Vietnam, Republic of Vietnam, Yugoslavia. The committees in these nations were responsible for the operation of more than 2,500 major scientific stations as well as several thousand small or temporary stations and the participation of 10,000 scientists and technicians as well as several thousands of amateur and volunteer observers in such programs as satellite tracking, visual auroral observations and radio-wave propagation studies. It is estimated that the IGY research effort cost about $500,000,000.

IGY measurements and observations fall into three major categories: (1) physics of the upper atmosphere, which includes solar activity, and particles and radiations from the sun, other stars and the interplanetary medium; (2) the heat and water regimen, which includes meteorology, oceanography and glaciology; and (3) the earth's structure and interior, which includes seismic, gravimetric, and longitude and latitude determinations. While rockets and satellites represented appreciable efforts, they are not fields of geophysics but are powerful tools for placing instruments in space. In addition to these areas, some work in biology, environmental medicine and geology was conducted in the arctic and antarctic.

Particularly in the first two categories, measurements and observations were conducted on regular, daily schedules. Here the influence of the sun is often at play. Because the IGY period was chosen to coincide with the maximum sunspot cycle, when solar flares and disturbances are prevalent, the role of the sun was even more significant. To study these disturbances and their effects on the high atmosphere, special provisions mere made for intensifying observations in a program called World Days. Indications of unusual solar activity were flashed from any IGY station to a World Warning agency operated by the national bureau of standards at Fort Belvoir, Va. Here such reports were evaluated; if major disturbances in the upper atmosphere were anticipated, warnings were radioed to all stations in the world-wide network. These stations then increased the frequency of their regular measurements of the earth's magnetic field and of the ionosphere, sent up balloons to detect increases in cosmic ray intensities and auroral activity and launched rockets to intercept directly the particles and radiations from the sun. There were three classes of special days or periods for such intensified observation: World Meteorological Intervals, Regular World Days and Special World Intervals.

World Meteorological Intervals consisted of periods of 10 consecutive days each, in June, September, December and March. They coincided exactly with two pentads (five-day periods) of the World Meteorological organization and always included either a solstice or equinox, periods during which intensified meteorological observations are most desirable.

Regular World Days were three or four days each month selected in advance. Two were consecutive days at the time of the new moon; the others were at times of unusual meteor showers (Geminid, Perseid, Taurid, etc.) or near one of the lunar quarter phases. They also included the days of solar eclipse, with adjacent days for control purposes. For observations insensitive to lunar phase or meteoric effects and for those which could not be carried out continuously throughout the IGY period, the Regular World Days constituted a representative sample of the IGY period.

Periods of Alerts and Special World Intervals were designated on a day-to-day basis. A period of Alert was declared whenever solar activity was unusually high and significant geomagnetic, auroral, ionospheric or cosmic ray effects were probable. During the period of Alert, an Interval would be declared whenever the probability was high that an outstanding geomagnetic storm, with associated effects in other disciplines, would begin within a few hours. The periods of Alert and Interval continued in effect until terminated by the World Warning agency.

The Upper Atmosphere. — The region of space between some 20 and 300 mi. above the earth is largely dominated by particles and radiations from stars and interplanetary space. The sun, our nearest star and the source of almost all of the earth's energy, emits a broad spectrum of radiations and particles that affect the earth and its atmosphere. Solar disturbances, particularly sunspots and flares, often result in magnetic storms, heightened auroral displays, ionospheric variations that frequently disrupt long-range radio communications and sometimes intensification of cosmic rays. IGY solar investigations had several objectives: to monitor solar activity so that warnings could be issued to all IGY scientists of disturbed or unusual conditions, to make comprehensive measurements of all possible solar phenomena and to analyze solar observations both with respect to the sun itself and in relation to events in the upper atmosphere. Thirty-one nations were engaged in solar observations at 120 stations.

A world-wide flare patrol network was established. Solar flares are considered to be the most significant of all solar phenomena in their direct relation to terrestrial effects. Solar radio noise, cosmic radio noise and propagation of atmospheric noise were also observed. The life histories of the variations of the width and intensity of spectrum lines of certain major flares were recorded, and an effort was made to map the magnetic-field pattern of the entire solar disk on a day-to-day basis.

Both aurora and airglow are optical phenomena of the upper atmosphere. The aurora is the luminous trace of charged particles streaming from the sun. These particles are deflected toward the geomagnetic poles by the earth's magnetic field, penetrate the atmosphere most often at high latitudes and excite gas atoms. The radiation of energy by the atoms as they return to their normal state produces the colourful curtains of the northern and southern lights.

A variety of instruments were used in the IGY auroral studies. Twenty-nine special cameras photographed the sky from horizon to horizon on film, recording spatial distribution and changes of the aurora as it began, increased and decayed. Hundreds of amateur observers assisted in plotting the extent of auroral displays. Radar devices were used to scan the skies in cloudy weather and during daylight. Spectrographs and spectrometers analyzed the auroral variations. The objectives of these studies were to map the aurora in the north and south, to learn more about the radiations and the action of the bombarding particles, to correlate auroral events with other phenomena in the atmosphere and the sun, and to examine the amount and nature of the disruptions in radio communications caused by aurora. Aside from hundreds of visual sites, over 140 instrumented stations were in operation.

Airglow at its brightest resembles faint aurora, but its cause is chemical reactions in the upper atmosphere rather than bombarding particles. Sensitive photometers and high-speed spectrographs were in use at 50 stations to detect airglow. The nature and distribution of airglow were the principal interests of IGY scientists in this field.

Although the main source of the earth's magnetic field lies deep within its interior, the small component of the field in space which gives rise to the rapid and storm variations was the chief object of interest during the IGY because it is highly variable, solar influenced and interacts with the ionosphere, cosmic rays and the charged particles responsible for aurora. More than 250 magnetic observatories were active in the IGY, and rockets and satellites were also used to carry instruments aloft. Particular attention mas directed to rapid magnetic-field fluctuations, which are usually accompanied by disturbances in radio-wave propagation and by auroral displays. They may appear only in high latitudes or they may spread over the earth, and they increase and decrease with the number of sunspots. The main features of the fluctuations are such as might be caused by three great electrical currents, hundreds of thousands of amperes in strength, flowing through the upper atmosphere, two moving in the high latitudes and one around the equator. IGY scientists also established a basis for more accurate correlations of magnetic effects and other atmospheric and solar phenomena.

In the tenuous region between about 40 and 200 mi. above the earth lies the region known as the ionosphere, so called because ultraviolet and X-radiations from the sun eject electrons from gaseous atoms and thereby create charged ions. The region is therefore electrically active and behaves toward radio waves much like a mirror toward light waves. This feature accounts for the long-range propagation of radio waves by reflection. The ionosphere consists of several layers of varying ion density. The D-layer, ranging from about 45 to 60 mi. above the earth, has the lowest electron density. Above it in increasing electron density are the E-layer (60–90 mi.), the F1-layer (90–150 mi.) and the F2-layer (150–200 mi.). Variations in the electron density of these regions, fluctuations in their heights, relationships to magnetic storms and solar phenomena were topics of intensive PGY study in which some 250 stations were involved.

Various types of ground-based electronic devices were in use, and rockets provided a means for direct measurements of ion density. The chief instrument for ionospheric research is the ionosonde. Radarlike pulses are directed vertically to the ionosphere, and the reflections are recorded by receivers. The pulses are varied in frequency so that a broad band of the spectrum can be studied. The travel time of the pulses and their reflections provide "virtual" ionospheric heights (which are greater than the actual physical heights because of the retardation of the pulses by the ionized medium) while phase shifts and intensities yield information on the state of ionization in the charged layers. Such studies lead not only to better knowledge of the ionosphere but

provide the basis for predictions of desirable frequencies for long-range radio communications.

Cosmic rays were studied at 130 stations. These particles are atomic nuclei, and possibly some high-energy electrons, which bombard the earth continuously from every direction. One of the difficulties in studying cosmic rays is the masking influence of the lower atmosphere. The primary cosmic rays fail to reach the earth because they collide with atmospheric particles in the high atmosphere, creating secondary rays in a kind of chain reaction. In general it is "secondaries," removed several generations from the primary particles, that are observed on earth. More cosmic ray primaries enter the high atmosphere at high latitudes than at low latitudes because at high latitudes, where the magnetic field is more or less parallel to particle trajectories, fewer of the lower-energy particles are deflected away from impact with the high atmosphere: at low latitudes, where the magnetic field is more or less perpendicular to particle trajectories. most of the particles with energies less than a certain amount, which depends on the geomagnetic co-ordinates, are deflected, giving rise to the "cut-off" effect. IGY investigations were concerned with fluctuations in cosmic ray intensity near sunspot maximum and with the sunspot cycle, intensity decreases during some magnetic storms, increases shortly after the onset of solar flares and chromospheric eruptions, and mass-energy determinations. A wide variety of instruments was used: neutron and meson telescopes. cloud and ionization chambers, photographic emulsions and Geiger counters.

Heat and Water.— Weather and climate represent the end products of complicated interplay between the sun's energy and the lower atmosphere (below 20 mi. or so). the oceans, and snow and ice fields. These many and diverse relationships not only largely determine weather and climate but affect sea levels, ocean currents and the food stocks of the seas.

In meteorology. networks of 650 upper-air, 700 radiation and 100 ozone stations conducted observations and measurements. Temperature, pressure, humidity and winds were recorded around the world. Circulation of the atmosphere around the world and interchanges between the tropics and polar regions were studied. The objectives were to obtain sufficient world-wide data in order that a planetary view of weather might be had, leading to improvements in forecasting, and to provide a sounder approach to climatic trends through analysis of meteorological, glaciological and oceanographic data.

The purposes of the IGY oceanographic program were to gain an understanding of oceanic circulation, of both short- and long-duration changes in sea level, and their relationships to other oceanic and atmospheric phenomena. Thirty-five countries operated 70 research vessels and some 225 tide stations in these investigations. Measurement of the movement of deep waters occupied much attention in the IGY, for these currents are important in determining mass movements of oceanic waters and the coincident transport of large amounts of energy. Sea levels provide one key to oceanic circulation and thereby to its meteorological influences. Recording of sea-level changes was undertaken at several hundred island stations.

Glaciers, once covering 32% of the earth and now extending over 10% of it, exist on all continents except Australia. Fluctuations in glacier extent provide clues to past and coming climatic changes, while polar ice sheets have an ever-present effect on world weather as sources of cold or sinks of heat from the tropics. Projects were under way to determine the volume of ice locked in the ice sheets of Antarctica, Greenland and the arctic pack; to study the heat and water exchanges between these ice bodies and the atmosphere; and to examine snow stratigraphy. ice movement, temperature and topography. Eighty-three stations were in operation.

The Earth's Structure and Composition.— Better knowledge of the earth's interior was one of the objectives in this part of the IGY program. Seismologists of 50 nations gathered earthquake information from almost all regions, particularly those like Antarctica where data have been almost completely lacking. Man-made explosions were also used to study the propagation of seismic waves and to determine ice thickness and the structure of underlying terrain. As such waves travel through the earth, their speed and direction are altered depending upon the composition of the medium. Knowledge of wave characteristics and travel-time measurements can thus shed light on the nature of the earth. Some 240 stations co-operated in this program of simultaneous land and sea measurements.

The size and shape of the earth remain imperfectly known. Because the earth is not uniform, the pull of gravity varies from place to place, affected by the distances to the centre of the earth and by variations in the distribution of the earth's mass. Gravity measurements thus provide a tool for better determinations of the configuration of the earth, and almost 200 stations co-operated in the gravity program. Earth tides are also susceptible to gravity measurements. Similar to ocean tides but much smaller, earth tides are created by the moon and sun. Hawaii. for example, rises and falls about four inches daily. Studies of these movements by gravimetry provide a means for determining the rigidity of the earth and its internal structure.

To improve man's knowledge of distances between points and land masses, 70 stations were engaged in longitude and latitude measurements. At many of these stations. classical astronomical techniques were in use. At 20 of them a new instrument — the dual-rate moon-position camera — was used. This camera permits position determinations precise within a few hundred feet, but independent of any local gravity effects, by using the moon as a reference point. Standard astronomical techniques were also used, at locations where local gravity surveys had provided a precise knowledge of the direction of the vertical, to obtain precisions to better than five feet. Such precision is of considerable basic scientific interest — foi example, in studying possible motions of the continents — and also has applications in the making of maps.

Rockets and Satellites.— Prior to World War II knowledge of the upper atmosphere was restricted to indirect observations from or close to the ground. During the decade folloa-ing the war, research rockets were successfully developed, largely in the United States, to carry instruments as high as 250 mi. The importance of such measurements led to the inclusion of a rocket program in the IGY. Several hundred rockets were fired during the IGY by Australia. .Canada. France, Great Britain, Japan, the United States and the Soviet Union. Data about pressures, temperatures and density of the atmosphere, particles, radiations and fields were telemetered back to earth and provided new discoveries and knowledge in several fields, including meteorology and atmospheric structure, ionospheric physics, aurora and airglow, geomagnetism, cosmic rays, and solar ultraviolet light and X-rays.

Rockets are particularly useful tools in measuring the altitude variation of atmospheric phenomena — for example, the variation of temperature with height. They are restricted, however, by their brief lives of several minutes and by their essentially vertical coverage. To overcome these limitations. the IGY included satellite vehicles in the program. Satellites are important geophysical tools because they traverse vast expanses of space about the earth, permitting studies of space variations, and they last appreciable periods of time, permitting studies of the time-variation of phenomena. Several satellites were launched during the IGY, as were three probes which traveled many earth radii out into space.

Results.— The scientific products of the IGY fall into several categories. In several fields, notably meteorology and ionospheric physics, the data as taken were immediately applicable and also provided information for longer term work such as the study of ionospheric storms and atmospheric circulation. Weather observations, for example, were promptly used in weather forecasting. One of the significant achievements of the IGY was the preparation of twice-daily weather maps of Antarctica; indeed, the IGY provided the first census of Antarctic weather. Recording of temperatures to a low of at least −124° F. suggested the possible role of this vast continent of cold in world weather. Studies of temperature, pressure, humidity and winds in both the arctic and Antarctica provided data from which the influence of these regions on world weather could be examined.

In many fields and in many parts of the world, new discoveries were made. Using seismic sounding techniques, traverse parties

ranging over thousands of miles in Antarctica measured the ice thickness and thereby secured a profile of underlying land masses. One hundred miles east of IGY Byrd station, in the heart of Marie Byrd Land. the ice measured 14,000 ft. thick, resting on bedrock 8,000 ft. below sea level. This is believed to be the thickest ice ever measured. It appeared that the antarctic might be a complex of island and mountain chains, particularly certain coastal parts where a few mountains protrude above the vast ice mantle but where, even were the ice to melt, some mountain chains would lie hidden beneath sea level. Moreover, there were increasing indications of a major division between east and west Antarctica. Seismic measurements also provided a better measure of the amount of snow and ice in the world. The old figure—about 3,240,000 cu.mi.—had to be revised upward by about 40%, to some 4,500,000 cu.mi.

In the arctic, gravimetric and seismic measurements uncovered an underwater ridge, several thousand feet in height. Three major counter-currents in the oceans were found and measured. One in the Atlantic flows beneath and opposite to the Gulf stream. traveling at a rate of 8 mi. per day some 9,000 ft. beneath the surface. The second, at depths between 200 and 1,000 ft., flows against the surface equatorial current of the Pacific, transporting 1,000,000,000 cu.ft. of water per second. The third lies beneath the surface 200 mi. north of the Pacific equator, transporting 1,500,000,000 cu.ft. per second. In studying ocean bottoms. a vast mineral-rich region in the Pacific was discovered; millions of square miles of the southeast Pacific bear a surface-bottom sludge laden with nodules of manganese and iron with up to 1% of cobalt mixed with copper. The value of these minerals was estimated at about $500,000 per square mile, and the economics of dredging up the sludge appeared promising at the close of the IGY.

Both the rocket and satellite programs of the IGY yielded new knowledge of the atmosphere and the heavens. Important though these data are, however, the most significant aspect of the programs was their pioneering nature: man for the first time had created small heavenly bodies and had taken his first steps in outer space.

Several fields were studied with satellite and space probe vehicles, where the emphasis was on the environmental characteristics of space. Most important, perhaps, was the discovery of the Van Allen radiation zones, two distinct, widely separated belts of high-intensity radiation occurring about 1,400 to 3,400, and about 8,000 to 12,000, miles from the surface of the earth. A high of 25,600 counts per second was registered in these belts. These high counts are equal to about 10 roentgens per hour, if electrons, or about 100 roentgens per hour, if protons. The maximum safe weekly human dosage has been recommended to be no more than $\frac{3}{10}$ of one roentgen. At the close of the IGY, it was still too early to offer a definite appraisal of whether the more penetrating component of the radiation consists of electrons or protons. From the point of view of space travel, it remained to be seen whether acceptable means of dealing with the problem could be found. However, the area between the lower Van Allen radiation belt and the earth appeared to be safe for travelers for extended periods of time.

Through the use of sounding rockets, solar X-rays were discovered low in the ionosphere. These X-rays, rather than the ultraviolet radiation responsible for the general electrification of the ionosphere, extend downward to the lowest D-region of the ionosphere and increase its ionization to such an extent that radio blackouts occur.

The data taken during the IGY represented a major accomplishment in science and in international co-operation. The number of measurements and observations itself was remarkable, for in one project (vertical incidence soundings) of one field (ionospheric physics) alone, 10,000,000 frames of film. each containing hundreds of bits of data, were accumulated. The reduction and processing of these data were made possible by automatic computers. To ensure the safety of the data and to make them accessible, three world data centres were established—in the U.S., the U.S.S.R. and in western Europe, with branches in Australia and Japan. Each data centre gathered, indexed and archived a complete set of all IGY data. Studies of these data will occupy theoretical scientists for many years. From these studies may well come the most significant results of the IGY as the interrelationships among the phenomena in the various fields are analyzed. These results will have practical aspects, particularly in connection with weather and radio communications problems. but more importantly they will provide new and basic knowledge of the planet earth and its relationships with the universe. Finally, the IGY showed that men of all nations, of different colours, creeds and political beliefs, can work harmoniously together in an enterprise dedicated to the welfare of mankind. *See* also INTERPLANETARY EXPLORATION. (HH. O.)

INTERNATIONAL INSTITUTE OF AGRICULTURE, a clearinghouse of world agricultural information in the international sphere whose functions included the collection, analysis and publication of facts about crop and livestock production, trade, prices and related subjects "for the protection of the common interests of the farmers" of all nations. The institute was founded in Rome in May 1905. It was disbanded and its activities were transferred in 1946 to the Food and Agriculture Organization of the United Nations (*q.v.*), which superseded it.

The idea of the institute was proposed by David Lubin, a merchant of Sacramento. Calif. King Victor Emanuel III of Italy called the first conference at Rome in 1905. The convention treaty establishing the institute was later ratified by the governments of 77 nations. The convention provided for a staff of experts to be directed by a permanent committee consisting of one delegate of each country. The institute was financed by contributions of the member nations according to the class of membership chosen.

The technical staff eventually grew to about 100 men and women of more than 30 nationalities. They assembled one of the largest agricultural libraries in the world. housed in the building donated to the institute by the king of Italy; later a special library building was erected, aided by a grant of funds by the International Education board.

The institute published several series of journals, monographs, yearbooks and special reports in both French and English. The first attempt to make a world-wide agricultural census was begun for the years 1930 and 1940. Much of the work of the staff was done in connection with the biennial general assemblies held at Rome as well as hundreds of special meetings throughout Europe. The institute collaborated with the League of Nations, the International Labour organization and the economic conferences of 1927, 1933 and 1939, and participated in the organization of world congresses on forestry, wheat, poultry and dairying.

During World War II the international character of the institute was recognized by the belligerents and its work continued on a reduced scale. When the Food and Agriculture Organization of the United Nations was started in 1943, the member nations of the institute decided to dissolve it and turn its archives and staff over to the new organization, which was planned to cover the same field with more adequate resources. The staff was either retired or employed by the FAO, and the work of the institute terminated on July 31, 1946.

The library of the institute, designated as the David Lubin Memorial library, was transferred to the FAO headquarters building in Rome, which had been provided by the Italian government. (J. C. Ms.)

INTERNATIONAL LABOUR ORGANIZATION, THE. The International Labour organization, an official international institution, was originally created by the 1919 peace settlement, but later became a specialized agency of the United Nations system. Uniquely among international organizations, member states' representation is tripartite (*i.e.,* not only by each government, but also by representatives of its workers' and employers' organizations).

The ILO's chief organs are its conference (annual, as a rule), at which all members are represented; its governing body of 40 members; and the permanent secretariat, known as the International Labour office, under the direction of an appointed director-general. Its chief forms of activity are proposing international

treaties (known as conventions), recommendations, technical assistance. investigations. and research and publicity. It has concerned itself with all forms of labour and social legislation and labour law administration. with hours of work. wages, social security. welfare facilities and social services, co-operative organization, handicrafts and reform. with increasing productivity and combating unemployment and underemployment, with manpower needs and international migration. with industrial relations. freedom of association and trade union rights, and with the labour aspects of international competition.

ORIGINS AND HISTORY

During the 19th century a number of economists urged international economic agreements by governments to minimize the hardships to workers and the dangers to peace which they saw as inherent in modern industrialization and international economic competition. In 1900 a private organization. the International Association for Labour Legislation. was established. with headquarters in Basle, Switz. It succeeded in petting a diplomatic conference in 1906 to adopt two conventions, one to limit the hours of night work of women in industry. another to prohibit the use of poisonous phosphorus in the manufacture of matches. Although only a few states ratified these conventions. the association's pioneering helped prepare the way for the ILO.

Labour in the Versailles Peace Treaty. — As World War I increased its demands on workers for effort in the factories and for sacrifice on the battlefields. labour spokesmen in the Allied nations asserted claims for representation at the peace conference and for a peace settlement that would enhance social and economic justice. The Russian Revolution increased the restiveness and the demands of labour in Europe. An international trade union conference in Berne. Switz., early in 1919 demanded an "international labour parliament," with law-making powers, in which labour would have half the votes.

The peace conference set up a commission for international labour legislation, headed by Samuel Gompers, president of the American Federation of Labor. The commission put aside the more ambitious dreams of a body with legislative authority and proposed a body with powers of recommendation to national governments for action by them, in composition a tripartite body in which half the representation would be by governments, and one-fourth each by labour and by employers. The peace conference adopted these proposals and, by inserting them in the treaty of Versailles, set up the ILO.

The ILO between World Wars I and 11.—The ILO offered far less than the European or even the U.S. labour movement had asked, but as much as they seemed likely to get. The democratic labour movements of Europe (as distinct from the Communist unions which soon were competing with them, unsuccessfully, in most countries) threw their support behind the ILO, a condition indispensable for its success.

The first International Labour conierence met in Oct. 1919 in Washington. D.C. The governing body chose as the ILO's first director-general, Albert Thomas, a moderate French Socialist deputy who had been his nation's wartime minister of armaments. Under his leadership (1920–32) the ILO defined its purposes broadly. firmed up its organization, built up its staff and achieved an almost complete autonomy of policy in the League of Nations system. Upon Thomas' death. his deputy, a former British career civil servant, Harold Butler, succeeded him. When Butler resigned in 1938. John G. Winant, former Republican governor of New Hampshire and first head of the federal Social Security board. who had served as assistant director of the ILO in 1937, became director-general.

ILO after World War 11.—In 1940 the ILO moved from Geneva, Switz., to Montreal, Can.! for the duration of World War 1 Actively engaged in postwar planning, it convened one international labour conierence at Philadelphia, Pa., in 1944. Its "Philadelphia declaration" was a restatement of ILO aims—"poverty anywhere constitutes a danger to prosperity everywhere"—and a reaffirmation and amplification of the social-economic purposes of the Atlantic charter. The ILO's hopes of a major role in the postn-ar world were hardly realized, however. It was somewhat suspect to states not members of the League of Nations because of its ties with the League. The San Francisco Cnited Nations founding conference snubbed the ILO, despite British support, for the United States was lukewarm toward it and the Soviet Union definitely hostile. The UN charter made no mention of it. while giving broad powers to the U S Economic and Social council. The ILO became one of the specialized agencies by its agreement with the CS. ratified by the International Labour conference (Oct. 2, 1946) and by the UN general assembly (Dec. 14, 1946). The ILO kept most of its autonomy of policy and received a budgetary autonomy it had not had under the League.

In 1941, Edward J. Phelan, an Irishman who had been Butler's deputy, and before that a career British civil servant, had succeeded Winant. On his retirement in 1948, David A. Morse, United States undersecretary of labour, became director-general.

Changing Emphases. — In the period between World Wars I and II, the ILO had been primarily concerned with its research and '.legislative" efforts, the attempts to define and enact proper minimum standards of labour conditions by international conventions and recommendations. In the post-World War II world, although conventions and recommendations continued important, the ILO shifted its major emphasis to the programs of technical assistance to underdeveloped areas. This emphasis, dominating the period from 1949 to 1954, led it to take on, for the first time, work of an operating character.

CONSTITUTION AND STRUCTURE

The ILO brought into official intergovernmental organization the representation of functional groups. a principle which had been applied to economic and social administration within various nations. In the International Labour conference: each member state is represented by two government delegates and (normally) one employer and one worker delegate, the latter named by the government in consultation with "the most representative organizations of employers and workers" (where such exist) in each country. Not all delegations are complete, however.

To avoid the rule of unanimity, the ILO from the outset required only a two-thirds vote by its conference for the passage of a convention or a recommendation. The government delegates often cast the deciding votes in differences of opinions between the employer and worker delegates.

While the conference is the supreme authority of the ILO on most policy matters. it is the governing body which discusses and votes the ILO budget, appoints the director-general and controls the International Labour office. Tripartite, like the conference! the governing body carried out another innovation of international representation. In the conference all nations are equal, with every delegate having a single vote. In the governing body, half of the 20 government representatives must come from the 10 member states "of chief industrial importance."

Tripartism, in the 2:1:1 ratio, is firmly established in the conference and governing body. Various proposals to amend the constitution to give workers a larger representation, or to put both worker and employer delegates on a numerical par with those of government, have been rejected. Governments must be persuaded of the practical value of any proposal if it is to begin to receive implementation. The 2:1:1 ratio. however, prevails only in the phases of ILO work requiring binding votes. In conference committees and in the industrial committees (see below), representation of the three interests is equal. Thus the organization seeks the maximum contribution of specialized knowledge and the democratic participation of the major parties to industrial life—unions and employers—in its substantive work.

Two problems raised by tripartism have been troublesome, because they involve fundamental differences of national political and social structure. One is the right of governments to name as employer representatives the managers of state industries. The other is the naming of worker delegates by governments which systematically manipulate or repress labour unions within their borders. The 1954 conference, by divided votes: rejected protests

against the credentials of delegates in each of these categories.

Membership. — The ILO's ideal has been universality of membership. It admitted Germany as early as 1919, long before the League of Nations did; after World War II it admitted Italy, Japan and the German Federal Republic (west Germany). Some nations — Brazil and, for a time, Japan — remained in the ILO after quitting the League. Others became members of the ILO without joining the League or the UN. The United States, aloof to the League, joined the ILO in 1934.

Post-World War II amendments made it easier to join the ILO. Members of the UN do not have automatic membership in the ILO, as did League members, but they may become members simply by filing a declaration accepting the obligations of the ILO constitution. Nonmembers of the UN must be accepted by a vote of two-thirds of the conference, including that of two-thirds of the government delegates.

OPERATION OF ILO

Conventions and Recommendations. — The standard-setting process of the ILO, the major activity of its first two decades, uses the instruments of conventions (treaties) and recommendations. Member states are obliged to submit either a convention or a recommendation to the national "authority or authorities within whose competence the matter lies, for the enactment of legislation or other action" within a year or, under exceptional circumstances. 18 months. In the case of a federal state, the federal government must submit the convention or recommendation not only to the national legislature, but to the state or provincial authorities whenever it is, in whole or part. within their iurisdictions. A convention ratified by the nation's constitutional process becomes binding upon the nation, which makes annual reports to the ILO on the measures taken to give it effect. If it is not ratified, the state undertakes to report on its "law and practice" with regard to the subject matter of the convention.

A recommendation makes it possible to offer an international standard higher than that which at a given time may seem the maximum suitable for a convention, or to offer a general principle where a binding obligation by states is not being sought. The same problem may be dealt with by both forms, the convention setting an international minimum, and the recommendation a higher norm for more advanced countries and a level of aspiration for others.

Frequently states do not ratify conventions where their practice is as good as, or in most ways better than, the ILO's standards, because (1) governments and labour organizations are against enactment of any standards not as high as existing practices, or (2) in many federal states, national government does not have the constitutional power to ratify, as the conventions deal with matters wholly or partly within state or provincial authority. On the other hand, some states, out of a desire to be or to appear "advanced," have ratified many conventions but have done little to put them into practice. This was, for example, the case betneen World Wars I and II with some social security conventions ratified (and codes enacted) without regard for countries' limited economic possibilities or weak administrative structures.

The ILO could not, even if it wished, try to enforce the binding ratifications. Its constitution provided that it could appoint a commission of inquiry and eventually refer complaints to the International Court of Justice, whose decision mould be final. But such recourse was impractical in an international society characterized by intense national sovereignty. As of the mid-1950s there had been no commissions of inquiry and no complaints to the International Court of Justice. The. only real sanction in practice is that of public opinion, aided by the examination at the conferences of the extent of ratification and implementation of conventions, appeals to governments and education of officials, employers and labour.

Technical Assistance. — The gap between reality and law in relation to conventions was one stimulus to the new stress on technical assistance Between World Wars I and II, ILO technical assistance took the form chiefly of expert advice on legislative drafting and administrative procedures With the emphasis of the UN and the United States on technical assistance to economic and social development, beginning in 1949, the ILO amplified its services to include new techniques and operational activities. Working to raise productivity and living standards in underdeveloped countries, it also sought "to ensure that social objectives are not overlooked or sacrificed to purely economic objectives."

Fields of assistance have included vocational guidance, training and rehabilitation for workers, supervisors, teachers and administrators; methods of production — industrial, agricultural, and handicrafts; cooperative organization; aid in the selection, training, movement and reception of workers migrating from one country to another (*e.g.,* Italians going to Brazil); employment service organization and manpower utilization surveys; as well as such older areas of ILO work as wages and hours, industrial relations, social security, labour inspection and statistical procedures.

Methods have included a heavy reliance on the use of visiting experts drawn from many countries, fellowships, study tours, seminars, the supply of equipment and worker-trainees (*e.g.,* almost 400 Yugoslav skilled workers, foremen and technicians placed for training in factories in a dozen European countries).

In addition to its own programs, out of its regular budget, the ILO undertook many projects under the United Nations expanded program of technical assistance. Some were undertaken together with other UN agencies; *e.g.,* the "Andean highlands" project, for which the ILO had chief responsibility and collaborated with the UN, its Food and Agriculture organization, UNESCO and the World Health organization to help raise the living standards of the Indians of the Bolivian, Ecuadorian and Peruvian Andes, and integrate them into the economic life of each nation.

Trade Union Rights and Forced Labour. — After World War II the ILO adopted its first conventions on trade union rights (1948) and on protection of the right to organize and bargain collectively (1949). This action was overshadowed by the bitter debates over charges of violation of trade union rights, made without regard to the ratification of the conventions. The lead was taken by the Communist-dominated World Federation of Trade Unions (W.F.T.U.); its complaints, laid before the Economic and Social council, were referred to the ILO. The W.F.T.U. showed great concern for union rights in countries outside the Soviet bloc but found no occasion for complaint with conditions in the Soviet Union or its satellites. This deficiency was made up by the American Federation of Labor (A.F. of L.) and (after its formation in 1949) by the International Confederation of Free Trade Unions (I.C.F.T.U.), of which the A.F. of L. is a member. Although concentrating its fire on the Soviet bloc governments, the I.C.F.T.U. also complained of violations of labour rights by non-Communist governments.

In 1951 the governing body established a committee on freedom of association, which made a preliminary inquiry into complaints and had the power, if it found complaints warranted, to refer them to an impartial hiph-level fact-finding and conciliation commission. The ILO committee had to deal largely with complaints patently of a political motivation remote from the issues ostensibly at stake (many W.F.T.U. charges), or with issues of complete suppression of free trade unionism inherent in the whole structure of a state (many complaints against Communist governments). As the consent of the government concerned was a prerequisite to reference to the commission, no cases had gone to it (as of 1954).

Even more dramatic were the charges of forced labour levelled at the Soviet Union (and later its satellites), originally by the A.F. of L. before the UN in 1947, and then by the I.C.F.T.U. In 1951 the UN and the ILO set up a joint ad *hoc* committee on forced labour of three members, headed by Sir Ramaswami Mudaliar of India. It inquired into a welter of charges against 28 countries, for by then countercharges had been levelled at governments outside the Soviet bloc. Although facilities for inquiry within the Soviet world were denied by the governments involved, the committee made public evidence of forced labour on a vast scale. The world's public opinion, dulled by a generation of horrors, took only slight note. The committee's temperate recommendations for international consideration and action were reminders to a few consciences.

Regional Activities and Industrial Committees. — Two forms of the ILO's adaptation to the enormous differences in problems of different regions and of different industries were the intensification of regional activities and the use of industrial committees. The ILO prior to World War II, for all its official relations with other continents, had been essentially European in outlook and in support. The insistent claims of national self-consciousness and of economic and social development in other continents after World War II caused it to give weight to regional conferences, to establish field offices, to appoint more non-Europeans to responsible positions and to tackle problems (notably technical assistance) primarily, though not entirely, of interest to the near east, Africa, Asia and Latin America.

From the first (1920), the ILO had had one specialized industry committee, the joint maritime commission. In this field, the ILO achieved some of its most concrete results. The industry itself was international in operations; its workers and employers were highly organized; governments had long been accustomed to legislating on its problems. The ILO's 25 conventions and 10 recommendations made up a comprehensive and influential international seafarers' code. After 1945, the ILO set up eight new tripartite industrial committees. Although they dealt with a wide variety of problems in major industries, they did not attain the importance of the joint maritime commission.

The International Labour Office. — The office, the secretariat of the organization (and of the conferences and the governing body) consisted in the mid-1950s of more than 700 international civil servants, from more than 50 nations, and some experts on temporary assignments. Most of them work in the ILO's headquarters at Geneva; a number are, at any given time, in the field, all over the world. Substantial reports

on subjects under consideration by conferences and committees, continuing research and statistics,, publicity, a large library, technical assistance, legislative and administrative drafting, expert counsel in any field of labour and social policy are among the staff's responsibilities. Something of the ILO's manifold activities may be seen in its publications, whose extent can be gauged from its *Catalogue of Publications.* Among the most widely used are the monthly *International Labour Review* and the *Year Book of Labour Statistics.*

BIBLIOGRAPHY.—James *T.* Shotwell (ed.), *The Origins of the International Labor Organization,* 2 vol. (1934); Edward J. Phelan, *Yes and Albert Thomas* (1936); Austin Van der Slice, *International Labor, Diplomacy and Peace, 1914–1919* (1941); Harold Butler, *The Lost Peace,* ch. 2 (1941); Albert Thomas, *International Social Policy,* speeches, reports, etc. (1948); John W. Follows, *Antecedents of the International Labour Organization* (1951); ILO, *The International Labour Code, 1951,* 2 vol. (1952); "The International Labour Organization Since the War," *International Labour Review* (Feb. 1953); UN/ILO, *Report of the Ad Hoc Committee on Forced Labour* (1953); Lewis L. Lorwin, *The International Labor Movement* (1953); ILO, *Technical Assistance* (1954); *Report of the Director-General to the International Labour Conference* (1921 *et seq.*); *Report of the Organization to the United Nations* (1947 *et seq.*); and a popular treatment, ILO, *Lasting Peace the ILO Way* (1953). (V. R. L.)

INTERNATIONAL LAW, PRIVATE: *see* CONFLICT OF LAWS.

INTERNATIONAL LAW, PUBLIC. International law, or the law of nations, is a body of rules and principles which states consider legally binding upon them. Its origins may in part be traced to the middle ages and antiquity; but the general body of modern international law dates from the late 16th and the early 17th centuries, when it was called into being to order the relationships and conduct of the newly appearing sovereign independent states of Europe. Clearly, a system of legal precepts binding upon sovereign states needed some prior authority. The writers of the formative period of international law—particularly the greatest of them. Hugo Grotius (Hugo de Groot), whose *De jure belli et pacis* (1625) remains one of the most important books of all time—found that authority both in the much older idea of a system of natural law discoverable by reason, and in that part of Roman law, the *jus gentium* ("law of nations"), which had always been considered to be *ratio script~*("written reason"), and to consist in rules both generally accepted and of universal validity.

Writers have always felt the need to explain and justify the legally binding nature of international law; for the notions of state sovereignty and the subjection of states to law do not easily ride together. When the idea of a system of natural law was unfashionable—particularly in the England of the 19th and early 20th centuries—an alternative basis of legal obligation was found by the so-called positivist school in the supposed consent of states to be bound; a consent, manifested sometimes expressly, as in a treaty, or sometimes tacitly, as in a rule of customary law. The positivists did a great service in emphasizing the importance of the study of actual state practice as a source of positive law; but their attempt to found obligation upon consent—though still echoed in innumerable judgments in English and United States courts—raised as many questions as it appeared to solve. It was never satisfactorily explained why, for example. a state which consented to a treaty and so became bound by it could not withdraw that consent at its discretion. It may well be a mistake to postulate some essential difference between international law and internal law in the matter of the basis of obligation. The notion that international law does not require a particular and special pleading to establish its legal nature has the advantage of being in accord with the factual situation. For while writers have sometimes found it convenient to deny the legal nature of international law, it is easily demonstrable that states do recognize their obligation to observe it.

The major difference between international law and internal law is not, as the layman often supposes, that international law is less consistently obeyed than internal law. It is true that much of the so-called law of war which used to be an important part of the system has in many ways proved both inadequate and irrelevant; this situation obtains for reasons which will be discussed later on. But the main body of the law between states in peacetime is probably more consistently applied and obeyed than many systems of internal law. Nor is the apparent lack of sanctions anything like so serious as the layman is apt to imagine. As J. L. Brierly put it in *The Basis of Obligation in International Law and Other Papers* (p. 54, Oxford University Press, London, 1958), "the regular observance of the international law of peace is explained only too easily; it is generally observed largely because there is little temptation to violate it, because its yoke lies easily—too easily—on the states, and also because to violate it habitually would invite reprisals and would not be in the interest of any state. But all that does not alter the fact that in spite of the vagueness of its sanctions, the law is very rarely broken."

Nevertheless, there are two important ways in which international law has less efficacy than internal laws. First, there are many areas of state activity, and these some of the most important, where the law reaches hardly at all. Thus, questions such as nationality, armament, immigration and fiscal and trade policies—all of which may vitally affect international relations—are traditionally within the untrammeled competence of the state itself to order and determine. It is true that there is a tendency of the law to feel its way gradually into these areas where formerly an anarchic sovereign discretion in each state was sanctioned by the law. Thus, until fairly recently, even the right to wage war was one which the law left to each state to exercise at its complete discretion but this is now no longer so. A serious qualification of the law that still remains, however, is the maxim that a court can exercise jurisdiction over a state only where the state has in some way consented to that jurisdiction; so that, for example, the International Court of Justice at The Hague has a compulsory jurisdiction, in the sense that a defendant state can be compelled to plead and to submit to judgment, only in a very limited sphere.

The second important difference between international and internal law is the comparative lack of international organizations and institutions. A developed system of internal law cannot be imagined without legislature, executive and judiciary. Yet, until about the middle of the 19th century, international law was virtually without institutional organizations, and thus dependent for action upon the separate governments of the states composing the family of nations. After the middle of the 19th century there was increasingly rapid development on the institutional side of international law, but 100 years later the machinery available was still far short of what is required for a mature and adequate system.

The Sources of International Law.—The term source is here used to connote "those agencies by which rules of conduct acquire the character of law by becoming objectively definite, uniform, and, above all, compulsory" (C. K. Allen, *Law in the Making,* 6th ed., *p.* 1, Oxford University Press, London, 1958). Obviously, every system of law must have criteria by which one can set about discovering the rule of law on a particular matter at a given time. For international law, those tests of validity have been authoritatively stated in art. 38 of the Statute of the International Court of Justice, by which it is provided:

1. The Court, who function is to decide in accordance with international law such disputes as are submitted to it, shall apply:
   a. international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;
   b. international custom, as evidence of a general practice accepted as law;
   c. the general principles of law recognized by civilized nations;
   d. . . . , judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.

By conventions is meant what are commonly called treaties. The many thousands of treaties in force now form much the greater part of the fabric of international law. This was not always so. Treaties were formerly mainly political in content: peace treaties, alliances and the like. It was not until the 19th century that the multipartite treaty began to be used for creating law between the parties. Nowadays, the multipartite lawmaking treaty is an indispensable instrument of the society of states. It must be remembered. however, that, with very fe exceptions, treaties are contractual in the sense that they are only binding upon states parties to them.

The customary element in international law is prior to treaty law in the sense that the binding force of treaties themselves depends upon rules of customary law. To establish a rule of cus-

tomary international law it must be shown that there exists not only a practice or habit among states, but also a recognition that the practice follows a rule legally binding on them. Customary law must accordingly be distinguished from mere usage, however well established; and from the rules of international comity, which, however well observed they may be, are recognized by states as being demanded by courtesy rather than by law. Thus, the elements necessary to establish a rule of customary law are, in the words of Judge M. O. Hudson *(Permanent Court of International Justice,* p. 609), "the concordant and recurring action of numerous states in the domain of international relations, the conception in each case that such action was enjoined by law, and the failure of other states to challenge that conception at the time."

There has been some controversy over the precise meaning of the provision in the court's statute requiring it to apply general principles of law; but there can be no doubt about its importance. One general principle common to, and necessary to, all systems of law is that the law is complete in the sense that there must be some legal answer to every legal problem. The positive aspect of this principle is neatly expressed in a well-known international arbitral award: "International law, as well as domestic law, may not contain. and generally does not contain, express rules decisive of particular cases; but the function of jurisprudence is to resolve the conflict of opposing rights and interests by applying, in default of any specific provisions of law, the corollaries of general principles, and so to find . . . the solution of the problem." *(Eastern Extension, Australasia and China Telegraph Co. Ltd., Case,* 1923).

Accordingly, international law, even where relatively lacking in detailed and elaborated rules in some of its aspects, is a complete system when seen against the back cloth of the general principles of law, which are to be collected from a study of the several internal systems and of law in general. Examples of general principles nhich have been assumed by tribunals to be part of international law are the principle of unjust enrichment, that he who is unjustly enriched to another's damage must make compensation; the rule called by common lawyers estoppel, that a party may not in his assertions be allowed to blow hot and cold in the same case; and the rule of *res* judicata, that a final decision by a proper tribunal disposes of a dispute once and for all.

It should not be supposed that this provision of the court's statute was an innovation; for general principles of law have necessarily been a source since the beginnings of international law. It should be added that the general principles of law are regarded by some as being nothing more or less than the principles of natural law. At any rate. the inclusion of this source in the statute of the International Court of Justice was a rejection of extreme positivist ideas that international law rests solely upon the consent of sovereign states.

Judicial decisions are, with text writers, recognized as "subsidiary means for the determination of rules of law." Obviously there can be no rigid system of binding precedent of the kind peculiar to the common law; but argument from persuasive precedent is inevitable, for it is a natural tendency of the human mind. The International Court of Justice has shown no reluctance to refer to its own earlier decisions, nor to the awards of other international tribunals. Case law is, of course, dependent on there being a system of reports; as well as the international court's own series. there are the *International Law Reports,* published in the United Kingdom, which report not only the decisions of all international courts and tribunals but also the many decisions involving questions of international law of national courts all over the world. The transformation of international law into a case law system, which has taken place mainly since 1930, is a movement the importance of which it would be difficult to exaggerate; for it provides a resilience and a factor of growth not easily achieved in other ways.

The opinions of writers serve as evidence of what the law is. exactly as they do in other systems. Their function was well described by Justice Horace Gray in a decision of the United States supreme court on an international law question *(Paquete Habana,* 1899, *American Prize Cases,* p. 1938):

> . . . where there is no treaty, and no controlling executive or legislative act or judicial decision, resort must be had to the customs and usages of civilized nations; and as evidence of these, to the words of jurists and commentators who by pears of labour, research, and experience have made themselves peculiarly well acquainted with the subjects of which they treat. Such works are resorted to by judicial tribunals, not for the speculations of their authors concerning what the law ought to be, but for trustworthy evidence of what the law really is.

Relationship With the Internal Law of States. — To understand international law it is necessary to appreciate its close relationship to the internal law of states, or, as lawyers say, the municipal lams of states; for it is increasingly penetrating that sphere. Even the traditional international law, at a time when it was supposed to be a law only between states, had many rules which required the co-operation of municipal courts for their realization; for example, the very ancient rules whereby foreign sovereigns and their diplomatic representatives enjoy certain immunities from the municipal jurisdiction. But a very large part of modern international law is directly concerned with the activities of individuals which come before municipal courts. So that it is in municipal courts that a large and increasing part of international law is enforced.

One school of thought accepts that international law may be per se a part of the law of the land and that the municipal court therefore, in the appropriate case, applies international law directly. Another insists that a municipal court can only apply and enforce its own municipal law, and that the international law rule is binding only on the state itself, which must by legislation transform the precept into one of municipal law. The two approaches can on occasions lead to different results; *e.g.,* in a case involving a treaty which the government has omitted to transform into a municipal statute. But the second, or dualist, theory can hardly be applied in any case in those many countries *(e.g.,* the Republic of Ireland, France and the German Federal Republic) where it is by the constitution provided that international law is part of the law of the land.

The position before English courts is not so straightforward. There can be no doubt that they regard customary international law as part of the law of the land, for they take "judicial notice" of it; that is to say they assume that the court knows the law and does not require it to be proved by calling expert evidence, as in all cases involving foreign and external systems of law. The courts do in fact regard any relevant rule of customary international law as incorporated into the domestic law.

However, this statement must be understood subject to certain qualifications. First, English courts have tended to apply their doctrine of rigidly binding precedent even in cases involving customary international law. Thus, although the court may initially have applied the pure rule of international law, the rule may in the English jurisprudence have become fossilized just because the original decision has become a binding precedent; while the rule as it exists in the main stock of international law may have changed considerably in the course of its natural development. A notorious example is the rule by which a foreign sovereign state enjoys immunity from the jurisdiction of the municipal courts: in origin a simple and reasonable principle which, in the course of English case lam, has become peculiar and technical while retaining an archaic form which some consider inappropriate to modern conditions. Secondly, it must be remembered that in England a statute is paramount law and must therefore be applied even if found to be contrary to international law *(cf. Mortensen* v. *Peters, 14* S.L.R. 227). In such an impasse it is for parliament to get itself out of difficulties of its own creating by changing the law. The municipal court cannot help.

A treaty, even though binding upon the United Kingdom internationally, will not be applied as such by the courts. If the implementation of the treaty requires a change in the law it is for parliament to make that change by statute. The reason for this rule is said to be that, since the treatymaking power is a prerogative power, it would, if the treaty were binding directly on the courts, amount to a power to legislate without parliament. The position is quite different for example in the United States, where treaties are binding on the courts even if in conflict with state laws or previous federal laws; on the other hand, a subsequent federal

statute will overrule a previous treaty.

The Sphere of Operation. — Up to the end of the 19th century and even later, international law was mainly if not entirely a law governing the conduct of sovereign states. Theorists tended to erect this fact into a principle, and it used to be asserted, therefore, that international law could not bind or confer rights upon individuals, or upon entities other than sovereign states. But in truth there never was anything inherent in the law to prevent it applying to individuals. Indeed, as we have already seen, municipal courts have constantly found themselves compelled to take account of rules of international law affecting individuals appearing in cases before them. Developments during the 20th century have long outstripped the old orthodoxies. In 1928, the Permanent Court of International Justice recognized, in the case concerning the Jurisdiction of the Courts of Danzig (PCIJ, series B, no. 15) that states may expressly grant rights directly to individuals by treaty if they wish to do so, and that such rights may validly exist and be enforceable even though they have not been incorporated into the municipal law. In 1949, the International Court of Justice, in its opinion on the Reparation for Injuries *Suffered* in the Service of the *United* Nations (ICJ Reports, 1949, p. 179), expressly rejected the view that only states can be the subjects of international lam. And, of course, the laws of war were always based on the assumption that their precepts were binding not only upon sovereign states but also upon the individuals who compose them. In its judgment of Sept. 30, 1946, the Nuremberg International tribunal said this:

> It was submitted that international law is concerned with the actions of sovereign States, and provides no punishment for individuals; and further that where the act in question is an act of State, those who carry it out are not personally responsible, but are protected by the doctrine of the sovereignty of the State. In the opinion of the Tribunal, both these submissions must be rejected. . . . Crimes against international law are committed by men, not by abstract entities, and only by punishing individuals who commit such crimes can the provisions of international law be enforced.

All this is not to say of course that some parts of the law—and particularly those which developed in the 19th century—are not still coloured by the old orthodoxies. For example, the influence of dualist doctrine is still to be seen in the so-called rule of nationality of claims, by which it is assumed that a wrong to an individual committed in a foreign state is a wrong not to him but to his own state, and that there is no redress unless his own state takes up the claim, and, moreover, is qualified to do so by reason of his having been its national both at the time of the injury and continuously until the claim is brought. This cumbrous and unrealistic procedure is being changed only slowly into something more apt to the doing of justice.

Codification. — Since the middle of the 19th century it has often been suggested that international law would be strengthened by codification, on the grounds that a code would add certainty and precision to the law, besides offering an opportunity for the completion of the system. While there can be no doubt that the movement has been a salutary one, with considerable achievements to its credit, it has only been realized slowly that codification presents peculiar difficulties in the international sphere. A codification in the strict sense—*i.e.*, where existing law is put into written form but the substance remains unchanged—is, except perhaps in a very few restricted fields, practically impossible, because any attempted codification must involve the resolution of differing opinions about what the law is; so that some changes in the law in the course of codification are unavoidable. This process presents no special difficulty in an internal system where there is a legislature competent not only to promulgate the new code with authority but also to abrogate the former sources and understandings of the law. But in international law there is no legislative process as yet available. The nearest approach to it is the multilateral treaty; which, however, is still only binding on the parties to it. Consequently, unless the treaty becomes universally accepted, the former customary sources of the law remain valid for those who are not parties to the treaty. Thus it may be possible to argue that the former customary law remains in existence as the general law, and that the codification is a novel law binding only those who have subscribed. Hence, a codification attempted at the wrong moment may easily complicate rather than clarify the law.

These and other difficulties were demonstrated by the disappointing results of the Hague Codification conference of 1930 when, in spite of preparatory work of unexampled thoroughness, the conference failed to reach any agreement on two major topics of the law and produced only minor, and for the most part still unratified, conventions on a third.

A great step forward, however, was taken in the charter of the United Nations, which required the general assembly to initiate studies and make recommendations for "encouraging the progressive development of international law and its codification" (art. 13), thus recognizing that codification and development of the law are in practice inseparable companions. To carry out this task an International Law commission of experts was established in 1947 and began its studies in 1949. Its method has been to study certain major topics of the law and to report the results of its labours to the general assembly in the form of draft conventions with comment. It is then for the general assembly to decide whether the time is opportune for a diplomatic conference to use the work as a basis for an actual codifying convention. But in any case the reports of the commission and the materials they collect and publish have themselves enriched the law, thus demonstrating the force of Sir Cecil Hurst's plea for codification in the form of restatements by technical experts which might be expected to achieve the inherent authority of accurate and persuasive scholarship (see Grotius Society *Transactions*, 1946). In the first ten years of its working life, the commission produced reports on such important topics as arbitral procedure, diplomatic immunities, state responsibility and offenses against peace and security.

In its final report on the very important question of the various aspects of the law of the sea the commission recommended the calling of a general diplomatic conference. Accordingly, the representatives of 86 countries met at the Geneva Conference on the Law of the Sea in 1958. The conference failed, not unexpectedly, to agree on the crucial question of the width of territorial waters: a question which nicely illustrated the difficulty of maintaining a distinction between the question of what the law is and the question of what it might become. Some countries were doubtless still jockeying for position in the controversy and were not at that moment wishing to reach a final agreement. On other topics of maritime law, however, the conference was a very considerable success, for it achieved very wide agreement on four draft conventions ranging over almost the entire field of maritime law, comprising in all 106 articles, dealing with the territorial sea and contiguous zone, the high seas, fishing and conservation of resources on the high seas and the continental shelf. The draft conventions mere of course subject to ratification before becoming binding upon states. The Geneva experiment was a very great advance over earlier attempts at development and codification by treaty and probably showed an increasing awareness in governments of the importance of international law and the urgent need for its development.

International Organizations. — As has been already noticed, there were in quite recent times no international organs of government and administration. International law could only function through the agency of the governments of the separate states. Thus, for example, new states were admitted—and indeed still are admitted—into the international comity of nations by the process of independent recognition by each separate state. It is true, of course, that there are legal rules governing various aspects of recognition; but the act of recognition is still a function of the states and not of an international institution. Again, the claims of individuals or corporations for reparation for international wrongs such as denial of justice have to be adopted and preferred by the government of their national state before they become viable in the international sphere. Until after World War I, the final sanction of the law was accepted as being the rough and ready one of various forms and degrees of self-help by states themselves, including ultimately war.

Some international institutions began to appear, however, in

restricted and mainly technical fields in the 19th century. The first was the International Telegraph union of 1865, followed by the Universal Postal union in 1874, the Copyright union in 1886, the International Institute of Agriculture in 1905 and the Radiotelegraph union in 1906.

This development of international institutions mas greatly accelerated after World War I by the establishment of the League of Nations with its many associated agencies, including two important ones which have nith some changes, survived World War II, namely the International Court and the International Labour organization. The movement gathered pace again at the close of World War II with the establishment of the United Nations and its 12 specialized agencies, and the creation of numerous intergovernmental organizations exercising functions bearing on the development or administration of international law. Thus the middle of the 20th century saw the emergence of a large number of international agencies. some well-nigh universal, some regional and many of them now an indispensable part of the daily working of international society; *e.g.,* the International Civil Aviation organization, the World Health organization, the United Nations Educational, Scientific and Cultural organization, the Food and Agriculture organization, the International Monetary fund and the Bank for International Settlements.

These bodies are creatures not of a particular municipal law but of international law. The International Court has given its opinion that the United Nations itself is a person in the lan in the sense that it can even bring certain kinds of claims on behalf of individuals against a state. The legal problems which are common to international organizations in general, such as questions of membership, voting powers and procedures, and relations nith other organizations, with states and nith individuals, were, by the middle of the 20th century, being welded into a systematic legal discipline comparable with the constitutional law of a state.

Important. however, as this emergence of an international constitutional law undoubtedly is, its significance clearly depends in the long run on the success or failure of that central part of it which is concerned with the problem of war; for a system of lam fails in its primary function if it fails to regulate the use of physical force within the society it purports to govern.

International Law and War.—The founding fathers of modern international lam had no doubt that the control of war must be the primary function of the system. Therefore they not only devised rules governing the conduct and methods of warfare—the so-called temperaments-but also attempted to distinguish between wars which were just and lawful and those which were unjust and therefore unlawful. This attempt. however, could be of little practical significance in a society in which there mas no international authority to make the determination one way or another. Consequently, from the 18th to the early 19th century, international law abandoned the attempt to distinguish between wars and followed the cynical maxim that "war is no illegality." War, which might therefore be made at the absolute discretion of each sovereign state strong enough to wage it or desperate enough to risk it, suspended the lam of peace between the belligerents and brought into operation the rules of war intended in some measure to mitigate its severities and to protect civilian lives and property. Between the belligerents and neutrals there came into operation a highly sophisticated law of neutrality. This traditional law was codified: though not without ambiguity, at the two Hague peace conferences of 1899 and 1907. It is important to remember therefore, that during much of its existence, international law made no practical attempt to control the use of war as an instrument of policy.

World War I demonstrated the need not merely to attempt to control the conduct of war, but to prevent it; both on account of the increasingly devastating scale of modern warfare and also because even the old rules governing its conduct, except for certain fundamental principles stemming from the ordinary rules of humanity. were being rendered constantly obsolete or irrelevant as a result of the application of modern science to the methods of warfare. The rules tended always to be more appropriate to the last war than the present one.

The 20th century has therefore seen a return in a new form to the classical attempt to distinguish between the just and the unjust war: first in the League of Nations covenant, then more generally in the still important and binding general treaty for the renunciation of war of 1928, sometimes known as the Peace Pact of Paris, or the Kellogg-Briand pact. This was a well-nigh universal treaty in which states renounced war as an instrument of national policy and undertook to settle their disputes by pacific means, thus making all wars illegal except those waged in self-defense or against a state that had already violated the treaty by an illegal resort to war. It was this instrument which formed the legal basis for the abandonment of formal neutrality by the United States in the early stages of World War II and for her assistance to the Allies before she herself became belligerent. In 1946 there was added the charter and structure of the United Nations, in which members undertook to "refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state. . . ." (ch. 1, art. 2, sec 4).

Conclusions.—The experience of two world mars the failure of the League of Nations experiment and the unforeseen difficulties and frustrations of the United Nations resulted in a prevailing temper of disillusionment which contrasted strongly with the optimism of the late 19th century. Yet it is true that the 20th century has seen an unprecedented and rapid development of the main body of international law which gathered even increased momentum after the close of World War II. There is a sense in which this development was inevitable. The industrial revolution and then the technological revolution forced states closer together and greatly increased the importance and variety of crossfrontier relationships in trade, communications and culture. Though political theory continued to describe states in terms of sovereign independence, the most important fact about them became their interdependence All this was bound to produce great changes in the law For law is not created by the speculations of jurists, or even by the desire of peoples for it, but by their real needs and by the pressures of events. Accordingly, if the international law of the mid-20th century is compared with the international law of the latter part of the 19th century great differences are found. The first and most immediately striking is the increase in the sheer bulk of it Some idea of this change can be gained by comparing the slim volume of a little more than 200 pages which Sir Henry Maine found sufficient to cover the subject in his Cambridge lectures of the 1880s, with the 2,000 or more pages of a modern basic text book such as L. F. L. Oppenheim's *Ifitel-national Law,* edited by *H.* Lauterpacht (vol. i, 8th ed , 1955; vol. ii, 7th ed , 1952). But the most important difference is the change in content. At the end of the 19th century and even perhaps after the end of World War I, it was still necessary to define international law in the traditional terms of a law to order the relations of states among themselves and to delimit the territorial spheres within which their respective sovereign and independent authorities might properly be exercised. As Sir Alfred Zimmern said, in a telling criticism of it, "modern international law was developed as a means for regulating external contacts rather than as the expression of the life of a true society" *(The League of Nations end the Rule of Law,* pp 98–99, The Macmillan Company, New York and London, 1939). And indeed it was to be expected that a lam coeval with the emergence of the nation state should have been much influenced by doctrines of the fundamental rights of states, so that much of the traditional law was concerned with aspects of state separateness and independence, rather than with the problems of an international society. But by the middle of the 20th century this was no longer the position. The proliferation of modern treaty law and relationships, the development of international organizations, the increasing concern of the law with the protection of fundamental human rights of the individual even as against his own state, the necessity for detailed international regulation of technological developments such as international civil aviation: all these factors resulted in a profound transformation of the nature and content of the law nhich is admirably summarized by Wilfred Jenks:

". . . . . the emphasis of the law is increasingly shifting from the formal structure of the relationships between States and the delimitation of their jurisdiction to the development of substantive rules on matters of common concern vital to the growth of an international community and to the individual well-being of the citizens of its member States. We shall also find that as the result of this change of emphasis the subject-matter of the law increasingly includes cross-frontier relationships of individuals, or organizations, and corporate bodies which call for appropriate legal regulation on an international basis, problems of economic and technological interdependence requiring the regulation on the basis of common rules of matters which do not *per se* involve inter-State relations in any real sense, and rights designed to provide the individual, and in some cases organizations, with a measure of protection against the individual member States of the international community. This international community, which is still far from having attained any political or moral unity and is always liable to be torn asunder by disruptive forces, continues to be organized on the basis of States, but its law has long since ceased to be merely, and is rapidly ceasing to be primarily, a law between States." (C W. Jenks, *The Common Law of Mankind,* p. 17, Stevens and Sons, London, and Frederick A. Praeger, Inc., New York, 1958).

The attention of the reader is especially drawn to the following articles: ARBITRATION, INTERNATIONAL; CONFLICT OF LAWS; HAGUE CONFERENCES; INTERNATIONAL COURT OF JUSTICE; INTERNATIOXAL LABOUR ORGANIZATION, THE; LAWS OF WAR; LEAGUE OF NATIONS; NEUTRALITY; SANCTIONS AND GUARANTEES; TREATIES; UNITED NATIONS.

BIBLIOGRAPHY.—J. L. Brierly, *The Law of Nations,* 5th ed. (1955) and *The Basis of Obligation in International Law and Other Papers (1958)*; C C. Hyde, *International Law, Chiefly as Interpreted and Applied by the United States,* 3 vol., 2nd rev. ed (1945); H. W. Briggs (ed), *The Law of Nations: Cases, Documents and Notes,* 2nd ed. (1952); Julius Stone, *Legal Controls of International Conflict* (1954).

(R. Y. J)

INTERNATIONAL MONETARY FUND, a specialized agency affiliated with the United Nations, designed to stabilize international monetary exchange rates. Together with the International Bank for Reconstruction and Development (see BANK FOR RECONSTRUCTION AND DEVELOPMENT. INTERNATIONAL) its articles of agreement were signed, after considerable prior negotiation, at Bretton Woods, N.H., in July 1944. Ratification and appropriation of funds by national governments enabled the fund to be constituted in March 1946. Initial exchange values of member currencies were accepted at the rates then current. The fund opened in March 1947 and made its first transactions in May 1947. By the late 1950s it had 67 members. No communist countries then belonged.

Organization. — Operating funds are subscribed by member governments. Each member has a quota, of which an amount equal either to 25% of the quota or 10% of the member's holdings of gold and U.S. dollars, whichever is smaller, is subscribed in gold and the remainder in national currency. By April 1958 the total quotas for 67 countries were $9,068,500,000 and the fund held gold and convertible currencies amounting to $2,506,800,000 of which $884,300,000 were subject to unutilized drawing rights under stand-by arrangements.

The fund mas designed to stabilize exchange rates by assisting members over temporary difficulties in their international balances of payments. It does so partly by consultation and technical advice, but also by allowing members to purchase from it with their own national currencies the gold or foreign exchange they need. In principle not more than 25% of the member's quota may be purchased in any one year, but in an emergency this limit may be, and often is, waived. Not more than 125% of the quota may be purchased in all Charges begin at ½% for the first 25% for the first year, rising by ½% for each additional 25% for each additional year. with a limit of 5%. Members may arrange stand-by credits to use as and if necessary. If demands for any currency outrun the fund's resources it may be declared scarce and rationed. Members may then impose discriminatory exchange controls against it. Members are required to repurchase the excess of their own currencies over their quotas within an agreed period (three to five years) and as their balances improve.

Members agree not to alter the exchange value of their currencies (except once by not more than 10%) uithout prior agreement by the fund. In 1949 Britain and many other countries secured such agreement, as did France in 1957 and other countries at different periods.

Members are pledged to the ultimate elimination of exchange control and multiple exchange rates. They must consult annually with the fund on both and it works with them toward greater freedom and uniformity of exchange rates. Such consultations offer opportunities for technical advice and assistance toward currency stabilization and the freeing of exchange transactions. Staff members also frequently visit member countries to consult with national monetary agencies.

The fund has no power to dictate national monetary policies. By providing technical assistance when asked and facilities to acquire needed reserves in emergencies, it may moderate exchange crises and minimize currency instability, but it had not by the late 1950s been able to get rid of exchange restrictions.

Policy is determined by a board of governors representing each member government. Governors cast votes weighted according to the quotas subscribed by members, ranging in the late 1950s from 25j votes for Panama to 27,750 for the United States. The 17 executive directors meet frequently. Five. representing the countries with the largest quotas (the United States. United Kingdom, China, France and India) are appointed. The remaining 12 are elected by the other members. The managing director and his staff are responsible for actual operations.

Transactions. — After years of relative inactivity, the number and amount of the fund's transactions increased sharply during the Suez crisis in 1956–57. In the organization's first ten years, ending April 30. 1957, total purchases amounted to $2,350,000,000 of which $1,114,000,000 were made in 1956–57. Another $1,212,000,000 was earmarked under stand-by arrangements in that year. Most purchases were of U.S. dollars, but there were also small purchases of German marks and Dutch guilders, as in earlier years there had been of sterling. Belgian francs and Canadian dollars. Not all stand-by arrangements were used. Up until 1958 repurchases of their national currencies by members were less than new purchases of dollars. Some national quotas were increased and there was discussion in the late 1950s of the need for a general increase to enlarge the fund's resources. It was widely recognized that the fund's action in making available large amounts of internationally acceptable currencies had eased the strain on national balances in the Suez crisis. See also INTERNATIONAL PAYMENTS; MONETARY AGREEMENT.

BIBLIOGRAPHY.—International Monetary Fund, *Annual Reports,* and *International Financial News Survey* (monthly), especially vol. x, no. 40, April 18, 1958; J. B. Condliffe, *The Commerce of Nations,* pp. 639–653 (1950); P. T. Ellsworth, *The International Economy,* rev. ed., pp. 421–433 (1958).

(J. B. CE.)

INTERNATIONAL ORGANIZATIONS, institutions drawing their membership from two or more states, and maintaining arrangements and facilities designed to promote periodic or continuous activities by their members.

The 20th-century trend toward the creation of international organizations on a wide scale was essentially a product of circumstances stemming from advances in the technology of communication. transportation and warfare, and from the growth of industrialism. These developments gave rise to a sense of interdependence among the peoples of the world. thereby stimulating recognition of the need for systematic international co-operation to avoid the dangers, curb the evils. solve the problems and exploit the opportunities which confront the society of nations. These same developments also gave an unprecedented air of feasibility to the project of creating and operating organizations on a world-wide scale. Such institutions vary greatly in geographical scope. ranging from regional organizations to universal bodies embracing virtually the whole world. Some are concerned only with single and relatively narrow problems, while others, *e.g.,* the United Nations, deal with a great variety of substantive matters. Finally, international organizations may be designated as either intergovernmental or nongovernmental agencies.

Nongovernmental **Organizations.**—Typically, international nongovernmental organizations are associations of private groups organized separately within various states: although some are based upon the membership of individuals. The distinction between the intergovernmental and nongovernmental types is not always clear

cut. Many organizations are mixed in composition. The International Labour organization, for instance, while fundainentally an intergovernmental body, included in the 20th century spokesmen for national employers' and workers' associations along with official representatives of governments as voting delegates to the sessions of its major organs.

On the nongovernmental level, groups were organized for such purposes as the international exchange of knowledge, the promotion of religious and humanitarian causes and the development of parallel or co-ordinated practices among nations in particular areas of activity. Nongovernmental organizations also in many instances promoted the creation of intergovernmental agencies in the fields of their concern, and advised and assisted the latter bodies in their operations. While most nongovernmental organizations were designed to stimulate co-operative achievement of practical results in rather specialized fields of endeavour, some reflected a desire to cultivate internationalism as a value in itself, promoting friendly contact and habits of international co-operation as a contribution to the creation of an orderly and peaceful world.

Intergovernmental Organizations. — The intergovernmental category includes those established by agreement among governments, and maintained by states, which exercise their membership functions through governmental representatives. Public international organizations, of the mid-20th century, although less numerous than the nongovernmental agencies. generally attracted greater attention and had more adequate financial support. Their creation reflected a disposition to seek new techniques and improved facilities for coping with the tasks of government under the increasingly complex circumstances of the modern era. In particular, the ancient moral ideal of world peace and the urgent practical requirement of avoiding the devastating results of modern war produced an emphasis upon the peace-preserving function of intergovernmental organizations. Although governments formed international institutions to deal with a variety of highly technical problems, there was at mid-century a growing tendency to express the formal purpose of these agencies in terms of their potential service to international peace and security.

Accelerated 20th-Century Development. — The association of the tendency to create international organizations with the development of the complexities of modern interdependence is dramatically illustrated by statistical analysis. According to a 1957 report by the Union of International Associations, *Les 1,978 organisations internationales fondées depuis le Congrès de Vienne* ("The 1,978 international organizations founded since the Congress of Vienna"), only a handful of international organizations in existence in the late 1950s were formed before 1850; approximately 10% were established before 1900; and about 90% of the organizing activity was concentrated in the period. 1900–56. The accelerating pace of the movement was particularly notable in the decade following World War II. when more than 600 nongovernmental and over 80 official organizations were formed.

According to the 1956–57 edition of the *Annuaire des organisations internationales,* published by the Union of International Associations, there were in the late 1950s 1,116 existing international organizations. This number included 136 intergovernmental agencies, of which the most notable were the United Nations, the various specialized agencies affiliated with the United Nations, and such regional organizations as the European Coal and Steel Community, the North Atlantic Treaty organization and the Organization of American States. The variety of subjects with which intergovernmental organizations were concerned was indicated by such names as the Central Commission for the Navigation of the Rhine, the International Tin Study group, the International Patent institute, the European Organization for Nuclear Research and the International Whaling commission. Nongovernmental organizations were listed under 19 headings ranging from "Religion and Moral Improvement" to "Sport and Recreation." The largest concentrations of private international organizations fell under "Labour and Professions, Employers, Trade Unions," "Commerce and Industry" and "Medicine, General and Mental Health."

The first half of the 20th century was marked not only by the rapid multiplication of international organizations, both private and public, but also by efforts to create a pattern of orderly relationships among them. The Union of International Associations, founded at Brussels, Belg., in 1907, was an early co-ordinating body. The League of Nations, created after World War I, provided a focal point for intergovernmental organizations and also for the growing network of nongovernmental agencies. Following World War II. the United Nations became a kind of "roof organization" for the major enterprises in systematic international cooperation. In accordance with art. 57 and 63 of its charter, the UN entered into co-ordinating agreements with intergovernmental agencies operating in economic, social, cultural, educational: health and related fields. In the second half of the 20th century the roster of specialized agencies affiliated with the United Nations included: Inter-Governmental Maritime Consultative organization (IMCO); International Labour organization (ILO); United Nations Educational, Scientific and Cultural organization (UNESCO); Food and Agriculture organization (FAO): International Civil Aviation organization (ICAO); International Monetary fund; International Bank for Reconstruction and Development (World Bank); World Health organization (WHO); International Telecommunication union (ITU); Universal Postal union (CPU); World Meteorological organization (WMO); International Atomic Energy agency; and the International Finance corporation. The Economic and Social council of the United Nations, acting under art. 71 of the charter, also maintained a consultative relationship with nearly 300 nongovernmental organizations, virtually all international in scope.

The United Nations did not, however, become, nor was it intended to become, a central authority with power to control the operations of other international organizations. A great number of international agencies of all types remained outside the institutional family over which the United Nations presided. Nevertheless. the United Nations was responsible for the closest approach made to the development of a system within which the work of the great mass of international organizations might be harmonized and co-ordinated. *See* also AMERICAN STATES, ORGAXIZATION OF; BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL; BENELUX; CENTRAL AMERICAN FEDERATION; FOOD AND AGRICULTURE ORGAKIZATION; INTERNATIONAL CIVIL AVIATION ORGAKIZATION; INTERNATIONAL COURT OF JUSTICE; INTERNATIONAL INSTITUTE OF AGRICULTURE; INTERNATIONAL LABOUR ORGANIZATION, THE; INTERNATIONAL MONETARY FUND; INTERNATIONAL REFUGEE ORGANIZATION; INTERKATIONAL TRADE ASSOCIATIONS AND CONGRESSES; NORTH ATLANTIC TREATY ORGANIZATION; PAN-AMERICAN CONFERENCES; PAN-EUROPEAN MOVEMENT; RED CKOSS; SOUTHEAST ASIA TREATY ORGANIZATION; UNITED NATIONS; UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION; UNITED NATIONS RELIEF AND REHABILITATION ADMINISTRATION; UNIVERSAL POSTAL UNION; WARSAW TREATY ORGANIZATION; WORLD GOVERNMENT MOVEMENTS; WORLD HEALTH ORGANIZATION.

BIBLIOGRAPHIY.—Institut International de la Paix, *Annuaire de la vie Internationale* (1905 *et seq.)*; publications of the Union of International Associations, Brussels, incl. *Yearbook of International Organizations (Annuaire des organisations internationales)*; Lyman C. White, *International Non-Governmental Organizations* (1951); Council of Europe, *Handbook of European Organizations* (1956); G. P. Speeckaert (comp.), *International Institutions and International Organization,* a bibliography *(1958).* (I. L. C.)

INTERNATIONAL PAYMENTS. The main difference in the settlement of international and domestic transactions is the existence of different currencies. This, however, is not a serious obstacle as long as the currencies are freely convertible into each other. and into gold. When, for example, British importers can buy United States dollars from their banks for sterling and U.S. exporters can sell sterling to their banks for dollars, it is immaterial in what currency the transaction is settled. Banks trading in foreign exchange normally keep balances in the appropriate currencies with their branches. agents or correspondents abroad in order to facilitate the clearing process But whereas interbank credits or debits outstanding can be settled internally in terms of local currency, they are settled internationally either from ac-

cumulated balances of foreign exchange, or by loans from the creditor to the debtor. or by drawings on the International Monetary fund (q.v.) or by movements of gold. Whenever this process is multilateral rather than bilateral, it provides an additional advantage. For if, in terms of the total annual turnover of transactions between them. England is in debit to the United States and in surplus with the colonies and the latter in surplus with the United States but in debit to England, there is no net change in the foreign-exchange position of the areas concerned if the various credits and debits exactly cancel out. In practice, however, it does not work out so smoothly; there always have been considerable fluctuations in net credit and debit positions within any given year as well as between years. The way in which a country balances its international accounts is one of the most important problems of its balance of payments.

BALANCE OF PAYMENTS

The balance of payments is a systematic record of all economic transactions during a given period between residents (including the government) of one country and residents (including the governments) of other countries, referred to for convenience as foreigners. The transactions are presented in the form of double-entry bookkeeping with credit entries balanced on the debit side, and vice versa. The balance of payments of a country thus necessarily balances. There can be no surplus or deficit in a country's balance of payments as a whole.

This accounting equality of a country's total credits (receipts) and total debits (payments) may be readily illustrated. The balance of payments of the United States, for example, records the various ways in which dollars are made available to foreigners through U.S. imports, tourists' expenditures, military expenditures, donations, foreign lending activities and so forth. These expenditures are shown on the debit (payments) side of the balance. The credit (receipts) side indicates the various uses to which foreigners put their dollars. such as paying for U.S. exports, servicing of debts to the United States and the like. If foreign countries do not spend all the dollars made available to them during a given period to obtain goods and services from the United States, the balance of payments will show on the credit (receipts) side an increase of foreign-held dollar balances. foreign purchases of U.S. securities, gold exports from the United States or some similar item. If, on the other hand, the dollars made available by the United States are insufficient to pay for the exports of U.S. goods and services, additional dollars can be obtained only by liquidation of foreign holdings in the United States, by gold imports into the United States and by similar operations which would necessarily be recorded on the payments side. This must mean that for any period the receipts measured in dollars are equal to the payments measured in dollars when all the receipts and payments are included. But this equality of payments and receipts in the formal "balance sheet" conceals the reasons why countries are so concerned with their balances of payments. Hence, not whether the accounts are balanced but how they are balanced is the important question.

Operations Entering Into the Balance.—Countries are greatly concerned about the types of transactions giving rise to the receipts and payments of foreign exchange and how these compare in size with one another. The accompanying table comprises all the items in the standard schedule for reporting a country's balance of payments to the International Monetary fund (I.M.F.). It is divided into two major sections: the current account and the capital account.

The current account records all transactions other than those representing changes in the international creditor-debtor position of the reporting country and in its monetary gold holdings. It includes two distinct types of transactions: items 1 through 8, which refer to transfers of goods and services, and items 9 and 10, which cover private and official donations. The credit entries under items 1 through 8 correspond to goods and services supplied, the debit entries to goods and services received. Credits under items 9 and 10 show donations received by the country; debits show donations made.

The capital account records all transactions representing changes in the international creditor-debtor position of the reporting country and in its holdings of gold and other monetary-reserves. It does not include valuation changes (e.g., changes in the market values of securities, or revaluations of assets and liabilities because of exchange-rate adjustments) since these are not transactions. The capital movements shown do not, therefore, necessarily reflect the total change in the creditor-debtor position of the reporting country during the given period. In order to present a maximum of information compactly, the capital account is shown in terms of net changes—increases or decreases—in assets and liabilities. Increases in assets and decreases in liabilities indicate an outflow of capital (a debit); decreases in assets and increases in liabilities indicate an inflow of capital (a credit). The capital account is divided into a private sector (items 11 to 14) and an official sector (items 15 to 19).

Since economic transactions included in the balance of payments involve directly or indirectly two entries—a debit and a credit—errors and omissions apart, any net balance on account of goods, services and donations taken together is matched by an equal balance with opposite sign on capital account. Because some transactions may be inaccurately recorded or not recorded at all, the "errors and omissions" item is included to bring the statement into balance (see table).

Various Concepts of Surplus or Deficit.—To speak of a surplus or deficit in the balance of payments would appear to be a contradiction in terms. Yet much of the discussion of international economic problems following World War II concerned certain "deficits" of the war-damaged countries and the underdeveloped areas. These problems, in part, revolved about whether certain segments of a country's balance of payments were in balance or whether they were in surplus or deficit by some amount.

The discussion sometimes ran in terms of the "trade balance":

Standard Schedule for Reporting Balance of Payments to International Monetary Fund

Current transactions Reporting country——Period covered——Currency——Unit—— Exchange rate: U.S. $ per——	Credit (receipts)	Debit (payments)	Net credit (+) or (−)
Item			
A. Goods and Services			
1. Merchandise: exports f.o.b.			
Merchandise: imports f.o.b.			
2. Nonmonetary gold			
3. Foreign travel: credit			
Foreign travel: debit			
4. Transportation: credit			
Transportation: debit			
5. Insurance: credit			
Insurance: debit			
6. Investment income: credit			
Investment income: debit.			
7. Government, n.i.e.: credit.			
Government, n.i.e.: debit			
8. Miscellaneous: credit.			
Miscellaneous: debit			
B. Donations			
9. Private			
10. Official			
Total (1 through 9)			
Total (1 through 10)			
Net errors and omissions			

Movement of capital and monetary gold. Reporting country——Period covered——Currency——Unit—— Exchange rate: U.S. $ per——	Net movement, increasing (+) or decreasing (−)		
Item	Assets	Liabilities	Net assets
C. Capital and Monetary Gold			
Private, excluding banks			
11. Long-term liabilities			
Direct investment (in country)			
Transaclions in securities			
12. Short-term liabilities			
13. Long-term assets			
Direct investment abroad			
New foreign security issues			
Retirement of foreign securities			
Transactions in outstanding securities.			
14. Short-term assets.			
Official and Banking Institutions			
15. Long-term liabilities			
16. Short-term liabilities			
To foreign officials and banks			
To other foreigners			
17. Long-term assets			
Official loans extended			
Official repayments			
Other			
18. Short-term assets.			
Government			
Other			
19. Monetary gold			

i.e., the net credit or debit of merchandise trade. While this is an important segment of the balance of payments, it may have very little significance by itself. An import surplus may be matched by net sales of services that are closely similar in their economic implications to sales of goods. There would then be no deficit in goods and services as a whole and this balance is a broader and more significant measure than is trade alone. Similarly, an export surplus may be reinforced by net sales of services, increasing the surplus in goods and services as a whole.

Often the balance of goods and services has been discussed as if it were the balance on current account. The current account as a whole has always had a basic importance since it is the counterpart of the capital account. A nation with a deficit on total current account is *ipso* facto decreasing its capital assets abroad (including gold) or increasing its capital liabilities to foreigners. A nation with a current-account surplus is gaining foreign assets or reducing its foreign liabilities. Manifestly a deficit or surplus on current account may be of crucial importance to a country. However, in addition to the goods and services that are sold to foreigners, there are many transactions for which no payment is made. Governments that extend grants, individuals who send goods or money to families or friends abroad, and institutions that provide charity are all engaged in such transactions. The goods, services and capital items that pass in these transactions without payment are all entered in the balance of payments as if payment were made for them. They are then simply offset by contra-entries under "donations" (which may be voluntary, automatic or semiforced) to show that, in fact, payment was not required. In many instances. to state that a country financed by foreign grants had no deficit to be met is a patent contradiction. Accordingly, while the full current account (including donations) is useful in revealing the factors that have altered the international capital position of a country, it is a seriously defective measure of balance-of-payments deficit or surplus from the standpoint of exchange problems.

Even if official donations are eliminated from the current account in arriving at a figure for deficit or surplus, the result may still be misleading as an indication of the exchange problem involved. A deficit in the balance of goods and services, for example, is not necessarily an indication of pressure on a country's exchange rate. It may be matched by an inflow of investment capital which strengthens the immediate exchange position and builds up a country's future exporting capacity. Similarly, a surplus in the balance of goods and services may be no ind cation of a strong exchange position. It may reflect the efforts of a country to pay reparations or to meet other fixed obligations abroad.

It is regrettable that in public discussions a deficit in the balance of trade is referred to as an "unfavourable trade balance" and a surplus as a "favourable trade balance." The notion that it is vitally important for a country to have an excess of exports over imports was stated as far back as the 14th century. A country that exports more commodities than it imports, so the argument runs, would receive the difference in gold and silver. This was regarded as a "favourable balance" because, for a country mith no gold or silver mines, it was the only way to increase its stock of the precious metals. But the grounds on which early writers based their beliefs in the desirability of an indefinite accumulation of the precious metals were for the most part erroneous. The mercantilists of the 16th: 17th and 18th centuries, for example, regarded any gain in the precious metals as a gain in economic power and prosperity. (See MERCANTILE SYSTEM.) Clearly, from the welfare point of view, it is goods and services that account for the economic advantages derived from foreign trade. Money is predominantly a mechanism of foreign commerce. Just as it is impossible for a country to maintain indefinitely an excess of exports over imports unless it is willing continuously to accumulate gold. invest abroad or give its goods away, so it is impossible for a country to maintain indefinitely an excess of imports over exports unless it is able continuously to obtain foreign exchange from the export of gold, from grants or investments abroad, or to default.

The terms "favourable" or "unfavourable" trade balance, when not wholly invalid, are subject to such grave limitations Chat they are rejected in modern treatments of the subject and are replaced by such terms as "active" and "passive," or "positive" and "negative," trade balance. Other terms used for the same phenomena are "export surplus" and "import surplus," or "credit" balance and "debit" balance. The more important item, net total on current account, is often designated by the terms "surplus" or "deficit" in a country's balance of current payments. The value of the net outflow of gold plus net increases in foreign holdings of a country's short-term balances has most frequently been used as a measure of a country's balance-of-payments deficit.

BRITISH BALANCE OF PAYMENTS

Britain has had a deficit in merchandise trade since before the Napoleonic Wars. Before World War II it had been able to pay for its imports of food and raw materials largely mith earnings from foreign investments built up over generations, and from services. The postwar balance-of-payments difficulties, however, which in some respects were typical of those of western Europe, were not of late origin. World War II merely hastened a great structural change in Britain's trade relations which had been going on since well before World War I.

Before World War I.—During the nation's great period of expansion—from 1780 to 1913—conditions favoured the import balance appropriate for Britain's creditor status. Its position as a pioneer in industrial development, with no tariffs or quota restrictions from 1860 to 1914, the complementary exchange of its manufactures for food and raw materials, general political stability, the large increase in overseas investment, free or "untied" lending, and stable world currencies all contributed to the relatively smooth multilateral adjustment of the British balance of payments. A fortuitous historical circumstance aided this adjustment process: Britain was able to invest much of its excess savings abroad whenever plans to invest at home declined relative to the level of total savings. But even before World War I, as Germany. the United States and Japan industrialized, world trade increased; Britain's export industries, however, were unable to keep pace with the manufactured products of the expanding industrial nations. Between 1870 and the start of World War I, world production of manufactures increased fourfold, but world trade in manufactures was a decreasing fraction of total production. In the 1870s one-third entered into international trade, in 1913 one-fifth. Nevertheless, the absolute volume of world trade in manufactures increased threefold between 1880 and 1913, and that of Britain also increased considerably although Britain's relative share of world trade declined. This trade expansion assisted the equilibration of Britain's external accounts. Even though its leadership in world trade was slowly being transferred to the United States, Britain's international accounts were not weak at the outbreak of World War I. It was the war, together with Britain's unavoidable sale of some foreign assets, that contributed to the deterioration in its balance of payments.

Between the World Wars.—Between World Wars I and II the volume of world trade in manufactures never appreciably exceeded that of 1913; the peak of 1926–30 was hardly above the 1913 level; the average of 1931–35 was only 76% of 1913; and the average of 1936–38 was 92%. The fact that Britain's share was declining rapidly within this reduced total was a significant factor in impeding adjustment of its international accounts. The external strains of the interwar period were in considerable part the result of the need for Europe—and Britain in particular—to adapt itself to this changing situation.

Furthermore, in the 1920s Britain's deficit between direct imports from. and exports to, the United States increased at the very time that invisible income (*i.e.*, shipping, insurance, banking receipts, etc.) from the United States decreased. The United States looked increasingly to the non-European world for imports, and Britain's share in U.S. trade continually declined. This decline was partially the result of a widening gap in productivity between the United States and Britain.

The gold standard, which Britain restored in 1925 following the period of currency disorder and inflation which engulfed Europe,

broke down in 1931. The great depression aggravated the external strains; comparatively free multilateral trade proved to be incompatible with mass unemployment. Multinational clearing disintegrated as restrictions on trade became ever more severe. The gains from the devaluation of sterling in 1931 proved short-lived; this action started a chain reaction that included devaluation of the U.S. dollar in 1933–34 and did not end until there had been further devaluations of the French and Belgian francs. Meanwhile, Britain (and many other countries) in the later 1930s had turned toward bilateral trade and direct controls as an effective method of relieving external strains. Despite all its efforts,Britain by 1938 was compelled to liquidate a small portion of its overseas assets to bring its international accounts into balance.

Effect of World War 11.—World War II dealt a staggering blow to Britain's balance of payments. Loss of income from overseas investments and from services impaired the nation's ability to meet the long-standing trade deficit with the Cnited States and Canada. The east-west barrier, the position of Germany and chaotic conditions in the far east and middle east increased British dependence on the dollar area. In effect, the prewar pattern of trade betueen Britain and the rest of Europe, and between Britain and the non-European world, had been practically destroyed.

Britain's postwar recovery in its balance of payments was irregular. Underlying the transitional problems was the long-term conjuncture of the great structural change in Britain's international position and the growing predominance in the world of a relatively self-contained, industrially efficient but highly unstable United States. Over the whole process of British reconstruction loomed the interrelated maladies of domestic inflation and external deficits which led to such events as the British convertibility crisis of 1547. Following that crisis, Britain made remarkable headway with the external problem, largely through a budgetary attack on inflation and, later, the European Recovery program (*q.v.*). Nevertheless, Britain suffered another reserve crisis in 1949 caused partially by a direct increase in Britain's own dollar gap (to some extent a result of "suppressed inflation"), a loss of dollar earnings by other members of the sterling area (occasioned by a recession in the United States) and an acceleration of a slow drain of gold to Belgium and Switzerland. The ominous decline in reserves compelled Britain to devalue the pound in Sept. 1949. Mass devaluations followed. Devaluation of the pound sterling, coupled with increased productivity at home and elsewhere, rapidly improved Britain's reserves. The deficit on current account with the United States and Canada was much reduced, and the surplus with the entire world was increased greatly. The over-all improvement was partly attributable to the expansion in net invisible earnings and to the continued restriction of the volume of imports. Certainly the latter could not have been accomplished without the most severe austerity in Britain.

Following the devaluations, the balance-of-payments position of the entire sterling area improved even more strikingly than did that of Britain. Actually, the sterling area raw material exporting countries had sold large quantities of wool, tin, rubber and cocoa at high prices, particularly to the United States and continental Europe, and had to a large extent "banked" the proceeds with the United Kingdom. The increase in reserves was therefore quite accidental; for the most part it was the result of the outbreak of war in Korea in 1950. Although this proved to be, with subsequent price decline of important raw materials, a temporary financial improvement, more fundamental forces were operating toward the strengthening of Britain's external accounts.

The continuing growth of British productivity during the 1950s and the more effective anti-inflationary monetary and fiscal policies helped immeasurably to reduce Britain's dollar deficit; indeed, in some years dollar surpluses were recorded. These factors, coupled with the high rates of economic growth in western Europe, Japan and the commonwealth. as well as the improvement in the United Kingdom's terms of trade, enabled it to increase its gold and dollar reserves. In 1958, with the collaboration of other western European countries, Britain consolidated the strength of its economy, which had been steadily built up in the preceding years, by establishing nonresident convertibility. As from Dec. 1958 British pounds earned by residents outside the sterling area were designated freely convertible into gold, dollars or any other currency. In effect, by 1960 the United Kingdom had achieved a workable balance in its international accounts. Despite all the stresses of World Wars I and II and their aftermaths, the pound—the international currency of the sterling area—remained one of the two leading world currencies. An important problem which remained unanswered, however, concerned the ability of the United Kingdom to maintain an appreciable rate of economic growth without rapidly encountering balance-of-payments strains. The complexity of the problems was evidenced by a recurrence of a balance-of-payments crisis in 1561. See STERLING AREA.

U.S. BALANCE OF PAYMENTS

For many years the United States had a merchandise export surplus. From 1876 to 1960 there were only three years (none after 1894) when it had a merchandise import surplus. The reasons for this development were many and varied. They included a deliberate national policy of high tariff protection; the continental character and climate of the United States; the abundance, richness and variety of its natural resources; the great distances from most foreign trading and producing centres; the protection given inland producers by high internal transportation costs; the technical skills of its people; the technological efficiency of its mass-scale production and distribution in manufacturing; the generally well-organized and mechanized agriculture; the greater tendency to generate excess capacity than other developed countries; and the nature of its commodity imports. All these factors tended to limit the expansion of American imports without heavy cost either in the production of domestic substitutes or in the deprivation of important products. Thus, compared with other important trading countries, the United States spent through the years an extremely small proportion of any dollar increases in national income on foreign products.

In the period before World War I, the United States export surplus was a sign of healthy economic development. It supplied foreign exchange for payments on foreign debt. In the 1920s, when the Cnited States became a creditor nation, it preserved its export surplus partly by making large loans to foreign countries. Other large debit items, purchases of shipping and insurance services, tourists' expenditures abroad and remittances by immigrants and charitable foundations contributed substantially to the foreign supply of dollars.

Depression and War.—The depression of the 1930s altered these conditions. Domestic investment, particularly during the spurt before the depression, tended to generate a rate of growth in income and an excess of planned saving over planned investment. With the coming of the depression, the disparity between the growth in physical capacity to produce and the growth of current demand became acute. As returns on domestic capital declined and political and economic troubles developed abroad, the excess of planned saving not only failed to be invested abroad but the flow of capital was reversed from a net outflow to a net inflow. The nation maintained a merchandise export surplus by readily importing the precious metals. From 1934 until the outbreak of World War II, rising levels of production and moderate reduction in tariffs contributed materially to a closer approach to balance in the nation's current account. On the nhole. U.S. industrial production, exports and imports moved together. During the period of U.S. participation as an active belligerent in World War II, more than 80% of total U.S. merchandise transfers represented lend-lease. In addition, for the three and one-half years following the war (from July 1, 1945, through 1948), net utilized foreign grants and credits of the U.S. government covered more than one-third of the United States total exports of goods and services.

Long-Range Trends.—What is often overlooked, however, is that powerful forces have for long been working toward international equilibration of U.S. external accounts. Thus, abstracting from the abnormal conditions of World War I and reconstruction, there has been a strong tendency since 1909 for the United States to have an excess of imports over exports of crude foodstuffs.

From 1923 to 1960 U.S. imports exceeded exports of crude foodstuffs virtually every year, despite depression conditions of the early 1930s. Similarly: since 1915. the U.S. excess of imports over exports of crude materials has been quite general, the only important exceptions being those of the years 1932–33. More noteworthy has been the long-term trend toward balance of U.S. trade in manufactured foodstuffs and in semifinished manufactures. From 1876 until 1932, U.S. exports of manufactured foodstuffs exceeded imports in every year but 1920. However, from 1932 to 1940 the trend mas reversed; and this new tendency toward net importation of manufactured foodstuffs was gradually resumed after World War II, although from 1953 to 1956 the structural maladjustments in U.S. agriculture brought about an excess of exports over imports of those products. From 1957 to 1960 imports of manufactured foodstuffs once again exceeded exports. Further. in most years from 1897 to 1921. U.S. exports of semifinished manufactures exceeded imports, but from 1922 until 1936 imports exceeded exports in every year. This trend was also resumed after World War II, although in the recession year of 1957 exports of semifinished manufactures exceeded imports. Lastly, C.S. exports of finished manufactures, the trade balance of which had been active since 1598, did not show a tendency to rise in the postwar period. whereas U.S. imports of finished manufactures continued steadily to expand.

Indeed. with one insignificant exception, throughout the 1950s U.S. total expenditures on imports of goods and services. donations and investment abroad exceeded foreign expenditures in the United States. The excess of total exports over imports in goods and services had in effect become insufficient to cover U.S. capital exports, governmental aid and expenditures. Measured in terms of gold outflow and the increase of foreign short-term balances held in the United States, from 1950 to 1957 the average annual deficit for the United States was about $1,000,000,000. In 1957 there was no such deficit, but it reached the embarrassingly large figure of over $3,000,000,000 in 1958 and 1959. The deficit in 1958 comprised a gold outflow of $2,300,000,000 and an increase of foreign short-term balances of $1,100,000,000; in 1959 it comprised a gold outflow of $776,000,000 and an increase of foreign short-term balances of $2,300,000,000. In the latter year, for the first time in the 20th century, the United States had an excess of commercial imports over exports of goods and services. It also had a deficit on total current account (items 1 through 10) and in goods and services and private donations (items 1 through 9).

During the first decade after World War II, the remarkable economic expansion in the United States and elsewhere, together with continued foreign assistance and tariff reductions, strengthened the long-term forces operating toward balance in U.S. international accounts. But at the close of the 1950s, events exhibited a "pendular" reaction. Supply conditions in western Europe had greatly improved. The high rates of economic growth at stable prices in the Federal Republic of Germany and at falling ones in Japan enabled them to expand their share of world exports of manufactures while that of the United States declined. The magnitude of the U.S deficits was aggravated by a sharp rise in U.S. imports relative to that of western Europe, an unusually prolonged steel strike. exceptionally low cotton exports, conversion to the production of commercial jet airplanes and abnormally large imports of small cars. The evidence does not disclose that U.S. prices had been rising appreciably as compared with those of most other industrial countries. With the relative expansion in Europe during 1960 the U.S. balance of payments in goods and services strongly improved. Nevertheless, the continuation of substantial deficits in 1960 and 1961 measured in terms of the outflow of gold and net increases in foreign holdings of liquid dollar assets, gave concern on both sides of the Atlantic over the long-term equilibrium of the C.S. balance of payments.

Balance-of-Payments Equilibrium.— Balances of payments are seldom in equilibrium in the theoretical sense that a small displacement of exports. imports or capital items would tend to be corrected and the original balance restored. In practice. equilibrium in a nation's balance of payments implies the absence of severe drain, or accumulation, of foreign reserves. Such drains may be the direct result of an excessive amount of domestic money being exchanged into foreign money. This may indicate that either the debtor or the creditor nation's monetary, fiscal and wage policies—and the resulting money incomes and product prices—are incompatible with the foreign-exchange rates. After World War II many countries found themselves in this situation *vis-à-vis* the United States and, by Sept. 1949, felt compelled to devalue their currencies. A persistent drain of reserves arising from an import balance in one of the selections of accounts (*e.g.*, total goods and services) may indicate that the nation in the past has been able to live partly on its foreign reserves and assets or to secure foreign loans or grants. Mounting international indebtedness may also be the result of unfulfilled or inconsistent plans with respect to domestic production and expenditures on the one hand, and imports and exports on the other. In such instances the gap between imports and exports has often been filled by foreign borrowing. Differential rates of interest may also contribute to international disequilibrium; thus the lower net-interest rates of the United States as compared with those of many other industrial countries have recently compounded the difficulty for U.S. net exports to cover capital outflows, governmental aid and expenditures.

Regardless of the source of disequilibrium, the problem of adjustment in a nation's balance of payments affects the creditor as well as the debtor. In the long term, measures appropriate to the debtor mill help solve the problems of the creditor, and measures appropriate to the creditor will help solve the problems of the debtor. But in the short term all policies are not equally acceptable, and creditors as well as debtors are tempted to resort to extreme national measures without regard for their effects on the world economy as a whole.

FOREIGN-EXCHANGE CONTROLS

As a consequence of the great depression, and attendant capital flight, from the 1930s a major complication arose in the international mechanism of adjustment, viz., the development of foreign-exchange controls. These controls restrict operations in all or specific foreign currencies on both current and capital account. They are usually administered by the central bank as the treasury's agent, and are invariably associated with trade controls. They take many forms, ranging from the licensing of all transactions involving foreign exchange to the supervision of transactions involving only specific foreign currencies or those of residents of specified countries. Nonetheless, they always constitute a method of rationing foreign currencies, particularly those which are scarce, and of ensuring that receipts of such foreign exchange are diverted into authorized channels.

The chief function of exchange controls is to prevent or redress an adverse balance of payments by limiting purchases of foreign exchange to an amount not in excess of foreign-exchange receipts. Usually, this entails setting a rate, or rates, at which exchange shall be bought and sold. When a single rate is established, it is normally higher than the rate that would prevail in a free market. Consequently, it tends to curb exports and stimulate imports. When multiple rates are established, they have the effect of differentiating between prices charged at home and abroad for specified exports and imports. The value of the currency is kept uniform for all residents with respect to their purchases of domestic products; but the multiple rates fix different prices for the same goods at home and abroad by stipulating different exchange rates for the various uses to which foreign exchange may be put. Although this practice may strengthen a country's balance of payments, it is a form of monopolistic price discrimination in international trade.

Most noncommunist countries have had occasion to adopt foreign-exchange controls out of necessity rather than preference. In periods of emergency it has often been impossible to achieve balance-of-payments equilibrium through the operation of demand and supply on the foreign-exchange market. Once adopted by some important country or countries, exchange controls have provided a source of special advantage as an instrument of trade bargaining; hence their tendency to spread. They have also been

used primarily for domestic reasons, such as to insulate an economy from external inflationary or deflationary pressures, or to assist in national economic planning and development However, in economies that are not centrally planned, exchange controls have had a tendency to direct trade into uneconomic channels, deteriorate its quality and reduce the extent of its potential contribution to the well-being of the participating countries. These factors are particularly relevant to full-employment conditions, for then exchange controls and their associated practices act as a constraint against further economic expansion. When the emergency that brought about their adoption has been removed. most noncommunist countries have tended to do away with exchange controls on trade account. They have usually been maintained on capital account, however, in order to control the flow of domestic versus foreign investment, and to deal with emergency conditions of capital flight.

Freely Fluctuating Rates.—Under normal circumstances international payments equilibrium might be achieved in a free system in which everyone is permitted to buy and sell foreign exchange in unlimited amounts. Shifts in demand and supply in foreign currencies would bring about changes in exchange rates which, in turn, would equalize the demand and supply for foreign currencies. If a country's demand for foreign exchange mere to exceed supply, the value of foreign currencies would tend to rise relative to the value of the domestic currency. Its imports would tend to fall and its exports rise, leading toward the restoration of equilibrium. This process of international equilibration, it will be observed. requires no disinflationary pressures in the country suffering from a balance-of-payments deficit; on the contrary, it tends to raise prices domestically in terms of the national currency but to lower them in terms of foreign currencies.

Despite its simplicity the system of freely fluctuating exchange rates has rarely been recommended. Almost no country for which foreign trade has been of great importance has ever been willing for long to tolerate completely uncushioned, fluctuating exchange rates. The reasons for this have been many and complex; they are grounded in the fact that fluctuating exchange rates are a powerful vehicle for disruptive speculation. A small, well-informed group customarily deals in the exchanges. In these markets there are no storage expenses. no physical deterioration or obsolescence caused by changes in tastes or wants. The asset in question is for practical purposes homogeneous, standardized and without grades Brokerage charges are minimal. the level of commissions by middlemen being lower than in any other field of speculation except national bond markets. The hedge normally earns income for the speculator and, be it foreign exchange or gold, it may be the best hedge with respect to expectations of a decline in the general price level. Lastly. there are no physical restraints. such as cost of production, on the possible extent of the swing downward in the value of a single country's currency. Exchange-rate fluctuations are often self-propelling and lead away from, rather than toward, international payments equilibrium.

It is generally recognized that once the brake of reasonably stable exchange rates is removed, the last significant obstacle to irresponsible monetary and fiscal behaviour, for a long period and for many countries, may also be removed. In addition, experience has proved that fluctuating exchange rates result in risks for foreign trade and investment which are economically costly, and for which the development of forward-exchange markets and other facilities for hedging provide only a very limited palliative. Nor is it desirable to let exchange rates fluctuate freely in response to temporary changes in demand and supply. Such fluctuations cause adjustments in production and transfers of resources which also are costly and should be avoided if the disturbance is merely of a short-term character. The crux of the matter is that changes in exchange rates are different from other price changes: they affect, directly, all prices of internationally traded commodities and, indirectly many prices in the national economy As a prerequisite for international economic stability, key trading countries must therefore maintain reasonably stable exchange rates.

Stable Rates.—Rigidly stable exchange rates also have their drawbacks, for under certain circumstances they tend to generate deflation. Between 1870 and 1914, when the gold standard was an almost universally accepted institution in the western world, gold-standard countries tied their currencies to each other in terms of gold. Residents of one gold-standard country were permitted to procure money from another gold-standard country at a rate of exchange determined by the gold-weight ratio of the two currency units and by the cost involved in sending the gold from one country to the other. Thus the price of the pound sterling in terms of dollars could not rise beyond the so-called upper or U.S. gold-export point, since at this point it would become cheaper to purchase pounds by exchanging dollars into gold in the United States and to ship the gold to Great Britain. Similarly, the price of the pound sterling could not drop below the lower or U.S. gold-import point, since at this point it would become cheaper to purchase dollars by exchanging pounds into gold in Great Britain and shipping the gold to the United States. Within limits of the gold points, the gold standard therefore directly achieved stable exchange rates. Indirectly, it contributed to the automatic operation of the international mechanism by stimulating the inflow of short-term funds to the country whose exchange rate had fallen to the lower limit and was expected soon to rise.

Should a country's demand for foreign exchange tend greatly to exceed the supply, however, the movement of short-term funds would be insufficient to re-establish equilibrium. Nevertheless, the gold-standard mechanism would still tend to produce an adjustment automatically by an outflow of gold from the country that had developed a deficit, and an inflow of gold into the country that had developed a surplus. As gold constituted the basis of the monetary system under the gold standard, a reduction in the gold base could lead to a contraction of money and credit of a country in amount several times larger than the gold export, and conversely. The outflow of gold would tend to depress prices, and if the wage-price level were not perfectly flexible, this would also tend to depress real incomes. These changes in turn would tend to reduce imports and expand exports of the country losing gold, while the opposite changes would tend to raise imports and lower exports of the country gaining gold. The monetary contraction of the country losing gold relative to the countries gaining it would have the additional effect of raising interest rates in the former and lowering them in the latter. Normally, this would aid the process of equilibration by attracting foreign capital to the country which had developed the deficit. Equilibrium would therefore tend to be restored with a minimum gold outflow, an export surplus and an inflow of foreign capital.

The gold standard clearly was conducive to the interdependent growth of free multilateral trade and large-scale private capital movements. It helped integrate the monetary and credit policies of the gold-standard countries. It also was compatible with the objectives of reasonable price level stability and satisfactory growth rates. But it could not prevent world-wide inflations or deflations. If gold-standard countries were simultaneously to go through an inflation, the gold-flow mechanism would only keep them in line by way of a gold flow from the more to the less inflationary countries. A parallel rise in prices would not set the mechanism in motion; and similarly for the case of simultaneous deflation. Furthermore, even in the 19th century, prices and costs were not flexible enough for a smooth adjustment in the event of a gold outflow. Wages were inflexible downward. Attempts to reduce prices through credit contraction often lowered profits and increased unemployment. In fact, the gold standard failed to accomplish one of the most significant aims of virtually all modern nations, the avoidance of major depressions and mass unemployment. When the gold standard was restored in the latter 1920s, its weaknesses became even more apparent. Not only had the United States replaced Britain as the pivotal country in world trade, and thus transformed the process of international equilibration, but economic rigidities had also increased: the rules, as well as objectives, of the gold standard became increasingly incompatible with the new conditions.

As an international mechanism, the gold standard failed and crumbled with the great depression. Experience and theory had shown that deflationary policies might not improve a country's

balance of payments during a world crisis. Moreover, countries suffering from external deficits could not tolerate an international mechanism which intensified unemployment. Hence, after the depressed conditions of the early 1930s, most governments eschewed financial contraction and undertook measures to increase the volume of output and employment.

A good deal of the theoretical literature of the period swept aside the classical assumptions of maintaining stable exchange rates and of relying on internal price adjustments to bear the brunt of the balancing process. Stress was laid, instead, on the equilibrating effects through income changes and on the insensitivity of internal adjustments to external forces. Emphasis was placed on greater exchange-rate variation and on trade controls as a guide to external policy; on internal stability at full employment and on effective demand as a guide to internal policy. Primarily, the equilibration of international accounts was achieved, in fact, through the adjustment of imports and exports to changes in the levels of production and income at home and abroad. When employment and production increased in one country. its imports would rise. The export industries in the countries supplying these goods would expand. Their income and employment would rise in turn, and their imports would increase. This adjustment process could readily cause a deficit in the country initiating the change, for the rise in its imports would not be followed by an immediate rise in its exports. A new balance would nevertheless tend to be established as an expansion of production, income and prices in the countries that had been stimulated would bring about an increase in their imports. On similar reasoning, a recession or depression in an important trading country could cause a contagious economic contraction. for the decline in its production would tend to result in a fall in its imports, and hence a fall in production and income abroad.

MONETARY AGREEMENT

It can readily be understood that when the representatives to the United Nations Monetary and Financial conference met in 1944 at Bretton Woods, N.H.. to establish the International Monetary fund (I.M.F.), they did not recommend a document that would have tied the hands of governments to rigidly stable exchange rates. Nor did they recommend freely fluctuating exchange rates or the complete abolition of foreign-exchange controls.

International Monetary Fund. — The main purposes of the I.M.F. were to promote international monetary co-operation; to facilitate the expansion and balanced growth of multilateral trade; to promote exchange stability and avoid competitive exchange depreciation; to assist in the establishment of free international payments and convertibility on current account without discriminatory trade or exchange restrictions; and to make international currency resources available to the contracting members. To this end. the agreement which came into force in 1945 assigned to each member a quota in the fund on which it could draw to cover a deficit in its balance of payments. The subscription of each member was equal to its quota, 25% of which was paid in gold (or, lacking this amount, 10% of its net official holdings of gold and U.S. dollars) and the balance in its own currency. Although the countries agreed to promote general stability of exchange rates, the par value of a member's currency could be changed by 10%, and the fund merely notified of such action. Changes in excess of 10% would reauire the concurrence of the fund.

The contracting members thus anticipated that exchange-rate changes would be more flexible in the postwar era than they had been under the gold standard, but that competitive exchange depreciation would be avoided. The new arrangements would give the member countries greater freedom with respect to domestic financial policies than did the gold standard. A country would be able to combat certain kinds of depressions or recessions by expanding effective demand, even though such policies might lead to an adverse balance of payments and a reduction of its exchange rate. On the other hand, if a country should suffer from a balance-of-payments deficit engendered by expansionary financial policies, the fund could withhold aid until the member adopted noninflationary policies.

After the establishment of the fund. the international mechanism of western nations consisted of arrangements lying between that of the gold standard and completely flexible exchange rates, with some measure of direct foreign-exchange controls. These arrangements have been used with a view to achieve external balance without sacrificing prevalent domestic economic objectives: a high average level of employment; avoidance of significant cyclical instability; appreciable long-run rates of growth; improvement in the average level of well-being; equity in the distribution of income; and a reasonably stable general price level. Within the limits of these objectives, most western nations have also endeavoured to keep their exchange rates stable over extended periods of time. There has thus been a general weakening in the emphasis on exchange-rate stability, although key countries have shown resolve to alter their own exchange rates only as a measure of Iast resort. All western governments have demonstrated greater determination to counteract economic fluctuations by central bank and fiscal policies. They have considered it undesirable to permit the self-regulating forces of the international mechanism to operate whenever such forces threatened the objectives of economic growth or price-level stability. In time of balance-of-payments deficit, some nations have therefore refused to follow contractionary policies; in time of surplus and full employment, others have been reluctant to follow expansionary policies. Consequently, the operation of the international mechanism of adjustment has been seriously curtailed.

In the early postwar years the I.M.F. was unable to deal effectively with the problem of international disequilibrium. Dollar deficits were inextricably interwoven with the gigantic task of European reconstruction; and the fund was never intended, nor did it possess the resources, to cope with these problems. Among other things, western European countries required larger international reserves. From 1946 to 1949 various types of monetary clearing agreements predominated in Europe. They usually involved an arrangement between the central banks of two countries; the importers of each country paid the sums they owed to the exporters of the other into an account of their own central bank. At specified intervals, the two central banks offset their mutual claims. If the imports of the two countries did not balance — as they usually did not — one country would for a considerable time accumulate claims on the other.

European Payments Union. — In 1950 these emergency arrangements were replaced in Europe by a new monetary agreement called the European Payments union (E.P.U.). The E.P.U. was a multilateral clearing agreement which allowed each country to offset a deficit in its balance of payments with any one of the member countries against surpluses with others. The clearing took place at the end of each month. If the country emerged with an over-all deficit vis-8-vis the rest of the group, the E.P.U. automatically extended credit to it either for the whole amount of the deficit or for part of it, depending on its cumulative debtor position. The difference between the deficit and the amount of credit obtained had to be paid in gold. Once the country had exhausted the quota allotted to it, the whole of the deficit had to be paid in gold. Similarly, a country that emerged with a surplus had to give credit to the E.P.U. to the extent of the whole or part of the surplus depending on its cumulative creditor position. Once it had reached the limit of its quota, the country received an agreed-upon proportion of the surplus in gold from the E.P.U. and granted the remaining credit to the E.P.U. The E.P.U. was renewed from year to year, until it was terminated in 1958.

European Monetary Agreement. — By that time western European countries felt able to make a major monetary reform to eliminate the discrimination between dollar and nondollar currencies in their formal exchange arrangements. With their adoption of nonresident convertibility in 1958, the E.P.U. was dissolved and its termination. brought into force the European Monetary agreement (E.M.A.). This agreement was signed as early as 1955 by the members of E.P.U. Under E.M.A.. the automatic credit arrangement was abolished but member countries were obliged to make available limited amounts of very short-term finance. Credits might be granted to assist in meeting temporary balance-

of-payments difficulties, the approval of each application being subject to examination of the merits of the case.

The I.M.F. had increased its quotas in 1958 and expanded its stand-by reserve arrangements. These acts were of importance in reinforcing the confidence of western Europe to establish nonresident convertibility. Even of greater significance were the deficits of the United States in improving the international liquidity position of its trading partners. These latter deficits were of great magnitude and clearly could not be continued. Hence, in 1961, the O.E.E.C. was transformed into the Organization for Economic Cooperation and Development (O.E.C.D.) with the full participation of the United States and Canada. It was established for the express purpose of achieving closer economic collaboration of the noncommunist world, and particularly to obtain larger contributions from western European countries and Japan to the development of newly independent countries. Western institutions were substantially strengthened to deal with moderate and isolated balance-of-payments strains. but they would be inadequate to meet a more severe and general international financial crisis.

In order to contribute to the defense and development of the noncommunist world, the United States is obliged to maintain an excess of exports over imports of goods and services. To achieve these ends. the United States and western Europe were faced in the early 1960s with the need to make serious adjustments. As for the United States, a substantial export surplus at appreciable rates of economic growth required the maintenance of a competitive price level. As for western Europe, it was essential to recognize that the burden of adjustment was as much the responsibility of countries with balance-of-payments surpluses as it was of countries with balance-of-payments deficits.

BIBLIOGRAPHY —G. Haberler, *The Theory of International Trade With Its Applications to Commercial Policy* (1936) and *A Survey of International Trade Theory* (1955); Jacob Viner, *Studies in the Theory of International Trade* (1937) and *International Trade and Economic Development* (1952); J. E. Meade, *The Balance of Payments* (1951) and *Trade and Welfare* (1955); J. H. B. Tew, *International Monetary Co-operation 1945* (1952); D. H. Robertson, *Britain in the World Economy* (1954); W. S. and E. S. Woytinsky, *World Commerce and Governments* (1955); T Scitovsky, *Economic Theory and Western European Integration* (1958); J. M. Letiche, *Balance of Payments and Economic Growth* (1959); R. E. Caves, *Trade and Economic Structure* (1960); R. Triffin, *Gold and the Dollar Crisis* (1960). For a classified bibliography of articles in French, German, Italian and Russian periodicals, *see* American Economic Association, *Readings in the Theory of International Trade*, ed. by H. S. Ellis and L. A. Metzler (1949). For post-World War II data see *Balance of Payments Yearbook* of the International Monetary Fund and the annual *Economic Survey of Europe* of the United Nations. For annual data *see* European Payments Union, *Annual Report of the Managing Board* (1951 *et seq.*); Bank for International Settlements, *Annual Report* (1930–31 *et seq.*); International Monetary Fund, *Annual Report* and *Annual Report on Exchange Restrictions* (1950 *et seq.*); *The Balance of International Payments of the United States* (annually). (Jo. M. L.)

INTERNATIONAL REFUGEE ORGANIZATION, commonly known as the IRO, was a temporary specialized agency of the United Nations, formally established in 1946, which assisted refugees and displaced persons remaining in many countries of Europe and China after World War II who either could not return to their countries of origin or were unwilling to return for political reasons. Between July 1947 and Jan. 1952 IRO cared for over 1,500,000 persons in special camps, particularly in Germany and Austria, pending repatriation or resettlement in other countries.

Functions. — The services supplied by IRO were care and maintenance in the camps, including food and clothing, medical care, vocational training and orientation in preparation for resettlement and transportation to overseas countries of permanent resettlement. IRO also conducted an extensive tracing service in many countries to find lost relatives and to reunite families, and assisted many thousands of unaccompanied children to rejoin their parents or to find new foster homes. The aged and the ill who could not qualify for admission to countries of immigration were placed in institutions for permanent care.

Beginning operations on July 1, 1947, the IRO preparatory commission took over from its principal predecessor organization, the United Nations Relief and Rehabilitation administration (UNRRA) (*q.v.*), the administration of the refugee camps in Germany and Austria and assisted many thousands of refugees resident temporarily in other European countries and in countries of North Africa. UNRRA had previously been engaged in collaboration with the occupying military authorities in Germany and Austria in assisting the repatriation of some 7,500,000 displaced persons to their home countries immediately after the war. IRO assisted the remaining 1,500,000 refugees and displaced persons who exercised their freedom of choice, recognized by the UN, not to return to their countries of origin for political or other reasons IRO also assumed at that time the responsibilities for the legal protection of refugees and for their resettlement in other countries previously carried out by the Intergovernmental Committee on Refugees, which had been organized in London in 1939 and which terminated its activities upon the organization of IRO.

Participation. — During the five years of IRO operations, member governments contributed $400,000,000 to IRO expenditures which included over $195,000,000 for the transportation overseas of approximately 1,000,000 refugees who were accepted by Australia, Canada, the United States and the Latin American countries. Some 23,000 refugees of European origin in China were assisted to find permanent homes in other countries. When IRO terminated its activities in Jan. 1952, some 500,000 refugees remained in an unsettled state in Europe of whom 200,000 were still living in camps. Eighteen governments participated as members of IRO and contributed to its expenditures: Australia, Belgium, Brazil, Canada, China. Denmark. Dominican Republic, France, Guatemala, Iceland, Italy, Luxembourg, the Netherlands, New Zealand, Norway, the United Kingdom, the United States and Venezuela. *See* also REFUGEES; UNITED NATIOSS.

See Louise W. Holborn, *The International Refugee Organization: Its History and Work, 1946–1952* (1956). (G. L. W.)

INTERNATIONAL RELATIONS (ARTICLES ON). Attempts to systematize the study of international relations date from antiquity. In the 20th century, however. the subject has acquired a new urgency. Because of the increasing destructiveness of war, the rise of new ideologies, the decline of colonialism, the establishment of universal international organizations and the increasing interdependence of all peoples through modern means of communication and transport, governments and peoples have been forced to pay primary attention to international relations. It has become an accepted field of education and research, and efforts have been made to state its principles in a unified discipline. INTERNATIONAL RELATIONS gives an introductory survey of this discipline, which has attempted to analyze the conditions, needs and aspirations influencing the foreign policies of nations; the patterns of power, interest and justification that have developed both universally and in regions; and the processes of accommodation, adjustment and change seeking to close the gap between practice and theory.

The evolution of international law, its scope, and the theoretical and practical basis of its authority are treated in INTERNATIONAL LAW, PUBLIC. The body of rules governing issues that arise between individuals belonging to different nations or between an individual and a nation other than his own, sometimes known as private international law, is discussed in CONFLICT OF LAWS.

DIPLOMACY deals with the conduct of international relations as a profession; the evolution of its traditions and methods; and the impact on these of World Wars I and II.

Major controversies of the 20th century have centred around the conditions under which a new regime is to be accepted as the legal representative of a state, or a newly established state is to be accepted in the family of nations. The factors involved in this question are discussed in RECOGNITION, DIPLOMATIC.

The varying degrees of authority exercised by fully and partially sovereign states are discussed in SOVEREIGNTY. Articles dealing with the influence of states beyond their national borders include EMPIRE; HEGEMONY; IMPERIALISM; MANDATE; PROTECTORATE; SPHERES OF INFLUENCE; SUZERAINTY.

Attempts to map a road to peace, and the methods that have been tried and proposed, are discussed in PEACE, INTERNATIONAL. Among the articles dealing with individual phases of the quest

for peace are ARBITRATION, INTERNATIONAL; DISARMAMENT; INTERNATIOKAL ORGANIZATIONS; PACIFISM; and WORLD GOVERNMENT MOVEMENTS.

SECURITY, INTERNATIONAL describes the various forms of isolationism and coalition to which states have turned to ensure their territorial and political integrity. The rise and fall of the first global organization for collective security are chronicled in LEAGUE OF NATIONS. The organization that inherited the League's problems is discussed in UNITED NATIONS, an article that describes the major executive and administrative units of the UN; its specialized agencies; and its successes and frustrations when its machinery has been called into action. Certain ideals which the UN was intended to realize are discussed in ATLANTIC CHARTER; HUMAN RIGHTS; and SELF-DETERMINATION.

INTERNATIONAL COURT OF JUSTICE describes the history, organization and administrative procedures of the chief judicial agency of the UN. Among other articles dealing with UN agencies and activities are FOOD AND AGRICULTURE ORGANIZATION; INTERNATIONAL LABOUR ORGANIZATION, THE; TRUSTEESHIP SYSTEM; UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION; UNIVERSAL POSTAL UNION; and WORLD HEALTH ORGANIZATION.

Among many articles dealing with international economics are BANK FOR RECONSTRUCTION AKD DEYELOPMENT, INTERNATIONAL; CAPITAL. EXPORT OF; CARTEL; COMMERCIAL TREATIES; ECONOMIC UNION; INTERKATIONAL PAYMENTS; INTERNATIONAL TRADE ASSOCIATIONS AND CONGRESSES; MERCANTILE SYSTEM; SHIPPING, HISTORY OF; SHIPPING INDUSTRY (especially the section International Problems); TARIFFS; TARIFFS AND TRADE, GENERAL AGREEMENT ON; TRADE, INTERNATIONAL; TRADE ROUTES; and WATERWAYS, INTERNATIONAL.

International alignments in general are treated in ALLIANCE; those sponsored by the U.S. include NORTH ATLANTIC TREATY ORGANIZATION and SOUTHEAST ASIA TREATY ORGANIZATION. Alignments associated with the U S S.R. are discussed in COMMUNISM; INTERNATIONAL, THE; MUTUAL ECONOMIC ASSISTANCE, COUNCIL OF; and WARSAW TREATY ORGANIZATION. Economic aid programs of both the U.S. and the U.S.S.R. are discussed in FOREIGN AID PROGRAMS.

Articles on other regional groupings in international relations include MONROE DOCTRINE, THE; AMERICAN STATES, ORGANIZATION OF; and PAN-EUROPEAN MOVEMENT. Articles on ethnological and religious groupings include PAN-GERMANISM; PAN-ISLAMISM; PAN-SLAVISM; PAN-TURANIANISM; and ZIONISM.

Since international conferences and treaties made at them are usually referred to by the name of the city where they were held, articles dealing with them will be found under such headings as BAGHDAD PACT; BANDUNG CONFERENCE; GENEVA SUMMIT CONFERENCE (1955); LOCARNO, PACT OF; SAN FRANCISCO CONFERENCE (1945); YALTA CONFERENCE (194j); and, for earlier conferences, under HAGUE COKFERENCES; WASHINGTON CONFERENCE; etc. Two key articles dealing with groups of conferences are PAN-AMERICAN CONFERENCES; and WORLD WAR II CONFERENCES, ALLIED, which treats all major Allied conferences (for example, those of Casablanca and Potsdam) with the exception of Yalta, which is the subject of the separate article listed above. The procedures usually followed in gatherings for the discussion of international issues are described in CONFERENCE. TREATY deals with methods of negotiation, the various types of treaty and the place of treaties in history and in the context of international law.

FAR EAST: RELATIONS WITH THE WEST surveys the history of these relations, from the Portuguese explorations of the 16th century to the political and military chain reactions that followed the rise of Communist China. EASTERN QUESTION similarly deals with the near east and middle east.

WAR examines military policy as a branch of foreign policy; also, it reviews ancient, medieval and modern types of war, their causes and their impact on civilization. INSURGENCY deals with the activities of irregular forces, particularly with reference to international law and politics. Among other articles concerned with the repercussions of war on the international community are AGGRESSION; BLOCKADE; CONTRABAND; ECONOMIC WARFARE; ESPIONAGE; LAWS OF WAR; NEUTRALITY; PRIZE COURTS AND PRIZE LAW; PSYCHOLOGICAL WARFARE; and REFUGEES. Articles on many aspects of warfare are listed under MILITARY AFFAIRS (ARTICLES ON); NAVAL AFFAIRS (ARTICLES ON); AIR WARFARE.

The foreign policies of specific states are discussed in the general articles on those states.

A sound understanding of international relations calls for knowledge of many allied fields, the most obvious of which is covered in the survey article GEOGRAPHY. The use and misuse of geographical science in international relations are treated in GEOPOLITICS. Among other important background articles are ANTHROPOLOGY (particularly the section Applied Anthropology); ATOMIC ENERGY; FOOD SUPPLY OF THE WORLD; MIGRATION; NATIONALISM; NATURAL RESOURCES; POPULATION; PROPAGANDA; PUBLIC OPINION; PSYCHOLOGY; RACES OF MANKIND; and SOCIAL ANTHROPOLOGY.

Biographical articles summarize the work of leaders in the field, from the classical commentator GROTIUS, HUGO to such modern authorities as ANZILOTTI, DIONISIO and WILSON, GEORGE GRAFTON.

INTERNATIONAL RELATIONS. In its broadest, literal meaning, this term denotes relations among the autonomous political units which today we call nations, or among individual members of such units. On the collective level, such relations can be political, military, economic or cultural; they can comprise all kinds of individual relations involving members of different nations. Yet when we refer to international relations as a distinct object of human action and understanding, we have in mind only those collective or individual relations, transcending national boundaries, which affect the position of nations vis-à-vis each other. International relations in this sense are political relations; they comprise, aside from the foreign policy of nations, all collective and individual relations which impinge upon the political position of a nation vis-à-vis other nations. The term in this sense is a synonym for foreign relations, as used, for instance, in the name "senate foreign relations committee."

International relations are as old as political history itself and have shown throughout the ages constant patterns of relationships and policies, whether entered into by hereditary monarchs or elective governments, cities or nation-states, continental empires or tiny principalities, ecclesiastic or secular rulers. The consistency of patterns beneath the variety of historic manifestations makes both historic understanding and theoretical analysis of international relations possible. Thus we are able to understand the international relations of the Greek city-states that Thucydides describes, the international relations of the Indian states of the 4th century B.C. from which Kautilya derived his philosophy, the international relations of the ancient near east of which the Old Testament tells, as well as those of the more recent past. By detecting in the international relations of different cultures and historic periods identical responses to identical challenges, we are able to develop certain theoretical propositions about international relations that are true regardless of time and place.

Basic Patterns. — The dynamic force that molds international relations is to be found in the aspirations for power of autonomous political units. These aspirations crystallize into three basic patterns: to keep one's power, to increase one's power, to demonstrate one's power. From these patterns three basic types of policy ensue: the policy of the status quo, the policy of imperialism and the policy of prestige. The clash of these policies —A trying to maintain the status quo, B trying to change it at the expense of A—leads to an unending struggle for power which characterizes all international relations. This struggle for power can be fought by two different means: diplomacy and military force. It leads of necessity to the balance of power through which nation A, either alone or in conjunction with other nations similarly threatened, tries to maintain itself against B. When A and B pursue their goals in conjunction with other nations, they embark upon a policy of alliances. When nations carry on the struggle for power by military means, they engage in an armaments race or war. When they try to justify and rationalize their position in the power struggle by reference to universal values,

typically of a moral nature, they develop political ideologies. Continuous peaceful contacts among them lead to the development of an institutionalized diplomacy (*q.v.*).

Throughout the better part of history, several systems of international relations have existed side by side with little or no contact among them. Until the discovery of America, the American system or systems of international relations led a completely separate existence. The Chinese and Indian systems had only intermittent contacts with others.

Three different patterns of international relations can be distinguished according to the distribution of power within them: multiple, bipolar and imperial systems. The multiple system is distinguished by a number of units of approximately equal strength which combine and oppose each other in ever-changing alignments. Its main characteristics are flexibility, uncertainty as to the relative strength and future policies of its members and the propensity for limited, inconclusive wars. The European state system. from the end of the Thirty Years' War in 1648 to the beginning of World War I in 1914, with the exception of the period of the Napoleonic Wars, conformed to this pattern.

The bipolar system is characterized by the predominance of two major powers of approximately equal strength, around which the other members are grouped in different degrees of closeness. This system is rigid and stable as long as the approximately equal distribution of power between its two predominant members persists. Any marked shift in that distribution threatens the system with destruction. The structure of international relations that emerged from World War II exemplifies this pattern.

The imperial system consists of one predominant nation with a number of subordinate members clustered around it. The stability of such a system is great, and conflicts within it tend to be marginal. Its existence can be threatened by the disintegration of the predominant member, the rise of a number of subordinate members to a position from which they can challenge the predominant one, or by a challenge from outside the system. The system of international relations dominated by the Roman empire is the classic example of this pattern.

Changes in Modern Times.—International relations have undergone in modern times four drastic changes: the formerly separate systems of international relations have merged into one world-wide system; the predominance of the European system has disappeared; the possibility and actuality of total war have come to dominate the international scene; the feasibility of universal destruction with nuclear weapons has radically altered the function of force as a means to the ends of foreign policy. While the first three changes do not affect the dynamics and structure of international relations as we have known them since the beginning of history. the last constitutes a veritable revolution, the only one in recorded history, in the structure of international relations.

The expansion of the European state system into the other continents by means of colonial empires, starting early in the 16th century, broke down the barriers which had separated the different systems of international relations. They were all brought into contact with, and into some form of dependence upon, the European state system, and through it they came into contact with each other. The two world wars of the 20th century, in which most nations of the world participated, point in their very name to the transformation of a number of separate systems of international relations into one world-wide system. That process of political unification was greatly advanced and expanded to the individual sphere through the development of the technology of transportation and communications. This development started uith the great voyages at the end of the 15th century and culminated in the drastic reduction of geographic distances for transportation and the virtual obliteration of the limits of time and space for communications.

The last phase of this transformation of international relations into a world-wide system, covering roughly the period from the end of World War I to the aftermath of World War II, coincides with a radical change in the distribution of power within the system. From the beginning of the 16th century to World War I the European system provided the dynamics and the preponderant power for this transformation; now two nations, either completely or predominantly non-European—the United States and the Soviet Union—have taken its place. This decline of Europe as the political centre of the world may be said to have started with the Monroe Doctrine of 1823 declaring the mutual political independence of Europe and the western hemisphere. This declaration foreshadowed the fragmentation of the European empires which was virtually consummated after World War II in the colonial revolutions sweeping Africa and Asia. Most of the colonial possessions of European nations, one after the other, gained their national independence, and many of them either withdrew their political support from the European nations or joined their enemies. The outstanding examples of these two different forms of political emancipation are India and China.

The decline of Europe resulting from the colonial revolutions coincided with the rise to predominance of formerly backward nations such as Russia and China. The technological unification of the world gave these nations the tools to transform their superior potential in geography, population and natural resources into the actuality of national power.

Total War.—The decisive factors in the decline of Europe as the political centre of the world were the two world wars of the 20th century. At the same time that they weakened the main European nations in their human and material resources, these conflicts brought non-European nations to the fore—the United States and Japan in consequence of World War I, the United States and the Soviet Union in consequence of World War II. These two world wars differed not only in their consequences but also in their intrinsic character from other wars fought in the western world in modern times. Most of the latter were limited wars in that only a fraction of the total human and material resources of the belligerents was committed to them. Only a fraction of the total population was morally identified with these wars and suffered from them, and each war was waged only for limited objectives. The two world wars and those for which the most powerful nations continued to prepare were total in all these four respects. The actuality and threat of total war were, indeed, the most important distinctive characteristics of international relations in the mid-20th century. They were due to an unprecedented accumulation of destructive power in the hands of the most powerful nations and to the incentive to use that power for national purposes. The accumulation of power resulted from drastic changes in the distribution of political and technological power in the world; the incentive was presented by the closing of the colonial frontier and the ascendancy of a universalistic nationalism.

Throughout the modern period, with the exception of the wars of religion of the 16th and 17th centuries and of the Napoleonic Wars, wars were limited in every respect. Power was so widely dispersed among a great number of sovereign states that no single state or possible combination of states was strong enough to gain more than limited objectives against its adversaries. The drastic reduction in the number of sovereign states and the resulting concentration of power in the hands of a few nations of the first rank, which occurred between the end of the Thirty Years' War and the end of World War II, created one precondition for total war. The treaty of Westphalia of 1648, for instance, reduced the number of sovereign states of which the German empire was composed from goo to 355. The diet of Regensburg of 1803 eliminated 200 more. When the German confederation was founded in 1815, only 36 sovereign states were left to join it. The unification of Italy in 1861 and that of Germany in 1871 eliminated 31 additional sovereign states.

At the end of the Napoleonic Wars in 1815, only five nations of the first rank were left—Austria, France, Great Britain, Russia and Prussia. In the 1860s Italy and the United States joined them, followed toward the end of the century by Japan. At the beginning of World War I in 1914, eight nations were of the first rank, with Germany having replaced Prussia. After World War I the trend toward reduction of the number of sovereign states was reversed; their number about doubled because the Ottoman, Austro-Hungarian, British and French empires were broken up. Yet the trend toward concentration of more and more

power in the hands of fewer and fewer states continued. At the end of World War II the number of nations of the first rank was reduced to two: the United States and the Soviet Union.

It is not by accident that the two most powerful nations. capable of threatening each other with total war, are also most advanced technologically and industrially. The mechanization of warfare in terms of weapons, supplies, transportation and communications requires, in case of actual hostilities, the virtually total commitment of the industrial productivity of the nation. This total commitment has been made possible by the enormous increase in economic productivity brought about by a series of technological and industrial revolutions, starting in the 18th century. By contrast, in earlier periods of history, economic productivity was so low that after it had barely provided for the needs of the population, little was left for military purposes. Thus premodern technology could support only limited war, while modern industry is productive enough to allow the commitment of the lion's share of its products for military purposes.

One incentive for the great nations to use this enormous productive power for the purposes of mutual destruction was provided by a change in international relations which can be called the disappearance of the colonial frontier. The generally limited character of the means and ends of foreign policy from the end of the middle ages to World War I was in good measure due to the opportunity for the great European nations to seek satisfaction for their aspirations for power not in all-out contests with each other but through competitive expansion into Africa, the Americas and the part of Asia bordering on the eastern oceans. Colonial competition and conflict during that period provided outlets through which the European nations could compete for power without endangering their existence. But by the beginning of the 20th century the colonial frontier was, for all practical purposes, closed. Virtually all politically weak or empty spaces around the globe had been transformed into colonies or spheres of influence by one or another of the European nations. From then on, as the two world wars showed, the great European powers, deprived of the colonial safety valve, fought each other not for limited advantage but for total stakes, and they could do so with the instruments of total war.

These stakes became total not only in that total war threatened the belligerents with total destruction, but also in that the issue over which nations competed and fought had become total. That issue was no longer a limited military or territorial advantage but the universal triumph or defeat of a particular philosophy and way of life, which was supposed to be incarnate in a particular nation. While traditionally the international relations of the western world were carried on within the framework of common moral principles and of a common way of life, which imposed effective limitations upon the struggle for power, international relations in the mid-20th century were dominated by the conflict between democracy and Communism, each putting forth a universal message of salvation, each trying—with different intensity—to extend its dominion to all mankind, and each identified with one of the two great powers left in the world. Thus international relations came to be characterized not only by the traditional threat and use of military force on behalf of the aspirations of individual nations but also by a struggle for the minds of men. The proponents of the two antagonistic philosophies and ways of life, using the instruments of propaganda, foreign aid and foreign trade, endeavoured to gain the allegiance of uncommitted nations. By the same token, the traditional methods of diplomacy were in eclipse. Nations can negotiate and bargain about their interests and conclude compromises concerning them, but they feel that they cannot yield an inch where their philosophies and ways of life are at stake.

While similar situations have existed before, temporarily and on a limited scale, especially in periods of religious conflicts and wars, international relations after World Wars I and II were marked by a change in structure unprecedented in recorded history. Throughout history, there has existed a rational relationship between the threat and use of military force and the ends of foreign policy. It was rational for a nation to ask itself whether it could achieve its ends vis-à-vis another nation by peaceful means or whether it had to resort to military force to achieve them, for the risks involved in the resort to military force were generally not out of proportion to the ends sought. Great ends justified great risks, since the risks were generally not so great as to obviate the ends. Yet all-out nuclear war, likely to destroy all belligerents and thus to eliminate the very distinction between victor and vanquished, is a completely irrational undertaking. No possible end can justify it; it is an instrument of mass murder and mass suicide.

Two **Modern** Dilemmas.— International relations, then, were faced with two interconnected dilemmas upon the solution of which depended the survival of western civilization and perhaps of mankind itself. The first dilemma consisted in the contrast between the technological unification of the world and the parochial moral commitments and political institutions of the age. Moral commitments and political institutions, dating from an age which modern technology had left behind, had not kept pace with technological achievements and, hence, were incapable of controlling their destructive potentialities. The second dilemma consisted in the contrast between the need of nations to support their interests by resort to violence and the irrationality of resort to nuclear arms. If a nation cannot resort to nuclear weapons without risking its own destruction, how can it support its interests in a world of sovereign nations which is ruled by violence as the last resort?

These two dilemmas put into question the very survival of the existing system of international relations. The first dilemma suggests a higher principle of international organization, transcending the nation-state, in the form either of a universal organization, such as the United Nations, which would minimize threats to international peace, or of regional organizations, such as the European communities or a projected Atlantic union, which would eliminate local threats to peace and facilitate the rational use of regional resources. The second dilemma suggests the abolition of international relations itself through the merger of all national sovereignties into one world state which would have a monopoly of the most destructive instruments of violence. Both kinds of solutions are supported by the awareness of the unity of mankind, underlying the inevitable fragmentation of international relations. However inarticulate and submerged, this awareness never completely disappeared even in the heyday of nationalism, and it has been sharpened by the threat of nuclear destruction facing all mankind. These solutions are also supported by the longing to give that unity a viable political form, a longing which has time and again endeavoured through theoretical schemes and practical measures to transform international relations into a supranational political order. This longing, in times past mainly a spiritual or humanitarian impulse, was in the nuclear age greatly strengthened by the desire for self-preservation, innate in all men.

See also DIPLOMACY: PEACE. INTERNATIONAL: WAR.

(H. J. Mu.)

INTERNATIONAL TRADE: see **EXPORTS**; IMPORTS; INTERNATIONAL PAYMENTS; TRADE, INTERNATIONAL.

INTERNATIONAL TRADE ASSOCIATIONS AND CONGRESSES. The 19th century, often regarded as the age of nationalism. was characterized by the growth of private international organizations covering almost every branch of human activity and expressing the supranational extent of modern interests. These organizations continued to multiply, some 2,000 being listed by the Union of International Associations by the 1950s, as compared with 185 in the first comprehensive account in 1907.

This article is limited to permanent international associations (those representing nationals of more than one country and having a more or less continuing central office or secretariat) in the fields of commerce, industry, finance, transport, communications, agriculture and ancillary professions. Official organizations founded by intergovernmental agreement are excluded, as are also profit-making international groups such as Standard Oil and the Havas agency; these latter are better regarded as unified business concerns operating in more than one country than as

federal associations of national economic interests.

Growth and General Characteristics. — The 19th-century international fairs beginning with the great exhibition of 1851 in London provided the occasion for the first international associations. Exhibitors at these meetings not only saw the value of more permanent collaboration, but they were also able to secure such official international agreements to protect their rights when abroad as the Union for the Protection of Industrial Property of 1883 and the Berne Copyright convention and union of 1886. Some impression of the rate of growth of private organizations can be derived from statistics (World Peace Foundation, Pamphlet Series. vol. vi, no. 6, [1916]) which show that, while there were 18 meetings of these bodies in 1850–59, the number had increased to 139 in 1870–79 and to 985 in 1900–09, and that 4j8 international assemblies met in 1910–14. Corresponding figures for 1919–39 are lacking, but it was reliably estimated that in the early 1930s between 200 and 250 of these meetings took place annually. The evidence from post-1945 experience suggests that these associations possess a remarkable capacity to survive war and political changes. By 1955, for example, 118 private international organizations had passed the rigorous tests of admission to consultative status with the United Nations Economic and Social council.

As for the interests in which international organization has proved most active and viable. a gradation appears between those activities, such as railway transport, which have an obvious international significance, and those, such as agriculture, in which national organization is itself weak or which have a predominantly local area of activity. On the whole, agricultural producers' associations have been ephemeral or regional, or confined to secondary or subsidiary agrarian pursuits. It is notable here that the development of official international institutions influenced the relative grouth of various types of private organizations; the International Labour organization (ILO), for example, prompted the formation of the International Organization of Industrial Employers for the better co-ordination of the employers' point of view. Another interesting form of nongovernmental organization intermediary between the two extremes just mentioned is that dealing with international standards for industry and commerce; the International Organization for Standardization is conspicuous here. Further, since some of the most typical activities of nongovernmental organizations are joint inquiries into questions of common interest to the membership. it is not surprising that professional organizations among actuaries, accountants, architects and engineers have had an important part to play.

The spontaneous growth of these organizations has naturally meant extreme variety in structure and function. Some have highly complex constitutions, with considerable incomes and authority over their members. Others are little more than annual meetings at an accessible centre for an informal exchange of views about trade prospects with little in the way of binding understandings being reached. Generally members are not individuals but national associations, though hybrid. forms exist. A convenient form of classification is the distinction between organizations which are wholly private and those in which there is some official component. The International Institute of Refrigeration is indisputably an official body; it was founded in 1920 by a convention between governments and is governed by a general conference composed of government representatives. But uhere an organization, such as the International Federation for Housing and Town Planning, is directed by a council having at one time a majority of delegates from official agencies and at another a majority of nongovernment representatives, the case is more difficult to determine. In the marginal zone betueen the private and the semi-official, limits of the former can probably be best discovered through scrutiny of the functioning of the organization's services.

The functions and activities of international nongovernmental organizations are not essentially different from those of their national correlatives. They are intended to further the special interests of members by providing permanent machinery for exchanging views and pooling information, for public relations on an international scale, for joint studies and research, for the elaboration of standards and metric systems to facilitate international commerce, and for bringing pressure to bear upon governments. Wherever a national business or calling has something to gain by links with its opposite numbers abroad, the basis for international organization exists. Sometimes the sectional character of these groups has been masked by pacifist or internationalist ideals, but in many instances the fact that technical collaboration between private national groups seemed to be more fruitful than negotiation at the diplomatic level genuinely gave rise to the belief that in this lay the road to ultimate world order.

Business and Commerce. — The colossus among commercial organizations is the International Chamber of Commerce (I.C.C.), with a history as a forum for business interests extending back to 1869, though it was not constituted as a permanent association until 1920. The I.C.C. announced itself as a "confederation of the main economic forces of the countries included in its membership"; these forces are (a) organization members, that is, national and local associations grouped for this purpose into national committees, of which there were 30 in different countries in 1955, and (b) associate members, consisting of individual businessmen, firms and corporations in 25 more countries where no national committee is functioning. Apart from individual members, some 1,200 organizations were estimated to be affiliated to the I.C.C. in the mid-1950s. There is a supreme policy-making organ, the biennial congress, a permanent council representing each national committee, and an executive committee elected by the council. Some 40 commissions and committees for technical work handle the four main departments of the I.C.C.'s activities: economic policy, distribution and advertising, transport and communications, law and commercial practice. A court of arbitration adjudicates upon disputes arising between businessmen of different countries; there is a council to determine what constitutes unfair practice in international advertising; and a central information bureau. The I.C.C. is commonly recognized as having exercised an appreciable influence on government policy during the period between the two world wars, especially in war debt and reparation issues: it is also said to have contributed much to the establishment of the International Bank for Reconstruction and Development and of the International Monetary fund of the United Nations.

The analogous body for co-operators, the International Co-operative alliance (I.C.A.), sprang from exchanges between the British and French co-operative congresses in the 1880s, though the first international congress which formally created the alliance did not meet until 1895. The I.C.A. has among its aims "to be the universal representative of co-operative organizations of all types" and "to propagate co-operative principles and methods throughout the world." Its members by the latter 1950s included about 377,000 co-operative societies in 34 countries with a total membership of over 100,000,000, of which the Soviet Union contributed one quarter. Its structure closely resembles that of the I.C.C.. its chief policy-making organ being a triennial congress. Some indication of the scope of the alliance's interests and activities is provided by the fact that at the Copenhagen congress, which met in 1951, there were auxiliary conferences dealing with international co-operative trade, banking, assurance, co-operative agriculture, workers' co-operative production, co-operative press and education, and the role of co-operation in housing. Co-operation in the underdeveloped countries forms one of the later preoccupations of the I.C.A.

In the business field are many organizations much smaller than these two giants. Typical of the wide variety of these groups are, in order of the foundation, the Union of International Fairs, started in 1925 for the improved co-ordination of facilities for international fairs offered by public authorities; the International Association of Department Stores, a European organization which in 1928 became responsible for research on management and distribution; and the World Trade Alliance association, an international group of individuals founded in 1941 to propagate principles "for the regulation of the main export products of all countries so as to ensure a satisfactory state of general employment, avoidance of want and poverty, and a steady uplifting of the standards of living."

Manufacturing Industry. — International organization in the

manufacturing trades has generally been stronger in the secondary than in the basic industries and in the production of those commodities which play a large part in international trade. One exception to this is the International Organization of Employers (formerly Industrial Employers), which was founded in 1919 with national federations of employers as its members in order to ensure permanent liaison between employers' representatives at conferences of the ILO. The organization is, however, more of a defensive reaction to international labour pressures than a spontaneous industrial organization.

Among the secondary trades, the food, hotel management, fuel and power, building and light industries are well represented. The International Office for Cocoa and Chocolate, which functions in Antwerp, was founded by cocoa and chocolate manufacturers in 1930 and studies all questions relating to the cultivation of cocoa and subsequent manufacturing processes. The International Federation of Meat Traders' associations met annually in general assembly for similar objects beginning in 1946; it is wholly a west European organism. The European Brewery convention, established in 1947, and the Federation of Coffee Growers of Central American-Mexico-Caribbean, a foundation of 1945, are other examples of the extent and variety of these associations in the food industries. The International Hotel association in 1946 took over the functions of the International Hotelmen's association and of the International Hotel alliance, which were founded in 1869 and 1921 respectively with the object of federating all the hotel associations of the world in order to formulate a common policy on international tourist traffic. Finally in this group may be mentioned the extensive and active organizations in the fuel and power industries. The World Power conference, representing national committees in about 50 countries. normally meets in plenary session once every six years in order to study existing resources of hydroelectric power, coal, oil and other fuels and minerals, and to explore the possibility of their more efficient utilization. It has a permanent central office managed by an executive council and is powerfully supported by such organizations as the International Electrotechnical commission (founded 1906), which facilitates "the co-ordination of national electrotechnical standards not already covered by the statutes of any other recognized international organization" among 29 countries of industrial importance; the International Union of Producers and Distributors of Electric Power (founded 1925), a professional organization for the study of the production and transmission of electrical energy; and the International Conference on Large Electric Systems (founded 1921), which also has within its purview the study of all technical questions concerning electrical energy.

Textiles are the foremost internationally organized trade among the group with an important interest in the world market. The International Wool secretariat (1937) originally represented the wool boards of Australia, New Zealand and South Africa with their branches in Europe, India and Pakistan, but in 1949 the Wool Bureau, Inc., representing wool producers in North America, was admitted to associate membership. The wool secretariat defines its purposes boldly as the promotion of the interests of the producers and users of wool everywhere. The manufacture of wool and allied fibres is represented by the International Wool Textile organization which began in 1924 as an arbitration agreement between the chambers of commerce of Bradford and Roubaix Tourcoing and gradually extended in membership and scope until by the latter 1950s it covered wool organizations in 15 European countries and in Argentina, Uruguay and Japan and represented the "production, commerce and industry of wool textiles in all branches of international economic activity." Similar organizations have been promoted for cotton and silk: the International Federation of Master Cotton Spinners' and Manufacturers' Associations (1904) represents organizations in Europe, India and Egypt and offers such important services to its members as the arbitration of international disputes and, from 1922, an annual survey of the state of the U.S. cotton crop; and the International Silk association (1949) maintains liaison between representative bodies in all parts of the world. Later stages in clothing manufactdre are represented by the International Association of Clothing Designers and the International Committee for Dyeing and Cleaning, among others; the former dates from 1920 and admits only approved designers to its membership, while the latter, founded in Paris in 1950, is an association of national federations, chiefly in western Europe.

Apart from textiles and clothing, motors and rolling stock have formed the most important manufacturing trades for international organization. The International Permanent Bureau of Motor Manufacturers succeeded in 1919 the pre-World War I Union of Motor Manufacturers; its constituent bodies operate in nine European countries and there are corresponding organizations in five others. The International Association of Rolling Stock Builders. founded in Paris in 1930, was originally a cartel for the allocation of the export market; its purpose in 1934 was re-defined more generally as to "defend on the international level the general interests of the rolling stock builders' industry." It has a European membership only.

Finance.—Notwithstanding the essentially international character of modern finance. nongovernmental organizations dealing with financial business are relatively few, since international clearings between the central banks of the different countries are generally officially regulated. The most important private organization in this field is the International Credit Insurance association, with its headquarters in Zurich, Switz.; it was founded in 1946 to carry on a previous organization of the same name founded in Paris in 1928. The association acts as a clearing centre for leading insurance companies in various countries-all European with the exception of Mexico. Its evidence bureau at Amsterdam, Neth., provides different firms with opportunities for joint consultation if they are approached to insure the same risks. A similar financial organization is the International Thrift institute, an association of savings banks in European. Asian and American countries, which was formed in 1924 and was reorganized in 1948 when its office was moved from Milan, It., to Amsterdam. The Thrift institute's aims, which include helping savings banks to "enhance their influence and prestige internationally," suitably introduce another class of organizations having an interest in finance but with some financial doctrine or policy to advertise: the International Centre for Research and Information on Collective Economy, the International Interchange committee, and the International Union for Land Value Taxation and Free Trade are interesting specimens of these.

Communications.— The international agreements into which communications have entered have generally been diplomatic instruments, such as the convention of 1873 which created the Universal Postal union. In radio broadcasting, however, it was unofficial effort to eliminate the overlapping use of wave lengths which led to official intervention. The "plan of Geneva" of the unofficial International Broadcasting union. founded in 1925 for the rational allocation of European wave bands, became the basis of the intergovernmental convention adopted at Lucerne, Switz., in 1933. Thereafter the union through its technical observation post at Brussels, Belg., verified daily the accuracy with which the various stations maintained their assigned wave lengths, and assisted the League of Nations Intellectual Co-operation organization in promoting international exchanges of broadcasting material In 1950 the union was superseded by the European Broadcasting union, which by the latter 1950s consisted of broadcasting organizations in 25 European and some Asian and North African countries and associate members outside Europe. Through a biennial general assembly and an administrative council the union works to "safeguard in all fields the interests of broadcasting organizations that have adhered to the statutes and establish links with others": its technical centre in Brussels maintains the frequency control of the period before World War II and studies all questions of technical interest.

Amateur radio is represented by the International Amateur Radio union (1925), which seeks to promote and co-ordinate two-way radio communication between the amateurs of various countries. For broadcasting in the Americas the Inter-American Association of Broadcasters, created by a radio conference at Mexico City in 1946, has for its objects both the strengthening of continental solidarity in the western hemisphere and the preserva-

tion of the freedom of broadcasting through the development of private initiative. To improve wireless services at sea, the International Radio Maritime committee was set up in **1928** at San Sebastian, Sp. After its reconstruction in Brussels in 1947 its effective members became **27** radio organizations in Atlantic and Mediterranean countries. The committee's scientific centre prevents interference between ships' radios much as the E.B.U. technical centre prevents interference between stations on land, and its technical commission keeps a watching brief for maritime radio at national and international conferences.

Transport. — Among the international associations for transport, as for communications, it is not always easy to distinguish between private and official bodies; this is particularly so in railway transport since the most important railway systems in Europe are state-managed. The organizations cited here are those which are nevertheless open to private companies, provided these be of international importance. and have not been established by agreement between governments. The International Union of Railways, with its headquarters in Paris, where it was founded in **1922,** is composed of railway administrations with at least 1,000 route km. **(621** mi.) of line and having traffic relations with each other within and outside Europe; it seeks to unify and improve the construction and operation of railways engaged in international traffic. Its annual general assembly controls a system of standing committees dealing with the standardization of rolling stock, the modernization of equipment, and international timetables. A somewhat similar organization is the International Railway Congress association, first established in 1885; its membership of state railway administrations and private companies in **59** countries is geographically more extensive than the International Union of Railways, and it aims at the more general objective of "promoting railway progress by holding periodical congresses and by publications." Similar work is carried on in the American continent by the Pan-American Railway Congress association, founded in 1910 and reorganized in 1941 and **1948.** This body is composed both of public and private companies and works through a system of committees toward the unification and modernization of railway transport and the reform of legislation affecting railways. Efforts to reduce inconvenience caused by transfer from one national railway network to another were made through the European Passenger Time Table conference (1923). This is in the main an official body but includes private delegates and works on a consultative basis with the International Union of Railways. The latter is also associated with the International (Railway) Wagon union, founded in 1921 to ensure the application of the Regolamento Internazionale Veicoli which provides for the reciprocal use of railway wagons in international traffic by its 50 member railway administrations, most of whom are European.

Some international organizations for shipping are more like profit-making concerns, such as the shipping conferences which grew up in the late 19th century to eliminate price cutting. The Baltic and International Maritime conference, however, first founded 'under another name in 1905, provides for mutual consultation in all matters affecting the shipping industry, for defining and circulating news of "objectionable practices" among its members and for approving documents for the use of shipowners. Its members are in three classes — owners, ship brokers and federations of owners' and protecting associations in all parts of the world. An even more general association of shipowners is the International Chamber of Shipping (I.C.S.), founded in **1921** as the International Shipping conference, a federation of **16** national associations of private owners. Wages and conditions of labour at sea are within the purview of the International Shipping Federation Ltd., having a membership similar to that of the I.C.S.; it was dealing with strikes in the industry before 1914 but was given a permanent form with the establishment of ILO. The important role in shipping of international maritime law and maritime insurance is indicated by the International Maritime committee, a federated law society which began to promote intergovernmental maritime conventions in **1897,** and the International Union of Marine Insurance, a federal association of insurance and underwriter groups; this was established in **1874** and reorganized in **1946.**

The obvious benefits of international connections for tourists is reflected in the associations which grew up for motor transport, especially in connection with sport and recreation. The International Automobile federation is a post-World War II form of the old International Association of Recognized Automobile clubs which had existed since before World War I. It serves motoring clubs in almost every country and is closely associated with the International Touring alliance, which was founded in **1898** to bring into touch with each other the various national touring groups. Among organizations for road transport as an industry are the Permanent International Association of Road congresses (1909), a semiofficial body concerned with the general improvement of world road conditions, and the International Union of Public Transport **(1885),** a mixed public and private body dealing principally with problems of urban transport.

When the official conference met in Chicago, Ill., in 1944 to approve the convention establishing the International Civil Aviation organization (1947), the airline operators attached to the national delegations met to reconstruct the old private International Air Traffic association, founded at the end of World War I. The new body, the International Air Transport association, an agency for mutual protection of airline companies in **45** countries, claims to speak for 90% of the world's scheduled air traffic; it acts as a central bank of information on all subjects and supplies technical advice to its members. The International Aeronautical federation, established by seven European governments and the United States in 1905, has for its object the promotion of world aeronautics, including private flying, in all its forms.

Agriculture. — Since organization among sectional interests is usually as strong internationally as it is nationally, agriculture did not produce an abundance of private international associations. While the functions and assets of the official International Institute of Agriculture (1905) were transferred to the Food and Agriculture Organization of the United Nations (FAO) in **1946,** the voluntary organization, the International Commission of Agriculture (I.C.A.), though dating from **1889,** tended to lack official encouragement; its chief function was to bring together representatives of its constituent organizations **(86** in **1938)** in biennial congresses to contribute concertedly to the basic knowledge of every branch of agriculture. The I.C.A. is said to have influenced the principles of agricultural policy adopted by the 1933 International Economic conference in London and the bilateral treaties on exchange of produce concluded by certain European countries in the 1930s. The commission was reorganized in **1948** as the European Confederation of Agriculture; it speaks for **278** national and regional associations with a membership of 50,000,000 in 19 countries in Europe and the Mediterranean basin (1955). It upholds independent family farming, agricultural co-operatives and private ownership.

Representations to official international conferences on behalf of European farming are made by the confederation, the organization speaking for the agricultural world as a whole being the International Federation of Agricultural Producers, which was created at a London conference of farm organizations in **1946.** This represents general farm and agricultural co-operative organizations in all parts of the world and meets in council once yearly.

Some farm organizations are specialized by product, such as the World Poultry Science association (1912), the International Federation of Olive Growers (1934) and the International Dairy federation (1903). Some are regional: the Liaison Committee of Mediterranean Citrus Fruit Culture (1949); the American Society of Agricultural Sciences (1940); and the International Centre of Anti-parasitics **(1950),** with an exclusively European membership. Certain associations, such as the International Agricultural Credit conference (1932), represent relationships between farming and other interests.

Professional. — Activities deriving special benefits from international co-operation are those which rely upon research or standardized methods for their efficiency. Thus professions serving trade and industry are relatively well organized internationally. The International Statistical institute (1885), with its highly qualified and geographically well-distributed membership, is de-

voted to the development and improvement of statistical methods; the International Conference of Agricultural Economists (1929) publishes records of current progress in agricultural economics; among others, the Permanent Committee of the International Congresses of Actuaries (1889) links together actuaries' associations in different countries. Similar associations for engineering include the International Association for Bridge and Structural Engineering (1929) and the Union of International Engineering Organizations, which originated in an engineering conference convened by the United Nations Educational, Scientific and Cultural organization (UNESCO) in 1950. One of the most useful of these professional bodies is the International Organization for Standardization, founded in 1946 on the basis of an older organization dating back to 1926: this is a federation of national standardizing bodies seeking through the adoption of universal standards to facilitate the world exchange of goods and services.

Relations with Intergovernmental Organizations.—The League of Nations.—Article XXIV of the covenant excluded international bureaus other than those "already established by general treaties" from the provision placing existing international organizations under the aegis of the League. The private organizations, however, were not without influence on national policies within the League. Representatives of important organizations were sometimes included in national delegations to the assembly and at international conferences under League auspices nongovernmental groups were often allowed to participate in a consultative capacity: the International Chamber of Commerce played an important part in the World Economic conference of 1927 and in the League conference on international trade restrictions in 1928. These associations were active also in the work of the relevant committees and ancillary organs attached to the League. Eight of them, for example, were invited to send representatives to sessions of the Consultative Technical Commission on Communications and Transit, and not only did the ILO constitution presuppose active unofficial organizations but the organization much depended upon them for the carrying out of ratified conventions.

The United *Nations.*—The UN Conference on International Organization at San Francisco, Calif., in 1945 decided not to admit representatives of private international organizations in a consultative capacity, though consultants from 50 private national groups served unofficially in the U.S. delegation. The charter issuing from the conference, however, gave the first recognition in any multilateral agreement to these bodies; article 71 permits the Economic and Social council to make arrangements for consultation with nongovernmental organizations, with which it may negotiate directly. These arrangements were put into effect in June 1946 and reviewed at the council's tenth session (Feb. 1950), which adopted a resolution setting out the present form of consultation.

A nongovernmental organization applying for consultative status with the council must satisfy certain conditions; inter alia it must deal with matters within the competence of the council; its aims and purposes should conform with those of the UN, which it must undertake to support and publicize; it must be of recognized standing and represent a substantial proportion of the organized persons in its field. Organizations having "a basic interest in most of the activities of the Council" and "closely linked with the economic or social life of the areas which they represent" are admitted to category A consultative status. Category B includes those which have a special competence or are concerned specifically with only a few of the fields of activity covered by the council. By 1955, 109 organizations were included in category B, as compared with 9 in category A. Other organizations which "have a significant contribution to make to the work of the Council" may be entered by the secretary-general in a register established for the purpose. In general, organizations in all three categories may attend the council as observers and submit written statements relative to the work of the council. Category A organizations may also have items of special interest inserted in the provisional agenda of the council, which they may address on such items. A special committee of the council determines the manner in which consultation in the three categories is to be effected.

These arrangements provided a model for similar relations between the UN specialized agencies and the private organizations. Three of the groups mentioned above, the International Chamber of Commerce, the International Co-operative alliance. and the International Federation of Agricultural Producers, acquired consultative status with the FAO. The International Civil Aviation organization by a resolution of June 1947 authorized its council to make suitable arrangements with private international bodies whose activities affectinternational civil aviation. Article XI (4) of the constitution of UNESCO provides for co-operation with international organizations of this type in its field. The Council of Europe is only one of many official organs outside the framework of the UN which accords consultative status to qualified private organizations.

BIBLIOGRAPHY.—Union of International Associations, *Yearbook of International Organizations* (Brussels) and *The Non-Governmental Organizations Bulletin* (monthly, Brussels); L. C. White, *International Non-Governmental Organizations* (1951). United Nations publications include: *Arrangements of the Economic and Social Council for Consultation with Non-Governmental Organizations* (E/C.2/INF/2) (July 1951); *Consultative Relations between the Specialized Agencies and Non-Governmental Organizations: Memorandum by the Secretary-General* (E/C.2/238) (Jan. 1950). (F. S. N.)

INTERNATIONAL WATERWAYS: see WATERWAYS, INTERNATIONAL.

INTERPLANETARY EXPLORATION: see SPACE EXPLORATION.

INTERPLEADER: see PRACTICE AND PROCEDURE.

INTERPOLATION, in mathematics, is the process of obtaining intermediate terms of a series of which particular terms are known. It is from the Latin *interpolare,* to insert something fresh, and is connected with *polire,* to polish. The logarithms, for instance, shown in Table I, may be regarded as terms of a series,

TABLE I

No.	Log.	1st diff. +
2.70	.4314	
		16
2.71	.4330	
		16
2.72	.4346	
		16
2.73	.4362	
		16
2.74	.4378	
		15
2.75	.4393	
.	.	.
.	.	.
.	.	

and the logarithm of any number between 2.70 and 2.75 may be found approximately by interpolation from the table. Finding the logarithm of a number lying outside these limits would be extrapolation; the formulae which apply to interpolation apply in theory to extrapolation, but in practice special precautions as to accuracy are necessary. The present article deals only with interpolation.

The term is usually limited to those cases in which there are two quantities, x and u, which are so related that when x has any arbitrary value, lying perhaps between certain limits, the value of u is determinate. There is a given series of associated values of x and of u, and interpolation consists in determining the value of u for any arbitrary value of x, or the value of x for any arbitrary value of u, lying between two of the values in the series. Either of the two quantities may be regarded as a function of the other; it is convenient to regard one, x, as the independent variable, the other, u, being treated as the dependent *variable, i.e.,* as a function of x. If. as is usually the case, the successive values of one of the quantities proceed by a constant increment, this quantity is to be regarded as the independent variable. The two series of values may be tabulated, those of x being placed in a column (or row), and those of u in a parallel column (or row); u is then said to be *tabulated* in *terms* of x.

The independent variable x is called the *argument,* and the dependent variable u is called the *entry.* Interpolation, in the ordinary sense, consists in determining the value of u for a value of x intermediate between two values appearing in the table. This may be described as *direct interpolatton,* to distinguish it from *inverse interpolation,* which consists in determining the value of x for a value of u intermediate between two in the table. Graphically. the data for interpolation are certain ordinates of the graph of u with regard to x, and direct interpolation consists in deducing the magnitude of any other ordinate whose position is given, while inverse interpolation consists in determining the position of an ordinate whose magnitude is given. The methods employed can be extended to cases in which the value of u depends on the values of two or more independent quantities x, y. . . .

The subject will be treated under three heads: I. Direct Interpolation (equal intervals), II. Direct Interpolation (unequal intervals), III. Inverse Interpolation.

I. DIRECT INTERPOLATION (EQUAL INTERVALS)

1. Notation and Arrangement. — Consider a table showing the values of a quantity u corresponding to values of a quantity x, where values of x proceed by a constant increment h. We denote the values of x by . . . x_0, x_1, x_2, . . ., so that $x_m \equiv x_0 + mh$; and the corresponding values of u are . . . u_0, u_1, u_2. . . . We want to find u_θ, which is the value of u corresponding to $x_\theta = x_0 + \theta h$; for preciseness, we can say that θ lies between -1 and $+1$.

The first step, usually, is to arrange the u's in a vertical column, followed by columns containing the successive differences. The differences of the u's are the *first differences,* those of the first differences are the *second differences,* and so on. These are also called *differences of the first, second . . . order.*

The differences, like the u's, have to be distinguished by suffixes. There are three systems, the advancing-difference, the receding-difference and the central-difference. On the *advancing-difference* system, $u_1 - u_0$ is regarded as the first difference of u_0, and is denoted by Δu_0, so that $\Delta u_1 - \Delta u_0$ is $\Delta^2 u_0$; on the receding-difference system, which is less important, $u_1 - u_0$ is the first difference of u_1. On the *central-difference* system, $u_1 - u_0$ is a difference corresponding to the interval between u_0 and u_1, and is therefore denoted by $\delta u_{\frac{1}{2}}$, so that $\Delta^2 u_{-1}$ is $\delta^2 u_0$; there is also a symbol μ for the mean of any two adjacent entries in a column, so that $\mu u_{\frac{1}{2}} \equiv \frac{1}{2}(u_0 + u_1)$, $\mu\delta u_0 \equiv \frac{1}{2}(\delta u_{-\frac{1}{2}} + \delta u_{\frac{1}{2}})$, and so on. The system is more fully set out in the article CALCULUS OF DIFFERENCES.

2. Fundamental Principle. — The methods which we are considering are, in general, applicable when the result of taking successive differences is to bring us ultimately to differences of a certain order, say the kth. which are practically constant. so that the differences of the next order. the $(k+1)$th, are zero or at any rate are negligible. The fundamental principle then is that we assume that interpolation can be performed as if these latter differences were actually zero.

3. Interpolation by First Difference. — In Table I we see that, as x increases, u increases steadily. We therefore use the *principle of proportional parts, i.e.,* we assume that for any increase in x there is a proportional increase in u.

Thus me can say that the logarithm of 2.725 is .4346 + 8 (where "+8" denotes the addition of 8 to the last figure of the tabulated entry, *i.e.,* means .0008) = ,4354; and similarly log 2.7225 = .4350.

Algebraically, we express the relation between x and u by saying that u is of the form $p + qx$. It follows that the formula for u_θ is

$$u_\theta = u_0 + \theta(u_1 - u_0) = u_0 + \theta\Delta u_0. \qquad (1)$$

To find log 2.724 we should have to add $.4 \times 16 = 6.4$. But it would be incorrect to write the result as .43524; for this would imply that we could find the logarithm to five decimal places, which the table does not enable us to do. We can do either of two things. If we only want the best value, to four places, that we can get, we must take $.4 \times 16$ to be 6. so that our answer is .4352. But a better method, if we are going to use log 2.724 for further calculation, is to retain an extra two or three figures in our work. We therefore, for the time being, write the logarithm in the form .4352 40 or $.4352^{40}$; any extra figures retained in this way are dropped at the conclusion of our work, the preceding figure being adjusted if necessary. This principle applies throughout the whole of our work.

As stated above, the table shows that as x increases u increases steadily. But this does not mean that the second differences of u are absolutely zero; it only means that when we are working to four places of decimals they are negligible. That they do exist, can be seen either by taking more correct values, as in Table II, or by taking values of x at greater intervals, as in Table III.

TABLE II

No.	Log.	1st diff.	2nd diff.
.	.	+	−
.	.	.	
.	.	.	.
2.70	.4313638	.	.
		16055	.
2.71	.4329693		59
		15996	
2.72	.4345689		59
		15937	
2.73	.4361626		57
		15880	
2.74	.4377506		59
		15821	.
2.75	.4393327	.	.
.	.	.	.
.	.	.	

TABLE III

No.	Log.	1st diff.	2nd diff.
.	.	+	−
.	.	.	
.	.	.	.
2.5	.3979	.	.
		171	.
2.6	.4150		7
		164	
2.7	.4314		6
		158	
2.8	.4472		6
		152	
2.9	.4624		5
		147	.
3.0	.4771	.	.
.	.	.	.
.	.	.	.

Similarly we could detect the existence of differences of the third or a higher order.

The sequence of differences, of whatever order, will present some irregularities. These are due to the fact that the tabulated values are necessarily not exact. Thus in Table I the occurrence of the difference 15 immediately following a series of 16's is due to the entry for 2.74 being slightly too large (as will be seen from Table 11), while the entry for 2.75 is slightly too small. A similar explanation applies to the 57 in Table II: the entry for 2.73 is too small, and that for 2.74 is too large.

4. Interpolation with Second Differences. — If we have to use second differences, but do not need third differences, the formula is

$$u_\theta = u_0 + \theta\Delta u_0 + \tfrac{1}{2}\theta(\theta - 1)\Delta^2 u, \qquad (2)$$

in which $\Delta^2 u$ may be either $\Delta^2 u_0$ or $\Delta^2 u_{-1}$. It is usually best to take the one which lies nearest in the table (see Table II or Table III); thus if θ lies between $-\frac{1}{2}$ and $+\frac{1}{2}$ we should use $\Delta^2 u_{-1}$, but if it lies between $+\frac{1}{2}$ and $+\frac{3}{2}$ we should use $\Delta^2 u_0$.

In most cases in which this formula has to be used, $A^2 u$ is small: a convenient form for calculation is then

$$u_\theta = u_0 + \theta\{\Delta u_0 - \tfrac{1}{2}(1 - \theta)\Delta^2 u\}. \qquad (3)$$

5. General Formula. — The general formula, involving differences beyond the second, may be written in terms of advancing differences or of central differences.

(i.) The advancing-difference formula is

$$u_\theta = u_0 + \theta\Delta u_0 + \frac{\theta(\theta-1)}{2!}\Delta^2 u_0 + \frac{\theta(\theta-1)(\theta-2)}{3!}\Delta^3 u_0 + \cdots, \qquad (4)$$

in which the coefficients of u_0, Δu_0, $\Delta^2 u_0$, . . ., are those of the powers of A in the expansion of $(1+\Delta)^\theta$ by the binomial theorem. If differences of order exceeding k are negligible, the series ends with a term in $\Delta^k u_0$. This is known as the *Gregory-Newton formula.*

(ii.) The central-difference formula is of two forms, but we need only consider one, viz., that which uses u_0 and the central differences on or adjoining a horizontal line through it. Thus (see §1) the differences involved are

u_0, $\mu\delta u_0 \equiv \frac{1}{2}(\delta u_{-\frac{1}{2}} + \delta u_{\frac{1}{2}})$, $\delta^2 u_0$, $\mu\delta^3 u_0 \equiv \frac{1}{2}(\delta^3 u_{-\frac{1}{2}} + \delta^3 u_{\frac{1}{2}})$, $\delta^4 u_0$ . . . .

Let us write *(see* CALCULUS OF DIFFERENCES)

$$\left.\begin{aligned} c_1 &\equiv \mu\delta u_0 - \tfrac{1}{6}\mu\delta^3 u_0 + \tfrac{1}{30}\mu\delta^5 u_0 - \tfrac{1}{140}\mu\delta^7 u_0 + \cdots \\ c_2 &\equiv \delta^2 u_0 - \tfrac{1}{12}\delta^4 u_0 + \tfrac{1}{90}\delta^6 u_0 - \tfrac{1}{560}\delta^8 u_0 + \cdots \\ c_3 &\equiv \mu\delta^3 u_0 - \tfrac{1}{4}\mu\delta^5 u_0 + \tfrac{7}{120}\mu\delta^7 u_0 - \cdots \\ c_4 &\equiv \delta^4 u_0 - \tfrac{1}{6}\delta^6 u_0 + \tfrac{7}{240}\delta^8 u_0 - \cdots \\ c_5 &\equiv \mu\delta^5 u_0 - \tfrac{1}{8}\mu\delta^7 u_0 + \cdots \\ c_6 &\equiv \delta^6 u_0 - \tfrac{1}{4}\delta^8 u_0 + \cdots \end{aligned}\right\} \quad (5)$$

Then the central-difference formula may be written as

$$u_\theta = u_0 + c_1\theta + c_2\frac{\theta^2}{2!} + c_3\frac{\theta^3}{3!} + c_4\frac{\theta^4}{4!} + \cdots \quad (6)$$

II. DIRECT INTERPOLATION (UNEQUAL INTERVALS)

6. When the differences of consecutive x's are not all equal, we use formulae analogous to ordinary interpolation-formulae, but with the differences prepared in a special way. The best-known formulae are Newton's (original) formulae and Lagrange's formula; the former uses "divided" differences.

Let the tabulated values of x be . . . , a, b, c, d, . . . , the corresponding values of u being denoted by . . . , $f(a)$, $f(b)$, $f(c)$, $f(d)$ . . . . Then our table is of the form:—

x	u	Divided Differences			
		1st	2nd	3rd	⋯
⋮	⋮				
a	$f(a)$				
		$f(a, b)$			
b	$f(b)$		$f(a, b, c)$		etc.
		$f(b, c)$		$f(a, b, c, d)$	
c	$f(c)$		$f(b, c, d)$		etc.
		$f(c, d)$			
d	$f(d)$				
⋮	⋮				

In this table

$$\left.\begin{aligned} f(a, b) &\equiv \frac{f(b)-f(a)}{b-a}, f(b, c) \equiv \frac{f(c)-f(b)}{c-b}, \cdots \\ f(a, b, c) &\equiv \frac{f(b, c)-f(a, b)}{c-a}, f(b, c, d) \equiv \frac{f(c, d)-f(b, c)}{d-b}, \cdots \\ f(a, b, c, d) &\equiv \frac{f(b, c, d)-f(a, b, c)}{d-a} \quad \cdots \end{aligned}\right\} \quad (7)$$

etc.

The quantities $f(a, b)$ . . . in the first line are called *divided differences of the first order;* those in the second line are *divided differencesof the second order;* and so on. If u is a polynomial of degree k in x, the divided differences of order k + 1 are all o. It should be observed that the value of any divided difference is independent of the order in which the u's involved in it are arranged; thus

$$f(a, b) = f(b, a), f(a, b, c) = f(a, c, b), \text{ etc.}$$

Newton's formula for unequal intervals is

$$f(x) = f(a) + (x-a)f(a, b) + (x-a)(x-b)f(a, b, c) + \cdots, \quad (8)$$

the series continuing until the differences are zero or negligible. This formula covers all those with which we have so far dealt; thus the Newton-Gauss formula, a zigzag formula involving u_0, $\delta u_{\frac{1}{2}}$, $\delta^2 u_0$, $\delta^3 u_{\frac{1}{2}}$ . . . , is obtained by taking the x's in the order o, 1, −1, 2, −2, . . .

The method was subsequently modified by Newton, in a manuscript written in 1676 but not known to the world until *1926.* Another method, similar to this modified method, but not identical with it, is that of "adjusted differences."

Lagrange's formula is

$$\left.\begin{aligned} f(x) = &\frac{(x-b)(x-c)(x-d)\cdots}{(a-b)(a-c)(a-d)\cdots} f(a) \\ &+ \frac{(x-a)(x-c)(x-d)\cdots}{(b-a)(b-c)(b-d)\cdots} f(b) \\ &+ \frac{(x-a)(x-b)(x-d)\cdots}{(c-a)(c-b)(c-d)\cdots} f(c) + \cdots. \end{aligned}\right\} \quad (9)$$

This gives exactly the same result as Newton's formula. It is not so convenient for calculation as the latter, and it does not show how many u's have to be taken into account.

III. INVERSE INTERPOLATION

7. Inverse Interpolation: Simple Cases.—In all cases of inverse interpolation we have to pay special attention to the degree of accuracy of the result. This depends largely, in ordinary cases, on the initial figure of the first difference.

If the first difference is practically constant, inverse interpolation is very simple. The direct formula

$$u_\theta = u_0 + \theta\Delta u_0$$

gives

$$\theta = (u_S - u_0)/\Delta u_0.$$

If we have to go to second differences, the direct formula is

$$\begin{aligned} u_\theta &= u_0 + \theta\Delta u_0 + \tfrac{1}{2}\theta(\theta-1)\Delta^2 u \\ &= u_0 + \theta\{\Delta u_0 + \tfrac{1}{2}(\theta-1)\Delta^2 u\}, \end{aligned}$$

where. if θ lies between o and 1, $\Delta^2 u$ may be either $\Delta^2 u_{-1}$ or $\Delta^2 u_0$. We can calculate the expression in { } by taking an approximate value of 8; and then 6 is found more accurately by dividing $u_\theta - u_0$ by this expression.

8. General Formula.— If third or higher differences have to be taken into account there are two methods.

(i) We can use the general formula (6), viz.:

$$u_\theta = u_0 + c_1\theta + c_2\frac{\theta^2}{2!} + c_3\frac{\theta^3}{3!} + c_4\frac{\theta^4}{4!} + \cdots,$$

and proceed by successive approximations. By transposition and division, we get

$$\theta = \left(u_\theta - u_0 - c_2\frac{\theta^2}{2!} - c_3\frac{\theta^3}{3!} - c_4\frac{\theta^4}{4!} - \cdots\right) \div c_1.$$

We begin with an approximate value of 8. Substituting this on the right-hand side, we get a closer approximation to θ, and so on.

(ii) The above method is only applicable when the intervals in x are equal. An alternative method, suitable for cases of unequal intervals, but not always applicable, is to invert the table (*i.e.,* to interchange the x column and the u column and find divided differences of the x's) and proceed by direct interpolation. *See* also CALCULUS OF DIFFERENCES. (W. F. S.; X.)

INTERPRETATION, in general, the action of explaining, or rendering the sense of an obscure form of words or an unknown tongue into a language comprehended by the person addressed.

In legal use the word is employed in the sense of ascertaining the meaning of the language of a document. It is usual for statutes to contain definitions and the British Interpretation act of 1889 is of general application *(see* STATUTE LAW). This term is used similarly in the United States.

INTERRACIAL RELATIONS. The great importance that has generally been attached to ideas of race, racial identity and racial differences in mentality and culture has in recent times played a major role in determining the relations between the peoples and nations of the world. A striking feature of these ideas is the fact that they have usually been based on a false conception of the meaning of race and on erroneous assumptions regarding its implications. Jacques Barzun, for example, entitled his hook on this subject *Race: a Study in Modern Superstition.* Ashley Montagu speaks of *Man's Most Dangerous Myth: the Fallacy of Race.* Gunnar Myrdal, in *An American Dilemma,* expresses the opinion

that in no other field is there so wide a gap between popular impressions and the conclusions reached by biological and social scientists. Race, in many of its aspects, exists only "in the minds of men."

The Problem of Definition.— The very term race is difficult to define. There is agreement to the effect that it is correctly applied to a subdivision of mankind which is distinguished by the possession of common characteristics, usually physical in their nature. determined by genetic or hereditary factors. Popularly. it has been confused with nation, although it is obvious that every modern nation is a mixture of inherited physical types; there is no British or Italian or German race. As a matter of fact, there is more physical or racial similarity between northern Italians and southern Germans than between the latter and Germans living in Hanover or Prussia. Similarly, there has been confusion between race and language; there is no Latin or Semitic or Aryan (Indo-European) race. since these languages are spoken by people of widely varying physical type. It follows that many of the phenomena usually included within the field of race relations have nothing to do with race as scientifically defined but rather with race as popularly, and erroneously, understood.

Difficulties of application remain even when care is taken to use race in the manner proposed by scientists. The geneticist Leslie C. Dunn, for example, believes that the word may have a valid biological meaning if applied to a group of related intermarrying individuais mhich differs from other groups in the relative commonness of certain hereditary traits. This leaves unresolved the questions of how large the group should be or which traits should be used for purposes of classification. G. Sergi, using head form as a criterion. proposes two races, the Eurasiatic or roundheaded, and the Eurafrican or longheaded; J. Deniker, relying upon a combination of features including head form, skin colour and others, concludes that there are 17 main races and 29 subraces. If the criterion of head form is preferred, this would unite in the same category the blondest Scandinavian and the darkest Negro if both are longheaded. If the more usual category of skin colour is used, differences in head form are ignored or at least relegated to the background. This means essentially that racial classification at the present stage of our knowledge is at least to some extent an arbitrary and subjective process. A group of experts consulted by the United Nations Educational, Scientific and Cultural organization (UNESCO) expressed the view that three major human divisions should be recognized, namely, the Mongoloid, Negroid and Caucasoid, and this is probably as satisfactory a classification as any now available, but it does not include all human groups, nor does it solve all the problems that have been raised. The reliance on blood properties. particularly the four blood types A. B. XB and 0, has facilitated significant genetic research, but has not as yet produced a satisfactory racial classification.

In view of these complications, it has been suggested that the term race should not be applied to existing human populations but should be replaced by the term ethnic group. which may be characterized by a particular inherited physical type, or culture, or nationality, or any combination of these. In any case, the geneticists have made it clear that the inherited similarities among all the peoples of the norld are much greater and far more common than the differences and that the distinctions that have been drawn between the so-called races of mankind are relatively unimportant.

Racialist Thinking.——This similarity among peoples has not prevented a number of influential writers, political leaders and people generally from regarding alleged racial differences as having paramount importance. It is difficult to establish definitely the origins of what has frequently been described as racialist thinking, but certainly one of the most influential of such thinkers was Count Arthur Joseph de Gobineau (*q.v.*), who published his four-volume *Essay on the Inequality of Human Races* in the middle of the 19th century. He taught the superiority of the white race over all others, and among the whites, of the Aryans as having reached the heights of civilization. This group was in fact considered to be responsible for civilization wherever it developed. The Teutons were taken to be the purest modern representatives of the Aryans. although Gobineau admitted that really "pure races" could no longer be found. As a matter of fact, he did not unequivocally favour such purity, since it was often at the point of contact and mixture between races that, in his opinion, civilization had a better chance to develop. This last point was conveniently neglected by many of his followers who. in the Gobineau societies which sprang up in Germany and elsewhere, not only glorified the Aryans and the Teutons but also insisted on keeping them "pure."

Gobineau's most important follower mas H. S. Chamberlain (*q v*). who published *The Foundations* of *the 19th Century* in German in 1899. An Englishman by birth, he spent most of his life in Germany, where he was active in the Gobineau society. and was so popular with the ruling class that he became known as the kaiser's anthropologist. He. too, insisted on the superiority of the Teutons. whom he characterized physically as being for the most part tall, fair and dolichocephalic (longheaded), that is to say. corresponding to the Nordic type. He regarded the Jews as alien in spirit to the favoured Teutons. although he admitted the difficulty of distinguishing Jews from Germans on the basis of physical characteristics alone.

Although there were many other writers who developed the racialist position, such as Ludwig Woltmann and H. F. K. Giinther in Germany. and Lothrop Stoddard and Madison Grant in the United States Gobineau and Chamberlain may be regarded as the intellectual forerunners of the racial theories of the German Nazis. Hitler himself acknowledged his indebtedness to these theorists, particularly to Chamberlain, for giving him the "scientific" basis for this aspect of his political philosophy. There were, of course, inner contradictions in the racialist approach—the fact that so many Germans did not look like Nordics and so many Jews did the alliance with the Japanese who had consequently to be exempted from the racial restrictions of the third *Reich*, the difficulty of giving any clear meaning to the concepts of German "blood" or "soul"—so that facts had to be replaced by mysticism. In spite of these and other deficiencies, racialism was used as a technique which helped to unify the Germans by identifying the "enemy." gave the people a strong sense of ego enhancement and self-confidence, justified economic exploitation and slave labour, obtained support for the war and convinced the Germans that they never could be defeated. Racialism thus functioned as one of the most effective techniques of Nazi propaganda for achieving and maintaining power over the German people.

Although colonialism cannot be compared with Naziism in terms of the violence and virulence of the human destruction it involved, it also found in racialism a helpful rationalization for conquest and expansion When the Spaniards first came to America. several of their apologists, particularly Francisco de Quevedo and Juan Ginés de Sepúlveda, supplied them with the proper excuses for taking the land away from the Indians and for treating them with complete lack of consideration. They developed the theory that the Indians had an entirely different origin from that of the Spaniards. that they were not human in the same sense and that there was therefore no need to accord to them the same treatment as to one's fellow human beings. The familiar refrain of the "white man's burden." which was mainly of British manufacture and which found its literary expression in the writings of Thomas Carlyle. James A. Froude Charles Kingsley and most strongly and clearly in those of Rudyard Kipling, made of imperialism a noble activity destined to bring civilization to the benighted members of other "races" What the British stood to gain as a result was never mentioned. Similarly the French justified the maintenance of their colonial empire on the basis of their *mission civilisatrice*, their duty to bring civilization to the backward peoples of the world.

In all of these colonizing empires, there were undoubtedly many individuals honestly convinced of the nobility of their motives and their enterprise: at the same time. the feelings of racial superiority which accompanied colonialism played an important part in developing resentments among the colonized which even the recent trend toward emancipation and independence has not always made it possible to overcome. There has even developed in some parts of the world a sort of racialism in reverse, a degree of hostility of coloured peoples against whites as whites, which has caused considerable worry to the responsible leaders of all the groups

concerned.

It remains true that in general, although with certain striking exceptions, the trend has been away from racialism. The rapid emergence of new nations, many of them former colonies, has meant that many more nations composed of "coloured peoples" have an independent voice in international affairs that commands a respectful hearing even from previous colonizers. The latter have, for their part, shown an evident willingness to grant such independence on an increasing scale. The recognition that the treatment of ethnic minorities within a country may have important implications for international relations has focused attention upon the need to improve intergroup relations in general. The work of scientists like Franz Boas in anthropology and Gunnar Myrdal and others in the social sciences has helped to destroy much of the mythological thinking associated with race. The trend has been reversed in the Republic of South Africa, where separation of ethnic groups has increased in recent years. In the United States, on the other hand, the movement has been gradually and progressively in the direction of providing greater equality of opportunity for all ethnic groups. The most dramatic expression of this tendency was furnished by the unanimous decision of the U.S. supreme court on May 17, 1954, based in part on social-science research, that the enforced segregation of Negro school children in certain states and localities was contrary to the principles of the U.S. constitution. (See NEGRO, AMERICAN.)

Studies **of Racial** Attitudes. — Although considerable progress has been made, a great deal of intergroup hostility remains, and much scientific effort has been expended in the attempt to understand its nature and its origin. One view has held that prejudice is inborn and inevitable; the philosopher Josiah Royce. for example, spoke of a "natural antipathy" against those who are different from ourselves. The fact that such antipathy is not found in young children, and the further fact that it does not occur in all individuals or even in all groups, throw considerable doubt upon this variety of explanation. There is, for example, much less prejudice against Negroes in Brazil than in South Africa or certain areas in the United States; there is more prejudice against Orientals in California and British Columbia than in Hawaii. Such variations are difficult if not impossible to reconcile with the theory that antipathy is natural and inevitable.

A variant of this theory is found in the writings of certain psychoanalysts who speak of a native aggressiveness or "death instinct" which may take the form of hostility against other ethnic groups. Others have suggested that aggressive tendencies can be explained as a consequence of the experiences of the individual, particularly the extent of his frustrations; the greater the frustration, other things being equal, the greater the tendency to aggressive action. Since, however, aggression may take many forms and may be directed against many different objects, this explanation does not carry us very far. The frustrated Brazilian does not look for a Negro scapegoat. There must be at least one additional factor; namely, that the individual learns what forms of aggression are permitted in his society, and against whom it may be expressed.

This learning process occurs in a variety of ways, and is facilitated from a number of different directions. In the home and in the school, the growing child learns, sometimes explicitly. sometimes indirectly, that others are "not like us," that they are not "our kind." The mass media often aid the process by developing or disseminating stereotypes of the pugnacious Irishman, the mercenary Jew, the lazy Negro, the dishonest Armenian — stereotypes that may frequently turn out to be untrue but which still affect our perceptions and our treatment of others. Institutions in the culture, sanctioned by law or by custom, which involve segregation, untouchability, occupational or recreational restrictions, may all contribute to feelings of ethnic or racial cleavage. A circular relation is established in which prejudice leads to discrimination, which in turn functions as an environmental support or stimulus for increased prejudice.

It is widely believed that our actual experience with members of other ethnic groups determines our attitudes toward them. This is undoubtedly true in many cases, but by no means always. Research has shown that there may be hostility or "social distance" among American students toward Turks, or among Guatemalans toward Jews, without any previous contact whatsoever. One investigator was able to demonstrate the existence of considerable rejection of even imaginary groups such as the Danerians, Pirenians and Wallonians. with whom there could hardly have been any unpleasant personal experience. This not only demonstrates the frequent irrationality of ethnic attitudes but also throws doubt on a theory described by the psychologist Gordon W. Allport as that of the "well deserved reputation"; namely, that if we dislike a particular group, they must certainly deserve our dislike. It seems more likely, as Eugene Hartley has suggested, that our attitudes toward other ethnic groups are not determined by contact with them but by contact with the attitudes that prevail in our community.

The question as to why such attitudes develop in the first place is not easy to answer, although at least a partial explanation can be found in the practical advantages that prejudice seems to confer on the dominant majority. The economic gain has been illustrated in the earlier reference to colonial expansion, in which a theory of racial superiority helped to rationalize and justify the expropriation of the property of others. This mechanism is easily discernible in the tendency to keep a minority "in its place," which essentially means to prevent it from competing with the dominant majority on equal terms. A second gain is represented by the practice of finding a scapegoat whom one can hold responsible for our ills, thus relieving ourselves of the obligation to blame ourselves for our shortcomings; the Jews served as such a scapegoat in Nazi Germany. A third gain, also illustrated by the Nazis, is in the feeling of superior status, of ego enhancement. A fourth may be described as a sex gain, which occurs when men of the dominant group have access to the women of the weaker but resist violently any effort by the men of the weaker group to obtain reciprocal privileges. The psychologist John Dollard believes that this was an important factor in maintaining the caste situation in the southern United States. This particular gain has evidently been renounced in South Africa, where all sexual contact between the races is strictly forbidden.

It should be added that prejudice and discrimination also involve significant losses. The sociologist Arnold Rose mentions, among others, the economic waste resulting from the failure to make adequate use of available manpower, the aggravation of social problems such as crime and delinquency, the harmful effect on international relations with the coloured peoples of the world. the creation of fears and anxieties and disrespect for the law. These are undoubtedly real losses, but they appear to be less obvious than the gains, which therefore are more likely to make themselves felt.

The gain in feelings of superior status and self-enhancement is related to a large amount of significant research on the part played by personality in the development of prejudice. Attention has been focused on the "authoritarian personality," characterized by generalized ethnocentrism but also by excessive conformity, rigidity, concern with status, a tendency to see the world as harsh and unfriendly and an inclination to favour strong punishment of deviants and offenders. This is only a partial list of traits found in prejudiced persons, who apparently "need" to feel superior to many out-groups and who dislike Jews and Negroes and Japanese and foreigners generally. The emphasis on the relation between prejudice and personality has added an important dimension to the understanding of intergroup relations, but it cannot be regarded as telling the whole story. Residents of South Carolina appear to be no more "authoritarian" than New Yorkers, but they usually have very different attitudes toward Negroes.

There is more than one dimension to prejudice. It may satisfy a number of different motives; it may be acquired in a variety of ways. An understanding of its many aspects, and of the manner in which they influence one another, has gradually replaced the attempts to explain the phenomena of race relations in terms of any one, single cause.

Similarly, programs designed to improve intergroup relations have become increasingly versatile instead of relying on any one method or technique. The debate as to whether one must first

reduce prejudice before embarking on legislation to combat discrimination, or whether the approach should be the other way round, has yielded to the conviction that both procedures should be followed simultaneously. As a result, many nations have developed a program of education and information, including the revision of their school textbooks, in order to improve attitudes toward other ethnic groups, at the same time strengthening the laws that make racial discrimination a punishable offense. At the international level. UNESCO has directed its efforts toward giving wide dissemination to scientific facts concerning race; and, on the other hand, the United Nations has sought to give human rights the sanction of a universal declaration leading to a universal covenant.

The fact that progress has been made cannot obscure the resistances that remain to be overcome. The birth of the new nation-states in Africa and Asia has frequently been accompanied by difficulties of racial adjustment. The international political situation has, on the other hand, paradoxically had a favourable effect on race relations because of the desire on the part of all the great powers to win the friendship of these new nations. There have been other favourable factors also, including a changed climate of public opinion. as well as a general desire to counteract the impressions and heal the wounds that resulted from colonialism and imperialism. There is still a long way to go before race is universally recognized for the myth it really is, but the movement is in that direction.

See SEGREGATION. RACIAL; see also references under "Interracial Relations" in the Index volume.

BIBLIOGRAPHY.—Romanzo Adams, *Interracial Marriage in Hawaii* (1937); *T*. W. Adorno *et al., The Authoritarian Personality* (1950); Gordon W. Allport, *The Nature oj Prejudice* (1954); Anne Anastasi, *Differential Psychology,* 3rd ed. (1958); Milton L. Barron (ed.), *American Minorities* (1957); Jacques Barzun, *Race: a Study in Modern Superstition* (1937); Ruth Benedict, *Race, Science and Politics* (1940); Franz Boas, *The Mind of Primitive Man* (1931); Catholic University of America, *Scientific Aspects of the Race Problem* (1941); Houston Stewart Chamberlain, *The Foundations of the 19th Century* (trans. from the German, 1910); Juan Comas, *La discriminacidn en America* (1945); *L*. C. Dunn and T. Dobzhansky, *Heredity, Race and Society* (1950); A. J. de Gobineau, *Essay on the Inequality of Human Races* (trans. from the French, 1856); Oscar Handlin, *Race and Nationality in American Life* (1948); E. L. Hartley, *Problems* in *Prejudice* (1946); Melville J. Herskovits, *The Myth of the Negro Past* (1941); Julian S. Huxley and A. C. Haddon, *We Europeans* (1949); Otto Klineberg, *Race Differences* (1935) and (ed.) *Characteristics of the American Negro* (1944); *K*. L. Little, *Negroes in Britain* (1948); *I*. D. MacCrone, *Race Attitudes in South Africa* (1937); M. F. Ashley Montagu, *Man's Most Dangerous Myth: the Fallacy of Race,* 2nd ed. (1945); Gunnar Myrdal, *An American Dilemma* (1944); Fernando Ortiz, *El engaño de las razas* (1946); Donald Pierson, *Negroes in Brazil* (1942); Arthur Ramos, *Guerra e Relações de Raça* (1943); Arnold Rose, *Studies in Reduction of Prejudice* (1947); Gerhart Saenger, *The Social Psychology of Prejudice* (1953); Muzafer Sherif and Carolyn W. Sherif, *Groups in Harmony and Tension* (1953); UNESCO, *The Race Question in Modern Science* (1956); Charles Wagley (ed.), *Race and Class in Rural Brazil* (1952); Charles Wagley and Marvin Harris, *Minorities* in *the New World* (1958). (O. KL.)

INTERREGNUM, strictly a period during which the normal constituted authority is in abeyance, and government is carried on by a temporary authority specially appointed (Lat, *inter,* "between!" and *regnum,* "reign"). Though originally and specifically confined to the sphere of sovereign authority, the term is commonly used by analogy in other connections.

The term originated in Rome during the regal period when an *interrex* was appointed (traditionally by the senate) to carry on the government between the death of one king and the election of his successor. The most noteworthy use of the term in post-classical times is that of the Great Interregnum between the death of Conrad IV (1254) and the election of Rudolf of Habsburg (1273). *See* GERMANY.

INTERSTATE COMMERCE, in U.S. usage, includes the movement of passengers and goods from one state to another, between a state and a territory of the United States and between points in territories or possessions. It includes the agencies and facilities by which the transfer is accomplished and comprises the mechanism and services of trade, transport and communication between citizens of different states' territories. Broadly defined, the term commerce applies to the wide range of economic services, including trade and the instrumentalities used in commerce, and to exchange or distribution in general. As here used, it is limited to the traffic and trade that crosses state boundaries or within or between territories in the internal or domestic commerce of the United States; foreign trade between the United States and other countries or their possessions is not included. Communication agencies and services, although closely related to interstate commerce. are excluded here.

Interstate commerce may be conducted by individuals or partnerships, but it is for the most part conducted by corporations, which, like those engaged in production, have tended to become larger as trade has increased. Their activities are increasingly subject to regulation by the states and particularly by the federal government. In the public interest the services and facilities employed by rail, highway, water, pipeline and air carriers must conform to standards fixed by state and national laws whose enforcement is furthered by government inspection of equipment of many kinds.

Corporations must compete in interstate commerce by methods that are "fair." and the accounts, finances, charges and services of carriers are comprehensively regulated by the federal government in the interests of the public, including the producers and users of their services.

The principal agencies by which interstate freight and passenger movements, or trade and travel. are effected are the railways; the vessels and barges operated in the intercoastal, coastwise, inland waterways trades, and on the Great Lakes; the carriers operating motor trucks and buses; the petroleum pipelines; express carriers; freight forwarders; and the air carriers. Carriers other than railroads subject to the Interstate Commerce act, as amended, include pipeline companies (other than water pipelines), sleeping car. express, motor carriers of freight and passengers, domestic common carrier water carriers and freight forwarders. A Federal Trade commission (*q.v.*) was created by congress in 1914 to prevent unfair competition in commerce. The Civil Aeronautics act of 1938 as amended, gave the Civil Aeronautics board and the Civil Aeronautics administration! which is subordinate to the secretary of commerce, jurisdiction over interstate air facilities and service. The Federal Maritime board and the Federal Maritime administrator. both under the jurisdiction of the United States department of commerce, were given jurisdiction over overseas water transportation.

Freedom of Interstate Commerce. — The commerce crossing state boundaries in the United States constitutes the world's largest interchange of commerce without customs duties. The United States is thus a vast free trade area. No state imposes customs duties upon imports from or exports to other states, and the United States throughout its continental territory and possessions is a single commercial unit with full freedom of internal trade. In this regard the United States is in marked contrast with Europe and countries on other continents where various historical causes brought about the existence of many nations, each concerned with safeguarding its own internal trade against the encroachment of the commerce of other countries.

Freedom of interstate commerce has been as great an aid to political success as to economic welfare in the United States. The commerce clause of the U.S. constitution made a united country possible. Despite sectional divergencies and a civil war. the nation has been held together, and the states have grown into a strong economic and political union because industry, trade. transport and communication have been kept relatively free of state taxes and restrictions. There are: however, some barriers to interstate cotnmerce.

Power of the United. States Government over Interstate Commerce. — The power of congress "To regulate Commerce with foreign Nations, and among the several States" is vested in congress by the commerce clause of the constitution so that no state can levy taxes on the export trade. The constitution provides that "No State shall. without the Consent of the Congress, lay any Imposts or Duties on Imports or Exports, except what may be absolutely necessary for executing its inspection Laws."

The constitution also provides that "No State shall, without the Consent of Congress, lay any Duty of tonnage," that the congress shall levy no tax or duty "on Articles exported from any State" and that "No Preference shall be given by any Regulation of Commerce or Revenue to the Ports of one State over those of another: nor shall vessels bound to, or from, one State be obliged to enter; clear, or pay Duties in another."

These prohibitions in the constitution prevent restrictive regulation of commerce by states, while the positive power granted to congress is comprehensive and has been so interpreted by that body and the U.S. supreme court as to make regulation positive and constructive. It has been held that the federal government's authority to regulate interstate commerce is "exclusive" and plenary." In regulating, congress can promote interstate commerce as well as regulate it, and that has been the policy of the federal government.

The interpretation of the commerce clause of the constitution, through a long series of supreme court decisions, tended to restrict the powers of the states and to broaden those of the federal government over interstate and indirectly over intrastate commerce. Chief Justice John Marshall laid a broad and firm foundation for federal authority in 1824, in the case of *Gibbons* v. *Ogden* (9 Wheaton 1). In this classic decision, denying to the state of New York the power to grant to a steamboat company a monopoly of steam navigation in the waters of the state to the exclusion of others owning vessels licensed by the United States, the supreme court enunciated the principle that guided the court in all subsequent interpretations of the commerce clause. It stated that "by virtue of the comprehensive terms of the grant, the authority of Congress is at all times adequate to meet the varying exigencies that arise, and to protect the national interests by securing the freedom of interstate commercial intercourse from local control."

The extension of the power of congress over interstate (and incidentally over some aspects of intrastate) commerce by legislation and court decisions has affected all categories of commerce and carriers.

Federal Regulation of Interstate Shipping.—Among the supreme court decisions defining the boundaries of state and federal power over shipping was *Sinnot* v. *Davenport* (22 Ho ard 227, 1860), which held unconstitutional a law enacted by Alabama in 1854 requiring special state registration of all vessels navigating waterways in the state.

The court ruled that a vessel enrolled by the United States cannot be required to obtain state registration. In 1871 the supreme court annulled a law enacted by Alabama in 1866 imposing a tax of $1.00 per ton on all vessels operating upon the navigable waters within the state. The supreme court held that states may tax ships as property, but they may not levy a tonnage tax *(Cox* v. *the Collector,* 12 Wall. 204, 1870). A state is also without power to impose port wardens' fees upon ships entering its ports *(Steamship Company* v. *Port Wardens,* 6 Wall. 31, 1867). It may not place an occupation tax on persons or corporations employing vessels in a manner authorized by a U.S. licence *(Moran* v. *New Orleans,* 112 U.S. 69, 1884).

These supreme court decisions negatived attempts of the states to burden unduly the facilities used in commerce. The legislative policy of federal regulation has been a positive one. Harbours have been improved, and inland waterways have been canalized and extended; the Shipping act of 1916 and the Merchant Marine acts of 1920, 1928 and 1936 provided for aiding and regulating shipping and water transportation.

Moreover, the Interstate Commerce act, particularly as amended by the Transportation act of 1920 and the Wheeler-Lea Transportation act of 1940, empowered the Interstate Commerce commission to establish through routes and rates by railroads and waterways and thus to promote the use of waterways by making them a part of a co-ordinated system of rail and water lines for the service of interstate commerce.

Regulation of Interstate Commerce by Rail.—The principal carriers of interstate commerce in volume of intercity traffic transported in the United States are the railroads. The federal regulation of railroads which began with the Act to Regulate Commerce of 1887 was extended in scope by subsequent laws until it applied comprehensively to all such carriers and many other types of carriers engaged in interstate commerce. Interstate and intrastate commerce and railroad services are so interrelated, moreover, that the federal government in exercising its plenary power over interstate commerce incidentally limited in large measure the regulation of intrastate trade and traffic by the states. The federal safety laws apply to all railroad equipment; railroad finances are regulated by the Interstate Commerce commission, which must approve of the location and construction of proposed railroads and of the issue of securities; and the states may not establish intrastate railroad rates that unreasonably discriminate against the interstate charges found reasonable and otherwise lawful by the Interstate Commerce commission.

When the states began to regulate railroad rates, shortly after 1870, some of the states, particularly the agricultural or Granger states of the midwest, fixed rates on all railroad traffic. including both that moving within and that crossing state boundaries. Some of these laws were upheld by decisions of the U.S. supreme court. In 1886 the supreme court in *Wabash* v. *Illinois* (118 U.S. 557) held that the states could not fix the rates on interstate traffic. To do so would be to regulate interstate commerce over which the United States has exclusive and plenary jurisdiction. For 25 years after that decision no question was raised as to the power of the states to fix rates on intrastate traffic that were per se reasonable.

In 1911, however, the railroad commission of Louisiana complained to the Interstate Commerce commission that the railroad rates fixed by the state authorities of Texas on traffic within that state were so much lower than the interstate rates, which had been found reasonable by the I.C.C., as to discriminate against traffic from Louisiana into Texas and to prevent Shreveport. La., from competing with Houston. Tex., and Dallas, Tex., for the trade of northeastern Texas. The commission decided in favour of the complainant and ordered the railroads to cease the discrimination, which they did by raising the rates that had been fixed by Texas. This order of the Interstate Commerce commission and this action of the carriers were sustained by the U.S. supreme court in the so-called Shreveport case, *Houston* E. *and W T. R. Co.* v. *United States* (234 U.S. 342, 1914). The principle established by this decision was extended and strengthened in the Transportation act of 1920, by which the Interstate Commerce commission was given authority to prescribe rates and fares in lieu of intrastate rates that the commission found to discriminate unjustly against interstate or foreign commerce.

To carry out the rate-making provisions of the Interstate Commerce act, as amended by the Transportation act of 1920, and to enable the carriers to obtain a reasonable return on their property, the Interstate Commerce commission raised rates and fares on all railroad traffic, intrastate as well as interstate. The state of Wisconsin had fixed passenger fares by statute at two cents a mile. The state commission did not change the statutory fare, but the carriers sought and obtained a federal court decree enjoining the state from fixing the intrastate fare on a level which would discriminate unjustly against the interstate fares. The U.S. supreme court in *Wisconsin* R. R. *Comm.* v. *C. B. and Q. R. Co.* (257 U.S. 563. 1922) upheld the federal statute and order of the Interstate Commerce commission.

On the same day that it handed down that decision, the court in *New York* v. *the United States* (257 U.S. 591, 1922) upheld the Interstate Commerce commission's order raising New Pork intrastate railroad rates and fares to the level of interstate rates and set aside as unconstitutional a contract provision in the charter of the New York Central railway in which the state had limited the fare on the main line of that road between Albany and Buffalo to two cents a mile, the court holding in effect that the state in requiring such a fare to be charged was unjustly discriminating against interstate passenger traffic subject, at that time, to a charge of 3.6 cents per mile.

Federal Authority Over Interstate Commerce by Highways.—The supreme court of the U.S., in a series of decisions,

defined the boundaries of state and federal authority over highway carriers engaged in interstate commerce, just as the powers of the states and the nation over commerce by railroads were determined by judicial interpretation. In 1923 the state of Michigan enacted a law requiring all motor carriers for hire upon the roads of the state to secure a certificate from the public utilities commission. The act also provided that such motor carriers for hire were common carriers subject to the laws applicable thereto and should be required to carry insurance or furnish an indemnity bond.

A motor carrier engaged solely in interstate transport on a contract basis contested the validity of the law, and the U.S. supreme court held that "It is a burden on interstate commerce to impose on plaintiff (a private interstate carrier) the . . . liability of a common carrier, and the obligation of furnishing such indemnity bond" and other regulations imposed on common carriers as conditions precedent to engaging in interstate commerce by highway. The court also held that a state could not by legislative fiat convert a private carrier into a common carrier, "for that would be taking private property for public use without just compensation" *(Public Utilities Commission, Michigan* v. *Duke,* 266 U.S. 570, 1923); *see* also *Frost* v. R. *R. Commission, California* (271 U.S. 583, 1926).

A person operating a common carrier bus line over a regular route between Seattle, Wash., and Portland, Ore., was granted an authorizing certificate by Oregon but was refused one by Washington. The director of public works in Washington ruled that there was no need for another carrier because the territory already was adequately served and denied the petition because "under the laws of the state, the certificate may not be granted for any territory which is already being adequately served." The U.S. supreme court, however. held that the law was a regulation of interstate commerce forbidden by the commerce clause of the federal constitution *(Buck* v. *Kuykendall,* 267 U.S. 307, 1925). But. in later decisions, particularly in such cases as *Stephenson* v. *Binford* (287 U.S. 251, 1932) and *Maurer* v. *Hamilton* (309 U.S. 598, 1940), the supreme court upheld the power of the states to regulate the use of their highways for gain by contract as well as common carriers. and the states were thus permitted to regulate motor carriers thoroughly subject to the limitation that the states may not prevent or unreasonably burden interstate commerce. The power of the states to regulate the use of the highways under the police power of the states is pervasive.

These and other decisions of the federal courts have given effect to a general definition of the powers of the states and of the United States respectively, which were clearly stated by the supreme court as early as 1915 in the case of *Hendrick* v. *State of Maryland* (235 U.S. 610). The court declared that "In the absence of national legislation covering the subject, a state may rightfully prescribe uniform regulations necessary for the public safety and order in respect to the operation upon its highways of all motor vehicles — those moving in interstate commerce as well as others. . . . The reasonableness of the state's action is always subject to inquiry in so far as it affects interstate commerce, and in that regard it is likewise subordinate to the will of Congress."

Federal **Aid** and Regulation of Air Transportation. — Congress encouraged the development of air transportation by liberal aid. The Air Commerce act of May 20, 1926. provided that all aircraft operated interstate or to foreign countries were to be registered and rated by the secretary of commerce, who was also empowered to establish airways and equip them with necessary lights, signals and landing fields, other than terminal landing fields or airports. The regulation of the services and charges of the air carriers began with the enactment of the Civil Aeronautics act of 1938. These economic regulations were made very comprehensive.

The government greatly aided the establishment and development of airline services by payments for the carriage of mail. Such payments initially were made large enough to enable the airlines to maintain and develop the services needed in the public interest. The Civil Aeronautics board was authorized to fix the compensation to be paid by the government for the transportation of airmail, part of the payments being considered subsidy and part compensation for service.

Terminal airports were provided by municipalities or other local government agencies and the facilities leased to the airline companies. Through the Work Projects administration and the Public Works administration, established to provide work for the unemployed, the federal government constructed a large number of airports for the municipalities. Federal funds were later granted to ensure the construction of airports of proper size, design and facilities under the National Airport plan.

The enforcement of the act of 1938 was vested in a Civil Aeronautics authority of five men and a three-man Air Safety board connected with the Civil Aeronautics authority. The act also provided for an administrator with the functions of establishing civil airways, surveying airports and developing a national system of airways. The Civil Aeronautics authority was reorganized in 1940 and renamed the Civil Aeronautics board. The board was associated with but was not made subordinate to the department of commerce, the board being independent of the secretary of commerce as regards its interpretation and enforcement of the Civil Aeronautics act. The functions exercised by the civil aeronautics administrator, an official of the department of commerce, include jurisdiction over the executive aspects of promotion and inspection. The functions of the Air Safety board were absorbed by the Civil Aeronautics board.

Thus, as a result of establishment and maintenance of landing fields and airports in large numbers by states and municipalities and the contributions of the federal government in adding to and extending the established air routes, equipping them with temporary landing fields, with navigation aids and communication facilities, the development of interstate and foreign air commerce proved to be spectacular.

Prohibition of Combinations in Restraint of Interstate Commerce. — The Sherman Antitrust act of 1890, as later amended and strengthened by the Clayton act of 1914 and other supplemental laws, made illegal contracts or combinations in the form of trusts, or in any other manner, in restraint of interstate or foreign commerce. In the case of *United States* v. *Trans-Missouri Freight Association* (166 U.S. 290, 1896). the U.S. supreme court held that the law applied to all combinations in restraint of interstate or foreign commerce, including those that had previously been considered reasonable under the common law. A similar decision was handed down in *United States* v. *Joint Traffic Association* (171 U.S. 505, 1898). This literal interpretation of the law hampered the development of large-scale organization in the conduct of commerce until 1911, when, in the Standard Oil company case *(United States* v. *Standard Oil Co.,* 221 U.S. 1), the supreme court enunciated and applied the "rule of reason," according to which the Sherman act prohibited only such combinations and restraints as were illegal at common law.

This decision was not satisfactory to those who favoured a stringent curb on combinations, and the Clayton act was passed to define more specifically what combinations or restraints were prohibited and to extend the law more definitely to agreements made to fix prices for the purpose of lessening competition or creating monopoly. The act, however, exempted labour and agricultural organizations from the provisions of the antitrust laws. The Clayton act did not, in fact, strengthen the Sherman act of 1890 in its general application, the terminology of the original law having proved more comprehensive than the more specific definitions and specifications of the later act.

Railroad rate agreements and associations, which by the decision of the supreme court in the Trans-Missouri Freight association case in 1896 and the Northern Securities case (*Northern Securities Co.* v. *United States,* 193 U.S. 197, 1904) had been brought under the prohibitions of the antitrust act, were, by the Reed-Bulwinkle act of June 17, 1948 (Interstate Commerce act, part i, section 5a), made legal when approved by the Interstate Commerce commission.

Fair Competition in Interstate Commerce. — In 1914 congress enacted a law "to create a Federal Trade Commission and to define its powers and duties." The purpose of the act was "to

prevent persons, partnerships. or corporations. except banks, and common carriers subject to the acts to regulate commerce. from using unfair methods in commerce." The commission of five members was given ample powers of investigation. If the commission found that methods of competition prohibited by law were being employed it might order the violator of the law to desist from such practices. If the order was not obeyed. the commission might apply to a C.S. circuit court of appeals to enforce the order. Since the court has the power to affirm, modify or set aside orders. the Federal Trade commission is essentially an investigating rather than a regulatory agency. It has. however, served a useful purpose, not only because it may proceed upon its own motion but also for the reason that it may be called upon by the United States attorney general to report upon the manner in which a corporation found by a court to be violating the antitrust laws is carrying out the court's decree. The FTC may also be directed by "the President or either house of Congress to investigate and report the facts relating to any alleged violation of the Antitrust Acts by any corporation."

The antitrust laws of 1890 and 1914 were enforced, broadened in scope and made increasingly effective by many decisions of the U.S. supreme court. The decision in the case of the *Cnited States* v. *Socony-Vacuum Oil Co.* (May 6, 1940) condemned as illegal an agreement of oil refining companies to pay independent refineries such a price for their excess or "distress" gasoline as to enable them to continue in business despite distress conditions resulting from a sudden excess in oil output caused by the opening of new wells. The court held that "Conspiracies under the Sherman Act (of 1890) are on the common law footing; they are not dependent on the doing of any act other than the act of conspiring." An agreement to raise the price of a commodity that enters into interstate commerce is a violation of the federal antitrust law irrespective of the reasonableness of the price agreed upon or of the purpose and intention of the members of the combination to pay a price that may be reasonable. The obvious purpose of the court proved to be to interpret the statutes so as to assure to consumers the full benefit of competition.

The fixing of prices through the use of "phantom freight" charges and by the use of the basing-point system of pricing were declared unlawful in several supreme court decisions, including *Corn Products Co.* v. *Federal Trade Commission* (324 U.S. 726, 1945); *Federal Trade Commission* v. *Cement Institute et al.* (331 U.S. 683. 1948).

The U.S. domestic commerce, most of which is interstate, changes constantly with the evolution of industry and industrial processes, with the shifting of the major centres of production of the leading products of manufacture and with improvements in transport agencies and in methods of transport. Moreover, while commerce was increasing in volume in the 1950s, large-scale organization of business was more and more taking the place of small enterprises. For these reasons! interstate commerce remained the subject of frequent legislation and of an increasing administrative regulation by the federal regulatory commissions. *(See* also FEDERAL TRADE COMMISSION.)

Volume of Interstate Commerce. — The volume of interstate as distinct from intrastate commerce is not stated in official records. A large percentage of goods shipped between points within the United States or sent to or received from foreign countries crosses state boundaries. A large share of the total traffic of railway. railway express, water, highway, pipeline, freight forwarder and airway carriers consists of goods carried from one state to another. Reference to the tonnage transported by these several carriers will indicate generally. therefore. the magnitude of interstate commerce in the United States.

During 1953, for example. the railroads in the United States originated about 33,000,000 carloads or about 1,876,000,000 tons of revenue freight. This was the tonnage originating on their several lines; many shipments of freight moved over more than one railroad in their routes between origin and destination. The total freight service was the equivalent of the movement of one ton over 605,000,000,000 ton-miles. The number of carloads and the ton-miles decreased after the peak traffic years during World War 1 More than 737,000,000,000 ton-miles of freight were moved by railroad in 1944. There were 8 tons and more than 3,750 ton-miles of railroad freight per inhabitant in 1953. Since the average distance a ton was hauled was nearly 420 mi., it is evident that most of the traffic must have been interstate.

The domestic water-borne commerce of the United States moving in the coastwise, intercoastal trades and on the Great Lakes and other inland waterways totals nearly 700,000,000 tons annually. The number of tons moved on rivers and canals is greater than the tonnage of the Great Lakes, but. as the average length of haul on the Great Lakes is much longer, the ton-mileage for the Great Lakes is about 20,000,000,000 annually as compared with 60,000,000,000 for the traffic on rivers and canals. The major portion of this large traffic on the Great Lakes consists of coal, iron ore, grain, stone and petroleum. Traffic on rivers and canals consists largely of bulk shipments of minerals, steel, petroleum products, sand and stone.

There is a large volume of traffic carried coastwise and via the Panama canal, although both the coastwise and intercoastal trades were adversely affected by World War II. during which vessels were placed in other services. and by railroad competition after the close of World War II.

In 1953 about 240,000 publicly and privately owned and operated motor buses were registered, but many of them were operated in private services, by contract carriers or by school authorities. At the same time the total mileage of highways and streets, state. county and local, was about 3,000,000, of which about one-half is surfaced. The number of motor trucks operated by contract, common and private carriers in intrastate and interstate operations was nearly 9,000,000. The total number of registered motor vehicles was about 45,000,000.

The bureau of public roads of the U.S. department of commerce conducted surveys in a number of states to determine the nature and volume of motor passenger and freight traffic. In small states with dense population and highly diversified industries there is usually a considerable use of the highways in interstate commerce. The same situation exists where several large cities are close together near state boundaries. In larger states a much smaller portion of the motor truck transportation is interstate. Interstate motor traffic constitutes a small share of the total because a large percentage of motor hauls are in local or short distance services.

Air transport routes are characteristically long, and most air services over regular routes are interstate. Air transportation has made rapid progress in the U.S. Its early development was relatively slow because. unlike the air transportation industries of several European countries, it did not receive direct government subsidies to establish and develop passenger, freight and mall air transport services. (See *Federal Aid and Regulation* of *Air Transportation,* above.) In 1953 airlines in domestic trunk line and local service operated over approximately 77,000 mi. of unduplicated routes. The number of passengers carried by the domestic scheduled airlines in 1953 was 3,475,065 and the lines provided more than 3,500,000,000 passenger miles of service. Air express matter carried totalled more than 42,000,000 ton-miles and 131,000,000 ton-miles of freight were transported. Scheduled airlines operated 1,122 planes in domestic services and 543 planes in international services.

Airmail transport in the United States was still rapidly increasing in the mid-1950s. In 1953 airmail carriers transported more than 72,000,000 ton-miles of airmail traffic in domestic services and more than 24,000,000 ton-miles in United States-foreign air services.

On Sept. 1. 1927, the American Railway Express company, later renamed the Railway Express agency, made an agreement with the airlines for an air express service. This service has been operated continuously since that time, and, in addition, airlines have their own freight service for freight of high value which requires fast transportation service. Frequent services are regularly operated between the principal cities in the United States and throughout the world carrying passengers, mail, express and freight in interstate and international commerce. Commercial air services

include domestic trunk lines, local service airlines, insular territorial airlines, international airlines, all-cargo airlines, helicopter airmail services, and nonscheduled and noncertificated air carriers.

BIBLIOGRAPHY.—The principal statutes concerning the regulation of interstate commerce by the U.S. may be found in convenient form in *The Interstate Commerce Act* (Washington). The U.S. supreme court decisions referred to in the article contain historical and economic information. These decisions are published in United States Supreme Court *Reports* (U.S. series). The annual reports oi the Interstate Commerce commission and of the chief of engineers, U.S. army (see volume on *Commercial Statistics),* may be consulted ior statistics of the volume of domestic traffic by rail and water. *See* also David Philip Locklin, *Economics and Transportation,* 4th ed. (1954); Truman Cicero Bigham and M. J. Roberts, *Transportation; Principles and Problems,* 2nd ed. (1952); George Lloyd Wilson, *Transportation and Communications* (1954) in which the services, basis of charges of railroad, highway, water, pipeline, and air carriers in the United States are discussed and the policy of regulation is summarized.

(E. R. J.; G. L. WN.)

INTERSTELLAR MATTER is material of exceedingly low density dispersed in the space between the stars in the form either of gas (detectable from its emission and absorption of light and radio waves, especially in certain spectral lines) or of "dust," which can be detected by its general absorption and reddening of starlight.

DARK MATTER IN THE MILKY WAY

Absorbing Clouds.—Inspection of the Milky Way with a small telescope (or in places with the naked eye) shows that the rich star fields of which it consists are interrupted by dark patches, such as the Coalsack near the Southern Cross. These dark clouds were examined around 1900 by Max Wolf and E. E. Barnard. who found them to be most abundant in Ophiuchus and Sagittarius, toward the centre of the Milky Way system. This fact. together with the appearance among them both of bright patches and of still darker globules. suggests that they are real dark clouds rather than starless "holes," which latter would have to be narrow tubes thousands of light-years in length converging on the solar system —an obvious absurdity. The absorptions. distances and thicknesses of these clouds have been determined by a method originally due to Wolf and improved by later workers: the apparent distances of stars (found from their spectral types and apparent brightnesses) are determined both through a cloud and in a neighbouring field outside the cloud.

The number of stars at a given distance is then plotted on a graph against this distance for the two cases; the tno curves coincide up to the distance of the near side of the cloud and then diverge until, on the far side, they run parallel with a constant horizontal displacement from which the amount of light absorbed by the cloud can be calculated. The results are greatly complicated by the frequent presence of several clouds in one direction, but a typical cloud seems to be about 100 parsecs across (1 parsec = 3.26 light-years) and to diminish the light passing through it by nearly 1 magnitude (equivalent to a factor of 2.512).

A further effect, known as interstellar reddening, arises in the clouds because blue light is absorbed more strongly than red light; hence a given star appears redder through a cloud than nhen seen through clear space, just as the sun appears red when near the horizon. The colours of stars are measured by their colour index; *i e ,* the difference between photographic or blue magnitude (measured in a wave length band centred near λ 4,250 Å) and visual magnitude (centred near λ 5,450 Å in the yellow-green region). The amount by which the colour index of a star exceeds the normal value for its spectral type is known as its colour excess In most clouds studied, the ratio of total absorption in photographic magnitude to colour excess has nearly the same value, about 3 j, suggesting the presence of the same absorbing material in these various cases. This fact has been applied by W. Becker and by H. L. Johnson and W. W. Morgan in order to obtain the degree of interstellar absorption and reddening for star clusters by comparing the normal colour index with an additional colour index obtained from photometry in the ultraviolet region of the spectrum (λ 3 600 -%).

General Absorption.— The possibility that the light of distant stars might be dimmed by absorption even where no dark clouds are actually visible was mentioned in 1720 by Edmund Halley, and discussed during the 19th century by H. W. M. Olbers, F. G. W. von Struve and others as a possible explanation of the fact that the number of stars per unit volume seems to diminish with distance in all directions. The alternative explanation is that we are near the galactic centre.

The 20th-century research on our galactic position has shown that we are close to the central plane of the galaxy, but a long way from the centre. so that the apparent distribution of stars in the Milky Way (though not at right angles to it) is indeed determined by absorption, although its amount varies greatly with direction and distance. Definite proofs of the presence of general absorption in the Milky Way have been provided by the invisibility of external galaxies in an irregular region roughly bounded by the circles of galactic latitude ± 20° ("zone of avoidance" studied in detail by E. P. Hubble and H. Shapley) and by R. J. Trumpler's extensive investigation in 1930 of galactic open clusters at distances between 600 and 2,200 parsecs.

By measuring the apparent brightnesses of cluster stars whose

RADCLIFFE OBSERVATORY (PRETORIA U OF S AF) PHOTOGRAPH, REPRODUCED BY COURTESY OF A D THACKERAY

M 16, A COMPLEX OF BRIGHT AND DARK INTERSTELLAR MATTER IN SERPENS, IN THE SOUTHERN MILKY WAY

real brightnesses could be estimated from their spectra. Trumpler estimated the actual diameters of the clusters and showed that these must increase systematically nith the distance of the clusters from us if the intervening space were assumed to be entirely transparent. This highly implausible effect is removed if one assumes an average absorption of about 1 photographic magnitude per 1,000 parsecs in the galactic plane.

A similar result was obtained by A. H. Joy (1939) and R. E. Wilson (1940) from a study of Cepheid variables whose absorptions and true distances were derived from the period–luminosity relation in conjunction with the theory of galactic rotation; but J. H. Oort, H C. van de Hulst and D. W. N. Stibbs later suggested twice this value. If the absorption is neglected, large distances are greatly overestimated; for example, the distance of the galactic centre—estimated at 16,000 parsecs by Shapley in 1930—turns out to be only 8.200 parsecs when the obscuration is allowed for. W. Baade's photographs of external galaxies suggest that the absorbing clouds are mainly confined to galactic spiral arms.

Scattering Nebulae.—When observed with a spectroscope, certain bright nebulae show a continuous spectrum with ddrk lines, identical with that of a nearby star, unlike the emission spectra of

gaseous nebulae near very hot stars. These nebulae are identical with the dark clouds mentioned above, which scatter incident starlight in all directions and thus appear bright when viewed sideways on. As in the case of the sunlit sky, but to a lesser degree, the scattered light is generally more blue than that of the illuminating star and shows a certain degree of polarization (see below). True absorption of starlight by obscuring clouds is probably absent, and the term "interstellar absorption" should strictly by interpreted as obscuration resulting from scattering by interstellar material.

Interstellar Polarization. — In 1949 W. A. Hiltner and J. S. Hall showed that the light of distant stars seen through obscuring matter often possesses an appreciable degree of polarization; *i.e.*, the electric vibration of the light is slightly (up to 8%) stronger in one plane than in the plane at right angles to it. The polarization is particularly strong toward Perseus, where we are probably looking along a spiral arm of the galaxy. In this direction, the strongest vibration is parallel to the galactic plane; this suggests the presence of elongated scattering particles with their long axes predominantly at right angles to the plane. According to L. Davis and J. L. Greenstein, this orientation may be caused by paramagnetic relaxation in a galactic magnetic field between 10^{-5} gauss and 10^{-4} gauss, if the particles have a small admixture of magnetic material.

Form of **Absorption-Colour** Curve and Nature **of** the Scattering Material. — The variation of the scattering coefficient from the violet to the red end of the spectrum has been studied by comparing the brightnesses ip various spectral regions of pairs of hot stars of identical spectral types seen through different degrees of obscuration. The most extensive measurements have been carried out photoelectrically (with colour filters) by J. Stebbins and A. E. Whitford (1943) and spectrographically by Greenstein (1938), C. Schalen (1952) and L. Divan (1951). The various results agree in showing that. in the limited range of wave lengths between λ 4,000 Å and λ 8,000 Å (roughly the visible range from violet to red) the scattering coefficient is nearly inversely proportional to wave length, but that the curve flattens off at both the ultraviolet and infrared ends. The absorption is thus neither neutral (as would be expected from large rocklike objects or from free electrons, neither of which could exist in sufficient quantities to explain the observations) nor is it in accordance with Lord Rayleigh's fourth-power law (which applies to atoms and molecules, *e.g.,* in the earth's atmosphere).

The absorption must arise from a fine dust or smoke with particles of dimensions comparable with the wave length of light (about $\frac{1}{20,000}$ cm). Van de Hulst has shown that the observed data, including the polarization of starlight observed through obscuring matter, are consistent with a distribution of dielectric grains (probably consisting of ice mith admixtures of solid hydrogen. methane, ammonia. metallic oxides and metals) having a typical diameter of 0.56μ (μ = micron. 1 micron = 10^{-4} cm.).

INTERSTELLAR GAS CLOUDS

Interstellar Absorption Lines.——Many distant, hot stars show in their spectra certain characteristic absorption lines with a red or violet shift differing from that shown by the remaining lines of the spectrum. This is particularly conspicuous in the case of certain spectroscopic double stars which show "stationary calcium lines," first discovered in the spectrum of δ Orionis by J. Hartmann (1904). Hartmann noted that the H and K lines of ionized calcium in the violet show a constant velocity shift, while that of the remaining lines goes through a cycle of variation every few days because of the orbital motion of the system. Hartmann recalled the behaviour of the exploding star Nova Persei 1901 in which the H and K absorption lines, and also the D lines of sodium in the yellow region, had remained sharp and fixed while the other lines underwent complex changes in position and structure; he concluded that these lines must, in the case of both stars. have been superimposed on the spectrum of the star proper by the passage of its light through a gaseous cloud in which calcium and sodium were present.

Afterward, M. L. Heger showed that the sodium D lines also remain stationary in δ Orionis, and high-dispersion spectra of this and other stars by T. H. Dunham and W. S. Adams revealed in addition stationary lines of potassium, titanium, neutral calcium and the diatomic molecules CH and CN. In cooler stars, these interstellar lines are hard to detect because of their blending with the corresponding lines in the star's own spectrum.

That the clouds mhich produce the interstellar lines are distributed throughout the galaxy and do not exist primarily in the neighbourhood of individual hot stars was first suggested by A. S. Eddington and confirmed from a study of numerous spectrograms in 1929 by Otto Struve, who showed that, on the whole, the intensity of the interstellar K line increases steadily with distance. In 1935, J. S. Plaskett and J. A. Pearce studied the velocities in the line of sight of numerous hot stars (which are distributed close to the galactic plane). They showed that, in a given direction, the velocities of individual stars increase in proportion to their distances, in accordance with Oort's theory of differential galactic rotation, and that the velocity shift of the interstellar K line generally corresponds to about one-half the velocity (and hence one-half the distance) of the star as though the gas were uniformly distributed in the intervening space.

Later work with spectrographs of higher dispersion by C. S. Beals (1936), R. F. Sanford, P. W. Merrill and **O.** C. Wilson (1938) and Adams (1943) showed that the interstellar lines are often split into numerous very narrow components, each being the effect of a separate cloud of gas with its own characteristic motion. According to estimates by A. Blaauw and B. Stromgren, a straight line 1,000 parsecs long in the galactic plane may traverse about 10 clouds with a mean diameter of about 5 parsecs. a mean density of 10 hydrogen atoms (or 2.7×10^{-23} g.) per cubic centimetre and a mean velocity relative to the average of the surrounding stars of about 7 km. per second. The chemical composition of the clouds seems to approximate closely to that of normal stars, but their temperatures are very low (of the order of 100° K., *i.e.*, 100° C. above absolute zero or −173° C.), so that the constituent atoms and molecules are practically all in their state of lowest energy. The absorption spectra therefore consist entirely of resonance lines, only a limited number of which occur in the observable spectral range. In 1953, Guido Munch showed that around Perseus the interstellar lines from hot stars at very great distances (up to 3.000 parsecs) split into two distinct groups of components, arising from gas clouds in the next spiral arm out from the centre of the galaxy as well as in the arm in which we are situated.

In addition to the lines mentioned above, certain highly diffuse absorption bands many ångströms wide are produced in interstellar space, the strongest being centred on λ 4,430 A. Their origin is unknown, but they appear to be associated with the clouds of obscuring dust rather than with the interstellar gas in general.

Radio Emission by Cosmic Gas. — In 1932, K. G. Jansky found that cosmic noise at radio frequencies was received by a directional antenna pointed at the sky; he and G. Reber afterward showed that the radio naves came from the Milky Way, the strongest radiation being received from the direction of the galactic centre in Sagittarius. After 1945, a number of point sources of radio emission were discovered both within and outside the galaxy. but only in certain cases was it possible to identify these visually. One such source within the galaxy is the Crab nebula in Taurus, which is the gaseous remnant of the supernova observed from China and Japan in 1054, a stellar outburst of unusual violence. An extragalactic source is Cygnus A, which was shown by Baade and R. Minkowski in 1952 to consist of two colliding galaxies. In this case the stars simply pass one another with little interference because of their enormous distances apart, but the clouds of interstellar gas and dust collide with relative velocities of 1,600 km. per second and are in violent turbulent motion.

Weak radio emission has been detected from the sun (enhanced by sudden bursts during solar flares), from the galactic plane, from the galactic corona (a large, spherical, extremely tenuous region roughly embracing the globular clusters and concentric with

the Milky Way) and from nearby extragalactic nebulae; but it is significant that the strongest sources always consist of ionized gas with violent internal motions. Furthermore. the Crab nebula shows a filamentary structure emitting polarized light which suggests the presence of a magnetic field. The evidence suggests that the chief cause of radio emission is the deceleration of electrons moving with velocities approaching that of light in a magnetic field (synchrotron radiation). These ionized, magnetized gas clouds also provide a likely mechanism for the production of some cosmic rays. In the case of the quiet sun and of ionized hydrogen clouds in the galactic plane. however, the radio emission is of thermal origin. as a result of the deceleration of electrons in the electric fields of nearby protons.

Interstellar Hydrogen and **21-cm.** Radiation.— Although hydrogen is by far the most abundant element in the interstellar gas, as in normal stars, its spectral lines are not detectable optically except as emissions from those clouds (known as H II regions) that are close enough to hot stars to be ionized by their ultraviolet radiation. In this case the capture of electrons by protons leads to the production of energetically excited hydrogen atoms which then lose their energy by emitting radiation, some of nhich appears in the visible region of the spectrum. At a certain distance from such a star (depending on its size and temperature and on the density of the nearby gas), the ultraviolet radiation is completely broken down into quanta of lower energies and longer wave lengths, so that hydrogen is no longer ionized (this is the H I region).

In accordance with the theory developed by H. Zanstra and Stromgren, the transition takes place quite suddenly, so that the typical H II region is a well-defined sphere surrounding a hot star or a group of hot stars. Such H II emission clouds are prominent in photographs of spiral galaxies, in which they were formerly often mistaken for bright stars. They occupy only about one-tenth the space taken up by the neutral H I clouds which produce the interstellar absorption lines; their physical state resembles that of the diffuse nebulae, such as the great emission nebula in Orion, but they are of a considerably lower density.

The development of radio astronomy has provided an extremely powerful method of detecting neutral hydrogen in interstellar clouds from the transition at 1,420 mc. per second (λ 21.1 cm.), a possibility which was suggested by van de Hulst in 1944. Radio waves of this frequency are respectively emitted or absorbed by a hydrogen atom in its lowest energy state, when the directions of spin of the proton and electron change from parallel to antiparallel or vice versa. This hyperfine structure transition takes place very rarely, the mean life of an atom in its upper state being about 11,000,000 years; but the clouds of interstellar gas are so vast that detectable amounts of radio noise are emitted at this frequency. The 21-cm. radiation from the Milky Way began to be observed in 1951, first by H. I. Ewen and E. M. Purcell (Harvard). then by C. A. Muller and Oort (Leiden, Neth.) and shortly afternard by W. N. Christiansen and J. V. Hindman (Sydney, Austr.). By observing the velocity shift of the 21-cm. line and applying Oort's theory of differential galactic rotation, van de Hulst, Muller and Oort plotted the spiral structure of the galaxy in the range of galactic longitude from 0° to 220°, while further spiral arms were detected in the southern Milky Way by Christiansen and Hindman.

In 1956, the 21-cm. line was detected in absorption from cool hydrogen clouds surrounding the intense radio source in Cygnus by A. E. Lilley and E. F. McClain, who showed that the recession velocity deduced from the Doppler shift of this line was in excellent agreement with the value of 16,700 km. per second measured in the optical spectrum by Minkowski. This result is strong confirmation of the view that the red shift observed in the spectral lines of distant galaxies is a true velocity shift.

Relationship Between Stars and Interstellar Material.— The distribution of interstellar gas and dust clouds is very heterogeneous, but roughly speaking they are confined within a distance of about 100 parsecs from the galactic plane (in the solar neighbourhood) and within the galactic spiral arms, which have a width of the order of 500 parsecs within the plane. While the dust appears to be confined to discrete clouds, which coincide with local concentrations of the gas with a density of about ten hydrogen atoms per cubic centimetre, there appears to be in addition a uniform distribution of gas with a density of about one hydrogen atom per cubic centimetre throughout the galactic disk. The temperature of the interstellar medium depends somewhat on the local intensity of stellar and cosmic radiation, but mainly on the absorbing properties of the medium; in H II regions it is about 10,000° K., in H I regions about 60° K. and the solid particles may be still cooler.

In the H I clouds there may be a statistical equilibrium between the gas and the dust grains, the latter being formed by combination and condensation and evaporated again by collisions between the clouds. The close association between bright, hot stars (which exhaust their nuclear energy sources so rapidly that they can be no more than 10,000,000 years old) and interstellar matter suggests that stars are being continuously formed by condensation from clouds of gas and dust. Possibly we are actually witnessing such a process in the T Tauri variables, stars which show emission spectra and are often accompanied by a visible nebulosity. The explosions of novae and supernovae and the slower ejection of matter from stars with expanding gaseous envelopes tend to replenish the interstellar medium, but only partially. since a certain fraction remains permanently locked up in white dwarfs. Thus the amount of interstellar material may be expected to diminish slowly with time.

At present the mean density of interstellar matter in the solar neighbourhood is about 3×10^{-24} g. per cubic centimetre, which is about equal to the density of material in the form of stars; but in the galaxy as a whole, most of which consists of relatively inconspicuous stars and of globular clusters distributed more or less spherically about the centre, the interstellar medium probably contributes only a small percentage of the total mass.

See also COSMIC RAYS; GALAXY; NEBULA; RADIO ASTRONOMY; SPECTROSCOPY, ASTRONOMICAL; STAR.

BIBLIOGRAPHY.—J. Dufay, *Galactic Nebulae and Interstellar Matter,* Eng. trans, *by* A. J. Pomerans (1957); B. J. and P. F Bok, *The Milky Way,* 3rd ed. (1957); H. Shapley, *Inner Metagalaxy* (1957); J M. Burgers and H. C. van de Hulst (eds.), *Gas Dynamics of Cosmic Clouds* (1955). (B E J P.)

INTESTACY. If an individual dies without having made a valid will, the succession to his property is determined by the rules of intestacy. In England, until far into the 19th century, descent to real property was subject to rules diflerent from those applying to the distribution of personal property. For the former, the common law courts of the king developed the canons of descent, under which it descended undivided to a single heir, who among several relatives of equal nearness to the ancestor was determined by the rules of preference for males and of primogeniture.

Personal property was distributed in accordance with rules which the church took over from the Corpus Juris Civilis of the Roman emperor Justinian and which were ultimately codified in the Statute of Distribution of 1670. In the latter half of the 20th century, uniform systems of succession to both real and personal property prevailed in all common law jurisdictions of both the United States and the British Commonwealth, generally following the pattern of the Statute of Distribution but diverging in matters of detail. Differences exist particularly with respect to the position of the surviving spouse who, in England and in several states of the U.S., is entitled to a fixed minimum amount. In practically all U.S. jurisdictions the nidow, and in some the nidower and minor children, are entitled to an award to cover living expenses for the period during which the decedent's estate is wound up by the administrator. In numerous states the surviving spouse is also entitled to a priority over both other heirs and creditors of the decedent with respect to a minimum portion of the land used by the family as its homestead.

In the community property states, the community property is divided at the death of one spouse so that the surviving spouse has one half, while the other half. together uith the separate estate of the predeceasing spouse, passes under intestacy or under the will, as the case may be. In all U.S. jurisdictions the sur-

viving spouse is protected against complete disinheritance, but children are not usually protected.

While under older laws an illegitimate child has no rights of succession, modern acts generally provide for rights of intestacy between the illegitimate child and his mother and maternal relatives. A child who has been legitimated by the marriage of his mother and his reputed father or (as is possible in some U.S. jurisdictions) through acknowledgment by his reputed father, has the same position as a legitimate child. As to the intestacy rights between a person adopted, his adoptive parents, his natural parents and the relatives of the adoptive and the natural parents, the statutes of the several jurisdictions contain provisions which vary from each other in many respects.

If no relative of a decedent can be found, his estate escheats to the state.

See also ESTATE AND INHERITANCE TAXES; INHERITANCE; WILL.

(M. RN.; X.)

England. — Formerly devolution of property where its owner died intestate depended upon whether such property was realty or personalty. The Administration of Estates act (1925) for England abolished the whole law of inheritance. An heir now takes only where he is mentioned as such in the grant of an estate in land, and on the death of an owner of real and personal property intestate all his estate vests in the president of the probate, divorce and admiralty division of the high court of justice until the court appoints an administrator, whereupon such property vests in him or her. who holds his real estate on a trust for sale; this and the personalty form a joint fund for the payment of his debts and thereafter for distribution among the persons entitled. If there are no such persons, the fund goes to the crown as bona *vacantia.*

The scheme of distribution for which the Administration of Estates act, 1925, provided was as follows:

1. A surviving spouse was to take the personal chattels absolutely and a net sum of £1,000. Of the residue of the estate, the surviving spouse took a life interest in half if the intestate had children or in the whole if he had none.

2. Subject to the rights of a surviving spouse, the estate was taken by the children at 21 or on marriage, the issue of children who had died taking at 21 or marriage their share of what their parent would have taken if alive.

3. If there was no issue, and again subject to the rights of a surviving spouse, the parents of the intestate took equally, or if one parent survived he or she took the whole.

4. If there was neither issue nor parent, the following was the order: (a) brothers and sisters of the whole blood and their issue; (b) brothers and sisters of the half blood and their issue; (c) grandparents; (d) uncles and aunts of the whole blood and their issue; and (e) uncles and aunts of the half blood and their issue.

The Intestates Estates act, 1952, makes some important changes, mainly in the interests of a surviving spouse. If the intestate leaves no issue, no parents and no brother or sister, the whole of the residuary estate is held in trust for the surviving spouse absolutely. If he or she leaves issue, instead of £1.000 the surviving spouse receives £5,000 in addition, as before, to a life interest in half the residue; if the deceased leaves no issue but leaves a parent or brother or sister of the whole blood, or issue of such brother or sister, the surviving spouse is to receive £20,000 after payment of all liabilities, and one-half of the residue, while the other half of the residue is held in trust for the parent (or in equal shares for the two parents, if both survive) or, where there is no parent. on the statutory trusts for the brothers and sisters or their issue. Other important features of the 1952 act are that it gives the surviving spouse the right to call for the purchase or redemption of his or her life interest; that it modifies the law as to partial intestacies so that a surviving spouse obtains a statutory legacy diminished by the value of any bequest; that it enables a surviving spouse, on certain terms, to acquire the deceased's interest in the matrimonial home; and that it applies the provisions of the Inheritance (Family Provision) act, 1938, as amended to an intestacy, so that a spouse, an infant child, an unmarried or incapable daughter or an incapable son may apply to the court for further provision out of the estate of an intestate. (W. T. Ws.)

Scotland. — In the law of Scotland heritage descends to the heirs-at-law while the free moveable estate of the intestate is divided among the heirs in *mobilibus; i.e.,* next of kin and those entitled to share in the succession under the Intestate Moveable Succession acts. See also SCOTS LAW: Intestate Succession.

See for a digest of the intestacy laws of the U.S., Canada and other countries, Martindale-Hubbell, ***Law Directory,*** vol. 3 (annual).

(M. RN.)

INTESTINAL OBSTRUCTIONS. The alimentary tract digests and assimilates ingested food and disposes of the refuse. Any obstruction to the continuity of the bowel interrupts these three normal functions. Moreover, a blocked bowel often is accompanied by a chain of events which threatens life seriously. If the obstruction remains unrelieved, death follows.

Causes. — The bowel may become obstructed through a number of agencies, of which the following types are recognized:

1. Strictures of the bowel wall, congenital or acquired. Atresia and imperforation are types of congenital strictures which result from failure of the bowel to develop its lumen (canal) and are present at birth. The former (atresia) usually concerns segments of the small intestine — duodenum, jejunum or ileum — though the proximal reaches of the colon may occasionally be involved. Ordinarily, the atresic area is a short segment of an inch or less in length which looks like a fibrous cord. Imperforation concerns invariably the terminal end of the alimentary canal and involves only the anal canal and distal half of the rectum. Acquired types of stricture of the bowel which may give rise to obstruction are traumatic, inflammatory or neoplastic (cancerous) in origin. The first two are rare; strictures of the bowel, caused by malignant growths, are rather common, especially in persons past 45 years of age and not infrequently give rise to obstruction, particularly in the colon or large bowel.

2. Obstruction by obturation occasioned by the presence of a foreign body within the bowel lumen occurs occasionally. Faecal impaction is the most frequent variety of this type of obstruction. A large gallstone, ulcerating from the gall-bladder in the small intestine now and then gives rise to obstruction by obturation.

3. Occlusions of the bowel may occur through the agency of compression by tumours outside the bowel, especially in areas where the bowel is fixed (retroperitoneal duodenum or terminal ileum).

4. Adhesive bands are a frequent cause of intestinal obstruction. Adhesions are usually inflammatory in origin and follow in the wake of suppuration of the appendix, gall-bladder and female generative organs (Fallopian tubes). Adhesions giving rise to obstruction are often the accompaniment of an antecedent abdominal operation.

Ordinary talcum, with which surgeons formerly powdered their hands to facilitate pulling on of rubber gloves, is known to be a keen stimulus to adhesion formation, and undoubtedly a patient who has undergone previous elective abdominal surgery, followed by an uncomplicated convalescence, has occasionally developed intestinal obstruction from adhesions at a remote date from the adhesion-stimulating property of talcum powder.

5. Hernia or protrusion of a loop of bowel through a normal (inguinal, femoral, obturator, mesenteric or diaphragmatic) or abnormal orifice (defect in abdominal wound following operation) is a common cause of obstruction.

6. Volvulus or torsion of the bowel may occur in the small intestine, caecum or sigmoid — areas in which a segment of bowel is pedicled on a narrow strip of mesentery.

7. Intussusception or telescoping of one segment of the bowel into another occurs with predilection in infants from four months of age through the first year of life. The actual cause is unknown. After two years of age, intussusception is relatively uncommon and a tumour such as a polyp, lipoma or cancer of the bowel is frequently found at the apex of the telescoped segment.

8. A number of miscellaneous congenital factors resulting from errors in development of the intestine may give rise to obstruction, among which the following may be enumerated: (a) anomalies of intestinal rotation; (b) extrinsic duodenal compression by congenital bands; (c) a persistent vitellomesenteric duct (Meckel's

diverticulum) and umbilical eventration. In all of these, save the last, the obstruction may occur for the first time in childhood or even later.

9. Physiological imbalance in the nervous tone of the intestine may give rise to obstruction, which in this instance is often referred to as ileus. It may be paralytic (adynamic) in nature or spastic (dynamic). Symptomatically spastic ileus mimics mechanical obstruction. Peritonitis is the most common cause of adynamic ileus. Deficiencies in the electrolyte pattern of the blood occasioned by loss of digestive fluids, either by vomiting or from severe diarrhoea may give rise to paralytic ileus. Notably, loss of potassium, chloride or the sodium ion may be followed by a paretic state of the intestine, which can only be restored by replacing the lost electrolytes.

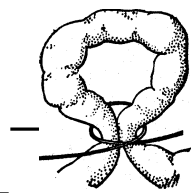


FIG. 1.—A LOOP OF SMALL INTESTINE STRANGULATED BY AN ADHESIVE BAND

10. Finally, thrombosis or embolism (plugging of the blood vessels of the mesenteric vessels, either arteries or veins) may give rise to intestinal obstruction.

Consequences.—Whereas a number of different causes may be responsible for the development of bowel obstruction, there are essentially only two pathological types: (1) simple obstruction to the continuity of the bowel, best exemplified by a stricture in the gut wall and (2) strangulating obstruction, in which in addition to mechanical occlusion there is actual or potential deprivation of blood supply to the bowel (hernia, volvulus and intussusception).

In obstructions high in the intestinal canal, the loss of intestinal fluids and electrolytes (salts) through the agency of vomiting is frequent and constitutes an important element in the disease. Obstructions in the lower reaches of the small intestine (ileum) and the large intestine (colon) are attended regularly by intestinal distension, because retrograde peristalsis and vomiting fail to evacuate the distended intestine.

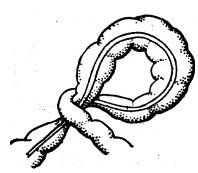


FIG. 2.—VOLVULUS OR TORSION OF THE SIGMOID LOOP OF COLON

In obstruction of the colon, moreover, the ileocaecal valve often delimits the distension to that segment of large intestine lying proximal to the obstruction, thus causing great hazard of rupture, particularly in the cecum which segment lies just beyond the ileocaecal valve and has the greatest diameter. It has been demonstrated by experiments on animals, in which the opportunity for the swallowing of air is excluded, that the chief source of gaseous distension in obstruction of the intestine is swallowed air.

Whereas students of intestinal obstruction prior to 1930 were likely to attribute the evil consequences of obstruction largely to abnormal permeability with absorption of noxious agents from the obstructed bowel, it later became more generally recognized that the ill effects of obstruction relate themselves essentially to the two items mentioned above: (1) loss of intestinal fluids and electrolytes by vomiting; and (2) the threatened loss of viability of the bowel wall occasioned by long-continued distension. With reference to the latter item, it is apparent that sustained intralumenal pressures maintained for some time above the mesenteric venous pressure (12 to 16 c.m. of water) will interfere with the normal nutrition of the bowel wall. Anoxia or poor oxygenation of the bowel wall ensues in consequence of the arrest of venous outflow as a result of which the bowel wall becomes devitalized. A bowel wall with impaired viability becomes abnormally permeable to noxious agents within its lumen, which now may migrate across the protective barrier of the damaged intestinal mucosa to the peritoneal cavity from which site absorption occurs readily.

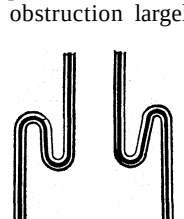


FIG. 3.—INVAGINATION OR TELESCOPING OF A SEGMENT OF BOWEL INTO THE PART BEYOND

Recognition.—All mechanical varieties of obstruction (by far the majority of all obstructions) are heralded by the presence of intestinal colic or "gas pains" occurring at the acme of an intestinal contraction or peristaltic wave. These contractions are accompanied by gurgling noises in the presence of a gut distended by both fluid and gas. The intestinal colic of gaseous distension (largely swallowed air) is accompanied by high-pitched sounds which have usually a metallic character. The noises (borborygmi) attending such contractions of the bowel are regularly attended by pain which is concurrent with the borborygmus, unlike the noise of the unobstructed gut which is painless. These noises may be audible to the unaided ear but are elicited readily on auscultation of the abdomen with a stethoscope. Recurrent crampy abdominal pain with concurrent intestinal noises is synonymous with intestinal colic. Food indiscretions and the taking of a cathartic may simulate the intestinal colic of intestinal obstruction; however, the history, observation and the absence of distension serve to distinguish them from mechanical obstruction of the bowel. Strangulating unlike simple obstructions regularly is attended by abdominal tenderness. Percussion reveals the presence of tympanitic areas caused by the distended intestine, and a scout X-ray film of the abdomen indicates the extent and the location of the distended intestinal coils. An experienced observer summarizing these various findings may therefore determine: (1) whether obstruction is present; (2) whether strangulating or mere interference with the continuity of the intestine is present; and (3) where the obstruction is. He cannot in many instances, without recourse to exploratory operation, determine the exact variety of obstruction present.

Treatment of Intestinal Obstruction.—The object of treatment is to relieve distension and to restore the continuity of the intestinal canal. In obstructions in which vomiting has been an important factor, restoration of fluid and electrolyte loss by the intravenous administration of physiological saline solution (0.6% to 0.85% sodium chloride) is important. Sir Frederick Treves of London who wrote an important monograph upon the subject of intestinal obstructions in 1899 stated: "Those who are enamoured of statistics could, I have little doubt, show that it is less dangerous to leap from the Clifton suspension bridge than to suffer from acute intestinal obstruction and decline operation." Operation is still the mainstay of therapy. Every strangulating obstruction must be operated upon, freeing the strangulated loop from the agent which threatens its viability. All simple obstructions, in which the block to intestinal continuity is persistent such as a stricture, must of necessity be subjected to operation. However, in a fairly large number of instances suction applied to an indwelling duodenal or long intestinal tube may succeed in decompressing the distended segment. Obstructions which owe their origin to inflammatory causes, nervous imbalance (paralytic or spastic ileus) or intestinal adhesions not uncommonly may relent with the decompression of the bowel achieved by an indwelling intestinal tube. The hazard of attempting to relieve obstruction by such a tube lies in the circumstance that, the obstruction may be strangulating in type or that the obstructive mechanism may continue unrelieved. When satisfactory decompression of the distended bowel has not occurred within 12 hours following the employment of suction attached to a long intestinal tube, recourse should be had to operation.

The necessity of transfusing blood into the veins of patients having strangulating obstructions is apparent; for under the motive force of systolic blood pressure, blood is pumped into the vessels of the bowel wall and becomes imprisoned in the strangulated intestinal loop, thereby causing loss of blood from the circulation with consequent shock.

The inhalation of high concentrations of oxygen has been advised on the assumption that, despite the low coefficient of diffusion of nitrogen, inasmuch as the gas in the distended intestine is largely swallowed air (80% nitrogen), the breathing of pure oxygen by the patient will succeed nevertheless in removing by exhalation small but definite increments of gas from the distended

bowel. Whereas this therapeutic procedure is sound in theory, it operates so slowly that it has little merit in practice.

Prognosis.—Recognition of the presence of intestinal obstruction earlier in its course, a better understanding of the ill consequences of obstruction, improvement in surgical technique, the employment of suction applied to indwelling long intestinal tubes and better schemes of intubating the duodenum quickly—all of these agencies have combined to reduce materially the hazards of intestinal obstruction. The mortality of the presuction era (1931) was in the neighbourhood of 40% to 60% in the best surgical clinics of the world. By the mid-1950s, however, mortality reduced to the range of 10% to 12% represented the accomplishment in surgical clinics with a special interest in the problem of intestinal obstruction. Despite this obvious progress, surgeons had yet to learn how to wrestle with conditions which may obstruct the intestine and give rise to distension with the same effectiveness as they can treat these same agencies in the absence of intestinal distension.

See Sir Frederick Treves, *Intestinal Obstructions; Their Varieties and the Pathology, Diagnosis and Treatment* (1899); O. H Wangensteen, *Intestinal Obstructions,* 3rd ed (1955). (O. H. W.)

INTESTINE: see DIGESTION; GASTROINTESTINAL TRACT.

INTOXICATION: see ALCOHOLISM; INEBRIETY, LAW OF; LIQUOR LAWS AND LIQUOR CONTROL.

INTROIT: *see* **PLAINSONG.**

INTROSPECTION, in psychology, is the process of observing the operations of one's own mind with a view to discovering the laws that govern the mind (Lat. *introspicere,* to look within). In a dualistic philosophy which divides the stuff of the natural world (matter, including the human body) from the contents of consciousness, introspection is the chief method of psychology. Thus it was the method of primary importance to the English school of philosophy—to Thomas Hobbes, John Locke. George Berkeley, David Hume, James Mill, John Stuart Mill. Alexander Bain and most of their contemporaries—as it was to the pioneers of the new experimental psychology, especially to Wilhelm Wundt, Oswald Kulpe and E. B. Titchener.

To all these men the contents of consciousness appeared to be immediate experience: to have an experience was for them also to know that you have it, and in this sense introspection appeared to be self-validating; it could not lie.

Wundt and Titchener, as well as Kulpe in his early years (1893), believed that introspection finds in consciousness only sensory materials—sensations proper, images which are centrally excited sensations, and feelings which closely resemble sensations. This view is known as classical introspection. Many other psychologists, however, found other kinds of content in consciousness. Franz Brentano and Kulpe in his later years were the most influential act psychologists who reported consciousness as constituted of both sensory contents and more impalpable acts.

Perpetual controversy about the results of introspection made it quite clear by 1920 that introspection is not infallible and. later, that its fallibility is due to the fact that it is not immediate but is an observational inferential process that takes time and is subject to errors of observation. This discovery came in with the rise of objective psychology and behaviouristics in America.

By 1940 both the concept of dualism and the word "introspection" had largely disappeared from scientific psychology, especially in the U.S. where behaviouristics ruled. It is true that Gestalt psychology retained a dualistic philosophy, but its leaders rejected introspection because the word was so closely identified with the classical form.

Actually the repudiation of dualism by modern experimental psychology led only to the surrender of the word "introspection," not to the abandonment of the method. The general method (not classical introspection) is used without the name (1) in phenomenological description as the Gestalt psychologists use it and as it is employed in the description of experience in perception; (2) in psychophysics where are determined the relations of conscious events, usually of a sensory nature, to magnitudes of the stimulus, especially in the determination of the sensory thresholds and sensory scales; and (3) in the protocols of patients as they describe their consciousnesses to psychiatrists and psychoanalysts, sometimes in free association on the psychoanalytic couch, sometimes in projective tests, like the Rorschach ink blots, where the subject. for diagnostic purposes, reports the train of thought aroused in him by an equivocal stimulus or situation.

See E G. Boring, "A History of Introspection," *Psychological Bulletin,* vol. 50 (1953). (E. G. BOR)

INTUITION is the power of obtaining knowledge directly, without recourse to inference or to reasoning. Two senses of the word must be distinguished, one of them ordinary and one technical, the technical differing from the ordinary in the respect that it refers to supposedly primary or self-substantiating and not alternative sources of knowledge. These senses are: (1) the acquisition of knowledge of matters of fact without reliance on the ordinary procedures of inquiry; (2) the acquisition of knowledge of a kind which cannot be obtained by inference (e g., the knowledge of the axioms and rules of inference employed in logic and mathematics and of the principles of morals). There are in addition two further technical senses (3 and 4), as mentioned below.

1. In its colloquial sense, as in the phrase, "feminine intuition," the word is used to refer to the capacity for making rapid and accurate assertions about matters of fact in circumstances where reliance on the standard procedure of inquiry is ruled out. It is often, perhaps usually, exercised predictively, on such matters as the outcome of horse races, impending disasters or the behaviour of someone in a yet unrealized state of affairs. For final justification of a claim to knowledge about the future we have to wait for the actual outcome. But before the event one may be quite confident of the truth of one's prediction. This confidence may arise from the strength of the inference leading to the prediction. But it may be that one "just knows," that one is not aware of any inference supporting one's prediction; and in such cases one is making a claim to intuition of the event predicted. This claim is not substantiated by the correctness of the prediction; it may have been a lucky guess. It is only if a man's claims to knowledge in advance about a certain subject matter are regularly correct that a power of intuition can be ascribed to him. For there is then inductive ground for taking his conviction as a reliable index of the truth of what he is convinced about. The existence and unequal distribution of such powers are not difficult to explain. One may be sensitive to significant features of what is currently observable without being aware of the fact (*e.g.*, facial expression as an index of character). This sensitivity will depend in part on natural endowment (*e.g.,* acute hearing) and in part on thorough familiarity with the subject matter in question. In this sense, then, claims to intuition arise either from implicit inference or from lucky guessing. We can only tell which, and thus on which to rely, by waiting to see if the claims are borne out significantly often.

So intuition here is not an independent source of knowledge. It is either inferential knowledge in a disguised form or not knowledge at all but guesswork.

2. In its most familiar philosophical interpretation intuition is the power of obtaining knowledge which cannot be acquired by either inference or observation, reason or experience. As such it is thought of as an original, independent source of knowledge, since it is designed to account for just those kinds of knowledge which other sources of knowledge do not provide. Our knowledge of necessary truths and of moral principles has been explained in this way.

In the first place, some necessary truths, statements of logic and mathematics, can be inferred, logically derived, from others. But not all can: there must be some uninferred statements (*i.e.,* axioms). Furthermore, the interconnected character of the system, the derivability of statements from axioms, presupposes rules of inference. Now the truth of axioms and the validity of basic rules of inference cannot be established by inference, since inference presupposes them, or by observation, which can never establish necessary truths. So they are held to be objects of intuition. Axioms are ordinarily truisms, consequently self-evidence is taken as a mark of intuition. To "see" that one statement follows from

another, that a particular inference is valid, enables one, it is said, to make an "intuitive induction" of the validity of all inferences of that kind. Other nonformal necessary truths (e g., "nothing can be red and green all over') are also explained as intuitive inductions: we are held to "see" a universal and necessary connection through a particular instance of it.

Secondly, moral philosophers, from Bishop Butler and the Moral Sense school to G. E. Moore and the Oxford moralists, have held that moral assertions record knowledge of a special kind. The rightness of actions (or, in Moore's case, the goodness of states of affairs) is discovered by a special moral faculty, seen as analogous to the power of observation (Moral Sense school, Moore) or the power of intuiting logical principles (Oxford moralists). This theory, like that which holds logical principles to be the outcome of intuition, bases its case on the self-evident and unarguable character of the assertions with which it is concerned.

Against both theories much the same argument can be brought forward. The "axioms" of logic and morality do not require for their interpretation a special source of knowledge. since neither record discoveries: rather they record resolutions or conventions, attitudes that we adopt toward discourse and conduct, not facts about the nature of the world or man. A further argument against the theory of moral intuition depends on the markedly discordant character of the deliverances of the supposed source of knowledge.

3 and 4. Two further technical senses of the word may be briefly mentioned. One, deriving from Kant, is that in which it is understood as referring to the source of all knowledge of matters of fact not based on, or capable of being supported by, observation; that is to say, of matters of fact which observation directly or immediately reveals. The other is the sense attached to the word by Spinoza and by Henri Bergson, in which it refers to supposedly concrete knowledge of the world as an interconnected whole as contrasted with the piecemeal. "abstract" knowledge obtained by science and by common observation.

BIBLIOGRAPHY.—Bertrand Russell, *Problenzs of Philosophy,* ch xi (London, New York, 1912); A. C. Ewing, *Reason and Intuition* (London, New York, 1941); W. H Walsh, *Reason and Experience,* ch iv–v (Oxford, Toronto, 1947); K R Popper, article in *Proceedzngs of the Aristotelian Society,* vol xx, supp (London, 1946); P F Strawson, "Ethical Intuitionism," *Philosophy* (1949). (A. M Q.)

INULIN, a polysaccharide which bears to levulose (D-fructose) a relationship similar to that of starch to glucose. Inulin occurs in many plants of the large family Compositae (*q.v.*) to which the elecampane (*Inula* helenzum) belongs and it is especially abundant in tuberous roots such as those of dahlia (*Dahlia variabilis*) and Jerusalem artichoke (*Helianthus tuberosus*) Inulinlike substances from various sources have been given distinctive names such as graminin (from Festuca, *Trisetum* and other grasses), irisin (from Iris *pseudacorus*), etc

Fine inulin forms a white tasteless powder, sparingly soluble in cold water, very soluble in hot water and insoluble in alcohol. Dilute mineral acids or the enzyme inulase convert inulin into levulose (D-fructose). In many plants the presence of inulin is detected by the spherocrystals which form on steeping tissue slices in strong alcohol. See CARBOHYDRATES. (F. C. SD.)

INVAR, an alloy of 36% nickel, small amounts of manganese, silicon. and carbon (less than 1% total) and balance iron characterized by an extremely small thermal expansion. The average coefficient is 0.70×10^{-6} per 1° F. for invar compared with $6 8 \times 10^{-6}$ per 1° F. for steel (0"–zoo" F.). In applying these alloys it is important to recognize that their expansivity is dependent upon the temperature involved. The range for lowest coefficient is —6o° F. to 175° F. Invar is used where it is advantageous to avoid temperature compensation; *i.e.,* for absolute standards of length, thermostatic strip, rods and tapes for surveying, and horological instruments. The name invar was selected to express the invariability of its dimensions with heat. (R. A. LR.)

INVARIABLE PLANE, in celestial mechanics (*q.v.*), that plane on which the sum of the moments of momentum of all the bodies which make up a system is a maximum. It derives its celebrity from the demonstration by Laplace that to whatever mutual actions all the bodies of a system may be subjected, the position of this plane remains invariable.

INVENTIONS AND DISCOVERIES. It is impossible to define "invention" with the breadth demanded by literary, scientific and legal usage. A poem, a musical composition, a theory which explains how light is transmitted from a source to the eye is as much of an invention as an electronic computer that solves in minutes problems that would ordinarily engage a mathematician for weeks. The atom is an invention. So is the universe of any cosmologist, ancient or modem. In this article technological inventions are the principal subject of discussion.

No sharp distinction can be drawn between invention and discovery. Gunpowder, a mixture of potassium nitrate, carbon and sulphur, certainly had to be discovered; yet it was also an invention. There are hundreds of such examples not only in chemistry but in engineering.

Discoveries often lead to invention. Thus the discovery that liquids expand and contract with variations in temperature led to the invention of the thermometer. Michael Faraday's discovery of electromagnetic induction was the basis of the telegraph, the telephone, the electric generator and motor, in fact of electric engineering. Conversely inventions often lead to discovery. Out of the steam engine came important theories that led to the development of thermodynamics and thus to more efficient steam engines. Out of Edison's electric lamp came the discovery that a feeble current could pass from the hot filament through empty space to a metal plate sealed in the bulb—the basis of the vacuum tube.

If the term "invention" is to be broadly defined as an act of the creative imagination, it is easy to understand why the French patent act of 1791, based on the Declaration of the Rights of Man (1789), placed economic or social inventions on the same footing as mechanical and scientific inventions. Patents were therefore granted for tontine life annuities, tariff systems, credit plans, types of mortgages, banking systems, exchange controls and methods for guaranteeing the value of assignats. When it became apparent that there would be an avalanche of such schemes the national assembly on Sept. 20, 1792 decreed that the executive power should not only cease to grant patents for financial inventions but also counteract the effect of those already granted.

Given a technical heritage and the right social environment, invention is inevitable. The phenomenon of simultaneous invention and discovery proves it Alexander Graham Bell and Elisha Gray filed applications for telephones on the same day. Charles Martin Hall (1863–1914) and Paul L. T. Héroult (1863–1914) discovered or invented the process of making aluminum independently and almost simultaneously. Tessie du Rlotay (French) and Thaddeus Lowe (American) independently devised the process for making street gas by passing steam over red-hot coal; William Kelly and Sir Henry Bessemer, the one in the Cnited States. the other in England, made steel by blowing air through molten iron to burn out the carbon. Every year there are "interferences" in the United States patent office—judicial processes to settle rights of inventors who apply for patents on identical machines or processes. The history of invention and of the patent law is full of such examples. Since so many important inventions are conceived simultaneously and independently it is evident that inventive genius is not unique. In any community of 100 000 there are bound to be a certain number of ingenious mechanics, exceptional painters and fine musicians.

From this it almost follows that there are very few "first" inventions, in the sense that they owe nothing to earlier technical knowledge. Most of these must be credited to primitive man Among them are the wheel. the bow and arrow, the fire drill. the boat. pottery, agriculture. domestication of animals. basket-making. The melting of metals (gold, copper), the use of the lever, saw, nedge, pulley and rope are very old. Modern inventions as a whole are combinations of well-known elements that produce new results and serve new and useful purposes. Without a heritage technology could not advance. It was largely lack of a technical heritage that made it impossible for Leonardo da Vinci to invent a practical flying machine. For lack of a technical

heritage Edison as a caveman would not have invented the phonograph. electric lamp and the hundreds of other devices with which his name is coupled.

How difficult it is to credit any inventor with having been the first in his field is shown by the history of the steamboat. About 30 steamers, more or less successful, had been built before Robert Fulton went up the Hudson river in his "Clermont" (1807). There was John Fitch who had a steamboat that ran on the Delaware river in 1787; Oliver Evans who built for Philadelphia in 1803 a combined scow and dredge nhich ran as a steam automobile on land and as a steamboat on the Schuylkill river; James Rumsey who began his experiments in the presence of George Washington; John Stevens who built a screw-propelled steamer in 1802; and William Spmington. an Englishman whose "Charlotte Dundas" was a notable success (1802). The histories of the telegraph, the reaper, the motion picture, the filament electric lamp, the sewing machine and the elevator also shatter the pretensions of "first" inventors as a class.

Much, though not all industrial progress, followed discoveries made in the laboratory. Thus the discovery of the benzene ring by Friedrich August Kekulé (1829–96) emphasized the importance of molecular structure in organic chemistry and made it possible literally to design organic molecules with valuable properties. Similarly the mathematical development of the theory of the electromagnetic field by James Clerk Maxwell (1831–79) left it to be inferred that there is a broad spectrum of electromagnetic waves at one end of which lie light Raves and at the other what were first called Hertzian waves and later radio waves. Inventors of mechanical and electrical machinery apply such broad generalizations and theories, but the original discoveries or theories are not patentable.

The Statute of Monopolies of James I of England, enacted in 1624. was designed to abolish privileges and monopolies which had become a public scandal. An exception was made of letters patent for the invention of new products. This dislike of monopolies as a whole and the exception made in the case of patents granted to inventions are part and parcel of the legal policy of the United States. Great Britain and some other countries.

Patent legislation in the modern sense made its appearance toward the end of the 18th century. The constitution of the United States provided for the granting of patents somewhat after the British system but with the important stipulation that an application for a patent could be filed only by the inventor. In France, as noted above, patent legislation goes back to 1791. Before that the granting of patents was a royal prerogative. Some of the German states passed patent laws as early as 1815, but an over-all German patent law was not enacted until 1842. Most European countries followed the example set by the United States. Britain and Germany, some applying the British system, some the German.

Though Anglo-Saxon countries encouraged invention by the granting of patents it became apparent in the first half of the 20th century that there mere as many objections to patent monopolies as to those that led to the promulgation of King James's Statute of Monopolies In the United States large corporations acquire literally several thousand patents to dominate an entire industry. This domination of a whole "art," as it is called in legal parlance, is opposed to Anglo-Saxon thinking on monopolies of any kind. Even in countries such as the United States, which are not socialistically inclined, the government is undermining the patent monopoly sometimes in direct violation of the patent law. The interests of the inventor are subordinated to those of society, with the result that in both Britain and the United States great corporations have been compelled to grant licences to those who want them. sometimes without the payment of royalties Thus the United Shoe Machinery company was forced to grant licences under its hundreds of patents to all its competitors Similarly the Aluminum Company of America had to relinquish monopolistic control of its many patents. Imperial Chemical Industries and du Pont de Nemours had to dissolve an agreement that was regarded as a cartel and to throw about 2,000 patents into the public

By the second half of the 20th century, about 2.000.000 inventions had been patented in the United States. Prior to 1900 about 600 000 patents covering the first 110 years of the United States patent system had been granted. Most of these patents described inventions which lacked novelty or which were commercially impractical. Adjudication is not the sole test of novelty of subject matter nor of industrial importance, but unless a patent has been adjudicated its commercial value is problematical for the simple reason that the government of the United States does not guarantee the validity of the patents that it grants. In defense of the U.S. patent system it is often argued that only two or three patents out of every thousand are invalidated by the courts. The argument loses force because so many patents cover unimportant and valueless inventions. The higher courts of the United States had invalidated considerably more than half the patents that had come up for consideration by the 1950s.

Patent laws in general and those of the United States in particular were formulated on the theory that inventors should be encouraged, that inventive genius was rare, that society must await the coming of a Morse, Bell, Marconi or Edison before it could receive a new technological impetus, and that privileges in the form of limited monopolies should be granted to such men to make, sell and use their inventions as they saw fit in return for complete disclosure. The principle seems sound, yet the hundreds of thousands of patents granted in advanced countries leave no doubt that inventive ability is commoner than is generally supposed. Moreover, physicians, surgeons, engineers and university professors of science invent many ingenious instruments and procedures that are never patented.

Leaders of industry attribute the remarkable rise of industry in the United States to the patent laws. There is no doubt that the patent laws have had a beneficent economic effect in exploiting rich natural resources, but after the earlier years of the 20th century sociologists and economists as a class discounted the encouragement-of-invention theory. Creative art stands on the same footing as creative mechanical invention. It can hardly be maintained that painters and poets need the spur of copyright laws to create, and copyrights, like patents, are intended to protect intellectual property rights. Frank William Taussig (1859–1940) in his lectures on *Inventors and Money-Makers* showed that inventors are much like artists and that the urge to create is so strong within them that they fly off at half a dozen tangents and too often fail to finish what they have begun.

No doubt professional inventors are encouraged to invent by rewards in the form of profits. Yet a study of the lives of such inventors as James Watt, Samuel F. B. Morse and Alexander Graham Bell fails to reveal any convincing evidence that they derived the slightest encouragement from the patent system, though all patented their inventions. The profit motive is as strong as it ever was; yet ior some undetermined reason the rate at which applications for patents had been filed in the United States up to the 1950s did not keep pace with the rate of population growth. From 1840 to 1921 the number of applications filed with the U.S. patent office rose steadily. Patents granted by the United States patent office in 1950 numbered 43,072, but in 1955 only 30,480. This decline was international. The trend was the same in Britain, France, Germany, Canada and Japan; it indicated that something was happening to invention itself. That something could have been the increasing complexity of technology. An electronic computer which can solve a dozen simultaneous equations in a minute or two is hardly the type of invention that can be evolved by an ordinary mechanic who can design a reaping machine. The release of atomic energy by fission and the application of that release to the making of an atomic bomb could be expected only of highly trained theoretical physicists.

Whether or not a country is distinguished ior its contribution to scientific discovery and invention depends on the social environment. Oriental countries played no important part in the development of modern technology, and yet the Arabs at one time were the most cultured and scientific people. In the Renaissance Italy led the world in science. In the early 18th century industrial supremacy passed to the northern countries, with Great Britain, Germany and the United States in the lead. It can hardly be maintained that one nation is naturally more inventive than another. The British, Germans, Swiss and Scandinavians have made quite as good a record in invention as citizens of the United States so far as quality is concerned, and in some branches of science they excel. The social environment is all important because it determines what will be discovered and invented. This does not mean that we can dispense with men of exceptional ability or so-called geniuses, but it does mean that only when the social environment is

favourable has ability the opportunity to express itself, whether or not there is a patent system. The progress of medicine was assuredly as remarkable as all the progress in technology. Though pharmaceutical companies patent drugs, it can be hardly maintained that patent laws encouraged medical discovery or improved health and raised the mean expectancy of life at birth. If anything, the spirit of medical research is opposed to patents.

That social pressure accounts for many important inventions and discoveries is proved by the events that brought about the industrial revolution. After the introduction of the earliest steam engines and the substitution of coke ior charcoal in the smelting of iron ore, coal was regarded as potential energy as well as a fuel. This brought about a profound change in outlook Coal ceased to be merely a fuel; it symbolized industrial might. With the invention of the gin by Eli Whitney (1765–1825), cotton became the most important of all textile fibres. Because of its leadership in metallurgy and in spinning and weaving, England was overwhelmed by the demand for yarns and cloths. The consequence was a further development of coke production and metallurgy to meet the demand for more and better textile machinery (chiefly power looms) and more steam engines to work mines and drive factory wheels. In the United States the introduction of Whitney's gin made it necessary to revivify the moribund institution of slavery because of the increasing demand ior cotton pickers. Slavery became one of the issues of the Civil War. The need of cloth woven in England irom cotton exported by the southern states inspired the high-tariff policy of the Republican party as a protection for the spinners and weavers of New England.

In the later stages oi the industrial revolution steam engines become more and more efficient, and the energy in coal was thereiore more rationally applied. An invention that gave industry an impetus second only to that of the steam engine of Watt was Eli Whitney's unpatentable system of interchangeable parts. As a government contractor Whitney had obligated himself to produce 10,000 muskets for the army. The parts of the muskets were interchangeable, so that out of a beterogenous mass it was possible to assemble hundreds of muskets. The principle was old, but it remained ior Whitney to apply it on a new scale. The innovation was of incalculable social and economic importance. Whitney was the forefather of standardization and hence of mass production by machine of countless articles ranging from automobiles to tins of vegetables, from bathtubs to electric lamps.

With the discovery in 1856 by William Henry Perkin (1838–1907) of mauve, the first aniline dye, the rise oi the coal tar chemical industry began. It was the Germans who realized that Perkin's achievement meant as much for synthetic chemistry as did Watt's condensing steam engine for mining and manufacturing. Germany rapidly assumed leadership in synthetic chemistry and maintained it up to the outbreak of World War I. Out of German laboratories came thousands of chemicals derived from coal tar—dyes, photographic developers, explosives, drugs.

The history of the industrial revolution is an illustration of the effect of social and economic pressure on the inventor. Moreover, the industrial revolution also changed the character of invention. By 1900 the professional inventor appeared in the person of the scientist hired by an industrial corporation to improve old processes and machines and to invent new ones. For this innovation the Germans deserve a large measure oi credit; the laboratories of their chemical industries demonstrated what could be accomplished by trained scientists and engineers, many of them former university proiessors, in transforming invention and discovery from a haphazard activity to an enterprise as systematic as manuiacturing and selling. Germany's example was ultimately followed by the industrial nations of the west.

Revolutionary inventions have been usually conceived not within but outside an industry. Here and there are found a iew spinners and weavers such as James Hargreaves (d. 1778) and Samuel Crompton (1753–1827) who patented daringly new types of labour-saving spinning machines, but, as a rule the inventors whose devices made it possible to spin and weave on a wholesale scale and to transfer yarn and clothmaking from the home to the factory were "outsiders," who neither made nor traded in textiles. Richard Xrkwright (1732–92), an illiterate barber and hairdresser, invented the spinning frame; Edmund Cartwright (1743–1823) was a clergyman and poet when chance turned his mind to the invention of the power loom; James Watt (1736–1819) never concerned himself with steam engines until a model of a Newcomen pump was given him to repair; Eli Whitney was not a cotton grower when he invented the gin but a young teacher who thought of becoming a lawyer; both Robert Fulton (1765–1815) and Samuel F. B. Morse (1791–1872) were artists; neither Ottmar Mergenthaler (1854–yg) nor Tolbert Lanston (1844–1913) were proiessional compositors when they patented the Linotype and Monotype.

Usually about 20 years elapse before an epoch-making invention is successfully introduced commercially, partly because time and money must be spent in its perfection, partly because of the inertia of businessmen. Until the outbreak of World War I it was the practice of inventors to offer their patents to businessmen at a price. It is always difficult to challenge vested interests in this way. Hence the many tales, most of them untrue, oi inventors who have all but starved to death before they succeed in selling their inventions or finding financial backers and disciplinarians, as James Watt did in Matthew Boulton or Alexander Graham Bell in Gardner Hubbard. The average businessman regarded an invention much as he did some new raw material that might be useiul. Too often he rejected the offered invention, partly because he did not see its potentialities, partly because he lacked the energy and the money to found a new industry. So patents in related fields accumulated until a venturesome promoter saw that they represented enormous wealth. Such is the history of inventing and patenting in the older industries.

No matter how it is conducted invention implies experimentation, hence research. The "heroic" theory of invention, the notion that an idea flashes from a brain and gives the world a sudden, fresh impulse must be dismissed. Watt's engine did not leap from his brain to the drafting board. New machine tools had to be devised by others to bore cylinders with the requisite accuracy; studies had to be made oi heat losses; model after model had to be built in order to proportion moving parts and to determine the precise point at which steam might be cut off and used expansively. So it was with the Linotype, the typewriter, the phonograph, the incandescent lamp and many other devices and processes. Crude as was the experimentation that culminated in commercial periection, it nevertheless deserved the name of research.

The laissez-iaire policy of letting invention take care of itself gave way to organized industrial research. An important invention is an assemblage of known elements that produces a new result. Organized research hastens the process of accumulation, aggregation and combination; the salaried engineers, chemists or physicists oi industry work contemporaneously in single establishments rather than separately decades or generations apart; correlation occurs simply, speedily and directly; time is telescoped. The "outside" inventor finds it more and more difficult to upset established manuiacturing methods because he is likely to have been anticipated by industrial research scientists who know the technical literature oi the field that they are exploring and who have at their disposal ample facilities for experimentation. By the 1950s about half the applications for patents in the United States were being filed by individual inventors; the other half were filed by research scientists and engineers in corporation laboratories or connected with such corporations.

From 1930 to 1940 private and public expenditures of the united' States for research increased from $166,000,000 to $345,000,000. Between 1941 and 1945 the total expenditure (excluding that for the development of atomic energy) was $600,000,000. The federal government's contribution steadily increased until in the war period of 1941–45 it reached 83% of the total. Peak annual expenditures during World War II for all research and development amounted in the United States to more than $800,000,000 in each of the years 1944 and 1945. By the mid-1950s total expenditures for research in the United States, predominantly industrial, rose to about $4,000,000,000. The acceleration in research was accompanied by an acceleration in the introduction oi new inventions and discoveries. It took more than a century for the steam engine to establish itseli, fewer than 50 years for electric energy, fewer than 30 years for the internal-combustion engine and fewer than 1: years for the vacuum tube.

BIBLIOGRAPHY.—John Beckmann, *A History of Inventions, Discoveries, and Origins* (London, 1846); Frank William Taussig, *Inventors and Money-Makers* (1915); Hermann Diels, *Antike Technik* (Leipzig, 1920); Holland Thompson, *The Age of Invention* (1921); Thorstein Veblen, *The Engineers and the Price System* (1921); *L. L.* Bernard, "Inventions and Social Progress," *Amer. J. Sociol.*, vol. xxix, pp. 1–33 (1923–24); Waldemar Bernhard Kaempffert, *A Popular History of American Invention* (1924); J. M. Montmasson, *Invention and the Unconscious* (Paris, 1928), trans. by H. S. Hatfield (1932); Abbot Payson Usher, *A History of Mechanical Inventions* (1929); *H.* N. Hart, *Technique of Social Progress* (1931); Lewis Mumiord, *Technics and Civilization* (1934); S. C. Gilfillan, *The Sociology of Invention* (1935); *W. F.* Ogburn (ed.), *Social Change and the New Deal* (1936); Patent Office, *Outline of the History of the United States* (1936); U.S. Government Printing Office, *Technological Trends and National Policy* (1937); Roger Burlingame, *March of the Iron Men* (1938) and *Engines of Democracy* (1940); Austin L. Porterfield, *Creative Factors in Scientific Research* (1941). (*W. KT.*)

INVENTORY: see STOCKTAKING.

INVENTORY CONTROL. An inventory is a stock of goods purchased or manufactured for use or for resale. Inventory control is the term applied to procedures designed to limit the investment in these goods to a minimum without interrupting their flow to production or to the customer. These control procedures are also designed to protect the investment from the moment an order for purchase is issued until the goods are used or sold to the customer.

The value of the investment in inventory is determined by the quantity and cost of the goods purchased and by the time elapsing between acquisition and disposal. Quantity control may be obtained by establishing maximum and minimum limits. The minimum number of units of each item to be carried in inventory should be determined by considering both the quantity used or sold in a given period and the time required to place and receive an order.

The maximum quantity should be determined by considering the most economical order size and the available storage space. The nature of the item will also affect these limits. Perishable goods and goods subject to style changes, for example, must be given special analysis.

The cost of the inventory items is determined to a large degree by the external factors of supply and demand. Yet inventory control procedures can aid immeasurably in limiting the investment in goods to a minimum. Centralized purchasing procedures may result in savings from quantity buying and reduce the cost of placing orders. Verification of the price to be paid for goods purchased, including freight, should be made by comparison of receiving reports, purchase orders and invoices. Invoices subject to cash discounts should be paid within the discount period.

The time required to dispose of an article, or turnover time, is quite frequently beyond the control of the business, but measures designed to speed up the turnover cycle cannot be ignored. A retailer may resort to markdowns, increased advertising and loss-leader sales (selling items at a loss to attract trade) to obtain a more rapid turnover. A manufacturer should institute procedures to follow the product through its stages of manufacture to ensure that costly work-in-process inventories do not accumulate. Overtime charges or additional machinery costs may be a small price to pay to avoid bottlenecks which build up work-in-process inventories.

One of the most effective inventory control procedures is the perpetual inventory system. An account is kept for each inventory item. Purchases are added to the existing balance, and items sold or issued upon proper authorization are deducted from the balance. The exact quantity on hand at any time may be determined by reference to the account. Frequent physical counts should be made to confirm the accuracy of the inventory card. (J. H. McM.)

INVERARAY, royal and small burgh and county town of Argyllshire, Scotland. Pop. (1961) 501. It lies on a small bay where Glen Aray comes down to Loch Fyne near its northern end, 40 mi. N.W. of Glasgow but 58 mi. by road. There is a pier at which steamers call and formerly the herring fishery was prosperous (the town arms represent herrings in a net). On the quay is a finely sculptured Iona cross. The town originally stood on the north side of the bay, clustered round the old castle, but was removed to its present site in 1742. Its history is that of the Campbells, earls and dukes of Argyll, whose ancestral seat is Inveraray castle. The present castle was built in Scottish baronial style by Robert Adam. The earls and dukes of Argyll were great planters of trees—mainly larch, spruce, silver fir and New England pines—and their estates are still among the most finely wooded in the highlands, despite drastic clearances during recent years. A celebrated beech avenue leads from the quay to the modern Episcopalian church, which has a fine peal of bells. Inveraray became a burgh of barony in 1472. Charles I while a prisoner in Carisbrooke castle raised it to a royal burgh in 1648.

INVERBERVIE, royal and small burgh, Kincardineshire, Scotland, at the mouth of the Bervie Water about 13 mi. N.E. of Montrose by road. Pop. (1961) 921. It is contained in the civil parish of Bervie (pop., 1951, 1,908). The leading industry is flax spinning. At the mouth of the Bervie is a salmon fishery. In 1341 David II, under stress of weather, landed there with his queen, Joanna, and out of gratitude for hospitality granted a charter which James VI confirmed. John Coutts (1699–1751), whose son Thomas founded the banking house of Coutts and Co., was born in Inverbervie. At Arbuthnot, on the banks of the Bervie 2½ mi. northwest of Inverbervie, is the Romanesque church (1242) of St. Teman. It comprises an aisleless nave and chancel to which the Arbuthnot aisle was added in 1508. John Arbuthnot, friend of Pope and Swift, was born in the village. Beneath the floor of Kinneff church (2 mi. N.E. on the coast) the Scottish regalia were concealed during the siege of Dunnottar castle in 1652, being removed to Edinburgh castle at the Restoration. A monument in the church recalls Mrs. Grainger, the minister's wife, who daringly smuggled the regalia out of the castle.

INVERCARGILL, chief town of Southland county, South Island, New Zealand, 139 mi. by rail S.W. by W. from Dunedin. Pop. (including Maoris) (1961) 35,604. It lies on an estuary of the south coast named New River harbour, which receives several streams famous for trout fishing. It is the centre of the grazing and farming district of Southland. which is an important cheese producing area, and has a number of factories, including breweries, foundries, woollen mills and timber works. The plan of the town is rectangular, with wide streets, and there is a fine open reserve. The harbour is deep and well sheltered, but the greater part of the trade passes through Bluff harbour, a few miles distant, with which Invercargill is connected by rail and road. Bluff harbour, the southernmost town of New Zealand, is a port of call and departure for vessels for Melbourne and Hobart. Southland was a separate province between 1860 and 1870, but subsequently it rejoined the parent province of Otago.

INVERCLYDE, BARON: see BURNS, SIR GEORGE.

INVERELL, a town of Gough county, New South Wales, Austr., on the Macintyre river, 415 mi. N. of Sydney by road and 509 mi. by rail. Pop. (1954) 7,514. It lies at an elevation of 1,912 ft. on the western margin of the New England plateau. The district produces chiefly wheat and wool and there is cattle raising, sheep breeding and fattening. There are silver, tin and diamond mines near the town. Inverell became a municipality in 1872.

INVERNESS, royal and large burgh, seaport and county town. Inverness-shire, Scotland. Pop. (1961) 29,773. Known as the "capital of the highlands," it lies at the north end of the Great Glen (Glen More), on either side of the River Ness about 1 mi. south of its entry into Beauly firth. Though the town is relatively low lying the beauty of its environment draws many tourists to it in the summer. Loch Ness lies about 5 mi. southwest. Commanding the main (and almost the only) routes between the central highlands and northern Scotland, Invemess is an important distributing centre, with a well-known annual market for sheep and wool. Industries are small and petroleum is the largest import. There is a little shipbuilding and a coastal trade with Aberdeen, Leith and east coast ports down to London. The harbour, formed by the mouth of the Ness, covers about three acres. There are piers, a breakwater, good anchorage and a slipway. The Caledonian canal passes through the western outskirts of the town shortly before entering Beauly firth. The river at Inverness is crossed by four bridges and a railway viaduct. The modern airport is at Dalcross, 8 mi. southeast of the town.

The modern castle (1835) crowns a low cliff on the east bank of the river and occupies part of the site of the ancient fortress blown up by the Jacobites in 1746. It houses the county offices and law courts. In the tower of the high or parish church (1769–72) is one of the bells which Cromwell removed from Fortrose cathedral. The town clock and bells are in the town steeple (1791) which was once the jail. St. Andrew's Episcopal cathedral for the see of Moray, Ross and Caithness, west of the river, dates from 1866. Public buildings include a library and museum with a collection of Jacobite relics. Inverness academy was founded as a school in 1792. Opposite the town hall (1882) is the old town cross (1685), in the foot of which (and protected since the fire of 1411) is an ancient stone known as Clach-na-Cudainn (stone of the tubs) from its having been the resting place of women carrying water from the river. West of the river rises the wooded hill of Tomnahurich (hill of the fairies) on which is the cemetery. Attractive islands in the river are connected by footbridges with the mainland and with each other and are laid out as a public park.

Inverness was one of the chief strongholds of the Picts and *c.* 565 was visited by St. Columba with the intention of converting the Pictish king Brude, who is supposed to have resided in the vitrified fort of Craig Phadrick (Patrick's rock), 1½ mi. west of the town. The castle is thought to have been built by Malcolm III (Canmore), after he had razed the one in which Macbeth is said to have murdered Malcolm's father, Duncan It was a royal residence and fortress for centuries and saw a great deal of fighting. William the Lion (d. 1214) granted the town four charters by one of which it was created a royal burgh. Hardly a trace remains of the Dominican abbey founded by Alexander III in 1233. On his way to the battle of Harlaw in 1411 Donald of the Isles burned the town, and 16 years later James I held a parliament in the castle to which the northern chiefs were summoned. Three of these chiefs were to be executed for asserting an independent sovereignty. The house occupied in 1562 by Mary, queen

of Scots, when denied admission to the castle, stands in Bridge street. At the north end oi the town Cromwell built a large fort, known as the Sconce, but it was practically demolished at the Restoration.

INVERNESS-SHIRE, highland county, Scotland, bounded north by Ross and Cromarty, and the Beauly and Moray firths, northeast by the shires of Nairn and Moray, east by Banff and Aberdeen shires, southeast by Perthshire, south by Argyllshire, west by the Atlantic. It includes the isles of Skye, the St. Kilda group and all the Outer Hebrides except Lewis, as well as several of the Inner Hebrides and is the largest shire in Scotland. Its land area is 2,695,094 ac., or 4,211.1 sq.mi., of which more than one-third belongs to the islands. The county comprises the districts of Moidart, Arisaig and Morar in the southwest, Knoydart in the west, Lochaber in the south, Badenoch in the southeast and the Aird in the north. Excepting comparatively small and fertile tracts in the north on both sides of the river Ness, in several of the glens and on the shores of some of the sea lochs, the county is wild and mountainous and the scenery is very beautiful. There are more than 50 mountains exceeding 3,000 ft., among them Ben Nevis (4,406), the highest mountain in the British Isles, the extraordinary assemblage of peaks forming the Monadhliadh mountains in the southeast, Ben Alder (3,757) in the south and the group of the Cairngorms on the confines of the shires of Aberdeen and Banff. Almost the whole mainland part of the county is occupied by the younger highland schists and metamorphic rocks, with many isolated patches of granite, of which the largest is on the eastern boundary, including Cairngorm. Across the county from southwest to northeast strikes Glen More (the Great Glen or Glen More-nan-Albin), an old fault or line of earth-fracture along which displacements have occurred during more than one geological period. It contains Loch Lochy and Loch Ness, and through it was constructed the Caledonian canal (*q.v.*). Striking similarities between rock formations at Foyers and at Strontian, about 56 mi. southwest, are thought to indicate that the fault was accompanied by a very considerable lateral movement. (On the islands, see HEBRIDES. SKYE and ST. KILDA.)

Rivers and Lakes.—In the northwest the Beauly river (10 mi.) is formed by the confluence of the Farrar and the Glass rivers. The Enrick (18 mi.), rising in Loch-nan-Eun, falls into Loch Ness, just beyond Drumnadrochit. The Ness (7 mi.) forms the natural outlet of Loch Ness to the sea north of Inverness. The Moriston (19 mi.) flows out of Loch Cluanie and falls into Loch Ness 4 mi. southwest of Mealfourvounie (2,284 ft.). The Lochy (8 mi.), issuing from the loch of that name, runs southward, parallel with the Caledonian canal, and enters Loch Linnhe at Fort William. The Spean (20 mi.), flowing westward from Loch Laggan, joins the Lochy as it leaves Loch Lochy. The Nevis (12 mi.), rising at the back of Ben Nevis, enters Loch Linnhe at Fort William. The headwaters of the Leven (16 mi.), which enters Loch Leven at its eastern end, was much affected by the construction of the Blackwater reservoir serving Kinlochleven aluminum works. The Dulnain (28 mi.), rising in the Monadhliadh mountains, enters the Spey near Grantown, falling in its course nearly 2,000 ft. The Truim (16 mi.), rising close to the Perthshire frontier, flows into the Spey near Newtonmore.

Three of the larger rivers of Inverness-shire finish their course in other counties. These are the Spey, which for the first 60 mi. of its course belongs to the shire; the Findhorn (72 mi.), rising in the Monadhliadh mountains a few miles northwest of the source of the Dulnain; and the Nairn (38 mi.), rising within a few miles of Loch Farraline.

There are many hill tarns and little lakes, considerably more than zoo being named. Loch Ness, the most beautiful and best known, is 223 mi. long, 1¾ mi. broad at its widest point and 754 ft. deep. It is the largest body of fresh water in Great Britain, and forms part of the scheme of the Caledonian canal. Loch Oich (3¾ mi. long) and Loch Lochy (10 mi.) also form portions of the canal. Loch Arkaig (12 mi.) lies in the country of the Camerons, Achnacarry house, the seat of Lochiel, the chief of the clan, being situated on the river Arkaig near the point where it issues from the lake. Near Spean bridge a monument commemorates Commando troops, trained around Achnacarry, who fell in World War II. The old castle was burned down by the duke of Cumberland in 1746, but a few ruins remain. Loch Quoich (5¼ mi.) lies north by west of Loch Arkaig, and Loch Garry (4½ mi.) a few miles to the northeast; Loch Morar (12 mi. long by 2 mi. broad) is only about 600 yd. from the sea, to which it drains by the river Morar, which falls over a rocky barrier. The loch is 1,017 ft. deep and is thus the deepest in Great Britain. Loch Ericht, partly in Perthshire, is 14½ mi. long and lies at a height of 1,153 ft., being thus the highest lake of such large size in Great Britain. In the south are Loch Laggan (7 mi.) and Loch Treig (5 mi.). The principal salt-water lochs on the Atlantic seaboard are Loch Hourn ("Hell's lake," so named from the wild precipices rising sheer from the water), running inland for 14 mi. from the Sound of Sleat and separating Glenelg from Knoydart; and Loch Nevis (14 mi.), a few miles farther south.

The "parallel roads of Glen Roy," a glen with a northeasterly to southwesterly trend, a few miles east of Loch Lochy, presented a problem that long interested geologists. At heights of 1.148 ft., 1.067 ft. and 835 ft., there run uninterruptedly along each side of the glen terraces of a width varying from 3 to 30 ft. They are now generally taken to be the gently sloping banks of lakes dammed up at different levels successively by glacier ice. Further evidences of glacial action are abundant in many places, in the form of *roches moutonnées,* striations, moraines, etc. At several points on the coasts remains of marine terraces are seen at 100 and 25 ft. above present sea level.

Among the finer glens are Glen Urquhart and Glen Moriston to the west of Loch Ness, Glen Feshie in the east, and Glen Nevis at the southern base of Ben Nevis. Glen Garry, to the west of Loch Oich, gave its name to the well-known cap or bonnet worn both in the Highlands and Lowlands. In Glen Finnan, at the head of Loch Shiel, Prince Charles Edward raised his standard in 1745. The great straths or valleys are in the north and east, the chief among them being Strathfarrar, Strathglass and Strathnairn, and the heads of Strathearn and Strathspey.

History.—In Roman times. Picts occupied the country to the north of the boundary hills of the present counties of Argyll and Perth (beyond which the Romans attemgted no occupation). The territory was afterward called the province of Moray, and extended from the Spey and Loch Lochy to Caithness. These limits it retained until the 17th century, when Caithness (in 1617), Sutherland (in 1633) and Ross-shire (in 1661) were successively detached. Toward the end of the 6th century Columba undertook the conversion of the Picts, himself baptizing their king. Brude, at Inverness; but paganism died hard and tribal wars prevented progress. In the 11th century, after the death of Duncan I (1040), Scotland was divided between Macbeth and the Norwegian leader Thorfinn, who took for his share the land peopled by the northern Picts.

Macbeth was defeated by Earl Siward in 1054 and was finally overthrown in 1057 when Malcolm III (Canmore), the son of Duncan I, became king of the Scots. Insurrections continued until the reign of David I, when colonists of noble birth were settled in various parts of the shire. After the battle of Largs (1263) the Norse yoke was thrown off. In 1300 Edward I's expedition to Scotland passed through the northern districts, his army laying siege to Urquhart and Beaufort castles. As a result of the colonization the clan system gradually developed and attained in the shire its fullest power. the chief being the Frassers, Chisholms, Grants. Camerons. Chattan, Macdonalds of the Isles, Clanranald Macdonalds, Macleods, Mackintoshes and Macphersons. The clans were constantly fighting each other. or their sovereigns.

In many quarters the Protestant movement made no headway, the clansmen remaining steadfast to the older creed. At the era of the Covenant. Montrose conducted a campaign in the interests of the royalists, gaining a brilliant victory at Inverlochy (1645), but the effects of his crusade were speedily neutralized by the equally masterly strategy of Cromwell. Next Episcopacy appeared to be securing a foothold. until Viscount Dundee fell at Killiecrankie, that battle being followed by a defeat of the Highlanders at Cromdale in 1690. Maj. Gen. Hugh Mackay suppressed an attempted rising and a combined effort was made to hold the clans in check.

Forts were constructed at Inverness, Kilchumin (Fort Augustus: a Benedictine abbey now occupies the site) and Kilmallie (Fort William); Marshal George Wade's famous roads constructed between 1726 and 1737—exhibiting at many points notable examples of engineering—enabled the king's soldiers rapidly to scour the country. and general disarming was required.

Prince Charles Edward's attempt in 1745 had the effect of bringing most of the clans together for a while; but the clan system was broken up after his defeat at Culloden in 1746 and subsequent escape. Heritable jurisdictions were abolished. Even the nearing of the highland dress was proscribed. The effects of this policy were soon evident. Many of the chieftains became financially embarrassed, their estates were sold, and the glensfolk, impoverished but high-spirited, sought homes in Canada and the United States. As time passed and passion abated, a proposal to raise several Highland regiments for the British army was entertained with surprising favour, among the regiments then enrolled being the 79th Cameron Highlanders. Fort George, afterward the depot of the Seaforth Highlanders. 124 mi. northeast of Inverness, mas begun in 1748.

Stone axes and other neapons or tools have been dug up in the peat, and prehistoric jewelry has also been found. Crannogs (*q.v.*) occur in some of the lochs and stone circles are numerous, as at Clava and in the valley of the Ness. Pictish towers or brochs are met with in and near Glenbeg, and duns (forts) in the Aird and to the west and southwest of Beauly and elsewhere. Among vitrified forts the principal are those on Craig Phadrick (Inverness), Dundbhairdghal in Glen Nevis, Dun Fionn or Fingal's fort on the Beauly near Kilmorack, Achterawe in Glen Garry and in Arisaig.

Agriculture and Forests.—Only a very small percentage of the total area is arable land, and apart from a narroa coastal fringe on the northeast it is of only poor to medium quality. The lowlying land bordering the Moray and Beauly firths is devoted to cropping and the rearing and fattening of stock. On the poorer arable land, at higher elevations, cattle rearing is important. Speyside has long been famous for the quality of its store cattle. which are sold to be fattened on lower and more fertile farms. The principal stock on the hills is sheep, the Blackface breed predominating. Stock are also raised on the islands off the coast, though on these the problem of winter fodder is acute because of poor soil and moist climate. Beginning in 1947 important experiments (near Fort William and in the northwest) in large-scale cattle raising combined with the reclamation of unproductive land demonstrated the possibility of providing ample winter feed in the form of silage.

Many of the rivers and several of the lochs abound with salmon and trout, the salmon fisheries of the Beauly, Ness and Lochy yielding a substantial return. Deer forests occupy an enormous area, particularly in the nest, in the centre. in the south and southeast and in Skye. From the number of trees found in peat bogs, the county must once have been thickly covered with mood. The famous forests of Strathspey were largely cut down in World War II Natural woods on Loch Arkaig, in Glen Garry, Glen Moriston, Strathglass and Strathfarrar, and at the head of Loch Sheil, are extensive and considerable reafforestation has taken place. Part of the ancient Caledonian forest extends for several miles near the Perthshire boundary. In 1952 reindeer from Sweden were introduced into Rothiemurchus forest. There are also large tracts of grouse moor.

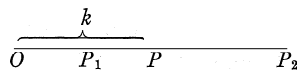
Communications.—The main railway between Inverness and the south (via Edinburgh and Perth) enters the county through the pass of Drumochter (1,484 ft. above sea level and the highest main line summit in Great Britain). It is joined near Inverness by the line from Aberdeen. Another line from the south (via Glasgow) enters 2 mi. N.W. of Rannoch station and runs via Fort William to Mallaig. For a short distance the Inverness-Kyle of Lochalsh (for Skye) line is in the county. Mallaig has important connections with the outer islands. There are good public motor services, an airport at Dalcross, 8 mi. S E. of Inverness and a landing ground at Barra. an island of the Outer Hebrides.

Industries.—Mallaig and Fort William are the main centres of the herring and lobster fisheries, but fishing is also carried on among the various outer islands. There is a whaling station at Tarbert in Harris and a deep-freeze food preserving plant at Bunchrew, $3\frac{1}{2}$ mi. W. of Inverness. Harris, Skye and other islands produce tweeds. There are distilleries at Tomatin, Dalwhinnie. Fort William, Inverlochy and Carbost in Skye. Seaweed is processed at Lochboisdale in South Uist and diatomite is exported from Staffin in Skye. Inverness has some small industries.

Hydroelectric stations for the aluminum works at Foyers. Kinlochleven and Fort William have been followed since 1947 by several great schemes of the Korth of Scotland Hydro-Electric board. Some, such as those at Morar, provide local supplies, while others, Glen Affric, Glen Garry and Glen Moriston, provide power for industrial areas further afield. 'lhe schemes include several large dams and many miles of tunnel. The power stations at Morar and Invergarry are mainly underground and efforts were made in all the schemes to spoil the scenery as little as possible.

Population and Government.—The population in 1951 was 84,930 In 1951 Gaelic only was spoken by 1,008 persons and Gaelic and English by 23,664. Inverness (1951 pop. 28,107) is a royal burgh and large burgh. Fort William (2,674) and Kingussie (1,075) are the small burghs. There are nine county districts. The county returns three members to parliament nith Ross and Cromarty: for Inverness. Ross and Cromarty. and the Western Isles. Inverness with Moray, Nairn, and Ross and Cromarty forms a sheriffdom, with resident sheriffs-substitute at Inverness, Fort William, Portree and Lochmaddy.

INVERSION, a term used in the study of geometric figures. To take a simple case, suppose in this figure



that $OP = 1$, $OP_1 = \frac{1}{2}$, and $OP_2 = 2$. Then $OP_1.OP_2 = OP$. Let us say that $OP = k$. Then it is evident that there is an infinite number of points P_1, P_2 on the line such that $OP_1.OP_2 = k$. A geometric transformation which replaces each point P_1 by a point P_2 such that $OP_1.OP_2 = k$ is called an inversion. In such case O is the centre of inversion and k is the radius of inversion. As P_1 moves nearer to O, P_2 moves farther away. As P_1 approaches P, P_2 also approaches P. In general we say that, when $xy = k$, x and y are inversely proportional, one decreasing as the other increases. We may also say that if $y = f(x)$, we may inversely consider x as a function (implicit) of y.

INVERSION OF TEMPERATURE. Over much of the earth most of the time the air temperature decreases with increasing elevation up to a height of 10 to 15 km. (6 to 10 mi.) above the surface. Frequently, however. layers of air are present through which the temperature increases with height instead of decreasing. Such layers are called inversions of temperature or. briefly, inversions. The rate of decrease of temperature with height is called the lapse rate. When the temperature increases with height, as in an inversion, the lapse rate is negative. Occasionally in meteorological articles the term inversion is applied loosely to any layer in which the lapse rate, though positive, is smaller than the lapse rates below and above it. In the following it will be used only in its strict sense.

Inversions are measured by (1) the thickness of the layer, (2) the rate at which the temperature increases and (3) the total rise in temperature through the layer. The last is called the magnitude of the inversion. Inversions with rapid rates of temperature increase are termed sharp, those which have large total temperature increase are called large, and those which are sharp and large are called strong.

The lower 10 to 15 km. of the atmosphere, where the lapse rate is usually positive, is called the troposphere. As has been stated, however, even in the troposphere inversions are frequent, and in some regions they are invariably present at small or moderate heights. An examination of all the aerological soundings made in Sweden in 1924 and 1925, for example, showed that inversions occurred in 44% of them and in 69% of those made in winter. The following table, resulting from another study, shows the number of soundings having inversions present at various heights up

to 6 km. out of 1,000 observations made over Europe:

Height (mean sea level)	0.j km.	1 km.	2 km.	4 km.	6 km.
Number of inversions	212	124	56	196	77

The stratosphere is the portion of the atmosphere above the troposphere. There the temperature normally is constant or increases slowly with height, and at higher levels it increases at a greater rate. Between 16 and 50 km. the evidence indicates that a permanent inversion of varying sharpness is present; *i.e.*, the "inverted" state is normal. The stratosphere is sometimes called the upper inversion.

An inversion starting at the earth's surface is called a ground inversion, while one uith normal temperature decrease in the layer of air below it is sometimes called a high inversion. In fig. 1, curve I shows the variation of temperature with height in a case of normal lapse rate at all levels, curve II shows a ground inversion, surmounted by a layer with normal lapse rate, and curve III shows a high inversion with normal lapse below and above.

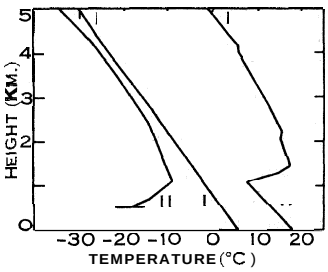


FIG 1.—CURVE I: SOUNDING IN SPRING AT HAMBURG, GER., SHOWING NORMAL DECREASE OF TEMPERATURE WITH HEIGHT CURVE II: SOUNDING IN LATE FALL AT BISMARCK, N.D., U.S.. SHOWING GROUND INVERSION. CURVE III: SOUNDING IN SUMMER OVER PACIFIC OCEAN AT 30° N., 125° W.. SHOWING TRADE-WIND INVERSION

Relation of Inversions to Weather.— Inversions play an important role in determining cloud forms, precipitation and visibility. The ease with which vertical motions of air parcels, and in particular vertical mixing, take place depends on the lapse rate. This can be understood readily when it is remembered that an ascending air parcel cools by expansion at the adiabatic rate of 1° C. der 102 m rise if it is unsaturated, or a somewhat smaller rate if saturated. (See ADIABATIC PROCESSES IN ATMOSPHERE.) If the air through which it rises has a lapse rate less than the rate of adiabatic cooling, the ascending air parcel becomes cooler and heavier than the surrounding air, and is subjected to a force which tends to return it to its original level. Even a parcel which is heated at the ground to a temperature higher than the surrounding air will in rising cool more rapidly than the temperature of its surroundings decreases with height. Thus it will reach a height where its temperature is the same as the air around it, and in rising higher under its momentum it will set up a force which will tend to return it to that level. The height to which a heated parcel will rise is smaller, and the force arising from a given vertical displacement of a parcel originally in equilibrium is larger, the smaller the lapse rate. In case of inversions vertical motions are resisted by large forces, and effectively suppressed. An inversion acts as a lid on vertical motions in layers below. The consequence is that convection produced by heating the air from below is limited to levels below the inversion. and diffusion of dust and smoke is likewise limited. In regions where a pronounced inversion is present at a low level, convective clouds cannot grow high enough to result in showers. and at the same time the visibility may be greatly reduced below the inversion. even in the absence of cloud, by the accumulation of dust and smoke particles. Because the air near the base of the inversion is cool, cloud or fog is frequently present there (see FOG).

The suppression of vertical turbulence allons inversions to act as slip surfaces across which the upper layers slide freely, unimpeded by the exchange of momentum aith the lower layers. The resulting wind shear, together with the abrupt density change, may produce bumpiness in an airplane flight through the inversion, even though the actual atmospheric motion is smooth. This is caused by the sudden change in dynamic lift on a plane passing from air moving slonly to less dense air moving rapidly or from a different direction. Furthermore. if the inversion slopes (frontal inversion), the air above it may be carried upward along the slope because of its motion relative to the air below, and layer clouds and precipitation may result from the adiabatic cooling of the ascending air.

Except in the last-named case, of air being carried upward above a sloping inversion, the base of the inversion forms a quite sharp boundary between air with low visibility below and extremely clear air above. Because the inversion likewise limits water vapour diffusion it also usually represents a boundary between humid air below and very low humidity above.

Another important influence of inversions on the weather is the effect upon the diurnal range in temperature. The principal heating of the air during the day is produced by contact with the ground. the temperature of which is raised by solar radiation to which the air is transparent. The sun's radiation is absorbed by the ground. and the heat is communicated to the air by conduction and convection. Since the inversion base represents the upper limit to which heat is carried by convection, only a shallow layer of air will be heated if the inversion is low and large, and the temperature rise mill be great. On the other hand, if the inversion is high or no inversion is present a deeper layer of air must be heated, and the temperature will rise less.

Ground Inversions.— These inversions are produced by cooling of the air by contact with a colder surface. The most general cause is cooling of the ground by radiation on clear nights, and for this reason they are also called nocturnal or radiation inversions. The radiation downward from the atmosphere is much less than that upward from the ground. resulting in a net loss of heat by the latter when the sun is not shining. The air in contact with the ground is cooled by conduction. and if the air is in motion, the cooling effect is transmitted upward by mixing of the air at the ground with that a little higher, as well as by radiation.

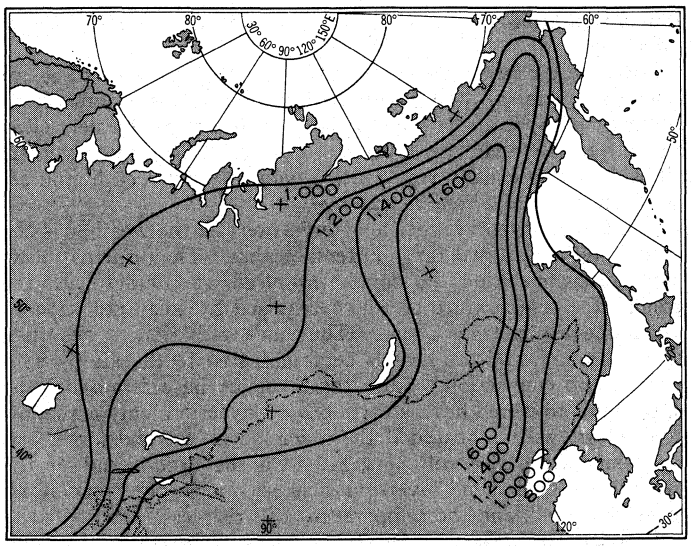
The effect of this turbulent mixing and radiational exchange is to increase the thickness and decrease the magnitude of the inversion. If the air is cooled below its dew point by this process, fog may result. When the wind is sufficiently strong, the turbulent mixing may wipe out the inversion at the ground, establishing an adiabatic lapse rate there and sharpening the upper part of the inversion. In this case if condensation occurs the fog is also raised from the surface to form "high fog" or stratus cloud in the coldest air just below the inversion.

Curve II in fig. 1 shows a large ground inversion, as observed at Bismarck, N.D., in the late fall, when the long nights provide a long period of radiational cooling of the ground. The temperature increase of 11° C. in 600 m. is not at all unusual in these circumstances.

Topography greatly affects the magnitude of ground inversions.. If the land is rolling or hilly, the cold air formed on the higher land surfaces tends to drain into the hollows, producing a larger and thicker inversion above low ground, and little or none above the higher points.

Ground inversions are usually removed during the day by heating from belon. The ground is warmed by solar radiation, and the air above it by conduction and convection. In middle latitudes in winter, however, the insolation during the day is often insufficient to offset the cooling which has occurred the previous night, and ground inversions are augmented day after day during periods of light winds. In these cases fog may persist both day and night. The great valleys of California and the valleys of central Europe are characterized by persistent fog of this type in winter.

Farther poleward, where little or no sunlight is received in winter, stagnating air is subjected to long periods of cooling at the ground. An inversion of great magnitude, considerable thickness and tremendous areal extent develops, blanketing the entire interior of high latitude continental areas, and also (in the northern hemisphere) the Arctic ocean. This inversion is known as the arctic (or. over the antarctic continent the antarctic) inversion. It is strongest and most persistent in the central portion of continents at high latitudes Thus, at Jakutsk, Sib., the arctic inversion occurs in 98% of the soundings during December. January and February, with average thickness 1,720 m. and average magnitude 18° C. Corresponding figures for Fairbanks. Alaska, are 91%, 1,355 m. and 14° C. Fig. 2 shows the average topography of the



BY COURTESY OF SPRINGER VERLAG, ADAPTED FROM A DIAGRAM BY HERMANN FLOHN

FIG. 2.— AVERAGE HEIGHT IN METRES OF THE TOP OF THE ARCTIC INVERSION OVER SIBERIA IN WINTER

top of the arctic inversion over Siberia. as evaluated by Hermann Flohn.

Inversions beginning at the earth's surface are also formed when warm air flows over a colder surface. In this case also the air undergoes contact cooling which is carried upward by mixing, and if the mixing is intense the inversion may be dissolved at the ground and sharpened higher up. Among the places where inversions produced in this fashion are dominant, the Grand Banks of Newfoundland are outstanding. In one case, for example, the air temperature increased from 4° C. immediately above the sea surface to 21.5° C. at an elevation of 1,150 m. The persistent sea fogs of this region are caused by the cooling of the warmer air flowing over the cold sea surface. Similar inversions are produced over continents by the flow of warm air from subtropical regions over snow-covered areas in middle latitudes, particularly in spring when the latent heat of melting or evaporation of the snow is withdrawn from the air, increasing the cooling effect.

Turbulence Inversions. — Turbulent mixing in strong winds would establish an inversion even in the absence of a pre-existing one. The effect of vertical mixing in case of a normal lapse rate is to carry heat downward, cooling the upper part of the mixed layer, and heating the lower, until an adiabatic lapse rate is established. If the mixed layer had an abrupt top, the cooling would be a maximum there. and there would be an abrupt increase in temperature at that level. Instead, the mixing tapers off gradually, and above the thoroughly mixed adiabatic layer there is a finite layer of transition to the unmixed and therefore uncooled air above; *i.e.*, a turbulence inversion is established above the thoroughly mixed layer.

If an inversion is already present, stronger winds than otherwise are required to mix the surface air and establish an adiabatic layer, but if they occur, the inversion is raised to a higher level and sharpened. The cooling in the upper part of the mixed layer may produce stratus or stratocumulus cloud there. while the heating in the lower part may dissolve fog at the ground.

The formation of stratus or stratocumulus clouds by turbulence is very general. The stratiform sky is typical of anticyclonic weather over the British Isles and western Europe in winter. The cloudiness may persist for several days, but no rain. or at most a slight drizzle, falls from it. While turbulence is the principal cause of the cloud in this type of anticyclonic weather, another factor contributes considerably to the formation or strengthening of the inversion. This factor is called subsidence.

Subsidence Inversions. — By subsidence is meant the sinking and vertical shrinking of a layer of air. When a layer of air descends bodily, the increase in pressure compresses it, so that the upper portion descends farther than the lower. The heat of compression will be greater for the upper part than the lower, consequently, and the lapse rate of temperature will thus be reduced. If at the same time as it sinks the air layer spreads out horizontally, the upper portion will descend still more. and the compression may be sufficient to heat it to a higher temperatuie than the lower part, producing an inversion.

Near the ground the air, because of the influence of friction, tends to flow outward from anticyclones (areas of high atmospheric pressure), and the air above must sink to take its place. In addition. because of the dynamics of atmospheric motion. the air moving around anticyclones and in equatorward currents must spread horizontally and shrink vertically (see WINDS, GENERAL CIRCULATION OF). Subsidence thus occurs in anticyclones at all levels, and especially in their eastern portions, where the air flows toward the equator.

The areas which are dominated by anticyclones are: (1) the northern portions of continents in winter; and (2) the subtropical oceans throughout the year. These regions, then, are the ones where subsidence inversions prevail.

The inversions associated with continental anticyclones frequently are dome shaped. The base of the inversion layer may be from three to five kilometres high somewhat to the east of the centre of highest pressure and slope gently downward in all directions to a level of one kilometre or lower. Where the subsidence

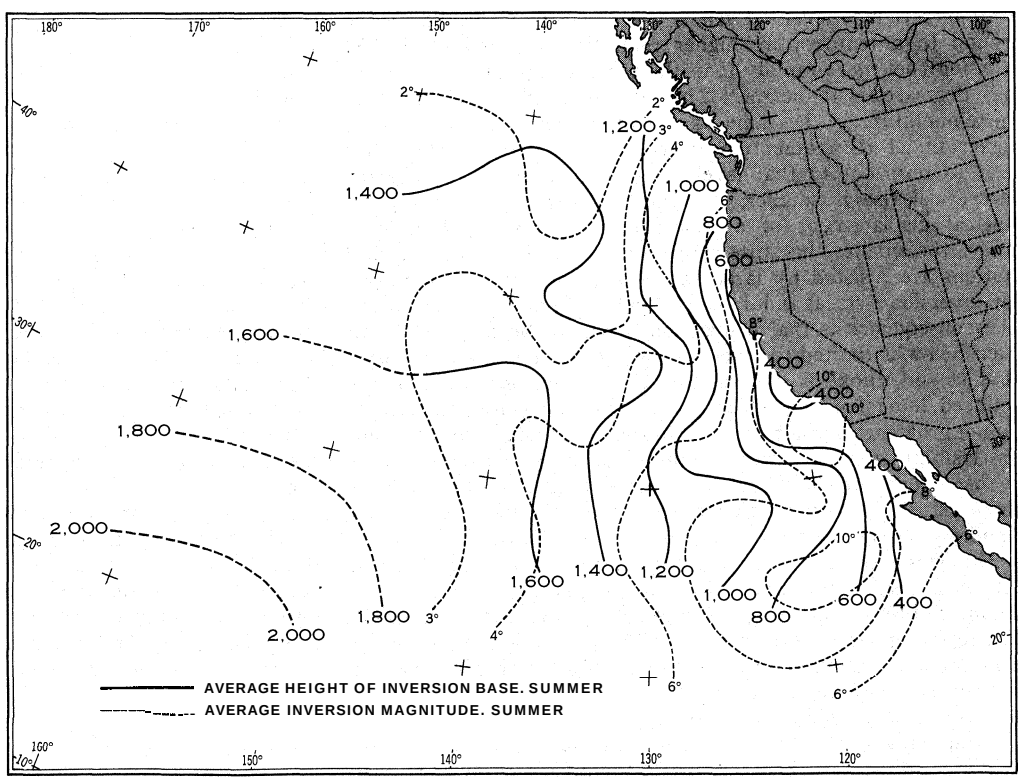


FIG. 3.— AVERAGE HEIGHT OF INVERSION BASE. IN METRES. AND AVERAGE MAGNITUDE OF INVERSION, IN ° C., OVER EASTERN NORTH PACIFIC OCEAN IN SUMMER

inversion is low, it may merge with the ground inversion to produce an extremely large and thick inversion. Whether or not they merge with ground inversions, low subsidence inversions in winter are usually associated with persistent fog or stratus cloudiness, with the valleys covered with cloud and the mountains which penetrate into the inversion enjoying clear mild weather.

Associated with anticyclones over the subtropical oceans there occur strong inversions with bases from 300 to 2,000 m. above sea level. Curve III in fig. 1 shows a typical sounding taken through such an inversion. These inversions persist throughout the year in tropical regions, and follow the seasonal migration of the subtropical high-pressure belt, extending into middle latitudes in summer. The extent and distribution of the inversion over the Atlantic ocean was investigated during an expedition of the German research ship "Meteor" during 1925–27. Numerous soundings made by kite over this area showed that the inversion is present everywhere over the Atlantic from 30° S. to 30° N., but is weaker and higher near the equator and over the western portion of the ocean than in the region where the trade winds are strongest.

Over the Pacific the inversion appears to extend from the North American coast westward about halfway across the ocean, with greatest strength and persistence in the trade-uind areas. Few data are available for the Pacific inversion in the southern hemisphere. Fig. 3 shows the average topography of the base of the inversion and its average magnitude over the eastern North Pacific ocean in summer. It will be noted that the inversion base slopes upward and its magnitude decreases as one proceeds westward from the North American coast. The inversion top slopes upward in fashion similar to the base, and the thickness varies only slightly, ranging between zoo and 400 m. The thickness is least just off the coast, where the large magnitude and small thickness combine to give increase of temperature with height greater than 5° C. per 100 m., and over the Hawaiian Islands, where the small magnitude and thickness and considerable height of base combine to permit convection to break through the inversion at times, producing showers.

When the inversions over subtropical oceans were first observed they were called trade-wind inversions and were attributed to the difference in source of air between the trade winds, originating on the poleward side of the subtropical anticyclones at low levels. and the antitrades flowing over them from equatorial regions at greater heights. This name was retained, although it was established as additional data became available that the change in wind direction does not coincide in position with the inversion layer.

Another theory suggested for the formation of the trade-wind inversion was that it is produced by vertical turbulence. This theory, too, was belied by the "Meteor" observations, which showed that the inversion is too large to be formed that way, with temperatures aloft frequently higher than at sea level, and that it is highest in the region of equatorial calms and lowest in the regions of strongest trade winds. Turbulence would produce the highest inversion where the winds are strongest. Study of the increased number of observations available enabled the demonstration, in 1945, that the explanation of the trade-wind inversion lay in the subsidence associated with the subtropical anticyclones. Analysis of the winds in these regions showed that there is sufficient divergence in them to produce the extremely large sinking motion needed to create the pronounced inversion. Over most of the tropical regions the lapse rate below the inversion is kept nearly adiabatic by heating from below by warmer water, by radiation from cloud tops and by turbulence. Along the west coasts of North America and Africa, however, the air passes over a belt of cold water which rises from considerable depths. In these regions the air is cooled by the surface and the inversion sometimes starts at sea level. On the California coast an inversion at the surface may be produced also at times by winds from the continent subsiding down the high coastal mountain ranges.

The Weather Associated With Trade-Wind Inversions.— The air structure resulting from the processes described above consists of a cool humid layer next to the sea surface and a much warmer dry layer above it. Stratus or stratocumulus clouds are usually present from a few hundred feet above the sea to the base of the inversion. If the inversion starts at sea level, fog will occur if the air is cool enough, or the air may be cloudless. The slope of the inversion upward to the west and equatorward permits more active convection to take place and the clouds to grow higher in those directions. Where convective activity takes place the clouds tend to be broken, but their greater thickness makes showers possible.

While the stratus associated with the trade-wind inversion is characteristic of the eastern portions of subtropical and equatorial oceans, it is commonly referred to as west coast stratus because it is at the shore that it affects aviation and other human activities.

Since a large proportion of the earth's surface is covered by the trade-wind circulation, the trade-wind inversion is one of the major features in the structure of the atmosphere. The principal ueather changes in low latitudes have been attributed to long waves in the inversion, convective showers occurring when the wave motion raises the inversion sufficiently high. The relationship of these waves to the genesis of tropical cyclones was studied, but no conclusive results were obtained. It appears to be definite that the formation of hurricanes or typhoons is associated with convergence which would lift the inversion and, offsetting the effect of earlier divergence and subsidence, wipe it out.

Frontal Inversions.— When a cold mass of air and a warm mass of air are side by side the cold one extends like a wedge below the warm one. The sloping boundary between the two air masses is called a front (*q.v.*). Because of mixing at the boundary, the front is not an abrupt discontinuity, but a transition zone. The warm air overlies the cold, and the transition zone represents a region where, in passing upward, the temperature increases from that characteristic of the cold air to the temperature of the warm air. Thus the frontal zone is an inversion.

The frontal inversion differs from the other inversions discussed in two respects: (1) it has considerable slope, while the others are nearly horizontal; (2) the humidity may be high and clouds may be present immediately above it. Frequently fronts, instead of being real inversions, have smaller positive lapse rates than the air masses below and above. In these cases the air above the front would be warmer than that below if brought to the same pressure. Because it is at a lower pressure, it actually has a lower temperature than the (potentially) colder air mass below. Because the warm air frequently is ascending over the cold-air wedge, and being cooled by expansion, actual inversions at fronts are rarely found at heights greater than two kilometres; at greater heights a slower rate of decrease of temperature almost always characterizes the transition zone, rather than an increase. On the other hand, there is frequently an inversion at the top of the cloud produced by the ascent of the warm air. Fronts and frontal inversions play a principal role in the modern theory of extratropical cyclones or depressions (*see* CYCLONE). Most of the precipitation in middle and polar latitudes in winter is associated with fronts.

Discussions of inversions in meteorological literature are spread through the treatments of the various associated phenomena: fog, clouds, haze, radiation, turbulence, and maximum and minimum temperature forecasting. The reader wishing further information on this topic cannot be directed to any single article or small number of articles. By looking at the index of any standard meteorological textbook he will be provided with additional material and with references to journal articles which enlarge upon the treatment given here. (Ms. N.; X.)

INVERTEBRATE, any animal not possessing a backbone or vertebral column (*e.g.*, worms, snails, insects, sea stars). Invertebrates are distinguished from vertebrates (*q.v.*), all of which possess some kind of cartilaginous or bony axial skeleton. In modern systematic zoology, some invertebrate forms (amphioxus, tunicates, etc.) are included with the vertebrates in the phylum Chordata (*see* CHORDATE); thus the invertebrates do not constitute a homogeneous or natural taxonomic grouping, but the distinction between vertebrates and invertebrates remains a convenient one. It is estimated that more than 90% of all known

species of animals are invertebrates. See INVERTEBRATE EMBRYOLOGY; ZOOLOGICAL NOMENCLATURE; ZOOLOGY. (J. M. A.)

INVERTEBRATE EMBRYOLOGY. Organisms reproduce themselves sexually, asexually, or by a combination of both methods. Asexual reproduction occurs by fission, on simple division into two, by budding, and by formation of spores, and is usually not included in discussions on embryology. Sexual reproduction implies the union of two germ cells, egg and sperm, to create a new individual. The history of an organism, from the first formation of germ cells whose union produced it until its death, is the life cycle of that animal, or its ontogeny. This cycle is made up of different stages, as follows: the development of the germ cells or gametogenesis, fertilization of the egg by the sperm, the embryological period during which the organs that are characteristic of the animal are laid down structurally and grow into a fully formed but small animal, infancy, youth, adolescence, maturity and old age, ending in death. This article deals only with that restricted portion known as embryology (*q.v.*). For other phases of ontogeny the reader is referred to appropriate accounts elsewhere.

Embryology in the broad sense includes the origin and development of germ cells and their union in fertilization to form a new zygote, or fertilized egg, which consists of one cell. Since all Metazoa are multicellular, the first step is the multiplication of that fertilized egg to form a multicellular individual. This multiplication is accomplished through cleavage, or segmentation, by which the materials within the egg are distributed to different cells, thus making further development possible. Cleavage is followed by germ-layer formation, that is, the formation of ectoderm and endoderm and then mesoderm. From the germ layers, the organs characteristic of the animal develop (organogeny). Finally these organs undergo histological and physiological differentiation by which the various tissues become structurally and functionally organized. This step is known as histogenesis, and when it is completed only growth remains in the transformation into the fully developed animal. In the narrower sense embryology is limited to the development of the fertilized egg through the stages up to the final histogenesis of tissues.

Many facts of embryology were accumulated by the ancients, but there was no organizing concept through which the scattered observations could be united into a science until 1828, when Karl Von Baer published his theory of the germ layers. He conceived that the goal of early development is the formation of the three layers — ectoderm, endoderm and mesoderm — out of which all later organs are formed. This view harmonized many apparently unrelated previous findings and offered a basis for new and scientific interpretations. The establishment of the cell theory by M. J. Schleiden and Theodor Schwann (*q.v.*) in 1838–39 made it possible to understand more details of the developing embryo. Charles Darwin's publication of his theory of evolution in 1859 offered further unification and gave a better foundation for the work of later years. When the method of cell division was worked out in the '70s and '80s, embryology was ready to enter into its modern period and the history of development could be carried back to the one-cell or fertilized-egg stage. At this same time F. M. Balfour founded comparative embryology, by gathering together what was known of the development of the different animals and showing that there were general principles of development, common to all of them, based on the broad generalizations just mentioned.

All of the observations up to about 1889 had to do with the structural or morphological aspects of embryology and are accordingly spoken of as descriptive embryology, as distinguished from functional embryology, which depends upon experimentation. While many descriptive studies must still be made, the dominant note in embryological study of the 20th century has been the experimental. The invertebrates have furnished much material for these studies, which have given insight into the causal aspects of development.

Since the emphasis in research has shifted from descriptive to experimental and causal embryology. the old distinctions between vertebrate and invertebrate embryology have lost much of their force. The animal kingdom is divided into great divisions called phyla, there being some 1 j to 18 according to different specialists. One of these, the Chordata. includes all vertebrate animals, and more embryological facts are known about them than about all other animals (see VERTEBRATE EMBRYOLOGY). The remaining phyla are, for convenience, called invertebrates, although technical systematists find little use for this term which of itself lacks essential unity. Embryological principles that clarify the development of both vertebrate and invertebrate animals have now been established. The principles are found to apply to many different forms or groups and to emphasize the fundamental biological unity among animals rather than their dissimilarities.

Although embryos come from eggs, not all eggs are alike. Balfour (*q.v.*), in 1880, distinguished three types: alecithal,[1] which lacks or nearly lacks yolk; telolecithal, in which the yolk is predominately at one pole of the egg; and centrolecithal, in which the yolk is at the centre surrounded by the developing cells. The name centrolecithal does not apply in a strict sense to the egg itself or to its very early stages, for in them the nucleus and the surrounding layer of protoplasm is in the centre of the egg. As cleavage progresses, however, the nucleated masses of protoplasm move to the periphery where they form the cells of the blastoderm (the cellular layer from which the embryo develops). leaving the yolk at the centre, as the name implies. The eggs of sponges, coelenterates and echinoderms are isolecithal. Centrolecithal eggs are characteristic of the arthropods. Most other animals produce eggs that are to a greater or less degree telolecithal in character. The amount and distribution of yolk in the egg cell is a factor of the greatest importance for subsequent development.

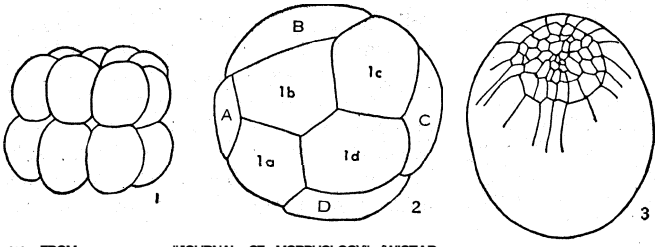
As do other cells, eggs contain nucleoplasm and cytoplasm, in the latter of which may be deposited various inert bodies such as yolk globules and oil spherules. While the nucleus is concerned chiefly with cell division, the cytoplasm contains the materials that are to undergo differentiation. Cleavage, or segmentation, by dividing the egg into numerous cells, the blastomeres, sorts the organ-forming contents of the egg into them. At the time of fertilization differentiation has progressed much farther in some eggs than in others. The former are said to be determinative and their cleavage pattern is that of a mosaic. The latter are indeterminate or regulatory eggs. Determinative eggs permit a sequence of cleavages, "cell lineage," to be worked out with great precision, and therefore in these eggs the history of a particular organ in the embryo can be traced back to the early cleavage. Indeterminative eggs do not display this sharp succession of stages; their differentiation into organs is slower and of later appearance.

Developmental processes are accomplished through the activity of the embryonic cells, and this activity in turn depends upon the operation of various factors and relationships involving cellular dynamics. Among these are the following: quantitative ratios be- t een nuclear and cytoplasmic materials; the ratio of nucleus to ectoplasm (which is the specialized surface layer of the cells and which, as cleavage progresses, increases relatively in amount when compared with both nucleus and endoplasm); the ratio between the amount of cytoplasm and deutoplasm, especially yolk (the amount and distribution of which is a major factor influencing the pattern of subsequent development); the direction of the axis of the mitotic spindle (which determines the plane of cell division, but for changes in which no adequate explanation can now be given); and the rhythm of development. It is not possible in the space at hand to discuss the significance of these factors nor of the application of the physical and chemical principles that are also involved.

Of the types of cleavage, the simplest is radial, which occurs in sponges, coelenterates and echinoderms. The only early evidence of differentiation in these eggs is polarity, the materials at the animal pole, where the polar bodies appear, being destined to form the sensory and covering tissues of the animal, and those at the vegetative pole being concerned with nutrition. In radial cleavage, any plane which passes through the two poles will divide the egg into like halves, since its symmetry is radial (fig. 1). In

[1] Actually, all eggs have sqme yolk, and it is, therefore, better to use the terms isolecithal or homolecithal, meaning the yolk uniformly distributed.

the group of coelenterates known as Ctenophores, radial symmetry is displaced by biradial or disymmetrical cleavage, in which there are two centres of symmetry. Ctenophore eggs differ from all others in that the polar bodies are given off at the vegetative pole, and cleavage begins to cut in there first. The third type of cleavage is bilateral and applies to eggs which are telolecithal in character. Only one plane passing through the axis can cut these eggs into two like halves. The anterior end of the embryo develops later in the animal hemisphere of these eggs



(2) FROM HOLMES IN "JOURNAL OF MORPHOLOGY" (WISTAR, 1900); (3) FROM WATASE IN "JOURNAL OF MORPHOLOGY" (WISTAR, 1891)

Fig. 1.—Blastula of the Starfish. 16-cell stage and radial cleavage. Animal pole at top. Fig. 2.—8-cell stage showing spiral cleavage of the snail, *Planorbis*. Fig. 3.— Discordial cleavage in the cephalopod, *Loligo*. A blastodere disc is formed separate from the yolk mass

and the posterior in the vegetative. Bilateral cleavage occurs in nematodes and rotifers and is the primary type in the Chordata. The fourth type is spiral cleavage, which occurs in the polyclads (flatworms), nemertians, annelids and molluscs (fig. 2). It is the most highly differentiated type and, therefore, the most strictly determinative of all. In eggs of these four types the entire egg participates in the act of division, and cleavage is said to be total or holoblastic.

In the remaining two types the cleavage planes do not cut the eggs completely, cleavage being partial, or meroblastic. Eggs in which the yolk is concentrated at the vegetative pole, and the cytoplasm is restricted to form a disc at the animal pole, are said to have discoidal cleavage. Scorpions, cephalopods and all of the vertebrate animals not of the bilateral type have eggs which cleave discoidally (fig. 3). There remain the centrolecithal eggs of the arthropods (fig. 4). These have superficial cleavage in which a blastoderm is formed on the outside, the yolk remaining in the interior, as explained above.

The end result of cleavage is the blastula, the simplest form of which is a hollow sphere of cells arranged in one layer. Blastulae of this type, called coeloblastulae, occur in eggs having radial cleavage and in those bilateral eggs in which there is not much yolk. Coeloblastulae are equal or unequal, depending upon the amount of yolk in their vegetative cells. If these cells which are to form endoderm contain much yolk, they are larger than those in the animal half, and the cleavage cavity is thus crowded out of centre into the animal hemisphere to make the coeloblastula "unequal." If a coeloblastula is much flattened, it becomes a placula (fig. 5). Blastulae without cavities, because their cells are large, are stereoblastulae, equal or unequal as the case may be (fig. 6). A special type of stereoblastula is the morula, in which some internal cells are not in contact with the surface of the blastula. This usage is in distinction to the former practice of calling the 16-cell stage of radial and bilateral eggs a morula because it resembles temporarily a mulberry. Technically a morula is produced by shifting the axis of the cleavage spindles

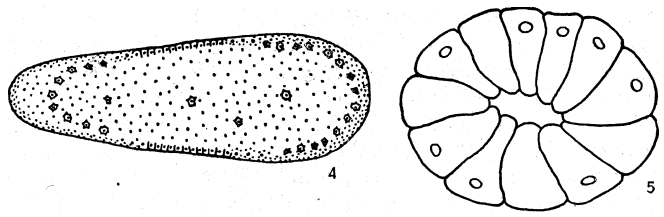
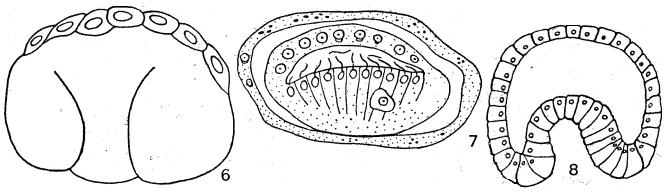


Fig. 4.—A superficial cleavage in the embryo of the blow fly. The cleaving nucleated cytoplasmic masses have reached the surface to form the blastoderm in some parts but not in others. Yolk is at the centre of the embryo. Fig. 5.—Placula of *Cynthia*, an Ascidian

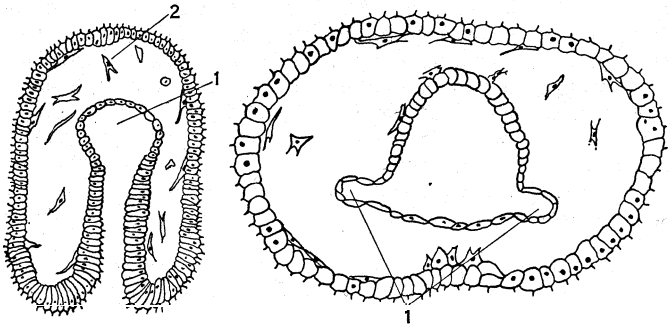


(7) FROM DUBOSCQ AND TUZET IN "ARCH. DE ZOOL. EXP. ET GEN." (

Fig. 6.— Stereoblastula of *Crepidula*, a marine gastropod. Fig. 7.—Stomoblastula of the sponge, *Sycon*. Fig. 8.— Beginning gastrulation in *Patiria*, a starfish

so that some cells are cut off in the interior and do not lie in contact with the surface. The other types of the blastulae are the discoblastula and the superficial blastula, which occur in forms having the corresponding types of cleavage, and, finally, the stomoblastula of a sponge (fig. 7), described by O. Duboscq and O. Tuzet in 1937 as a stage preceding the amphiblastula which is really a larva.

Blastulae next undergo germ-layer formation, the first step being gastrulation, or the separation of the blastula into primary ectoderm and endoderm (fig. 8). In the simplest case (equal coeloblastula) gastrulation is comparable with the pushing in of one side of a hollow rubber ball and the subsequent closure of the opening thus formed (fig. 9). This converts the hollow one-layered ball into a two-layered or double one. An embryo of two



BY COURTESY OF "QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE"

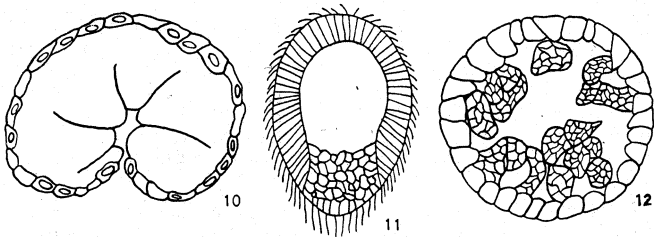
FIG. 9. —THE GASTRULA LARVA OF ASTERIAS VULGARIS
A. Optical longitudinal section. B. Cross section. 1. Rudiment of coelom; 2. Mesenchyme cells budded into blastocoele

layers of cells is a gastrula, and this simple process is invagination, or embolic gastrulation. In blastulae in which the cavity is very small or absent the cells of the animal hemisphere begin to grow over the vegetative cells and thus form a two-layered embryo by the method of epiboly (fig. 10). A third method of gastrulation known as ingression occurs in eggs whose cells do not retain their layerlike formation but crowd into the interior en *masse*, usually from one point, the vegetative pole (fig. 11). The fourth type of gastrulation is delamination, or the formation of an inner layer of cells by division of the cells of the blastula in which the spindle axes are perpendicular to the surface of the egg (fig. 12).

Gastrulation by invagination is found to occur in a great many different phyla of animals. Among them the Coelenterata. Chaetognatha, Molluscoidea, Nemertinea, Echinodermata, Arthropoda, Annelida, Mollusca and the Protochordata—in short: wherever coeloblastulae are found. Epiboly occurs in Ctenophores, Rotifera, Turbellaria, some molluscs, some annelids and many crustaceans. Ingression is found in many coelenterates, some nematodes, some molluscs and some arthropods. The various types of endoderm formation by delamination are known mostly from the embryos of the Hydrozoa.

From the primary ectoderm and endoderm come the three definitive germ layers—ectoderm, endoderm, and mesoderm—primary ectoderm producing definitive ectoderm and ectomesoderm, and primary endoderm producing definitive endoderm and endomesoderm. All triploblastic animals (those with three germ layers) possess endomesoderm. Some possess in addition ectomesoderm, sometimes called secondary mesoderm. The group in

which only endomesoderm occurs is called by some the Deuterostomia, and includes Chaetognatha, Echinodermata and Chordata. Current phylogenetic assumptions derive the echinoderms and the



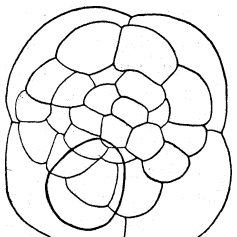
(11) REPRINTED BY PERMISSION FROM "OUTLINE OF COMPARATIVE EMBRYOLOGY" BY A. RICHARDS. PUBLISHED BY JOHN WILEY & SONS, INC.

Fig. 10.—Epibolic gastrulation in Crepidula. Small cells make up the cap of ectoderm, large endodermal cells containing yolk are at the centre. Fig. 11.—Gastrulation by ingression in planula of the jellyfish, *Aequoria*. After Claus, from Korschelt and Heider. Fig. 12.—Delamination in an embryo of Hydra

Enteropneusta from a hypothetical ancestor, the dipleurula, and from the enteropneustan stock come the higher chordates. The animals of the other portion of the phylogenetic scheme, those possessing ectomesoderm, are of three main groups, first, the Platyhelminthes and nemertines; second, the Rotifera, the Nematoda, the Acanthocephala and the Nematomorpha; and third, those which are derived from a trochophorelike ancestor, these being the Echiuroidea, the Annelida, the Arthropoda and the Mollusca. Those who hold to this interpretation of phylogeny see the main line of development progressing from the flagellate protozoa through the planula of the coelenterates to the triploblastic forms represented by a primitive ancestral flatworm having no coelom, to the two main branches just mentioned, the Deuterostomia, and the Protostomia. The possession of the ectomesoderm by the Protostomia and of an endoskeleton by echinoderms and chordates are embryological points in favour of this diphyletic treatment.

Ectomesoderm is best known from the study of annelids and molluscs, in nhich it produces connective tissues and the larval musculature. There is some doubt as to whether other organs developed from it. At least in the annelids and molluscs it degenerates upon the metamorphosis of the trochophores.

There are said to be five methods by which the endomesoderm arises. One of them, the aggregation of scattered mesenchyme cells, has been described chiefly for Phoronis, one of the Molluscoidea, and is not generally significant. In the Deuterostomia the formation of mesoderm is either as enterocoeles which arise as out-pocketings of the gut wall (echinoderms, amphioxus, etc.) (fig. 15) or as solid masses of cells which grow out from the gut.[1] The distinction between enterocoeles and solid outgronths arises largely because the cells retain their layerlike arrangement in the enterocoeles and hence form the cavity as the evagination develops, while in solid outgrowth they proliferate outward as a mass, the cavity of which appears later as they split apart. In the Protostomia, endomesoderm arises either as teloblastic bands or as secondary bands on either side of the gut which presently segment and form the somites that hollow out to produce coeloms (where these occur). Teloblastic bands of the annelids (fig. 14) and molluscs come from the mesentoblast cell *4d* of the spiral cleavage (fig. 13), which after further divisions gives rise to the teloblast cells, M^1 and M^2, and by continued proliferation produces the bands. These grow posteriorly and are converted into the mesodermal organs. Secondary bands occur in the arthropods, and form somites, in a manner much like the teloblastic bands But they do not originate from teloblast cells. They form as solid bands from



FROM CONKLIN IN "JOURNAL OF MORPHOLOGY" (WISTAR, 1897)

Fig. 13.—A 29-cell stage of *Crepidula* showing mesentoblast cell, *4d*, in the interior of the embryo. It produces mesoderm

[1]The trunk coelorns of the New England tornaria of *Balanoglossus*, that of the tunicates, of some brittle stars, and of the mesoderm of vertebrates usually arise as solid outgrowths also.

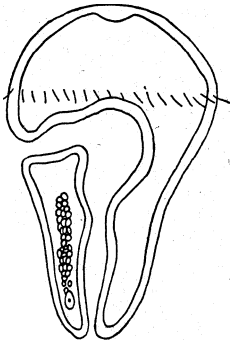


Fig. 14.—Diagram of an annelid trochophore larva showing the left teloblastic band which elongates and segments to form mesodermal somites. The right one is similar

an area which is multicellular from its first recognized appearance. The primitive endoderm separates into an endodermal mass and into the paired mesoderm bands.

The production of mesoderm completes the formation of germ layers, from which the organs of the embryo arise. Primordia which are to become the various organs appear by changes of a few types, such as rapid and differential multiplication of cells resulting in localized thickenings of any one of the layers, and, conversely, the retention of embryonic thinness of some areas; invagination to form sacs and pockets, or evagination to form rods or tubes or pouches of tissue; unequal growth, folding, and bending. These devices occur in many combinations at varying times and speeds, thus accounting for the different processes of organ formation as they are observed in the embryology of the many invertebrates. Organogeny is a series of formative events during which the organs take on their structural characters but are not yet able to function. When the organs, at least the essential ones, have reached sufficient differentiation to begin functioning, the embryonic stages (strictly speaking) have passed, the little animals hatching either as larvae or as immature young. If they hatch as larvae. development is said to be indirect, involving partial or complete metamorphosis. Thereupon the larvae transform into small, complete. but immature animals morphologically like the adults. If there is no metamorphosis, development is direct, proceeding to the characteristic form of the adults without the intervention of any unlike intermediate conditions. In this event the further histological differentiation of tissues and the growth (increase in size) of the entire organism are the major processes of later development.

There is an ecological background to the embryological pattern of all embryos. Ecology (see ECOLOGY, ANIMAL), which concerns the relation of organisms to their surroundings, is not a matter of adults only, but embryos and larvae must also be so adapted as to exist where they find themselves. If an embryo undergoes development in a habitat where both it and the adults may find sustenance suitable to both, development is direct. But if the egg is laid in a place where it can develop but the adult cannot live, then embryonic development leads toward a larva which is adapted to that type of environment and its metamorphosis is necessary before the adult can become established in its final habitat. Sometimes several larval stages are needed for the transition from the early habitat to that of the adult, but all find their explanation in the succession of different adaptive relationships.

There are many kinds of larvae in the various groups of invertebrates, but their diversity is more apparent than real and the principles of their growth and metamorphosis are less numerous than one might think. Most animals develop either while submerged in sea or fresh water, or while in a watery medium within the egg membranes. This relation is necessary to promote the interchange of solutes of gases and salts which are needed for nutrition, for osmotic processes can take place only through moist membranes. The typical form of a primitive larva. therefore is that of a ciliated swimming larva nhich is easily derived from the common invaginate and epibolic gastrulae. Assuming this type as the starting point for the diverging types of invertebrate larvae, a few principles of larval growth may be listed.

Larval metamorphosis (see METAMORPHOSIS) involves principles and processes that recur frequently throughout the animal kingdom. They operate at different stages of development in different larvae, the duration of their effectiveness varies, and they are present in all different combinations, a single one rarely being responsible for any major changes in metamorphosis. The variation in the times of onset of the dynamic principles. the duration and speed of their effectiveness, and the co-operation of each with the others, are responsible for the diversity f developmental results. These phenomena in their turn depend upon causes that are

up to the present outside the scope of observation and experiment. Some of the processes involved in the dynamics of metamorphosis may be listed under the following heads: differential growth, loss of parts. continuous and uniform growth and cellular and histological differentiation.

Differential growth manifests itself through the acceleration of the rate of cell division in the regions which become the primordia of organs to appear later. The increase may be detected by a study of the comparative number of cells during rest and in division. Acceleration may also involve migration of cells into the primordia from neighbouring regions, for embryonic cells which are still undergoing differentiation have not lost their powers of independent movement. Acceleration of growth may also be accomplished by the imbibition of water and of nutrient materials in solution. Opposed to the acceleration of growth is partial or complete arrest of development in localized regions. These tno factors have to do with the rhythm of growth. and not a few embryological processes are largely explicable on this basis. Their timing, related in part to the genic mechanism, is an important factor in determining their significance. It has been discovered that there are "critical moments" at which developmental changes are effective and upon which the sequence of later events depends. The processes of differential growth are by no means limited to indirect development. They play their part also in the establishment of organs nhere animals develop without metamorphosis.

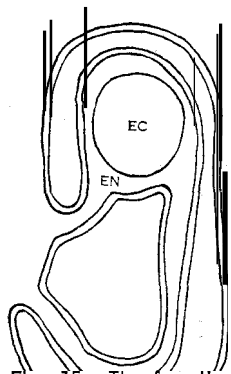


Fig. 15.—The formation of mesoderm in *Patiria* as an enterocoele (ec), an outgrowth from the enteron (en)

It is common to speak of the "loss of parts" in the metamorphosis of some larva, but this process may be relative rather than actual. Where temporary larval organs occur, whose functioning is needed for a limited period of development only, these organs sometimes become constricted off and are actually discarded. In other cases loss of parts occurs by resorption, which may be brought about by disintegration of tissue through phagocytosis (destruction by phagocytes), or by enzymolysis (induced by enzymes), and it may follow liquifaction of cells in some larva. The loss of parts may also result from dedifferentiation of cells (that is, their return to a more primitive embryological condition), whereupon morphogenetic reconstitution causes them to migrate elsewhere and to be incorporated in other tissues. In still other instances the loss of parts may be apparent only, for the extensive growth of adjacent parts may be sufficient simply to include them as the animal grows.

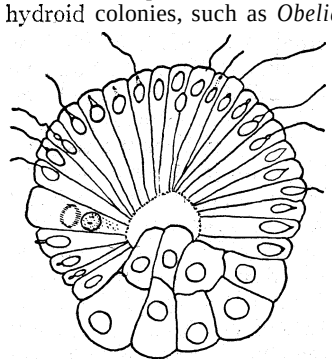
An innate property of cell protoplasm is that of continuous and uniform rhythmic growth, nhich is as much a factor in larval metamorphosis as it is in direct development. Where new primordia are being established, both cellular and histological differentiations are undergone. Differentiation of cells involves their organization into layers, with changes in their shapes in line nith the assumption of the histological characteristics of the different tissues; the deposition in the cytoplasm of specialized structures such as granules. fibrils and others; and the production of noncellular material, largely for support and protection. One thinks of these embryological devices as comparable with the notes of the musical scale which, when employed in different combinations, durations and frequencies make possible the endless varieties of musical forms.

The embryological stages of sponges (the Porifera) are simple, as they must be, in view of the low degree of integration of the cells of these animals. Cleavage results in the formation of a blastula (fig. 7) for which in *Sycon* and *Grantia* the term "stomoblastula" has been suggested by Doboscq and Tuzet. There are two kinds of cells in it. dermal and flagellated, the flagella developing on the inner ends of the cells of the stomoblastula. By a curious phenomenon the entire inner, flagellated surface arches itself to form a dome, then inverts through the mouth to form the amphiblastula, which is the typical larva of a sponge (fig. 16). It consists of large posterior granular and anterior flagellate6 cells, and swims at the surface of the water for some hours. then sinks and presently attaches. Fixation is at the anterior end, the flagellated cells being overgrown by the granular, and thus again taking up an internal position. Since the adult sponge is a body of organized tissues rather than of specialized organs, subsequent changes are only in the nature of histological differentiations. A dermal layer and a gastral layer of cells results. In the dermal layer there are two kinds of cells, the superficial which secretes monaxone spicules and the deeper which produces triradiate ones. The gastral cells take on a radial arrangement, develop collars and flagella (as choanocytes). The canals and pores develop gradually and the gelatinous middle layer, the mesoglea, with its feltwork of spicules, is formed as the gastral cells are rearranged and the flagellated chambers appear.

Animals which belong to the phylum Coelenterata are diploblastic with quite definite cell layers, and there is a mouth opening into a gastric cavity that is not homologous to the cavity of the sponges. In addition to the organs concerned uith digestion, coelenterates exhibit sensory, prehensile, protective and reproductive organs. Individual animals, the zooids, are of two general forms, the hydranths (polyps) and medusae. Sometimes both of these types occur in the life cycle of a single species, as in the colonial Hydrozoa, and in other cases all the animals of a class are developed from one or the other of them. The Anthozoa, the sea anemones and corals, are elaborations of the hydranth, while the Scyphozoa, the jellyfishes, are medusae. Although these two morphological types are very different in appearance, they have much in common and are both derived from a simpler larval form, the planula. Some authorities regard the hydranth as an immature form, a sort of persistent larva, and the medusae as the adult which through a series of changes came to be produced by budding rather than by the direct transformation of the larva.

Although the methods of cleavage and gastrulation are varied, as indicated earlier, the typical larva of coelenterates is almost always a ciliated planula (fig. 17). It is elongated and has an outer ectodermal layer of cells and an inner mass of endoderm, usually solid at first, the cells of which rearrange themselves and form a gastric cavity with an oral opening. The planula settles down, develops tentacles at the oral end, and in the simplest cases grows to form a primitive type of polyp or hydranth. This primitive polypoid larva may develop: (1) into an animal like the familiar *Hydra;* (2) into the first zooid of a hydroid colony as in *Obelia;* or (3) into the actinula (fig. 18) nhich is an interposed larva in some hydroids and in the trachyline forms as *Gonionemus* and *Craspedacusta.* The larva of Scyphozoa is the hydra-tuba or scyphistoma, which undergoes an interesting and complicated series of metamorphoses to develop into adult jellyfishes (fig. 19. 20). Only further differentiation and direct growth are necessary to convert the polypoid larva of the Anthozoa into typical coral polyps or into sea anemones.

According to some, the actinula most closely resembles the primitive larva, and, therefore, it suggests the ancestral type. From it five possibilities of development are presented: (1) the hydroid colonies, such as *Obelia,* in which the hydranth and medusae generations are of equal importance; (2) the gradual reduction of the medusae. leading to a form like *Hydra,* in which no medusa stage is present; (3) the reduction of the hydranth. leading to a form like *Cunina,* in which no hydranth stage occurs; (4) the line leading to the Anthozoa; and (j) that leading to the Scyphozoa.

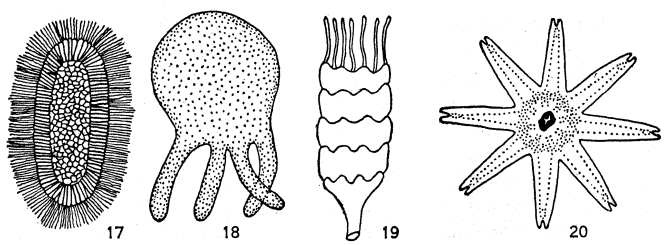

FROM DUBOSCO AND TUZET IN "ARCH DE ZOOL EXP ET GEN (1937)
FIG. 16 —THE AMPHIBLASTULA OF A SPONGE, SYCON RAPHANUS

In the typical hydroid colony such as *Obelia,* the hydranths developing from the sexually produced egg become differentiated into nutritive and reproductive

polyps. The reproductive ones give rise by budding to medusae which form the free-swimming stage, develop sex organs, and produce eggs and sperm. Thus the alternation of generations characteristic of coelenterates comes about. Asexual budding is a common phenomenon in the group, as is further illustrated by the metamorphosis of the scyphistoma. After this larva has settled down and grown for a time, a process of successive terminal budding begins in which the first bud is not completely cut off before a second one appears. In well nourished individuals there may be formed perhaps a dozen and a half ephyrae (the larvae resulting from the budding process) before the outer one is cut off. The ephyrae grow rapidly and become transformed from their immature condition to that of a fully differentiated sexual adult.

Above the Coelenterates the progress of phylogeny follows two lines. the Protostomia and the Deuterostomia, as already described. The coelenterate type of organization could hardly have given rise directly to this divergence and it may be presumed that an intermediate form not now alive (the so-called Bilateria) may have been interposed. In any event in both lines the animals are bilaterally symmetrical, have anterioposterior and dorsoventral axes, and a digestive cavity; and a third germ layer, the mesoderm, in the first line ectomesoderm as well as endomesoderm, is present.

The first group of the Protostomia is represented by the flatworms. Of them only the first class, the Turbellaria, is regarded as on the direct line of evolution, for both trematodes and cestodes have undergone such extensive parasitism that they are quite anomalous. In the Turbellaria spiral cleavage leads to an unequal coelablastula which gastrulates by epiboly. The resulting oval, ciliated larva known as Miiller's larva (fig. 21) swims about for a while, gradually elongates and acquires bilateral symmetry. Meanwhile the mouth shifts to the prospective ventral side and the eight ciliated lobes which distinguish this larval type appear. The continuous band of cilia which edges the lobes is the locomotor organ. Eye spots develop in the region where the apical cells of the blastula were. As the larva elongates, the lobes become proportionately smaller and they disappear with its conversion into a creeping polyclad worm. The eight lobes have been



(17) REPRINTED BY PERMISSION FROM "OUTLINE OF COMPARATIVE EMBRYOLOGY" BY A. RICHARDS, PUBLISHED BY JOHN WILEY & SONS, INC.

Fig. 17.—A planula of *Clytia*, a hydrozoan jellyfish. Redrawn from Metschnikoff. Fig. 18.—A very young actinula of the hydroid, *Tubularia*. Fig. 19.—A scyphistorna of *Aurelia*, a jellyfish, undergoing strobolization. Fig. 20.—Ephyra of *Aurelia*

thought to show relation to the eight comb plates of the ctenophores.

All nemerteans except the Heteronemertini develop directly, but in one family of that group the pilidium larva is found, and in another there is the "larva of Desor," which is a pilidium modified for creeping. The nemerteans are the first forms showing a posterior opening to the digestive tract, in which feature they are advanced over the flatworms, but they also have some primitive developmental traits that suggest the ctenophores. The pilidium has likewise been thought to foretell the trochophore larva of the annelids (fig. 22). It has the shape of a child's helmet and has an apical sense organ, atop of which is a long spike of cilia. Except for this tuft and the marginal locomotor cilia called the prototroch, the cilia are uniform in size and distribution. The two lobes which hang from the sides suggest the corresponding ones of Müller's larva. The gut cavity opens by a wide blastopore and curves posteriorly to form a stomach. Four ectodermal invaginations from the base of the caplike portion of the helmet grow inward between the gut and the apical organ, coalesce and form the amnion. Its innermost layer surrounds the intestinal tract, the rudiment of the proboscis sheath, the excretory organ, and the brain primordium, which are parts of the definitive animal. The outer layer of the amnion, the larval ectoderm, the prototroch, lobes, apical sense organ, and the larval musculature are all left behind like a discarded cap when the little worm has become sufficientlydifferentiated to constrict itself free from its coverings. The discarded portion presently dies, but the worm takes up its life at the bottom.

Above the flatworms the course of evolution evidently led through a stock resembling the trochophores (Trochozoon?) which is represented among living creatures only by these larva. As is true of both the pilidium and Miiller's larva, the trochophore has features resembling the ctenophore type of organization, and it may be presumed that the ctenophores are near the base of this evolutionary line, the Protostomia. From the trochophore stock is derived a group of invertebrate phyla which are clearly related to this branch of the phylogenetic tree but whose development and metamorphosis as well as adult structures have been clouded by some uncertainties of details and of interpretation. These are the Rotatoria, Podaxonia, Polyzoa and Brachiopoda, whose larvae are all modified trochophores, and the Nematoda, Gordiacea and Acanthocephala, which develop directly or are parasitic. The embryology of these forms must be left for more detailed accounts. The trochophore stock then gives rise to the segmented Annelida and the nonmetameric Mollusca.

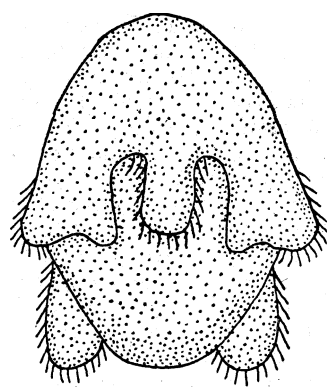
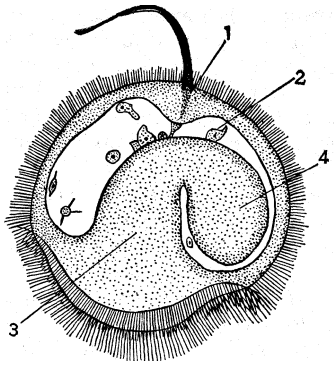


Fig. 21.—Müller's larva, ventral view

The trochophore larva as it occurs in these two phyla is important not only for its own embryological story but for the light it casts on evolutionary processes (figs. 23, 24, 25). The adults of these phyla are exceedingly diverse and, if their life histories were unknown, would not be thought to be closely related. But their early embryological development is almost identical until the fully formed trochophore is reached, after which the divergence begins. The metamorphosis of the annelid and molluscan trochophores are practical demonstrations of the meaning of evolution, for by the further development of different regions of the larvae completely different types of organization are produced.

The trochophore is at first a simple ovoid larva the most conspicuous features of which are the equatorial band of powerful cilia, called the prototroch, and the apical sense organ with its tuft of cilia. In the primitive annelid, *Polygordius,* and in the limpet, Patella, it has been shown that the prototroch first appears from cells in the four quadrants of the embryo on which the cilia are arranged in transverse rows like the "combs" of the ctenophores, and E. B. Wilson called this stage in Patella the "ctenophore" stage. In Polygordius there is also an additional band of cilia, the metatroch, a row of weaker cilia posterior to the prototroch, and the telotroch which is only a posterior tuft of cilia. In other annelids the arrangement of the bands varies from the atrochal conditions (having only the apical tuft and a uniformly ciliated covering) through monotrochal (having only the prototroch), telotrochal (having also the telotroch), mesotrochal (having only the metatroch), to the polytrochal state which comes later as additional locomotor organs are developed as circlets of cilia to assist the worm in movement. The trochophores of other phyla exhibit somewhat similar variability.

Trochophores have a complete digestive tract, with a wide mouth derived from part of the blastopore, a bulblike stomach, and a short intestine leading to a posterior anus. There is a pair of archinephridia, which are basically flame cells and tubules. Mesodermal structures in these larvae are of special interest. The ectomesoderm produces mostly larvae musculature, while the



BY COURTESY OF THE "QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE"

FIG. 22.—THE PILIDIUM LARVA OF THE NEMERTINE WORM, CEREBRATULUS LACTEUS

1. Apical sense organ: 2. Mesenchyme cells; 3. Mouth; 4. Stomach

endomesoderm, also called adult mesoderm, is largely concerned with the coelomic walls and related structures. It is derived from the mesentoblast cell, *4d*, whose division products are the two teloblasts or mother cells of the mesoderm bands. From the continued multiplication of the teloblasts, a band of cells forms on each side of the gut. The coelomic spaces and their walls come from the hollowing out and swelling of these bands.

The transformation of a trochophore into an annelid worm is accomplished primarily by the lengthening of the region behind the prototroch (fig. 24), the intestine becoming a long tube and the mesoderm long bands. Segmentation of the bands and later of the body of the worm then sets in. The bands are cut into a series of blocks, each of which becomes hollow by the separation of the cells and perhaps by absorption of some of them. The spaces thus formed are the coelomic cavities, and the mesodermal layers between them form the septa. The external appearance of a segmented worm is produced by the superficial annulations which arise through a series of indentations of the skin and body musculature. The prototrochal cells, and those anterior to them, are either absorbed or cast off while the body of the worm is being completed through the growth of the post-trochal region.

This procedure is quite in contrast with the metamorphosis of the molluscan trochophore, the early development of which is almost the exact counterpart of that of the annelid trochophore. The distinguishing characters of molluscs include the presence of shell, the mantle which secretes it, and the foot, the absence of segmentation and the reduction of the coelom. Therefore, the differentiation of the trochophore is not by the elongation of the posterior post-trochal portion but by the differentiation of dorsal and ventral post-trochal regions (fig. 25). A dorsal region just behind the prototroch arches into a visceral hump at the apex of which the shell gland, a mere groove of thickened cells, appears. This gland secretes the first semblance of a shell as a horny cap. At the middle of the ventral side the foot is formed as a median projection just back of the prototroch. Thus the metamorphosis of the mollusc proceeds on different lines because of a changed regional differentiation. The annelids find their food by burrowing, the molluscs by creeping or gliding over surfaces. Adaptive structures to correspond to these needs are the result of very different evolutionary steps.

The final metamorphosis of some molluscs involves some other larval stages such as the veliger and the glochidium. When the trochophore of a gastropod has developed its visceral hump and caplike shell. its girdle of prototrochal cells becomes much enlarged to form a velum and the entire larva is now called a veliger. Further changes occur producing torsion of the visceral mass and rearrangement and modifications of the forming organs. These may be looked upon as secondary larval characteristics having to do with special modes of life of the particular animals. The glochidium is similarly a secondary adaptation of the Unionidae to the last part of their immature life as parasites on the gills or fins of fresh-water fish. This larva lacks mouth, velum and foot. but possesses a shell of two valves each of which is equipped with a sharp inturned hook. These hooks seize upon the soft projecting gill or fin of a passing fish, injure it sufficiently to stimulate the swelling and growth of its tissue until it encloses the glochidium in a cyst. In this chamber the larva lives until ready to emerge as a tiny clam. In contrast with these secondary types of larvae, the trochophore is regarded as primary since its characters are related to many different great groups of the animal kingdom. These primary forms show what has been the evolutionary history of these groups and are the basis for present view on the racial history or phylogeny.

The remaining phylum of the Protostomia is that of the Arthropoda, of which the three major classes are the Crustacea, the Insects and the Arachnida. There are also other forms—the Myriapoda, Onychophora, the Trilobita, Pycnogonida, Pentastomida. and Tardigrada—whose relationships to the three main groups are of varying degrees. It is generally held that the entire phylum descended from the Annelida, but beyond this fact there is much uncertainty and little agreement. This division is by far the Largest of the animal kingdom and by far the most studied excepting possibly the vertebrates, but its diversity is so great and its problems so difficult that its phylogeny is still too little understood. Our embryological knowledge often does not warrant assurance. The characters of special interest embryologically are the reduction of the coelom so that the body cavity is morphologically a haemocoele developed in relation to the circulatory system, the increased importance of metamerism so that each typical segment bears a pair of appendages, the greater thickness of the cuticle over that of the annelids, and the general absence of cilia.

There is wide variation in the extent to which the larval phase is shown. In most Arachnida development within the eggsnell sees the formation of all the organs nearly completed before hatching. In the Crustacea there are many kinds of larva, and

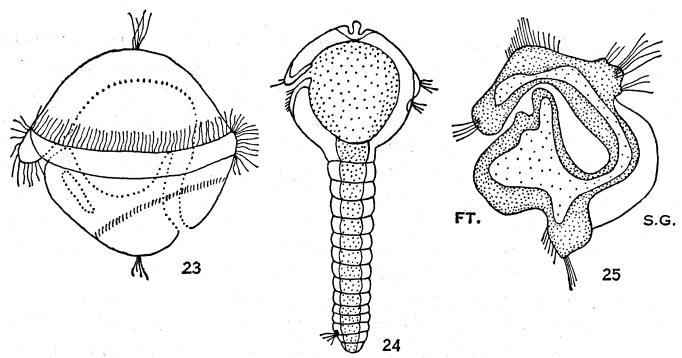


Fig. 23.—Trochophore of *Polygordius*, an annelid. Redrawn from Woltereck. Heavy band of cilia is the prototroch; secondary band is the metatroch. Apical tuft of long cilia, the telotroch at opposite pole, alimentary tract and position of protoneptridium are also shown. Fig. 24.—Older trochophore of *Polygordius*, showing posterior growth which is to transform the larva into a worm. Also redrawn from Woltereck. Fig. 25.—A diagram of a transforming larva of the limpet, *Patella*, showing the dorsal enlargement of the shell gland, the ventral differentiation of the foot. The posterior portion does not elongate. Diagram based on Patten's figures

they hatch in different stages of similarity to the adult. In the Insecta some animals show no metamorphosis while others undergo a series of changes that are the most complete in the animal kingdom.

The primitive crustacean larva is the nauplius (fig. 26) which in the lower members of the class is free swimming with three pair of appendages, the first and second antenna1 and the mandibular, and a single median egg. In the higher classes the nauplius may occur merely as an embryonic stage in which the appendages are represented as cellular aggregations or thickenings. Following the nauplius, there is a series of larvae among Crustacea which show increasing degrees of progress at the time of hatching. The metanauplius adds the next two pair of appendages in order, the first and second maxillae, and shows the first signs of segmentation. The protozoea has the first and second maxillipeds and shows the first compound eyes. The zoea[1] has third maxillipeds, some thoracic appendages, stalked compound eyes, the abdomen completely segmented, and that process begun in the thorax. The mysis is completely segmented in both thorax and abdomen, has all the eight pair of thoracic appendages characteristic of the higher Crustacea. and six pair of abdominal appendages. The walking legs of the mysis larva are equipped with well developed exopods or outer branches for it is a swimming

[1]The common English spelling, zoaea, is incorrect, for this larva is named for the genus Zoea (Bosc, 1801).

animal as contrasted with the heavy bottom living lobsters whose walking legs have only strong endopods. There are about 14 different kinds of crustacean larvae, but those listed are the most important. In addition, the fresh-water shrimp. *Crangon,* hatches in what is practically the adult condition; that is, it has direct development. The nauplius larva is found in the primitive Phyllopoda (leaf-footed), the Copepoda, Ostracoda, Cirripedia (barnacles), and in some shrimps (*Penaeus*) and crabs. In most higher orders. however. it is recognizable only in the embryo. The metanauplius is found in *Eubranchipus,* the fairy shrimp, and in *Lucifer,* a prawn. The young of *Squilla* hatches as a protozoean. The crabs commonly hatch as zoeae and the lobster as a mysis larva (fig. 27).

The chitinous exoskeleton of all arthropods is a hard resistant protective cuticle secreted by the cells of the skin. The animal, therefore, is confined in its own exoskeleton and can grow only by moulting. At intervals the animal breaks out of its skeleton and moults. It then expands rapidly while the new chitin is being secreted and is hardening. The periods between moults are called instars, during each of which the external appearance does not change but the soft internal parts continue development in preparation for the next moult. In the larval series just mentioned, as they pass from one larval stage to another, the higher forms undergo successive moults. Of course the lower crustacea complete the progress only through the stages appropriate for each order.

The embryological record is especially useful in determining the relationships of some of the Crustacea. The outstanding example is that of *Sacculina,* parasitic on the abdomen of crabs, a creature which looks more like a tumour than a separate animal. Parasitism has brought about extreme modification and the animal is unrecognizable except for its embryological history. The egg develops into a nauplius which transforms into a larva resembling the ostracod, *Cypris.* Further development shows the degenerate adult, with the rootlike branches penetrating into the tissues of the crab, to be a close relative of the barnacles.

This case, as well as other larval relationships of this class and the numerous others that could be cited, has been used to illustrate the biogenetic law, especially as it was propounded by Ernst Haeckel (*q.v.*), or, as it is usually referred to, the recapitulation theory. This doctrine concerns the parallel which in general exists between the embryological story and the development of the race. "Ontogeny recapitulates phylogeny." This theory was very important in the history of embryology, for much of the research of the 19th century was stimulated by it. But later studies first cast doubt in it, then showed many instances in which it was a misinterpretation, and now it is looked upon merely as a tendency and not a law in any proper sense of that term.

The embryology of insects (see EMBRYOLOGY) differs from that of other animals in that all eggs are centrolecithal and are well filled with yolk. This limits the embryonic cells to a peripheral position where they form a wall, the blastoderm, about the central yolk mass. Along the midventral, longitudinal line an aggregation of cells arises that forms the germ band from which the body proper of the insect is to come. This ventral position is in contrast with the formative regions of other eggs. The germ bands grow in length and also laterally and dorsally until their edges meet to form the dorsal wall, under the flattened dorsal cells of the original blastoderm which have been converted into the serosa. Mesoderm is formed as an invaginating groove along the midline, by the proliferation of a flat middle plate of cells that is overgrown at the edges by the lateral folds, or by the proliferation and invagination of median ventral cells of the blastoderm. This last method is responsible for the formation of amnion and serosa, embryonic membranes inside the shell which protect the embryo during development. The amnion is formed either as an invagination by the posterior end of the germ band forming a cavity inside the yolk, or by "overgrowth" of the amniotic folds (and the tail fold) until the edges meet closing over the germ band (fig. 28). The outer thin flattened cells are the serosa, and the inner the amnion. These later become membranous and enclose the cavity in which the embryo develops.

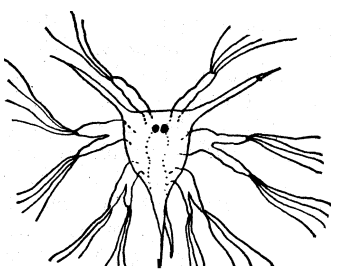


FIG. 26. — NAUPLIUS LARVA OF LEPAS, A BARNACLE

Life histories of insects are markedly adaptive, and the variety of environmental conditions to ahich they are exposed is very wide. Therefore larval forms are of many types. The significance of these larvae is a matter of dispute, some thinking them to be secondary modifications of life histories and others that they are recapitulations of primitive ancestral insects. In either case, it is a matter of interest that some very simple insects hatch in a condition very like their parents, the development being well completed in the embryo, while on the contrary many of the most specialized insects hatch at an early stage in their development and have larvae (often a series of them) that are wormlike in appearance.

There are three kinds of development in the insects, so far as larval conditions go, and the orders may be grouped correspondingly. First, the Ametabola hatch as small fully-formed insects. They are the Thysanura and Collembola. Second, the Heterometabola have incomplete metamorphosis, that is, they hatch as nymphs which are quite similar to the adults but have only rudimentary wings. This group includes the orders Orthoptera, Dermoptera, Hornoptera, Hemiptera and Anoplura. Third, the most highly specialized insects undergo complete metamorphosis, often involving several larval moults and several larval phases. These are the Holometabola and comprise the orders Coleoptera, Strepsiptera, Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Diptera, Siphonaptera and Hymenoptera.

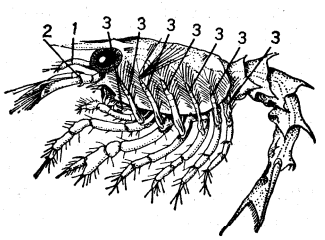


FIG. 27. — THE MYSIS LARVA OF THE AMERICAN LOBSTER, HOMARUS AMERICANUS

1 Antennule; 2. Antenna; 3. The seven pairs of exopodites borne by the thoracic limbs

The Protostomia reach their climax in the arthropods, which are very unlike the primitive flatworms from which this great branch of the animal kingdom originated, or the more primitive ctenophore, whose relationships are suggested in many of the embryological stages of the phyla included in it. Among these animals is the greatest diversity in form, size, habits, habitats, and numbers of species and individuals.

Some are very well suited to their environment, while others have not reached much stability in regard to their surroundings, and hence are actively undergoing evolutionary changes even now.

The branch of the animal kingdom opposed to the Protostomia is the Deuterostomia, which doubtless was derived from the same primitive bilateral ancestors as the flatworms. Presumably these two main branches represent divergent developments from about the same low ancestral types. The Deuterostomia include the peculiar, aberrant animal, *Sagitta,* belonging to the phylum Chaetognatha, and also the echinoderms and the chordates. Animals belonging to this stock are characterized by the development of an anus which is one of blastoporal origin; by the absence of ectomesoderm; the formation of the coelom primarily as enterocoeles, or out-pocketings from the primitive alimentary tract; by skeletal structures which are derived from mesoderm and hence are endoskeletal; and by numerous features which are probably less important phylogenetically.

The position of the chaetognaths in classification has been the subject of much debate. Their embryology is known chiefly from the work of Leonard Doncaster on *Sagitta,* published in 1902. This work shed light upon the general problem, but left many points far from clear. It showed no larval form that could be closely compared with any other invertebrate larva, although it recorded the general scheme of embryology fairly well. The blastopore closes and a new mouth develops; a head coelom is

formed as an evagination from the primitive gut; it is not clear that there is any ectomesoderm. For these reasons it seems hardly possible that the animals can be included among the Protostomia. However, they are much more primitive than other Deuterostomia, and many of the characters of the latter are lacking. About all that one can safely say is that this phylum is one of the earliest representatives of the Deuterostomia, but that it shows little affinity for other animals of this general stock that are higher in the scale of development.

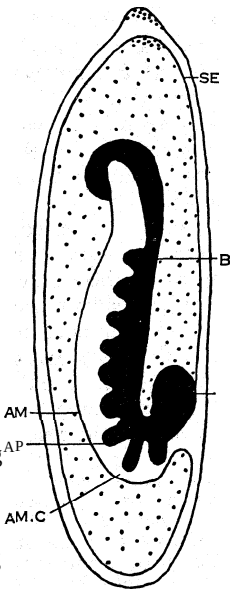


Fig. 2s.— Diagram of embryo of grasshopper, after Brandt. am, amnion; am.c, amniotic cavity; ap, appendage; b, body, h, head lobe; ser, serosa

The development of the embryos of the Echinodermata has been much studied and is of great importance because of the light that it throws upon fundamental living processes. Experimental embryology especially has profited from the study of the echinoderm eggs. The echinoderms represent an ancient group of which the living classes go back to Cambrian times. They are of wide-spread distribution and well adjusted to their present environments, but the range of variation in their individual habitats is not very wide, nor is there much variation in the habitat within a species. Where a species is well adjusted to its environment, little evolutionary change takes place at any given time and, therefore, this phylum displays little of the diversity that is found in those comprising the Protostomia. Evolution at the present time is not progressing rapidly in this great group.

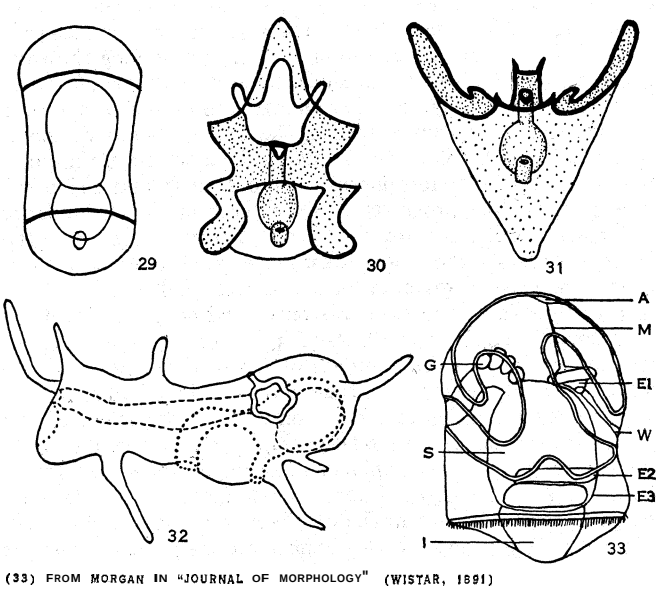
There are five living classes of echinoderms, one of which attaches itself to the substratum and the others of which move very slowly over the bottom and in very limited range. Sessile animals or slow moving ones can be distributed widely only because they have active larvae, a principle which is amply illustrated in the echinoderms. There are four general larval types, of which all were thought by their discoverers to represent separate genera, and their present names are those originally given them as genera. These types include the larva of the Asteroidea, or starfishes, which is the bipinnaria; that of the Ophiuroidea, or brittle stars, the ophiopluteus; that of the Echinoidea, or sea cucumbers, the auricularia. There is also the pentacrinus larva of the Crinoidea, but the development of only one crinoid has been well studied and its eggs are heavily yolk laden so that its entire history is quite unlike other echinoderms. Hence the larvae of the other classes are much more important. They show characteristically different structural features, as well as different habits. But there are many common features in their development which indicate that they must have come from a common ancestor. The larval phases are of long duration and the types of metamorphosis are very involved, implying distinctive differences in the mode of life before and after metamorphosis. Since the individual larvae present characteristic features, each for its own class, it may be assumed that the modifications which each has undergone are departures from a common stock that existed long ago in simpler and more primitive form than any living echinoderm now displays. From the characters that are common to the various types of development, it has been possible to reconstruct a hypothetical ancestor which has been called "dipleurula." From it, or some similar form, it may be presumed that the modern larval types were derived.

The distinctive characters of the echinoderms are the adult radial type of symmetry (secondarily bilateral) following the embryological bilateral arrangement, and the unique water vascular (ambulacral) system which arises from the differentiation of the coelom. It is to be noted also that the muscle cells, connective tissue and skeletal plates are all of mesodermal origin. These characteristics of the adults, in addition to the active phases of larval life, are the bases both for the interpretations of the larvae and for the reconstruction of the hypothetical dipleurula.

The dipleurula is conceived to have had the following features: the symmetry was bilateral; the locomotor organ took the form of a longitudinal ciliated band with preoral and anal loops; the alimentary canal, with mouth, narrow oesophagus, globular stomach and narrow intestine was derived as an invaginate archenteron from a coeloblastula. The widely open blastopore was posterior in position and later became the anus, while the mouth appeared at the opposite end as a new structure (hence the name, deuterostomia). As the embryo bent upon itself, the mouth was carried to a new position which became ventral. The coeloms arose as two pockets evaginating outward from the primitive gut. They opened to the exterior through a dorsally directed ciliated tube (sometimes there were two) called the stone canal. From the coeloms the water-vascular system was differentiated.

The living form which is most nearly like the dipleurula is the ophiopluteus. (The name pluteus was given to larvae of the ophiuroids by Johannes Muller because he inverted his specimens uhich he had not seen alive and thought they resembled painters' easels. The term pluteus was also applied to the larvae of the echinoids because they are of quite similar appearance) (fig. 31). Long arms with skeletal rods give these larvae their shape and distinguish them from the other types found in echinoderms. But if the arms are disregarded, all of the types look surprisingly alike and are easily comparable with the dipleurula. As the larvae grow toward maturity, the arms are gradually absorbed.

The most important transformations which the bipinnaria of the starfish display are clearly those concerned with the coeloms (figs. 29, 30). In bipinnaria the right and left coelomic cavities fuse anteriorly around the oesophagus while partially constricting into two, sometimes three, parts posteriorly. Then the hinder part of the left anterior coelom grows to form a five-lobed swelling, the first trace of the hydrocoele. It is the beginning of the water-vascular system. Meanwhile the eight arms of the bipinnaria have formed, a median ventral and a median dorsal, a pair each of anterior dorsals, posterior dorsals and postoral arms. The bipinnaria swims about for perhaps two months, after which it settles



(33) FROM MORGAN IN "JOURNAL OF MORPHOLOGY" (WISTAR, 1891)

Fig. 29.— Young bipinnaria of *Patiria* in a condition comparable with a young dipleurula. Ciliated bands and three-part alimentary tract are shown. Fig. 30.— Older bipinnaria redrawn from Leuckart's chart. Pre- and postoral ciliated bands, the arms and the three part alimentary tract are shown. Fig 31.— An echinopluteus redrawn from Leuckart's chart. Its parts are comparable with those of a bipinnaria. Fig. 32.— Brachiolaria of *Patiria* from left side. Semidiagrammatic. The hydrocoele is shown in solid lines with the beginning of the radial buds that are to develop into arms and show radial symmetry. Alimentary canal drawn in dotted lines and anterior and posterior coeloms with short dashes. Position of fixation disc is at left end. Fig. 33.— A tornaria larva of *Balanoglossus* from the left side The anterior ciliated band is folded both in front of and behind the oesophagus. The posterior band is a simple circlet. Gill slits (g) are shown in the wail of the oesophagus. Of special importance are the anterior enterocoeles (e1), and the paired second (e2), and third (e3) enterocoeles. A, apical organ; m, muscle band leading to enterocoele; s, stomach; I, intestine; w, water pore

to the bottom to become an attached brachiolaria (fig. 32). The brachiolar arms appear, there being of these a median dorsal and two laterals. This partly-transformed larva fastens itself by the fixation disc near the anterior end, and that portion is thus converted into a stalk for the growing left, posterior swelling that is to become the disc of the starfish. Into the latter the lobes of hydrocoele project. In the disc also the other coelomic structures, the mouth, oesophagus, stomach and intestine develop. But the relations of the mouth, oesophagus and anterior coeloms are altered, for the anterior parts that formed the stalk are resorbed into the growing disc. The new mouth appears in such a way as to make the left side of the larva become the oral side of the adult. The hydrocoele separates entirely from the other parts of the coelom, puts out processes that grow to form the radial canals, the tube feet, and other ambulaceral parts. Thus the distinctive water vascular system arises in these larvae, and the peculiar symmetry of the starfish is explained.

The egg of the sea urchin corresponds in its development to that of the starfish through the stages preceding the formation of the echinopluteus. After gastrulation, right and left vesicles appear as outgrowths from the gut and from them the coeloms develop. The sides of the larva flatten in such a manner that it becomes wedge-shaped and is sometimes known as the prism larva. A stomodeum breaks through from the outside and connects up with the primitive gut whose blastoporal opening forms the anus. Lobes, or arms, develop, supported by calcareous skeletal rods. The first arms are postoral, the second are the anterolateral, then follow the preoral and finally the posterodorsal.

After some weeks of increase in size, the larva goes to the bottom and transforms into a young sea urchin. The hydrocoele develops from the anterior section of the left side. It grows, curves on itself, its ends join to make a ring, which is the ring canal of the water vascular system. From the ectoderm opposite it a depression forms and deepens. Its sides fold upward, and close together, thus making a sac the outer part, or roof, of which is the amnion. On the floor of this sac the spines and tube feet are formed and into them the hydrocoele then branches. The adult mouth, unrelated to the larval mouth, appears at the centre of the floor of the amniotic sac. This portion of the larva is spoken of as the echinus rudiment. It grows, presently becoming the entire side of the larva. Then the amniotic covering is absorbed and the tube feet project freely. Further changes are passed through rapidly, the larval arms are absorbed, the ciliated bands disappear, and there is left a small flat disclike animal which is the young sea urchin. The metamorphoses of the starfish and sea urchin larvae illustrate the processes as they occur in the echinoderms. For further details, and for the special embryology of the other echinoderm classes, the reader must be referred to more extensive accounts than can be given in the space here available.

The final larva of the Deuterostomia, and of the entire list, is the tornaria of *Balanoglossus* (fig. 33). Strictly speaking, this animal is regarded as the chordate of lowest development, but it bridges the gap between that group and the echinoderms, and this fact justifies its mention in connection with invertebrate embryology. It also emphasizes the relationship of the vertebrates to the invertebrate groups. Some animals belonging to the genus *Balanoglossus* develop directly without the formation of a tornaria. Others display variations in the details of the larval morphology. But the correspondence to the basic structure of the dipleurula is sufficient to establish the relationship to the satisfaction of most authorities of our day. The tornaria resembles the larva of the echinoderm so closely that it could easily be mistaken for one of them. (The name was originally proposed by Johannes Müller in 1848 as a generic name.) But in contrast to the radial symmetry of the adult echinoderm, it transforms into an animal that is wormlike and bilateral. Some workers feel that the Enteropneusta, to which this genus belongs, should be separated from the other chordates and given a separate status; but in any case, the relationship is clear enough to warrant the inclusion of them and the other chordates into the Deuterostomia.

Modern embryological research has thrown light on the structural development of animals, upon the varied functions which animals perform, upon taxonomic relationships, upon the phylogenetic and evolutionary tendencies both of individuals and of the different larger groups including phyla, and upon the nature of living processes. The transformations of a one-celled egg into a complex multicellular organism are expressions of the activities of the living stuff itself, and their study offers one of the best approaches to the understanding of the nature of that stuff, protoplasm.

During the period from Von Baer to Balfour, embryos, including invertebrates, were studied morphologically. The structure of organs in their different stages and their bases of organization were gradually worked out with the aid of the cell theory and the evolution doctrine. Then Balfour, by comparing the development of the systems of different groups of animals, made embryology comparative and derived many of the principles now familiar. After that time (1881), experimental embryology, cytology, general physiology and genetics clarified many of the problems raised by the older embryologists. Therefore the embryology of our day has only a basis in morphological discoveries (many of which still demand further research); present day students pass on from morphology to functional studies, evolutionary, genetic and now chemical.

Much that is known of genetics is based upon invertebrates, especially insects, and the same is true of cytology. At the present time there is probably no question more puzzling than that of the manner in which the genetically determined characters of the fertilized egg become translated into the functioning structures of embryos and adults. Invertebrate embryology has its part in answering questions of this kind. Differentiation of embryos is an obvious process hut a very intangible one both as to its exact nature and the factors which bring it about.

Much research is now being directed to the solution of the influences that govern embryological development. Both invertebrates and vertebrates are used for these studies, and much of the work is experimental in method. The presence of "organizers" has been demonstrated by Hans Spemann and his school; these are chemical substances produced in early stages which condition the future development of a given region. There is a special division of the general subject which has been called "chemical embryology" (Joseph Needham); it indicates something of the direction further studies may take. Organic chemists are now finding it possible to correlate some of the features of protoplasm with peculiarities of the complex structural formulae they are now able to derive. Much more may be expected of this phase of study. Some somatic characters may now be related to definite genes in the chromosomes by the methods of both genetics and cytology. Already embryological studies have been made on some of these characters, and it may be assumed that many more will follow in the not distant future.

Thus invertebrate embryology is much more than an immense subject filled with detailed observations. It ramifies into the most significant phases of biology, unifying and integrating them and suggesting new directions for research.

See also EMBRYOLOGY; REPRODUCTION; METAMORPHOSIS and the articles on the various groups of invertebrates.

BIBLIOGRAPHY.—E. Korschelt and K. Heider, *Lehrbuch der vergleichenden Entwicklungsgeschichte der Wirbellosen Thiere* (Jena, 1902 et seq.); E. W. MacBride, *Textbook of Embryology, Invertebrates* (London, 1914); Aute Richards, *Outline of Comparative Embryology* (New York, 1931); O. Duboscq and O. Tuzet, *Archives de Zoologie Experimentale and Generale*, vol. 79 (1937); Joseph Needham, *Chemical Embryology* (Cambridge, 1931); Hans Spemann, *Embryonic Development and Induction* (New Haven, 1938); d'Arcy W. Thompson, *On Growth and Form* (Cambridge, 1942). (A. Rs.)

INVERURIE, a royal and small burgh of Aberdeenshire, Scot., situated at the confluence of the rivers Don and Urie, 16 mi. N.W. of Aberdeen by road. Pop. (1951) 5,057. Papermaking and the making of mineral waters and gloves are the chief manufactures; and it is the centre of a large agricultural district with a big bulb farm. It also contains railway workshops and is a summer resort.

To the N.N.E. near Old Meldrum is Barra hill where Robert Bruce is held to have defeated Comyn, earl of Buchan, in 1308. At Harlaw. about 3 mi. to the N.W., was fought in 1411 the great battle between Donald, lord of the Isles, and the victorious royal forces under the earl of Mar. Not far from the scene of this conflict stands Balquhain castle, a seat of the Leslies, now a mere shell, which was occupied by Queen Mary in Sept. 1562 before the fight at Corrichie.

INVESTIGATION, CRIMINAL. Criminal investigation is that branch of criminal jurisprudence which applies the principles and practices of philosophical analyses, science, art and

technical skill in judicial proceedings, subject to legal rules and forms in which there must be elucidation of questions relating to crime. This covers the questions: who the victim mas; the exact place at which the offence occurred; how the crime was committed, with what weapon it was committed, or what were the means employed in its commission; what was the time of attack, what was the motive or object of attack, and the identity of the offender or offenders. Criminal investigation is employed also in the search for and interrogation of material witnesses who are able and willing to give competent and relevant testimony against the suspect or offender, and in the reconstruction of all facts connected with the crime in order that, at the trial of a defendant, a true picture of what occurred may be presented in such manner as to leave no doubt in the minds of the jurors or judge regarding the guilt or innocence of the accused.

History. — Although the beginning of criminal investigation is unknown, there is reason to believe that in a very rudimentary form it came into existence with the origin of legal trials. It is clearly laid down in the Code of Hammurabi that suspicion does not give ground for condemnation; receiving of testimony and even elaborate examination of sites or circumstances by the court itself were established rules of procedure.

In Athens, by about 500 B.C., the examination of facts had become meticulous; a defendant, having lost his case, might bring suit against a witness for bearing false testimony and, if successful in his new suit, would go free of his earlier condemnation. In the Fuotinian legislation (6th century A.D.) evidence was so construed as to imply the co-operation of experts in certain cases. In the middle ages, whether in civil or in ecclesiastical courts, and generally in the commercial and customary tribunals, the weighing of evidence was as careful as it has ever been. The introduction, in that period, of courts of inquest whose object was avowedly to procure condemnations, such as those of heretics, and the survival of certain ancient uses of the ordeal have obscured the prevalence of careful taking of evidence in the middle ages.

In 1507 a penal code containing exact instructions as to evidence was issued by a bishop of Bamberg, and in 1532 the Caroline code of the German states contained provisions for the examination of criminals. In 1575 a French physician described the form in which judicial reports should be made in medico-legal cases, and at the close of the 16th century outlines of the method of testifying in such cases were numerous, especially in Italy. Toward the end of the 18th century legal medicine was recognized as a science. Mathieu Orfila, who occupied the chair of chemistry and medical jurisprudence in the University of Paris, was employed as an expert in judicial proceedings; in 1814 he published a *Traité* des Poisons. In 1689 Johannes Bohn, of Leipzig, published a work on the examination of wounds. the distinction between ante-mortem and post-mortem wounds. the different effects of death by injury, strangulation and drowning. In another of his works, published in 1704, he gives rules for the conduct of physicians during court testimony. During the latter part of the 18th century German scientists published numerous books on the subject. Lectures in medical jurisprudence were given at the University of Edinburgh in 1792, and in 1806 the university gave the title of "Professor of Medical Jurisprudence" to A. Duncan, Jr. Thomas Percival, with his *Medical Ethics* (1803), made himself one of the first noteworthy English contributors to medical jurisprudence. and was followed by John Gordon Smith. In 1823, Paris and Fonblanque published the first English work which associated the medical and legal professions. In 1836, Alfred Swaine Taylor published his Elements of *Medical* Jurisprudence, an authoritative work. The first Spanish treatise on legal medicine (1796–97) was written by Juan Fernández de Valles. In 1844, Pedro Mata of Madrid published the first edition of a work on legal medicine and toxicology, which, in the development of its subsequent editions, became the most important Spanish treatise on the subject. The fathers of the modern school of scientific investigation were Hans Gross, a professor of criminology; R. A. Reiss, of the University of Lausanne and Alfred Niceforo. Most procedure came to follow their principles.

The old trial-and-error method in criminal investigation was rapidly displaced in the 19th and 20th centuries by scientific methods, including the use of very highly specialized instruments. Philip Valois had initiated the modern police system of criminal investigation. In Paris, as early as 1327, he appointed *commissaires,* or royal officers, who were not part of the judicial system and who conducted preliminary examinations in the enforcement of police regulations. The *Maréchaussée,* a military police, was organized in 1356, becoming the Gendarmerie in 1720. The first modern police organization, however, was founded in London in 1829. Twenty-five years later the Paris civil police were reorganized on the London model. In 1830 all ungarrisoned Prussian cities were authorized to establish a police force.

Large police departments make two major divisions of their detective force. First, there are groups of detectives assigned to definite geographical areas and responsible for the investigation of crimes committed therein. Second are the specialized "squads" or "details," formed for the purpose of dealing with specific types of crime such as homicide, safe burglary, forgery, and confidence games. These investigators are expected to possess special sources of information and an intimate knonledge of the special types of crime together with an acquaintanceship with the physical appearance, haunts and practices of known criminals.

With the development of rapid means of transportation the scope of an individual criminal's activity became greatly enlarged, and jurisdictional boundaries of police forces often hindered the success of an investigation. To combat this trend local police forces maintain close liaison with their neighbours by means of such methods of communication as teletype, telephone, radio and television. In this manner the pursuit of a fugitive can be pressed by broadcasting his description together with information concerning his haunts and personal habits.

The complex organization of the modern state led to the establishment of large investigative forces within the various departments of the government. Thus, the military, post office, state and other departments maintain their own, independent investigative units to conduct inquiries into crimes affecting these departments. Since these investigations are often nation-wide in scope, an elaborate system of report writing, mutual co-operation and centralized control has been developed. These agencies are also better equipped to cope with such crimes as espionage and sedition, which are directed against the nation as a whole and which, consequently, assume the form of a widespread conspiracy. In addition, the character of modern organized crime has tended toward increasingly complex structure. A key group of criminals, centrally located, may have representatives in every large city. Local police forces can deal with the problem only in a fragmentary way. A national investigative agency can form a coherent and unified picture of the crime situation and take the necessary remedial measures with the co-operation of the local police departments. (A. Vo.; C. E. O'H.)

METHODS OF INVESTIGATION

General Principles. — The threefold aim of the criminal investigator is to identify and find the guilty person and to provide evidence of his guilt. He must proceed objectively to gather data and uncover facts which may be presented in court to establish the guilt of the defendant. The final test of the efficiency of an investigation is the presentation of the evidence in court. Does the evidence establish the fact that a crime has been committed? Are all the elements of the offense present? Can the defendant be identified? Can he be associated with the scene of the crime? Has the probative value of the evidence been fully realized? Have competent, credible witnesses been obtained? Can all these elements of the investigation be integrated to provide an orderly, coherent presentation of the case so that the guilt of the defendant is established beyond a reasonable doubt under the appropriate rules of evidence?

To accomplish this objective the investigation must be intelligently managed at its inception. At the scene of the crime the evidence must be regarded from two points of view. First, will

it enable the investigator to reconstruct the manner in which the crime was committed? Second, mill it provide clues to the identity of the culprit? Thus, the examination and collection of the evidence should be made with a view to preserving its validity and integrity for ultimate presentation in court. The following procedures are useful: examine localities with minute care; make measurements of places and things, and take photographs; never alter the position of, pick up, or even touch an object before it has been described in the report; note all points where traces of the crime or important details are to be found, *e.g.*, clothing, fingerprints, footprints, hair, stains, and marks caused by firearms or tools; record and check statements of witnesses; interview persons living or employed in the district; obtain preliminary information regarding the crime from the victim, relative, or interested person.

Identification. — The major concern of criminal investigation is the professional criminal — the recidivist, whose name will appear periodically on the arrest record. If his identity can be conclusively established, his later efforts at concealment can usually be thwarted. A system whereby the identity of the criminal can be positively determined at each arrest is an invaluable aid to the investigator. The qualities of an effective identification medium are the following: (1) it should be fixed and unalterable by deformation or replacement; (2) it should be found on every person; (3) it should be unique for each person; (4) it should be susceptible of being recorded in a simple manner; (5) the records should be classifiable so that each person has a unique position in the files.

The search for a valid identification medium has been a constantly recurring quest in the history of investigation. Tattooing, branding, physical description, measuring and photography have had their successive vogues. The latter three methods, still in common use at mid-20th century, were established as techniques of identification by Alphonse Bertillon, chief of the identification bureau of Paris. He is best known for his development of the science of anthropometry in which an individual is identified by means of his bodily measurements. In the Bertillon system of identification, which he introduced in 1882, identification is completely accomplished by a series of refined bodily measurements, peculiar markings such as scars, and personality characteristics. Bertillon's system was later discarded by most police departments in favour of fingerprint systems, but his descriptive methods are used by investigators as an excellent means of furnishing a minutely descriptive verbal portrait of an individual.

Large police departments possess an identification division where experts compile information which will assist the investigator in his work. The duties of an identification expert are as follows:

1. To ascertain identification of the perpetrator of the crime prior to his apprehension (a) by the use of the alphabetical index when the name of the offender is known; (b) by photograph when the criminal has been seen by his victim or by witnesses; (c) by the *modus* operandi of the criminal; (d) by the handwriting of the criminal; (e) by finger impressions left at the scene of the crime.

2. To ascertain identification of offenders after arrest (a) by the alphabetical index; (b) by a photograph, where no fingerprints have been taken; (c) by the *modus* operandi system connecting the arrested criminal with numerous other crimes; (d) by comparison of the criminal's handwriting with documents connected with criminal offences; (e) by finger impressions of the criminal found at scenes of crimes committed by him, of which he was not suspected by the investigator; (f) by the ten-digit fingerprint system when the offender has been previously recorded in the bureau.

Fingerprints. — Identification by means of fingerprints (*q.v.*) was removed from the realm of theory and made practical by Juan Vucetich of Buenos Aires in July 1891. A fingerprint registry was established by him at La Platte on Sept. 1 of the same year to supplement the Bertillon system, which at that time was found to be wanting in many respects. Later the Bertillon system was eliminated.

Vucetich divided all fingerprints into four primary groups. The first group (arches) consists of all those designs formed by curved ridges without angles or deltas, the ridges extending from one side of the finger to the other without recurving. The second group (internal loops) has the angle or delta situated at the right of the person observing it and the directive lines have their exit toward the left. The third group (external loops) has the delta situated at the left of the person observing it and the direction of the lines runs to the right. The fourth group (whorls) has two deltas and the directive lines circumscribe circular figures.

In 1900 E. R. Henry published the system of fingerprint classification which was later adopted by English speaking countries, Henry divided all impressions into four types, namely: arches, loops, whorls, and composites; (1) in arches the ridges run from one side to the other without backward turn or twist and, ordinarily, have no delta; (2) loops have at least one recurving ridge and at least one ridge between the delta and the core. In ulnar loops the ridges recurve toward the little finger; in radial loops the ridges recurve toward the thumb; (3) whorls have at least one ridge making a complete circuit; (4) composites are patterns having characteristics of two or more of the foregoing patterns.

By means of these primary groups or types and by using a method of ridge counting between conventional points of reference, a set of fingerprints can be represented by a formula and filed accordingly. In each system it is a relatively simple matter to search for a given set of ten fingerprints. It is difficult, however, to discover the identity of a person from a single finger impression left at the scene of the crime, even though the criminal's fingerprints are filed in the identification bureau.

At the scene of the crime the investigator endeavours to discover the criminal's latent fingerprints, which he can "develop" or make visible for photography. The latent print is a thin layer of perspiration or grease deposited in the pattern of the friction ridges. Hard, glossy objects such as glass and enamel paint present ideal surfaces for the development of latent fingerprints. Dirty objects and absorbent materials do not readily bear prints. On smooth surfaces the print is made visible by carefully applying a fine powder of suitable colour with a brush. The powder adheres to the small amount of fat present in the perspiration or to the grease which frequently lies on the fingers. Chemical treatment such as iodine fuming or a 5% silver nitrate bath is used to develop fingerprints of paper. The silver nitrate reacts with the sodium chloride present in the perspiration to give silver chloride, a light-sensitive substance that darkens on exposure to a bright light source to reveal the fingerprint outline. The developed print is photographed and retained in the files for subsequent comparison with the prints of suspects.

Modus Operan&. — Criminals have a tendency to use the same techniques in their operations. Often the procedure is highly characteristic and will serve to identify the criminal and enable the police to attribute a series of crimes to one offender. Classification of criminals by their methods of operation thus became a permanent and invaluable feature of investigation. Some departments use the Atcherley *modus* operandi system for this purpose. L. W. Atcherley, originator of this system of classifying criminals according to their *modus* operandi, utilizes the following classes:

(1) Classword — Kind of property attacked, whether dwelling house, lodging house, hotel, etc.
(2) Entry — The actual point of entry, front window, back window, etc.
(3) Means — Whether implements or tools used, such as a ladder, jimmy, etc.
(4) Object — Kind of property taken.
(5) Time — Not only time of day or night, but whether church time, market day, during meal hours, etc.
(6) Style — Whether criminal describes himself as mechanic, canvasser, agent, etc., to obtain entrance.
(7) Tale — Any disclosure as to his alleged business or errand which the crlminal may make.
(8) *Pals* — Whether crime was committed with confederates, etc.
(9) Transport — Whether bicycle or other vehicle was used in connection with crime.
(10) Trademark — Whether criminal committed any unusual act in connection with crime, such as poisoning a dog, changing his clothes, leaving a note for the owner, etc.

Police Files. — Informational files are maintained by police departments to assist the investigator in his efforts to trace the fugi-

tive from justice. The primary purpose of these records is to indicate the source of evidence material discovered in connection with a crime. For example, a file of automobile tire patterns will assist in identifying a tire impression found at the scene of a crime. Automobile registrations and records of firearms will assist in establishing ownership. In addition to their own files the police have recourse to the records of the many governmental agencies that record titles, contracts, significant events, and official acts in general. Among other files maintained by the police the following prove exceptionally useful:

Missing Persons.—Each year thousands of persons are reported missing to the police. In addition, the police must investigate cases of unidentified persons, living and dead, since a suspicion of foul play is often present. Ordinarily the police are not concerned with adult missing persons unless they are wanted for the commission of a crime. Descriptive files are maintained of missing persons under the age of twenty-one, unidentified dead, and unidentified persons who are physically and mentally afflicted.

Laundry and Dry Cleaners Marks.—One of the best clues to the identity of an unknown person is the mark in his clothing placed there by the laundry, dry cleaner, or tailor. The dry cleaner, for example, identifies each article of clothing received by means of a set of numbers and letters. These marks are kept in a systematic file by larger police departments for the purpose of tracing a lost, dead. or wanted person by means of clothing, whether found on his person or at the scene of a crime. Each mark is associated with an individual laundry, dry cleaner's or tailor's establishment, which can often give the investigator the address of the wanted person. In many cities more crimes are solved by means of this file than through the medium of latent fingerprints.

Lost or Stolen Property.—Many burglaries are solved merely by tracing stolen property to the possession of the criminal. For this purpose police maintain a central cross-indexed file of property lost and articles of value pledged at pawnbrokers or sold to secondhand dealers. The common objects of larceny—automobiles, watches, jewelry, furs and cameras—usually bear identifying serial numbers or marks.

If the criminal disposes of the stolen article through a pawnbroker or a secondhand dealer, the police may trace him through the record of sale whicn is fonvarded to them by the dealer, as required by law.

Informants and Surveillance.—In combatting crime the police require an effective system of positive intelligence. Owners of licensed premises, cab drivers, bartenders, and others whose business involves contact with the public at late hours are excellent sources of information. Their co-operation can be enlisted without any difficulty because of the nature of their occupations. In some countries criminals, prostitutes, gamblers and other underworld characters are employed as undercover agents and report regularly to one or more contact officials. A safe burglar lavishly spending money; a bandit suffering from gunshot wounds; an automobile thief with stolen licence plates; a pawnbroker buying "hot stuff"—all these are types of instances reported to contact officials by undercover agents. Apart from the regularly employed undercover agents, individual investigators obtain information from criminals and other persons whom they have befriended.

It is customary in some courts for the judge to instruct the jury to weigh with extreme care the testimony of informers and accomplices, since their credibility is particularly vulnerable to attack on the grounds of character as well as motivation. In general, a conviction cannot be had upon the testimony of an accomplice unless corroborated by other evidence. A coniession of the accomplice cannot be used against another offender unless it is made in court or unless the confession was made in the presence of the accused and he made no reply or otherwise failed to deny it.

Where the services of an informant cannot be obtained, the investigator can initiate a surveillance of criminal activities. This may be done by covert observation or by arranging to have a police agent work within the criminal group, ostensibly as one of them, When this method is successfully employed, it is extraordinarily effective since it provides the direct testimony of a reliable witness. Past crimes can be solved and projected illegal ventures anticipated. Another form of surveillance is the "planting" of microphones and "tapping" of telephone lines. Radio communication can also be employed.

Legal difficultiesare encountered with evidence obtained through tapping telephones or planting microphones. The United States code prohibits the use of information acquired by tapping a telephone as evidence against an accused. if he is being tried in a United States district court. State courts are less rigorous in the limitations they place on evidence of this nature, some permitting the interception of telephone messages if a court warrant is first obtained. In regard to information acquired by means of concealed microphones, federal courts have ruled that such evidence is permitted if the microphone is installed without committing a trespass. For example, placing a contact microphone on the opposite side of the wall of the hotel room of a subject would not constitute a trespass.

Interrogation.— Since the purpose of a criminal investigation is to discover the truth of the facts surrounding a crime, obviously the shortest road to this goal is to obtain a confession from the guilty person and to elicit significant information from witnesses and informants. The skilful interrogation of a suspect is often the key to a successful investigation. Experience, shrewdness, patience, and imagination are required for effective questioning. Guile, forcefulness of character and practical psychology must be employed without resorting to duress or other violation of the suspect's rights. The interrogation is, therefore a delicate proceeding, since a confession obtained in violation of the suspect's rights can be repudiated in court.

The skilful interrogator briefly analyses the character of the subject and estimates his weaknesses. Experimentally he assumes different attitudes and employs various procedures to determine the most effective technique of questioning the subject. If he can enlist the subject's co-operation, a confession will be readily forthcoming. In the case of a reluctant or obstinate subject, he will endeavour to lead him into contradictions, inconsistencies and improbable statements, thus showing him the futility of continued deception.

The most difficult of all subjects is one who flatly refuses to talk about the case. In these situations, the investigator, who must respect the rights of the subject, is usually forced to abandon the interrogation and rely on other types of evidence.

Detection **of** Deception.—The act of lying is ordinarily accompanied by a bodily reaction such as flushing, increased heart beat, swallowing, or other evidence of emotional reaction. Some understanding of the practical psychology of lie detection has always been part of man's knowledge. The 20th century saw the introduction of a number of efforts to apply instrumentation to the art of detecting deception. These instruments are called "deception indicators" or "lie-detectors." Their function is to produce a record of physiological phenomena which may be used as the basis of applying a technique for diagnosing deception. The success of a deception indicator depends on the sensitivity of the mechanism, the phenomena chosen for record, and the ability of the operator.

It cannot be stressed too greatly that the greatest single factor in the success of a lie detection technique is the professional capacity of the operator.

The phenomena which should be chosen for recording are those that are not subject in any great degree to voluntary control and which, moreover, are such that the subject is not usually aware of them. Experts in the field consider blood pressure, pulse and respiration as the most dependable criteria. The electrodermal response or current flow between two different areas of the body is also considered useful. To these was added the unobserved muscular activity which has been found to affect the blood pressure. None of these phenomena is a sufficient indicator in itself, but taken together, their recording offers an effective means of determining deception. The blood pressure-pulse-respiration recorder employs pens to record impulses on moving graph paper driven by a small synchronous electric motor. A pneumograph tube is adjusted around the subject's chest and a blood pressure-

pulse cuff is strapped around the arm. The examiner first acquaints himself with the details of the case. He establishes norms of reaction by asking preliminary questions of an irrelevant nature and then injecting questions pertaining to the investigation. Three or four lie-detector records are ordinarily required for a diagnosis. A study of the graphical records and an evaluation of the deviations caused by certain responses will reveal unusual emotional activity. To attach significance to a given reaction the response must appear on at least two different test records.

Although the lie-detector test proved a great boon to the investigator, information obtained by this means is not generally accepted as direct evidence in the United States courts of law. Many of the court decisions denying recognition to this evidence have been based on the contention that the technique has not won general scientific acceptance. Confessions obtained consequent to but not as part of a voluntary lie-detector test have been admitted. In the event that these tests are accepted as competent legal evidence, it is anticipated that the question of compulsory tests will give rise to legal disputes as to whether they affect the subject's privilege against self-incrimination.

SCIENTIFIC AIDS

Police Laboratory.——With the rapid advance of scientific methods of analysis physical evidence such as paint, dirt, and fibres assumed increasing importance as sources of clues. After 1920 the larger police departments endeavoured to employ experts for the purpose of examining evidence at the scene of the crime and at the laboratory. These police scientists are distinguished from medical examiners in that the latter are ordinarily concerned with homicides and then only with regard to the cause of death and the nature of the fatal weapon. The police laboratory expert, however, must deal with a wide variety of crimes and with all the possible clue materials that can be used to provide evidence. The application of the physical sciences to the detection of crime is sometimes called scientific criminology or, more specifically, criminalistics. Chemistry, biology. and physics are the major branches of knowledge employed in examining evidence.

The physical evidence found in connection with a crime may be divided into two classes. In the first the evidence constitutes part of the corpus *delicti;* it is one of the essential facts of the crime. Thus the white powder found on the person of an alleged narcotics seller constitutes an essential part of the crime. It must be identified as being a particular narcotic such as heroin or morphine. Poisons and other substances used illegally fall into this category. The second class consists of associative evidence, clue materials which link a suspect to the scene of the crime and thereby establish a higher probability of his guilt. A suspect, for example, apprehended near the scene of a burglary may have glass fragments in the lining of his trouser cuffs. A spectrogrdphic analysis of the glass fragments may show that the chemical composition is the same as that of a broken glass window at the scene of the crime, thus connecting the suspect with the crime. Similarly a foot impression at the scene of a murder can be traced to the owner of a particular shoe; a flake of paint at the scene of a motor vehicle accident can be connected with a definite automobile; a tool mark can be matched with the defects in the blade of a burglar's jimmy. In all these comparisons the aim of the investigator is the same as that of the fingerprint expert: to discover a sufficient number of characteristics in the evidence to connect it uniquely with a known source by the laws of probability.

Chemical Analysis.— The forensic chemist ordinarily performs the relatively few biological examinations as well as the chemical analyses associated with criminal investigation. In cases of homicide the medical examiner makes the examinations connected with the autopsy and the cause of death. In the field of biology the chemist is primarily concerned with blood and semen stains. Semen stains occur in connection with rape cases, and their analysis is a simple microscopic examination to discover spermatozoa. Blood stains are found quite commonly in assault cases. A preliminary field test such as the benzidine or the phenolphthalein test is used to establish the probability that the stain is blood. These tests require only a minute stain area. The precipitin test, employing a larger area, may then be used to determine whether the blood is human. Depending on the amount, age, and preservation of the stain, the blood may be grouped into one of the four major divisions and in some cases into the subdivisions.

Micro-analysis is employed by the forensic chemist to study structures by means of the compound microscope. Minute quantities of trace materials can be identified and their source determined. Plants and animal tissues, vegetable, animal, and synthetic fibres, sand. soil, and minerals are recognized and their connection with the case under investigation is established.

Deposits found under fingernails and dust or stains found in or attached to clothing or weapons have furnished the investigator with significant clues. Hair can be identified as human and the race of the person determined from it. It is not, however, possible to identify hair as belonging to a single individual. At best a similarity can be established.

The most challenging problem of the police chemist is the analysis of a minute sample of evidence material such as paint or glass to determine the source of the substance. If sufficient trace elements and impurities are present. the evidence sample can be connected uniquely with the source material. A stain on a suspect's shoe can be shown to have been acquired at the crime scene. The spectrograph serves well in this work.

Instrumentation has provided other techniques of rapid chemical analysis such as X-ray diffraction, spectrophotometry, and electron microscopy. These instruments can deal with minute samples. which are often the only clue present, and can reveal physical or chemical characteristics so great in number, so diverse in nature or so rare in occurrence as to preclude all but a negligible probability of duplication by coincidence. They permit analysis nithout disturbing the sample, thus making it possible to keep the evidence intact for presentation in court and for tests by the defense.

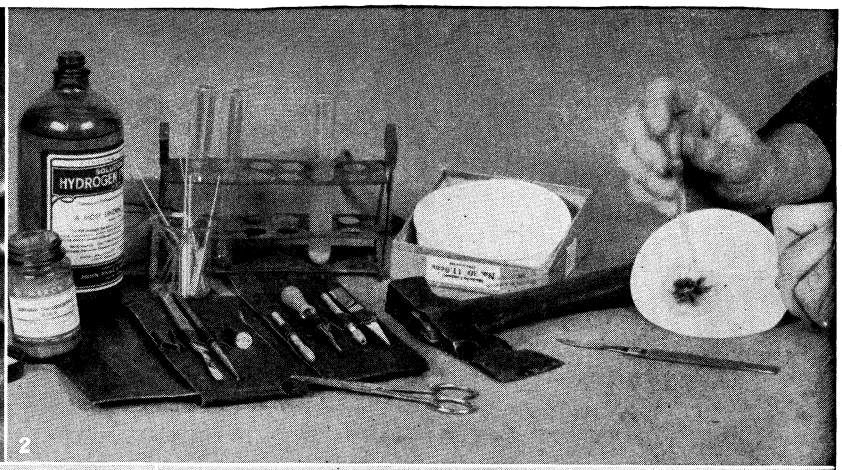
Moreover, a police scientist does not have to be an expert in every branch of chemical analysis to use these instruments effectively. A reasonable familiarity with the techniques, the basic materials, the fillers, and the accidental trace elements of the industries from which his samples come is usually sufficient.

Photography.— Of the technical aids available to the investigator the camera is by far the most important and the most widely used. The full resources of photographic science are employed: photography through the spectral range from the infra-red region to gamma rays; photomicrography; microphotography; cinematography; orthostereoscopy; radiography in the hard and soft X-ray regions; and electron photomicrography. Six major functions are served by investigative photography: (1) for identification records, it provides a picture of the criminal or missing person; (2) in conducting a surveillance the, camera can be used to obtain a visual record of the illegal activities; (3) the original appearance of the scene of the crime can be preserved for the court's consideration; similarly, a re-enactment of the crime can be recorded in motion pictures for court demonstration; (4) the initial appearance of evidence can be photographed before it is submitted to necessary changes by the police laboratory; (5) the camera can be used to reveal hidden aspects of the evidence; by the employment of filters or magnification certain details and relationships of the evidence can be revealed and emphasized to prove a point in question; (6) to demonstrate investigative findings to the court the photograph serves as an invaluable visual aid. Court exhibits in the form of photographic enlargements vividly supplement the testimony of investigators and laboratory experts and provide a meeting ground for the contentions of opposing counsels.

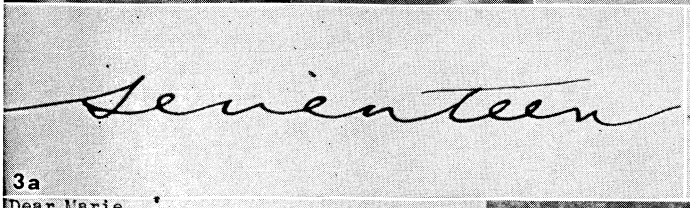
Firearms.— In crimes of violence, the bullet or cartridge case found at the scene of a homicide is often the most valuable clue available to the investigator. From an examination of these articles of evidence the firearms expert is usually able to determine the type of ammunition and weapon employed. From his knowledge of ballistics (*q.v.*) and the characteristics of various types of firearms he endeavours to determine the distance and direction of discharge by examining the size and relative positions of bullet holes. The owner of a firearm left at the crime scene may often be determined by tracing the serial number from records of

INVESTIGATION, CRIMINAL

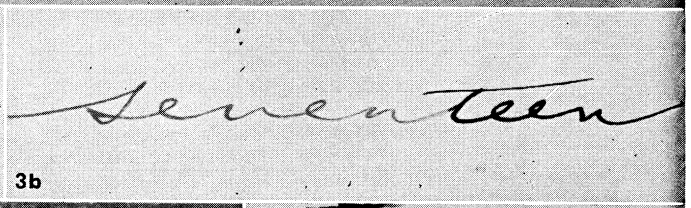
1



2



3a



3b

Dear Marie,

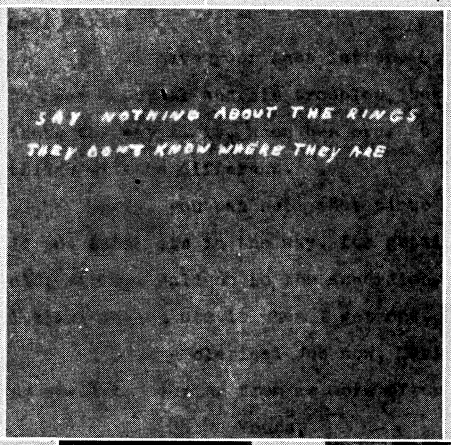
I have your last letter. Sorry to hear about Al and his troubles, but thats the way Al is. When hes over it things will be different.

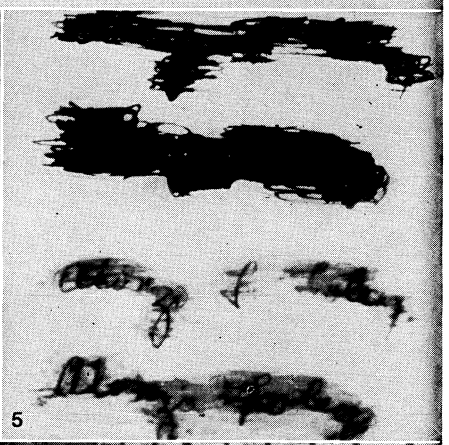
Marie, you can sell that piano if you think its in the way. Its getting old, anyway. Hold on to the accordion. I think I can use it when I get out.

I have a clerical job now, Marie, so youll be hearing from me more often.

Yours.

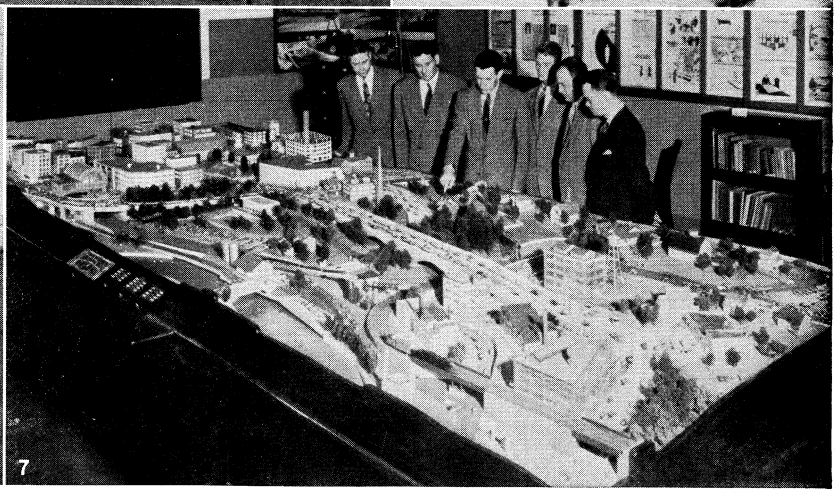
4





5

6



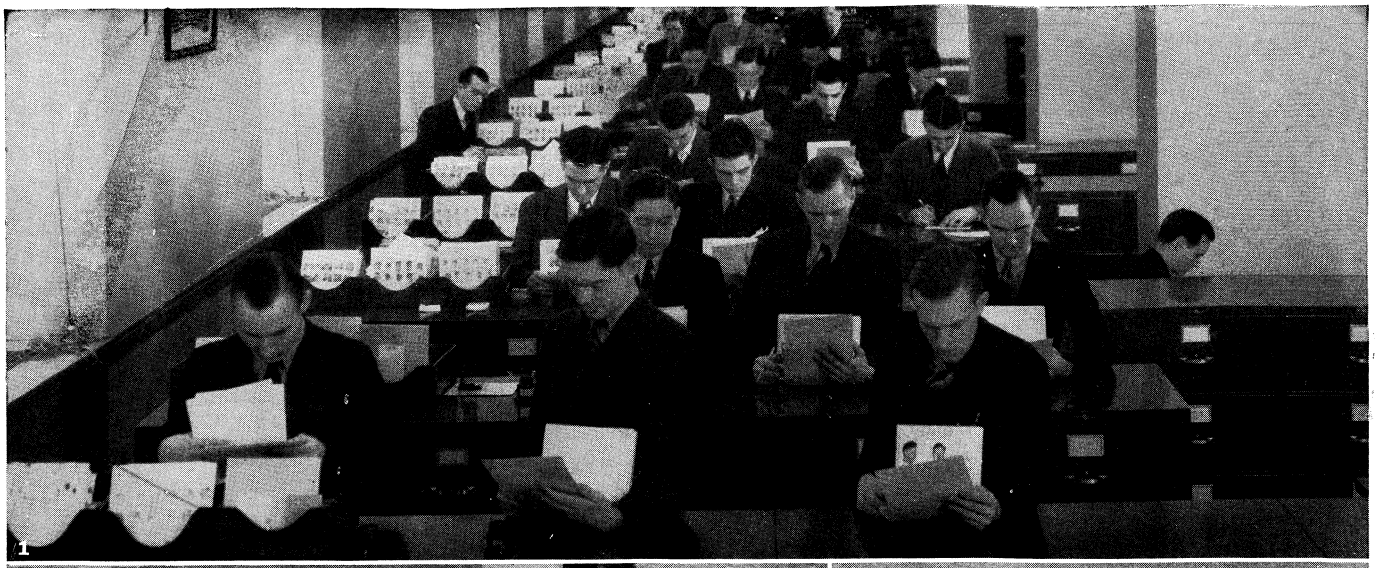
7

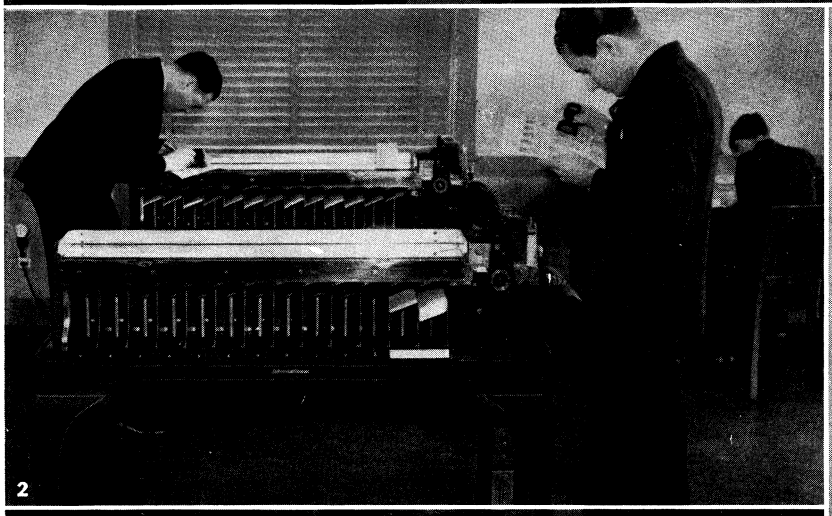
BY COURTESY OF (1–5) NEW YORK POLICE DEPARTMENT, (6) JOHN E. REID & ASSOCIATES, (7) FEDERAL BUREAU OF INVESTIGATION

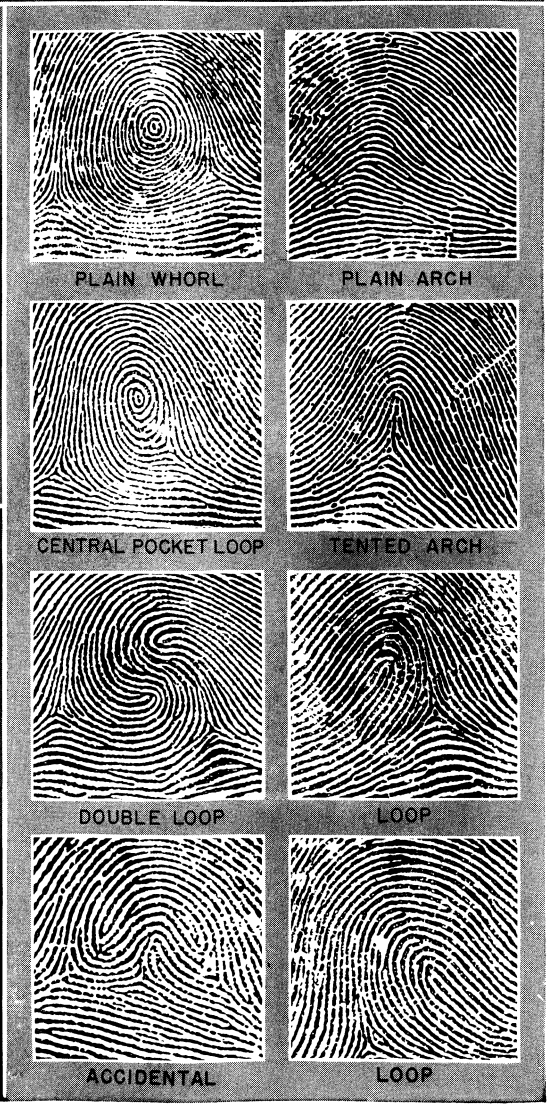
TECHNIQUES OF CRIMINAL INVESTIGATION

1. Photomicrograph comparison of firing pin markings on two bullet shells. The concurrence of the fine lines in the central area indicates that both the evidence shell (left) and the test shell (right) were fired from the same gun
2. Chemical testing for blood stains on an ax found in connection with a homicide
3. Using infra-red radiation, film and filter, suspected check (a) is shown to be a forgery (b), the letters "teen" having been added to the original word "seven" at a later time with a different ink
4. An apparently innocuous note (left) is photographed by means of its fluorescence under ultra-violet radiation to reveal secret writing (right)
5. Blue ink signatures obliterated with red ink (top) are rendered visible (bottom) by use of a red filter and panchromatic film
6. Posed picture of a subject undergoing examination with a lie detector
7. Model city used at the national academy of the Federal Bureau of Investigation for Instruction in raid, arrest and traffic problems

INVESTIGATION, CRIMINAL







OFFICIAL PHOTOGRAPHS, FEDERAL BUREAU OF INVESTIGATION, U.S. DEPARTMENT OF JUSTICE

FINGERPRINT RECORDING AT THE FEDERAL BUREAU OF INVESTIGATION

1. Section of the fingerprint files department, where finger impressions are classified and compared
2. Electrical sorting machine which obviates the necessity of searching among large groups of fingerprints. punch cards bearing coded classifications are seoarated by electrical contacts
3. A child being fingerprinted in the identification division of the Federal Bureau of Investigation. The bureau maintains separate noncriminal files for civil identification

In the various fingerprint patterns illustrated, whorl types are shown in the left column; other types in the right column

But investment in a wider sense includes hoarding, since that too is an addition to the individual's capital, though in money form. His investment cannot therefore be different from his saving. Saving and investment are only different aspects of the same phenomenon. If we look at it as the part of his income which he does not consume we call it saving. If we look at it as the addition to his capital (which is what any unconsumed income must be) we call it investment. Every individual's investment is equal to his saving.

The Social Point of View.—Investment by an individual does not necessarily mean social investment. If an individual invests by buying a security there is no investment from the point of view of society because there is no addition to society's capital. The individual's private investment is offset by the equal private disinvestment of the man who sells the securities which he buys. Nor does hoarding by an individual constitute social investment. Any increase in the amount of money held by one individual must diminish the amount of money held by the others, the hoarding being offset by the dishoarding, unless the total amount of money in the economy is increased. And even in that case there would be no addition to the social capital, the issuing of new money being itself a kind of dishoarding by the monetary authorities.

On the other hand if an individual builds a new factory with borrowed money this is not private investment by him because his own wealth or capital is not increased by the value of the factory, but it is social investment because it is an addition to social capital. Although there is no reason why any individual's social investment should be equal to his private investment, the sum of all the social investment by the individuals (the total social investment) is equal to the sum of all the private investment by individuals, and so also equal to the sum of all the private saving (which is the total social saving). Total social investment is equal to total social saving just as any individual's private investment is equal to his private saving. This is because every divergence between an individual's private investment and his social investment is due to an equal and opposite divergence for somebody else. Only when an individual's private investment is offset by another's private disinvestment or when his hoarding is offset by another's dishoarding can there arise any divergence between an individual's private investment and his social investment.

Individual incomes can be considered either from the point of view of where they come from or from the point of view of where they go—either as income created in one way or another or as income available to be used in one way or another.

The first point of view shows that all individual incomes originate from the sale of goods and services and are created by the outlay of the purchasers. The goods and services are either consumed or not consumed. If any goods are not consumed they are additions to the social capital and constitute social investment.

The second point of view enables us to see that all incomes available to be used can be divided into the part that is spent on consumption and the part that is not consumed but saved—that is, into consumption and saving. The part of total income that is created by consumption must be equal to the part of total income that is spent on consumption, since these are merely two different aspects of the same transactions. It follows that the remaining part of the total income created—the total social investment—must be equal to the remaining part of the total income available to be used—the total social saving—and so also to the sum of individual private investment. Since total social investment and total private investment can never differ from each other, it is possible to speak simply and yet unambiguously, of total investment which is both social and private. It does not matter whether total investment is considered as the sum of individual private investment or of individual social investment.

But in the case of individual investment it is necessary to be very clear whether private or social investment is meant. Most of a prolonged discussion in the 1930s about differences between saving and investment was due to the use of mixed definitions, individual saving being defined as private saving while individual investment was defined as social investment.

Investment and Income—The decisions to undertake (private) saving and the decisions to undertake social investment are freely made by different people and in response to apparently quite different stimuli. But the fact that their sums are inevitably equal shows that there must be some connection which compels this equality and belies the apparent freedom. To some degree the compulsion takes the form of unintended social investment in swollen inventories forced on sellers by the saving of customers who restrict their purchases. But this can last only as long as the sellers acquiesce in increasing inventories. Much more important is the effect of social investment in making individuals save.

There is first of all the direct effect. An increase in social investment creates additional income and so there is inevitably an equal increase in saving. This direct saving can last only until the recipients of the additional income consume some of it. But as quickly as they consume it, so that their additional saving disappears, they create other income by this consumption expenditure so that the total rate of saving is not diminished at all and stays equal to the increased rate of investment.

The degree to which a change in investment will indirectly affect the level of income depends on the marginal propensity to consume. This is the fraction of any increment of income that the society will consume out of the increment of income, saving the rest of it. The marginal propensity to save is the complementary fraction. The ratio of the increase in income to the increment of investment is the inverse of the marginal propensity to save and is called the "multiplier." Thus if the marginal propensity to consume is four-fifths, the marginal propensity to save is one-fifth and the multiplier is five. An increase in the rate of investment of $roo (per week or per month) results in an increase in income of $500. Only when income has increased by this amount will the population feel that the additional $100 which it cannot help saving corresponds to what it freely and voluntarily wants to save.

The increase in income, which makes the public feel they are perfectly free agents in deciding to save just as much as is being invested, must be an increase in real income and not merely in the money value of the same real income through a rise in prices. Such a real increase is possible only if there are unemployed resources which can be put to work to produce additional real income. The multiplier measures the effectiveness of investment in increasing the national income in times of depression. The $100 of investment not only directly increases the accumulated capital wealth of society by this amount but indirectly results in an increase in output of consumption goods by another $400 which would otherwise have been wasted in unemployment.

The indirect benefit stems from the income-creating effect of the investment and will be just as effective even if the products produced directly by the investment should turn out to be completely useless—even if it consists of paying people for "digging holes in the ground and filling them up again." It is of course better for more useful things to be done, but because of the indirect benefits in increasing consumption and income it is better, in times of depression, to invest in completely useless activities than to permit resources to remain unemployed. There is however no need for such wasteful investment, even if no useful investments are possible, because additional expenditure on consumption is just as income-creating as investment. The multiplier works just as much on an increase in consumption as on an increase in investment. An investment of $100 by the government in subsidizing additional consumption by some deserving part of the population will also increase income by $500. Of this, $400 will be spent in buying additional consumption goods that would otherwise not have been produced while $100 will be saved parallel with the increased investment.

Special Definitions of Saving **and** Investment.—The inevitable equality of saving and investment has oppressed many economists who sought to discover a source of economic instability in differences between the two. The more careful of these have seen that it is necessary to give a special definition to at least one of the terms if reference to differences between them is to be meaningful.

Since saving is defined by all economists as the excess of in-

come over consumption, it is possible to redefine saving by redefining income. In *A Treatise on Money* (1931), John Maynard Keynes defined "normal" income as actual income exclusive of windfall profits. The resultant saving is therefore less than saving in the usual sense by the amount of these windfall profits and is less than investment by exactly the same amount. An excess of investment over such saving is equal to the windfall profits and an excess of saving over investment is equal to windfall losses. Such differences reflect important causal forces operating on the economy which cannot be expressed as differences between the usual saving and investment. But these forces can be discussed just as effectively without the special definitions by simply speaking of the effects of windfall profits and of windfall losses. When this was made clear Keynes abandoned his special definitions.

Professor D. H. Robertson found many followers in defining income as the income earned in a preceding period and consequently disposable for consumption or saving in the current period. His saving is consequently obtained by subtracting consumption from the income earned yesterday instead of from today's income, and differs from saving in the usual sense by the difference between yesterday's income and today's income.

This procedure is useful insofar as it draws attention to the income earned yesterday as one of many influences on today's consumption. But it tends to give excessive emphasis to this influence and encounters very great difficulties in trying to fit many different time lags into a single series of periods of days. It has led many to say that an excess of saving over investment causes income to fall when it does nothing but repeat in other terms the amount by which today's income is less than yesterday's. There seems to be nothing which this difference between saving and investment enables us to say that cannot be said more clearly in explicit statements about changes in income from period to period.

Professor Gunnar Myrdal and the Swedish economists distinguish between *ex ante* and *ex post* concepts of both saving and investment. *Ex post* saving and *ex post* investment are the actual saving and investment that take place as they would appear to anyone *ex post* or *after the event,* and are inevitably equal to each other. *Ex ante* saving and *ex ante* investment are the amounts that the public expects to save or invest — in each case *ex ante* or *before the event.* Since expectations may be in error there is no need for these to be equal to their *ex post* counterparts or to each other. It is therefore possible to speak without self-contradiction about differences between saving and investment if these are defined as *ex ante.*

In an economy where all expectations are fulfilled there is no difference between *ex ante* and *ex post* and there cannot be any difference between saving and investment even *ex ante.* A difference between them, therefore, indicates that we are not in such a society because it means that the expectations are inconsistent with each other and therefore cannot both be fulfilled. But it does not tell us how the expectations mill be falsified or in what direction. Furthermore, the absence of any difference might merely mean that equal errors are made in both sets of expectations or that correct expectations about saving and investment are accompanied by serious instabilities in the level of income because of inconsistent expectations about other important elements such as the level of consumption.

All the advantages of *ex ante* analysis are obtained more simply and more thoroughly by R. G. Hautrey *(Capital and Employment,* 1937), who speaks of planned or active investment and saving. Unintended or passive investment can take place when sellers find they have unwittingly invested in stocks that they had expected to sell, and unintended saving can take place when there is an unexpected increase in one's income or a failure to spend because of the temporary unavailability of goods to buy. This procedure enables one to consider separately all the unexpected elements, positive and negative, which are merged in their algebraic sum called the difference between *ex ante* saving and investment.

Net and Gross Investment. — The definition of income as the amount that can be consumed without eating into capital is not quite free from arbitrariness. Capital is a variable collection of many different kinds of things, some of which are worn out and replaced by others and even by entirely new elements. There is always some arbitrariness in deciding just how much of the total output must be considered as replacing the disappearing old elements. Saving and investment suffer from the same arbitrariness because the definition of saving is derived from that of income, and because the definition of investment as additions to capital means additions over and above the replacements necessary to keep the capital intact.

This arbitrariness is not of practical significance since the same conclusions always follow, no matter where the line is fixed from which income, saving and investment are to be measured, as long as the same line is applied to all three concepts and is not moved in the middle of the argument. The arbitrariness can be avoided altogether by considering *gross investment* which includes all expenditure on output which is not consumed, whether it is needed for replacement or not; *gross income* which includes the expenditure on all output whether consumed or not (*i.e.,* it is equal to the sum of gross investment and consumption); and *gross saving* which is the excess of gross income over consumption, and which is always equal to gross investment.

The Determinants of Investment. — The volume of investment, together with the volume of consumption, make up the income of society and determine the volume of output and employment. Investment comes to much less than consumption but it is of special importance for problems of employment because investment is much more variable than consumption and the changes in consumption are themselves due to changes in income brought about primarily by the multiplier operating on changes in the volume of investment.

The volume of investment in society is determined by the decisions of the entrepreneurs who undertake social investment. These decisions themselves depend on the entrepreneurs feeling that the chances of gain outweigh the risks of loss. While subtle psychological influences are very important in colouring the entrepreneurs' judgments, there are several general objective elements that are also important in determining the volume of investment.

The volume of investment will be greater if the level of income is greater because this means better prospects for the success of any venture as well as a more optimistic entrepreneur. It will also be greater if the rate of interest is lower because among the costs must be reckoned the interest on the capital invested. Even if the investor invests his own capital, so that he does not have to borrow it and actually pay interest, he must count among the costs of the investment the interest that he could have earned by lending out his capital instead of applying it to social investment. This element is not as important as it used to be because with the modern rate of technical advance in many fields an investment must often pay for itself in three or four years or less. For such short periods the interest becomes unimportant in relation to the capital amortization that must be earned, especially at the low rates of interest that monetary authorities are likely to maintain to facilitate the management of the enormous public debts incurred during World War II.

The Marginal Efficiency of Investment. — The relationship between the volume of investment and the rate of interest can be illustrated by a curve or schedule showing a greater rate of investment for lower and lower rates of interest. Relative unimportance of the rate of interest would mean that changes in it would result in relatively small changes in the rate of investment. At any rate of interest the rate of investment would adjust itself to the volume where the yield on an increment of investment which is the *marginal efficiency of investment* is just equal to the rate of interest.

The marginal efficiency of investment is frequently called the "marginal efficiency of capital," following Keynes who first clarified the concept but gave it this unfortunate title which suggests that it is a function of capital rather than of investment.

The actual connection between capital and investment is that as investment takes place the capital of society is being added to uhile the opportunities of profitable investment are being used up. This has the effect of lowering the whole schedule of the marginal

efficiency investment, diminishing the rate of investment corresponding to each rate of interest on the schedule.

The Mature **Economy.**—Other forces tending to diminish the opportunities of profitable investment are the declining increase in population and the end of the frontier of free land. This means that the investment opportunities used up as the capital grows are no longer being recreated to the same extent by an increase of the other factors, labour and available land. A recognition of this has given rise to the notion of the mature economy. in which consumption can be increased because resources need no longer be used up so much in investment (and in which consumption must be increased if the decline in investment is not to cause extremes of unemployment).

Many economists have tried to belittle the argument by pointing to the investment opportunities to be provided by the increasing rate of new inventions. This overlooks an important change in the nature of inventions. In the 19th century most inventions resulted in the substitution of production with complicated machinery for production by hand and so created vast opportunities for investment in providing the machinery. In the 20th century, inventions result more and more in the substitution of one kind of machine production for another. Whether an invention increases investment opportunities or decreases them depends on whether the new machine absorbs more capital than the old one. It is .impossible to say beforehand which kind of invention is likely to predominate.

Investment Policy.—Investment policy consists of governmental measures for encouraging or discouraging either particular investments or the rate of investment in general. Discouragement of investment is easily accomplished by taxes, by credit restrictions, by curtailing supplies, or even by direct prohibition. It is important only when demand threatens to outstrip supply as in times of wartime shortages. Investment policy is nearly always concerned with the encouragement of private investment or the direct undertaking of public investment.

Some people believe that only private investment can safely be expanded while others believe that only public investment can work in the general interest. The experience of public investment in the depression of the 1930s and in World War II has tended to make the partisans less extreme so that more and more would allow the kind of investment they disapprove of to be undertaken in cases where it can clearly be shown to work much better than the other kind. This is only a step from the rational view that both kinds of investment are periectly legitimate and that each should be able to supplant the other wherever it is more efficient in serving society.

In capitalist societies it is still felt that public investment needs special justification, such as that without public investment some useiul investment would not be undertaken at all.

In time of depression this special justification is satisfied not only by highways and flood control and the like, hut by any kind of investment that provides employment for workers who would otherwise be unemployed. The public investment is of great social useiulness, even if the immediate product is not counted at all, because of the multiplier effect in increasing employment in the production of additional consumption goods.

Such benefits are not limited to investment but flow from any kind of additional expenditure. They derive not irom the direct addition to social capital but irom the income created by the additional expenditure. The recognition oi this has led to an extension of the word investment to cover additional expenditures even if they do not directly add to social capital. When men were employed by the government in the depression to rake leaves, the expenditure was called government investment because the effects of providing employment and increasing the demand for and output of consumption goods were just the same as if real investment had been taking place and these effects were much more important than whether or not real investment—additions to social capital—was taking place.

This extension oi the meaning oi investment can be reconciled with its relationships to income and saving by redefining investment as expenditure (in this case by the government) other than on goods currently being consumed. Normally this will mean expenditure on goods that are produced but not consumed so that they are additions to the capital stock, but the definition also covers the case where the expenditures are made without bringing about any addition to social capital. This is not so serious a perversion of language because whether any investment will in fact bring about an addition to the social capital is always a matter for the iuture. There may in the end turn out to be no real useful increase in social capital, even if the investor's intentions are of the best. The future useiulness of any investment may be destroyed by fire or flood, by new inventions or by competing investments, or may simply have been misguided in the first place.

As it becomes clearer that investment is important for employment policy only as one of several forms of income-creating expenditure, it becomes more and more possible for governments to maintain a satisfactory level of employment without having to disguise their operations on total expenditure as investment. Thus in March 1945, the Swedish Postwar Planning commission, headed by Gunnar Myrdal, proposed to combat unemployment in depression by subsidizing the sale of clothes and household equipment, on the theory that these are more useiul than investment in digging holes in the ground and filling them up again. The completion of this process of clarification will enahle the kind of expenditure to be supported which is socially most useiul even if it means increasing the output of even less durable goods than clothes and waffle irons.

BIBLIOGRAPHY.—R. F. Kahn, "The Relation of Home Investment to Unemployment," *Economic Journal* (1931); J. M. Keynes, *The General Throry of Employment, Interest and Money* (London, New York, 1936); R. G. Hawtrey, *Capital and Employment* (New York, London, 1937); Bertil Ohlin, "Some Notes on the Stockholm Theory of Saving and Investment,!' *Economic Journal* (1937); Alvin H. Hansen, *Full Recovery or Stagnation?* (New York, London, 1938); F. *A.* von Hayek, *Profits, Interest and Investment* (London, Toronto, 1939); Gottfried von Haberler, *Prosperity and Depression,* new ed. (New York. London, 1939); American Economic Association, *Readings in Business Cycle Theory* (Philadelphia, 1944); Abba P. Lerner, *The Economics of Control* (New York, 1944; London, 1945); L. Klein, *The Keynesian Revolution* (New York, London, 1947); L. M. Lachmann, "Investment Repercussions," *Quarterly Journal of Economics* (1948); B. S. Kelrstead, *Thr Theory of Economic Change* (New York, London, 1949): R. F. Harrod, *Towards a Dynamic Economics* (London, New York, 1948); J. R. Hicks, *Contribution to the Theory of the Trade Cycle* (London, New York, 1950); F. and V. Lutz, *The Theory of Investment of the Firm* (Princeton, N.J., London, 1951).

(A. P. LR.)

INVESTMENT BANKING. Business enterprises attempt to make a profit by rendering a product or service more want-satisfying than its competitors and by selling it at a price higher than its cost of production. This process requires an extensive variety and large amounts of physical goods. Enterprises assign to each physical object in use a value, stated in the currency of the country in question, combine these objects into groups and list the value of these groups of objects on the asset side of their balance sheets. These assets represent purchases made with cash obtained from various sources. Assets are spoken of as uses of funds. The sources from which funds are acquired are listed on the opposite side of the balance sheet and are designated as liabilities and capital. . The part which investment banking plays in the acquisition of business funds can be described in two ways. (1) In a broad sense, investment banking includes all the institutions and processes by which capital formation takes place, including: (a) the transfer of ownership of existing wealth through brokerage houses; (b) security substitution, such as is involved in the issuance of securities by investment companies; and (c) security management, or the decision as to where investors' funds are to be placed. (2) In a narrower sense, investment banks are firms which originate, underwrite and distribute new security issues of corporations and government agencies.

Investment banking requires an understanding of the place of the corporation in modern economic society and of the organization of the market for funds within which investment banking makes funds available.

It is often said that modern production is "capitalistic," that it requires large amounts of physical capital, of assets, of funds used. This need for funds explains to a significant degree the shift from the sole proprietorship and the partnership to the corporation as the dominant legal form of business organization. Individual proprietorships and partnerships can for the most part look only to their owners, one or a few, as sources of funds. Corporations can obtain funds from thousands and hundreds of thousands of owners (shareholders) and can obtain these funds by varying the terms of successive stock issues in such a manner as to make the most effective appeal to prospective stock purchasers. In addition, corporations can borrow funds and can tailor their debt contracts to the requirements of lenders. The corporation has access to larger amounts of funds because it can offer a greater variety of security contracts and thus can adapt itself to the willingness or unwillingness of investors to take risks. Bonds (debt contracts) can be offered when investors demand safety; stocks (equity contracts) can be sold when investors are willing to take greater risks for the opportunity of greater gains.

The market for funds, the commodity with which investment deals, is made up of the demand for funds and the supply of funds. Three important component parts of the demand for funds may be distinguished. The business demand for funds has already been mentioned. Similarly. governments and public authorities demand funds for the construction of public buildings, highways and governmentally owned utility plants. Third, consumers enter the market to borrow funds to finance the purchase of homes and other durable consumer goods. The supply side of the funds market is made up of four constituent parts. Individuals save portions of their disposable income and make them available in the funds market through the purchase of bonds, stocks and mortgages. Financial institutions (insurance companies, savings and loan associations. investment companies) and nonfinancial institutions (churches, hospitals, universities) receive funds from individuals and make them available to fund users by buying securities. Business corporations provide funds by retaining portions of income earned and using this income to purchase operating assets, thus supplying some of their own demand for funds And governments may provide funds by collecting taxes in excess of current revenues and investing the funds in outstanding government security issues.

Institutions in the Funds Market. — It has been pointed out that individuals, financial institutions and government; operate in the market for funds. The financial institutions referred to in this sense are sometimes called fund-aggregative institutions. They obtain funds through some form of arrangement with those whose investments they manage. For example, insurance companies obtain funds through the receipt of premiums on policies; commercial banks and savings banks receive deposits; and savings and loan associations and investment companies sell shares. These institutions then purchase the bonds and stocks of governments and corporations which are in the market for funds on the demand side. Institutions operating in this manner gather together the small funds of many individual investors and attempt to provide such investors with a better diversification and a more skilful management of funds than the individual could have achieved through his own efforts. Individual savers, rather than buying bonds or stocks of operating companies directly. also place their funds with financial institutions oi the fund-accumulative type. which in turn offer them in the funds market.

This means that corporations and governments seeking funds must take note of this trend and adapt their security offerings to the requirements of these institutions.

A second class of financial institutions in the field of investment banking engages in the marketing of securities rather than holding them for investment. Such institutions are not on the supply side of the market, as are the fund-aggregative institutions. Rather, they are in between those who demand the funds and those who supply them; they endeavour to bring the two sides of the market together with as little friction and as low a cost as possible. Securities marketing institutions are divided into two groups: institutions which facilitate the original distribution of securities from corporations to investors; and those which assist investors to trade among themselves in securities which corporations have issued some time in the past. Marketing institutions which purchase security issues from corporations and sell them to investors are often spoken of as investment banking firms, but it should be noted that investment banking in the proper sense encompasses all the institutions, processes and procedures by which funds are transferred from savers to users. Marketing institutions having to do with "old" or already-issued securities are in turn subdivided into two classes: the securities exchanges, together with the members and member firms which buy and sell securities on the floors of these exchanges; and the over-the-counter market, made up of security brokers and dealers who buy and sell through contacts provided by the telephone, the telegraph and the teletypewriter.

Financial houses dealing in securities which have been outstanding for some time aid in the transfer of funds in several ways. Corporations desire to have their outstanding securities sell at as high prices as possible since the prices of these securities determine the prices at which new securities can be issued and thus determine the cost of new funds. For example, if a corporation's stock is selling at 40, the firm cannot sell a new issue of stock having the same contractual features at 60, for no one would buy it. Often a corporation will find it to its advantage to list its securities on a securities exchange. (*See* LISTED SECURITIES.) Trading on the floor of an exchange takes place among individuals who are members of the exchange. Those who are not members can use the facilities of the exchange by employing a member, through a member firm of which the exchange member is a partner, to trade on the floor for a commission paid to the member firm. (See STOCK EXCHANGE.)

The securities of most corporations are not listed on an exchange, but are bought and sold among investors through purchases irom and sales to dealers. This is the over-the-counter market. A dealer may buy a security from an investor and sell it to another investor. or may sell it to another dealer who in turn sells it to one of his investor clients. Most small and medium-sized corporations find that theinterest in and sponsorship of their securities provided by a dealer serves to maintain prices at higher levels than if the securities were listed. Practically all trading in government bonds and most trading in corporate bonds takes place in the'over-the-counter market. Since the stock issues of the largest corporations are listed on exchanges and since the stocks of these companies are traded in more frequently. it is probable that the volume of trading in stocks on the exchange exceeds that on the over-the-counter market, but many classes of stocks are traded predominantly in the over-the-counter market) particularly the stocks of insurance companies, banks and mutual investment companies.

Acquisition of New Funds. — The next consideration is that of investment banking in the narrower sense, the origination, underwriting and distribution of new security issues. Corporations obtain funds from two major sources on the basis of the term of the contract with the supplier of the funds. Short-term funds which must be repaid within one year are obtained from commercial banks, from trade creditors and from the government in the form of accrued tax liabilities. Long-term funds are obtained from individual and institutional investors through the sale of securities to these investors. These funds may be acquired from investors as creditors through the sale of bonds and mortgages, or from equity investors through the sale to owners of shares of stock or through the retention in the business of earnings which might have been paid to the owners as dividends. It is the function of investment banking firms operating in the new-issue market to assist corporations to acquire new long-term funds. Corporations use these iunds to enlarge their operating assets or to pay off maturing security issues.

The investment banking house operates by purchasing all of the new security issue from a corporation and selling the issue in smaller units to the investing public. It buys from the corporation at one price and attempts to sell to investors at a higher price, a price sufficiently high to cover expenses of sale and leave a profit. Since the expenses of undertaking the sale may be relatively large for small issues, small and new corporations often find it uneconomical to pay the required "spread" of the investment bankers. Such corporations may obtain funds privately by sale of stock and bond issues to friends and relatives of the management and to employees without the intermediation of an investment banking firm. In other cases investment banking houses decline to assist new and small companies because they believe that the risks of investment in these companies are too great, and they are unwilling to recommend to their clients that the securities be purchased. As a result, investment banking firms are used to a much greater extent by companies which have lived through the first few difficult years, are now able to present a good earnings record and show promise of being able to make profitable use of additional funds.

Often a corporation seeks funds from its common stockholders by offering them the opportunity to buy more shares of the common stock issue presently outstanding. These shares may be offered to present shareholders at a price of, say. 40 even though the price of shares currently outstanding is 50. If the price falls be-

low 40 before the new shares have been sold, the corporation will be unable to sell any more at the offering price, the stock offering will be a failure and the corporation will not have all the funds it planned to acquire from the issuance of the shares. To meet such a contingency the corporation will make a contract with an investment banking firm whereby the latter agrees to buy from the corporation at a price of 40 all shares which, by a certain date, have not been taken by the stockholders. In this way the corporation is assured of getting the funds it needs. The investment bank is paid a few cents a share for assuming the risk that it will have to take the shares, and a larger compensation per share for those shares which it has to take at the end of the period and sell to the general public. This arrangement is often called a pure underwriting contract or a stand-by underwriting.

'The Mechanics of Underwriting and Distribution.— The typical underwriting arrangement involves the purchase of a security issue from a corporation by an investment banking firm or a group of such firms! and the sale of the issue to the general investing public, institutional investors as well as individuals. This procedure is followed in the case of bond issues of corporations as well as for stock issues which are not required by law or by decision of the board of directors to be offered first to old shareholders. The first step in the origination of a new security issue is a conference between officials of the corporation and the investment banker to determine whether the issue is feasible. The buying department of the investment bank conducts a preliminary investigation and decides whether the assets and earning power of the corporation are such that it can recommend the securities of this company to its clients. This action is followed by conferences in which it is decided what amount and type of security is best suited to the corporation's needs. When this has been accomplished the formal documents in connection with the issue are prepared. In the United States the issue must in most cases be registered with the federal Securities and Exchange commission. Also a prospectus describing the security must be prepared and sufficient copies printed so that a copy may be given to each investor considering purchase. The arrangements between corporation and underwriters are set forth in a purchase agreement.

The underwriting and distribution of most security issues involves the organization of two groups or syndicates of investment banking firms. The first is called the purchase or underwriting group. When a corporation puts out a $100,000,000 bond issue no one investment banking firm nishes to take the risk of purchasing the entire issue. Therefore the investment bank which initiates the issue with the corporation organizes a group of investment bankers to divide the liability for the purchase, with the originator acting as manager of the group. Each member of the purchase group agrees to take a specific part of the entire issue. This arrangement is formalized in a contract called a purchase group agreement, or agreement among underwriters.

In addition to the underwriting group, the originator forms a selling group whose function is wholly one of distribution. Distribution is effected both by the purchase group and by the selling group. The members of the purchase group reserve portions of the issue for themselves and distribute these amounts through their own merchandising facilities. The remainder of the issue is "given up" to members of the selling group. The selling group members buy from the purchase or underwriting group the amounts given up by this group and sell them to investors. Generally the selling group has more members than the purchase group. Members of the selling group are widely distributed geographically and are selected on the basis of their ability to sell the issue rapidly. The members of the purchase group may be thought of as wholesalers who purchase from the "manufacturer" (the issuing corporation), who sell some of the issue themselves to large "consumers," particularly institutional investors, and who sell the remainder to retailers nho in turn sell to small investors.

Determining the Price.—One of the most important problems in security distribution is the pricing of the issue. There must be a decision first on the public offering price, the price which investors are to be asked to pay. If this price is too high. the issue will not be sold and the purchase group will bear a heavy loss. If the offering price is too low, the issue will be sold quickly but it will be traded in above the offering price immediately after issuance and the corporation will be dissatisfied with the price received. The major responsibility for setting the offering price rests on the investment bank, since it is in close contact with the market and is best able to judge the probable demand for the issue in question.

The underwriters pay to the corporation a price which is lower than the public offering price by the amount of the spread. The spread is affected by the costs which the investment bankers anticipate in marketing the issue, by the difficulties foreseen in selling the issue at the offering price and by competition among investment bankers to obtain the issue for sale. The spread is divided into three parts, a fee to the originator of the issue, compensation to the members of the purchase group for undertaking the risk and a commission to the members of the selling group for selling the securities to investors. When new securities are to be issued the investment firm having close contact with the corporation is likely to be asked to originate the issue. This process is often called private negotiation. An alternative arrangement is competitive bidding. The corporation may itself settle upon the terms of the issue to be offered, and then invite all banking firms to submit bids. The issue will be sold to that firm which bids the highest. Competitive bidding has increased in importance in the United States, partially because it is favoured by the federal Securities and Exchange commission.

The investment banking system plays a significant role in the process of capital formation by transferring funds from savers to users. It is an extremely dynamic system, and adjustments to adapt it to changing conditions take place continually.

See Investment Bankers Association of America, *Fundamentals* of *Investment Banking* (1949). (M. D. KM.)

INVESTMENT PAPER. The term investment paper, or, commonly, corporate or investment securities, applies to bonds, debentures, share certificates, collateral notes. equipment trust certificates and the like. Though called securities, not all such paper is issued upon mortgage or other security; and, though usually issued by a corporation, this too is not a requisite. The financial community divides investment paper—by issuer—into four main categories. governments, rails, utilities, and industrials.

Bonds and Debentures.— It is not clear what were the antecedents of the bond. The East India bond before the court in *Glyn* v. ***Baker,*** 1811, commenced as a receipt. "The United Company etc, do acknowledge to have received of W. G. Sibley 100 *l*," (£100) and ended with an indemnity clause "in the penal sum of 200 l." But midway it contained a promise to repay 100 *l* "to the said W. G. S. his executors, Etc. (by indorsement hereon)," and it was urged that this made for negotiability. The court, however, was clear that instruments of the sort were not negotiable "like bills of exchange." Parliament provided soon afterward that East India bonds were negotiable.

In the U.S., during the early part of the 19th century, great numbers of bonds were issued by states and counties in a frenzy to build canals and railroads. Like the modern bond these were elegantly engraved instruments, thrice the size of a merchant's note, and with the seal of the issuer "conspicuously put"; all with an eye to inspire confidence. But there were almost as many frauds as bond issues, and accordingly many were defaulted. By 1868, however, it was established that such bonds. as a simple promise to pay a sum certain in money to bearer, must be held fully negotiable. It made no difference that they were issued under seal while the merchant's note was not; the same law should apply.

Instruments called debentures, or debenture bonds, are usually issued for short terms, say, 10 or 15 years. In the U.S., the word debenture signifies that there is no mortgage security, as is usual with the corporate bond. But, to add a speculative element (and, ultimately, to bring about a better capital structure), many debentures—like some bonds—are issued with a conversion privilege. That is, the holder is given an option, on stated terms, to turn his debentures into stock. To add further spice to the transaction, the issuer may establish a sinking fund, and agree to call a given number of debentures by lot, at stated times, for

payment. The lottery provisions were all spelled out on the back of the debenture in the *Crouch* case, 1873, which inclined the court to say that such an instrument could not be negotiable; later English cases reached a contrary result. These regulations, and many others lodging powers with a trustee, are now put in the indenture.

Bonds and debentures are almost as precarious to hold as money. That is, if they should be lost or stolen, a subsequent purchaser in good faith would get good title, since they are payable to bearer. Why a practice did not develop to issue such paper payable to "so-and-so or order," thus requiring an indorsement upon transfer, is a matter of surmise. But, for one thing, the long maturities, often 30 years or more in the case of bonds, would make the usual indorsement machinery very cumbersome. For another, there never was any thought that the transferor of a bond should engage to pay the instrument, upon default of the issuer, as the indorser of a negotiable note engages to do. Bonds are not negotiable in that sense; at most the transferor makes certain warranties, of title and so on, as upon the sale of a chattel.

One consequence was the invention of the coupon. It would be highly unsafe, as well as inconvenient, if holders had to bring their bonds and debentures to the issuer each time when collecting interest. But, by writing one coupon for each interest payment, and printing these with the bond, this was made unnecessary. Thus a 30-year bond, for example, is issued with 60 coupons attached, one for each semiannual interest payment, and the holder may clip his coupons as they mature and put them through his bank for collection with relative safety. Coupons are themselves small promissory notes, payable to bearer, and may be negotiated apart from the bond. The following is a typical wording: The company "will pay to bearer twenty five dollars . . . on the first day of July, A.D. 1900 . . . being six months interest on its first mortgage bond number 4028."

Registration provides a further safeguard. That is, most bonds and debentures are issued payable "to bearer, or, if registered, to the registered holder hereof." This means that a holder of such a bond may send it to the issuer to have it recorded in his name. If fully registered, the issuer will return the bond, minus all coupons, with the name of the sender entered on the back of the bond as owner. It is more usual to register only as to principal, in which case the coupons are not detached. In the U.S., registration renders the bond not negotiable, since it is no longer payable to order or to bearer, though of course it may be sold by being transferred on the issuer's books. Only a small percentage of an issue is ever registered; bonds are quoted at a slight discount when registered.

Share Certificates. — It was not until late in the 19th century that share certificates became a medium for the investment of vast sums of money. At one time, in fact, no certificate at all was issued; the shares were simply inscribed in the owner's name on the books of the company. Transfer was effected, as it still is, by giving a power of attorney (usually with an assignment) to someone to appear before the company or its transfer agent and have the shares entered in the name of the transferee. One reason for this was that the corporation's share obligation was looked on as a chose in action (shares are called *actions* in France), of a different tenor than that of a bond or promissory note, but still a chose in action, to be set up on the liabilities side of the ledger, as is done in modern practice. Thus, while the common law said that a chose in action could not be assigned, it was nevertheless possible to achieve the same result by other means.

However, the shareholder wanted some evidence of his claim. The few specially created corporations of the 17th and 18th centuries, therefore, commenced to issue certificates. When the many privately organized joint-stock companies also started to do so, abuses crept in, and the British parliament passed the Bubble act, forbidding them to issue certificates. Thus, for more than a century, or until 1825 when the act was repealed, there were relatively few share certificates in the market. By the middle of the 19th century, though, the dam had burst; general incorporation statutes were being passed everywhere, and these enabled anyone — on complying with certain simple requirements — to form a corporation and to issue share certificates for sale to the public.

The wording of the certificate has not changed materially. It is a bare recital: "This is to certify that (so-and-so) is the owner of 100 full paid and non-assessable shares of the Common Stock of the General Popcorn Corporation. par value $100, transferable on the books of the company by the holder hereof in person or by duly authorized attorney. . . ." It became the practice for the corporation, as in the case of bonds, to issue elegantly engraved certificates, over the seal of the corporation, "conspicuously put." It may be doubted, though, that this inspired much confidence in the investor, for he has long since come to look first to such things as the company's dividend record, the quality of its management, the price-earnings ratio and the like.

Share certificates are spoken of in financial circles as "equities," bonds and debentures as "debt." This is a useful, but loose, way of speaking. For, as was pointed out in the Rhode Island Trust Co. case (1926), the shareholder "does not own the corporate property"; it is owned, in legal theory, by the corporation. Upon liquidation the shareholder, like the bond or debenture holder, merely has a claim upon the corporate assets, with mortgage bond holders generally being paid first (if the security is adequate), debenture and other unsecured claims next, and common shareholders last. Many corporations also issue preferred stock, which may be given precedence over the common upon liquidation, and usually has priority in the payment of dividends. But common shareholders, unlike other security holders, do have voting rights, though these are coming to have less significance in the large corporation, where shares are widely held.

Negotiability. — The share certificate, in the U.S., never attained negotiability before the courts. The McNeil case (1871), held that they would be treated as quasi-negotiable, where an owner had entrusted his certificates to another, indorsed in blank, but that was on estoppel principles. When equipment trust certificates and security receipts were introduced early in the 20th century, they, too, were denied negotiability: the latter because the promise is to deliver securities, not to pay money, the former because the trustee promises to pay only if and when money is received from the equipment buyer, usually a railroad. When bonds and debentures came to be issued with clauses making the holder's rights subject to the provisions of the indenture, these too were held to be not negotiable; the promise of the issuer, not being an unconditional one, did not fit the pattern of the merchant's note.

The share certificate presented special difficulties. Instead of being regarded as a mere chose in action, shares had come to be looked on fictitiously as tangible property, having a situs at the corporation's office; the certificate was called a muniment of title, like a deed to real estate. The recital on the face of the certificate, providing for transfer on the books of the company, gave some support for the view; but in 1909 the Commissioners on Uniform State Laws proposed the Stock Transfer act to give controlling importance to the market sale of the certificate. The act, with few modifications, was soon adopted throughout the U.S. Under it the good-faith purchaser of a stolen certificate, properly indorsed, obtains full title, and may have the shares transferred into his own name on the company books; nor may a creditor of the registered holder defeat transfer, as once was possible, by serving a writ of attachment upon the issuer. The book transfer recital is recognized only to the extent necessary to protect the issuer; that is, the issuer may still treat the registered holder as share owner: to vote, to receive notices, and as the person to whom dividends may be paid.

Until mid-20th century no comparable legislation was proposed for bonds and similar instruments. In Great Britain, none was necessary, for the court in *Goodwin* v. *Robarts* (1875), assumed jurisdiction to declare new instruments negotiable upon proof of custom. However, in the U.S., a few states amended the Negotiable Instruments Law to include bonds. New York in 1926 passed a more ambitious act, bringing "security receipts," "equipment trust certificates," and "corporate bonds" into the fold. Government issues, such as income or toll-road bonds and special assessment bonds, which also were being held not negotiable, were

sometimes covered by the statute authorizing the issue, that is. by a clause providing specially for negotiability. Finally, in 1952. the Commissioners proposed a Uniform Commercial Code which deals comprehensively with investment securities.

The code defined investment securities in broad terms to include any instrument that is commonly dealt in as a medium for investment, is issued in series, and evidences either a share interest or an obligation, provided only, it is "issued in bearer or registered form" Thus, notes and bills payable to "so-and-so or order," which must be transferred by indorsement, are excluded; these are dealt with in a section of the code concerning commercial paper. The line is a somewhat arbitrary one, but it is an important one to draw, for those instruments defined in the code as investment securities may take such form as the issuer may choose to give them and still be negotiable, while commercial paper is held closely to the traditional pattern. Moreover, there are several places where different law applies; defaulted or overdue securities, for example, are given a limited negotiability, contrary to the rule concerning commercial paper.

Liquidity. — During the first half of the 20th century corporate wealth reached vast proportions. Mines, ships, factories, skyscrapers, whole industries in fact, came to be represented by paper instruments, negotiable in form. Thus the buyer may readily put his savings into a bond or debenture of a Delaaare corporation, which in turn may own gypsum mines in Canada or a banana plantation in Guatemala. So, too, a person in San Francisco, by simply indorsing his name on the back of a share certificate, may transfer control of the company to a buyer in New York or London. Many things have contributed to this, but the existence of a securities market is essential; it provides liquidity. Savings would never have been put into paper securities on this scale were it not readily possible to sell them again, at a price.

A market for shares in common stocks (stocks are called shares in England) existed in London throughout the 18th century; it was provided by the brokers of the time who met in coffee houses, in Change alley and elsewhere. The first regular list of prices, for the dozen or more stocks then being traded, appeared in 1714. The present London stock exchange was organized in 1802; the New York stock exchange was organized in 1792, though it did not assume its present name until 1863. Essentially a stock exchange (*q.v.*) is a place where members meet to execute customers' buy and sell orders for listed stocks; sales "at the market" are made to the highest bidder. Thus it is possible in a very few minutes for stocks worth millions of dollars to be sold. The ticker, which has been in use since 1871, reports current sales and prices by wire to all parts of the country.

The exchanges list only those securities which meet their standards. Many issues are not listed, either because the issue is too small, because it is not sufficiently seasoned, because the company does not wish to make the required reports, or for other reasons. These securities, which in the aggregate greatly exceed the value of the listed securities, are traded in by brokers in what is called the over-the-counter market. Aiso, new issues, which customarily are sold to syndicates of investment bankers on a negotiated basis for later distribution to investors, are traded over-the-counter prior to listing. Since 1926, when the Interstate Commerce commission ordered that equipment trust certificates be sold at competitive bidding, many rail and utility issues have been sold in that way to investment bankers.

Following the stock market crash of 1929, Congress passed the Securities act of 1933 and the Securities Exchange act of 1934 to regulate the securities business; these acts do not apply to securities issued and sold intrastate. Many states have blue-sky laws, so-called because their purpose is to prevent promoters from selling blue sky to the unwary investor. The Securities act, on the other hand, follows the British model, and is designed to safeguard investors, both new and existing, by giving publicity to the important facts concerning each issue before it comes on the market. Bonds and shares today may be purchased with far more information than was the case prior to 1929. See also BOND (IN FINANCE); COMMERCIAL PAPER; FINANCE; STOCK. (R. T. S.)

INVESTMENTS: INDIVIDUAL. In the economic sense investment is the productive employment of capital — the direction of savings into uses that fill an economic need. From the point of view of the suppliers of capital, investment is the commitment of present funds for the purpose of deriving a future return in the form of income or capital appreciation. Inherent in the concept of investment (as against speculation) is the emphasis on income and/or growth in value over a period of time (as against short-term trading profits), and the assumption of only that degree of risk that the investor can afford. This requires the selection of investment mediums that are appropriate to the investor's objectives.

Investment Mediums. — Investors have a wide range of general mediums from which to choose. These include: (1) savings types: social security benefits. pensions: annuities, the reserve element in life insurance contracts. savings deposits in commercial and savings banks and United States savings bonds; (2) securities: federal! state and municipal obligations and corporate securities including bonds (debentures), preferred stocks (preference shares) and common stocks (ordinary or deferred shares) in a variety of industries; (3) real estate held for occupancy and for income, and real estate mortgages; (4) direct investment in a business.

Other classifications of investments are: (1) by investor status: either that of creditor (as through the holding of bonds and annuities) or owner (as through common stocks and real estate); (2) by security: whether the investment (if debt) is a secured (viz., mortgage) or general (viz.. bank account) claim; (3) by maturity: whether the principal will mature at a future date (bond or life insurance) or will never mature except through market resale (viz., stocks); (4) by degree of marketability: whether the principal can be recovered through resale (as in a listed stock) or may suffer from a poor market (viz., specialized real estate); (5) by tax status: whether the investment has advantages to investors concerned with high income (tax-free municipal bonds) or seeking capital gains (stocks for appreciation) as against investments producing current taxable income (viz., dividend-paying stocks); (6) by degree of management required: whether constant care and attention is required of the investor (as in a portfolio of corporate securities) as against delegation of investment management to others (viz., life insurance, pensions, trust funds, investment company securities); (7) by degree of risk to income and principal: no risk (United States savings bonds) versus high risk (speculative stocks); (8) by degree of protection against inflation: no protection (bonds. pensions, bank accounts) versus possible protection (stocks, real estate).

Types of Investment Risk. — Investors must take into account various types of risks associated with different investment mediums and develop an investment program that is appropriate to their resources and particular investment objectives.

Quality Risk. — Investments differ with respect to assurance of income and safety of principal. At the one extreme are federal obligations and the savings types; at the other extreme, low-grade common stocks. Corporate securities and real estate include a wide range of quality. The task of selection to minimize risk or to assume only that degree the investor can afford may be undertaken by the investor, or the analysis and selection can be delegated to others. In the investment market the quality of an investment is evidenced by the yield or return that is produced in relation to market price — the higher the quality, the lower the yield. (An exception is iound in those "growth" common stocks that pay low dividends in relation to market price and whose appeal is mainly one of possible price appreciation.)

Risk of Price Change. — Cyclical variations occur in interest rates and in corporate profits and dividends that affect the price and income of marketable fixed-income investments as well as equities. The value of high-grade (marketable) bonds rises and falls moderately as interest rates fall and rise. Equity-type securities (common stocks) rise and fall with investors' and traders' estimates of expected earnings and dividends. They reap the benefit of high corporate profits and suffer the most in periods of recession. Purchase of bonds with varying maturities and diversification of stockholdings over various industries will reduce the price risk somewhat; complete avoidance of price risk would re-

quire concentration on the savings types of investments. A long-range program of "dollar-cost averaging" whereby the same dollar amount is regularly invested in a diversified selection of stocks, through high and low prices, will minimize the problem of timing their purchase and sale.

Various formula plans that involve an automatic switching to and from defensive securities — high-grade bonds — into more volatile common stocks, depending on the course of stock prices, have been developed to obviate the need for judgment with respect to the course of security prices. Or the task of timing the changes in the investment portfolio may be turned over to others such as trustees, investment counsel or investment companies, which provide investment management (at a fee).

Money-Rate Risk. — As indicated previously, the prices of marketable securities that return a fixed dollar income (bonds and preferred stocks) rise and fall inversely with interest rates, without necessarily any change in quality. If the investor wishes to avoid such price changes he must concentrate his investments in the savings types whose return is not influenced by any but long-run changes in interest rates, or attempt to select equities whose value is determined mainly by prospective profits.

Purchasing-Power Risk. — The purchasing power of the income and principal of fixed-income investments rises and falls with changes in the general price level or cost of living. Placement of a substantial proportion of the fund in equities — common stocks and real estate — in the hope of obtaining a higher dollar income and an appreciation of dollar value offers the best possibility of an inflation hedge. But such a hedge works only over a considerable period of time. The equities must be purchased at depressed levels (a problem of timing); and all equities are not equally good for inflation protection because industries and companies do not behave alike during any phase of the general business cycle

Investment Goals and Objectives. — The steps in an investment program are: (1) to determine the investor's goals or objectives in order of their relative priority or importance and to select the general types of mediums that are appropriate; (2) to select the specific investments after careful analysis and with due consideration of the problem of timing.

Individual investors and their needs differ in so many respects that it is impossible to generalize concerning investment objectives or the means by which these may be attained. There are variations in the amount of income available for investment. size of the investor's total resources, age, health, number of dependents, standard of living desired, time and skill available for investment management. And these and other factors change through the years, so that the objectives themselves change. In budgets allowing for modest savings, only the most urgent goals can be attained. As savings accumulate or responsibilities diminish. the objectives can be widened and more risk can be assumed. The following is a suggested list of objectives offered as an illustration of the approach.

Emergency Funds. — The first goal is to provide for unexpected expenditures or interruptions to income. Absolute safety is required, at a sacrifice of investment income. Savings accounts and savings bonds are the mediums used. These provide assurance of principal with very modest income, require no management and have satisfactory denominations (savings bonds may be purchased in units of face value as low as $25). They have no tax advantages and offer no protection against inflation.

Protection *Against* Death *of* the Income Producer. — Until a living estate is created, this goal is accomplished for the majority of investors through adequate life insurance. Policies should be selected that provide the greatest protection during the earlier years at the lowest cost; additiondl and later policies can provide substantial reserves and retirement income. The amount of insurance needed depends on number and age of dependents, income desired for dependents and the size of the estate exclusive of the insurance element. Insurance provides assurance of some income or principal for dependents, freedom from care and management, satisfactory denomination and diversification. It does not provide against inflation save through an increase in the dollar amount of coverage.

Over and above insurance sufficient to provide a minimum income for dependents, funds accumulated for their support can be invested in a variety of mediums. For small investors, savings types and high-grade bonds are indicated. For wealthier investors, who can assume more risk, common stocks and real estate offer opportunities for appreciation and the tax advantages of capital gains, while tax-free municipal bonds are useful in protecting current income against high tax-bracket rates.

Home Ownership. — This is probably the most substantial single investment goal of most investors. The modern method of amortizing the purchase of a home through a long-term mortgage forces savings into this use and relieves the investor of the problem of accumulating and managing funds for this objective. Once invested in real estate for occupancy, savings are concentrated and are subject to special risks pertaining to such property. An offsetting advantage is the possible increase in value as a protection against inflation.

Education and Other Family Needs. — A variety of objectives fall within this category. In most instances safety, of principal and assurance of modest income are important. Accumulations toward this goal should be so planned as to provide definite sums at definite times of need. A program of regular investment in savings bonds is appropriate in many cases. Special insurance protection should be arranged to assure the fulfilment of these goals in the event of the death of the income producer.

Retirement Income. — This is the next investment objective in many cases. Its importance will vary with the age and standards of the investor and his dependents. Annuities, pensions and social security benefits should be combined to provide a minimum risk-free income. In addition, an investment portfolio consisting first of high-grade bonds such as savings bonds, then of carefully selected equities chosen for appreciation as well as soundness may be added as the investor's income and savings increase. The additional sums invested in equities will depend not only on the size of the fund but also on the investment skill of the investor. as well as on his tax requirements and his need for offsetting possible inflation. New York Stock exchange houses make possible the purchase of stocks through constant monthly payments. For many investors equities can best be acquired indirectly through regular purchase of investment company shares (see below).

Supplementary Income Before Retirement. — When the above primary goals have been fulfilled, or while the later ones are being concurrently fulfilled, the remainder of the program may involve more risk taking. Safety of principal and future assured income may be given less attention, and current income to supplement salary or business earnings may be stressed. If the investor does not wish to undertake the tasks of selection. timing and management of a fund he may seek the advice of brokers, investment bankers or investment counsel; or he may set up a trust fund or buy investment company shares. The wealthy investor may take advantage of the tax-exempt feature of municipal securities, and much of his fund can be invested in higher-risk equities.

Creation of an Estate. — The final goal of some investors, after providing for the above requirements, is the creation of an estate (over and above minimum requirements) for dependents, charities and other beneficiaries. The complex aspects of estate planning may deserve the employment of firms that make a specialty of advice on such problems. The general investment requirements in planning for an eventual estate are: (1) tax relief on current income; (2) substantial liquidity (and insurance) to provide for estate taxes; (3) growth of some of the fund through capital appreciation; and (4) provision against inflation. Practically all of the general mediums of investment listed previously might be involved in such a program.

Selection of Specific Investments. — Selection of the savings types of investments presents few difficulties. Questions of form and convenience predominate. The same is almost true of high-grade bonds, although these must be watched for possible deterioration in quality; also the timing of their purchase (and possible resale) requires some forecast of the trend of interest rates.

The chief difficulties arise in connection with the selection and timing of investment in equity-type investments in those programs

in which such investments are appropriate. Investment in real estate for income involves so many special problems that most investors would be advised to avoid it; also, they may already have a substantial commitment in real estate held for occupancy. Common stocks show the greatest cyclical changes in value, the greatest range in quality and may involve considerable risk. Their exact value is always indefinite. The investor faces the task of appraising general business conditions, the course of stock prices as a whole, the relative outlook for different industries and the earnings, dividends and price performance of individual companies. If he undertakes the task himself he may study business and financial sources, subscribe to investment and statistical services and seek the advice of his broker or bank. Having selected the industries that appear to have the most promise or are most suited to the type of diversification he needs, he will then give attention to the analysis of the individual enterprise. emphasizing its characteristics and peculiar risks, quality of management, financial strength and earning power as revealed by financial statements, prospects for earnings, dividends and price appreciation and the degree of seasoning and marketability of the issue. He must also make a valuation to compare with current market price and be prepared to reappraise his holdings for changes in quality and appropriateness for his particular purposes.

These problems of timing, selection, diversification and continuous management of a portfolio of common stocks are too formidable or too time-consuming for many investors. Consequently, they may turn to one or more of several methods of transferring the responsibility to others. Professional investment counsel may be retained, at a fee. For those who can afford his advice, the registered investment adviser can fit the program to his client's individual needs, balancing the several factors of income, preservation of capital, appreciation. tax matters and diversification in one co-ordinated program. Other methods of transferring managerial responsibility on a fee basis include the use of investment departments of larger banks, the supervisory services of the larger stock exchange firms and the common trust funds operated by some banks and trust companies. These funds are conservatively invested but, through diversification, superior stability and emphasis on regular income and protection of principal and purchasing power value, have a strong appeal to many investors seeking these requirements.

Two types of institutions provide means for buying into a large portfolio of common stocks by way of the purchase of their shares —fire insurance companies and investment companies. While established to underwrite risks, the insurance company invests its reserves in a diversified portfolio of securities from which it derives a substantial investment income. Depending on the nature of the portfolio, its shares may offer opportunity for substantial capital appreciation as well as regular income.

Stocks of fire insurance companies are, however, highly specialized and difficult for the layman to analyze and evaluate. He is likely to turn to the investment company (investment trust) for a more understandable medium for indirect purchase of equities. So important has this institution become that it merits special consideration at this point.

Investment Companies (Investment Trusts.)— Investment companies are financial corporations that pool the funds of their shareholders in a substantial portfolio of securities. so that the investor has a part interest in a variety of individual concerns. Each share of the company's stock represents a fractional interest in the portfolio. The general advantages held out to the investor are: (1) diversification and spreading of risk through holding securities in a cross-section of industries and companies; (2) selection and management of the portfolio by professional experts who through research and constant study adjust the fund continually to changes in market and business conditions; (3) timing of purchases and sales within the portfolio, presumably on the basis of seasoned judgment; (4) convenience through handling for shareholders the details connected with the ownership of corporate securities. These advantages would be especially valuable to the investor who cannot afford investment counsel, cannot obtain diversification with his limited capital and lacks the time and skill to select and manage his own portfolio with successful results.

Most modern investment companies are of the management type, that is, their management has complete discretion over the portfolio held, subject to any charter provisions concerning the general nature of the portfolio, in contrast with the older fixed trusts that could only invest in a given list of securities. The two main classes of investment companies are closed-end companies having a fixed capitalization and whose shares are bought and sold by the investor in the market, and open-end or mutual funds which make a continuous offering of new shares (through distributors) and redeem them on demand; the shares of open-end funds are offered at their net asset value plus. in most cases, a loading fee of 2% to 9% and are redeemed at net asset value, calculated daily. Investment companies may also be classified by type of portfolio securities held as assets. Those owning both bonds and stocks are called balanced funds. Others are common-stock funds holding common stock only. plus a varying amount of cash. Some of the latter are diversified funds; others hold securities in one or more special industries.

Investment companies also differ with respect to their investment purpose. Some are designed primarily to produce income, others for capital appreciation, still others for a combination of both. They differ also in the degree of risk undertaken, ranging from very conservative to frankly speculative funds.

The problem of the investor is to select the fund or funds whose objectives and degree of risk taking most closely match his own situation — the ones that will accomplish for him what he would wish to do for himself if he could diversify and manage his own holdings.

Investment companies in the United States are closely regulated by the Securities and Exchange commission, under the federal Investment Company act of 1940, vith respect to promotion and sales practices, standards of operation and dissemination of information concerning financial condition and investment policies.

Investment companies (including a few that still operate as trusts rather than as corporations) had their origin in the English and Scottish trusts that were formed as early as 1860 to provide an investment service to individuals either unable or unwilling to select and manage their own security holdings. The early British trusts were mostly of the closed-end type and were conservatively managed. Wide diversification was practised and operating expenses were modest. The early American trusts copied the basic idea of diversification but were less soundly managed. They often indulged in short-term trading; inferior securities were acquired for the portfolio; affiliations with sponsoring banking firms led to abuses.

The collapse of the stock market in 1929–32 brought enormous losses and many failures. After a period of confusion in the 1930s, the stronger survivors and new companies enjoyed the renewal of general interest in equities and, by improved performance under federal regulation, grew rapidly and became widely accepted. This is not to say, however, that they have all been well managed and have all produced satisfactory results for their shareholders.

As indicated previously, investment companies do not follow uniform investment policies. They differ with respect to the general types of portfolio securities held, the degree of risk undertaken, the extent of diversification of investment holdings, the extent to which they keep their funds fully invested in various stages of the securities cycle, the relative emphasis placed on income as against capital appreciation and the results obtained for their owners. Most investment companies pay out at least 90% of their net investment income (after expenses) in dividends, and thus avoid taxation on income. Capital gains taxes are paid on any realized but undistributed gains from buying and selling portfolio securities.

In the selection of an investment company, the investor should first eliminate those whose purposes and record do not coincide with his own aims and objectives, and whose general policies indicate more risk taking than he is prepared to assume. The reputation of the management, the size and growth of the company and its performance during periods of market weakness should all be

examined. Performance is best measured by the cumulative results over a considerable period of time (preferably covering all phases of the business cycle) with respect to dividends and change in net asset value per share as compared with other companies, individual securities and general stock market averages. Other factors to be studied include the expense ratio (per cent of income or of asset value consumed by operating expenses of research and administration), the dividend yield on purchase price and the proportion of dividends representing investment income and capital gains, respectively.

Many open-end investment companies make it possible for the shareholders to reinvest any dividends in new shares without a loading fee and to accumulate new shares by deposit of a regular sum at stated intervals: and thus to obtain the advantages of dollar-cost averaging as the value of the shares rises and falls.

Regulation in the Investor's Interest.— In addition to state blue-sky laws, U.S. federal laws provide protection to investors in a number of respects. The Securities act of 1933 requires corporations that offer new securities in interstate commerce or through the mails to present prospectuses containing a description of the securities and the issuer. Civil and criminal penalties are imposed for fraud and for omission or misstatement of material facts in the prospectus.

The Securities Exchange act of 1934 provides for regulation of securities exchanges and trading to prevent manipulation of prices and abuses of credit in securities transactions. The Trust Indenture act of 1939 requires compliance with standards concerning the indentures that support corporate bond issues and regulates the activities of corporate trustees. The Investment Company act of 1940 (above) and the Investment Advisers act of 1940 regulate investment companies and registered investment counsel firms.

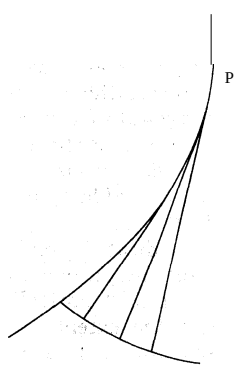
The Securities and Exchange commission is the regulatory body under all of these federal statutes.

BIBLIOGRAPHY.—D. F. Jordan and H. E. Dougall, Investments, 6th ed. (1952); H. C. Sauvain, Investment *Management,* 2nd ed. (1959); B. Graham, The Intelligent Investor, 2nd ed. (1954); B. Graham and D. L. Dodd, Security Analysis, 3rd ed. (1951); R. U. Cooper, Investments for Professional People (1951); S. F. Feyler, *Income Growth* With Security (1958); R. L. Weissman, The *Investment Company* and the Investor (1951); Arthur Wiesenberger, Investment *Companies* (annually). (H. E. DL.)

INVISIBLE EXPORTS: see EXPORTS: *Invisible* Exports.

INVOLUTE, of a curve C, is a curve which intersects all the tangents of the curve C at right angles. Each curve has infinitely many involutes.

To construct an involute of a curve C, use may be made of the so-called "string property." Let one end of a piece of string of fixed length be attached to a point P on the curve C and let the string be wrapped along C. Then, as the string is unwrapped, being held taut so that the portion of the string that has been unwrapped is always tangent to C, the locus of the free end of the string is an involute of C. With the same point of attachment P, different involutes of C are obtained by using pieces of string of different lengths. (E. P. L.)



INVOLUTE OF A CURVE C (*see* TEXT)

INVOLUTION, in arithmetic, is the operation of raising a number to any power; rolling it up, as it were, by continued multiplication. Before the invention of a satisfactory symbol like a^2 or a^3, the Greeks spoke of the second power as a tetragon number (*tetragonos arithmos,* "four-angled number") or a "power" (dynamis, from which also "dynamo" and "dynamite").

Diophantus (c. 275) called the third power a cube (*cubos,* see CUBE); the fourth power, a "power-power" (*dynamodynamis*); the fifth power, a "power-cube"; and so on, using the additive principle.

Involution is the converse of evolution (*q.v.*), which is the operation of finding a root. (See ARITHMETIC.) In projective geometry (*q.v.*), involution is a special kind of one-to-one correspondence between the points of a line, the lines of a flat pencil, or the planes of an axial pencil. etc. For example, consider all the points on a straight line and select two distinct points I_1, I_2 on the line. Then. given any other point P_1 on the line, there is a unique point P_2 on the line such that P_1 and P_2 separate I_1 and I_2 harmonically, and this relation between P_1 and P_2 is reciprocal. When the point P_1 is allowed to vary, the point P_2 also varies. This pairing of the points of the line into pairs P_1, P_2 separating the fixed pair I_1, I_2 harmonically is an involution on the line. It may be said that an involution is a projective transformation of period two. and also that an involution is a symmetric projective transformation.

IO, in Greek mythology, daughter of Inachus. the river-god of Argos and its first king. Under the name of Callithyia, Io was regarded as the first priestess of Hera. Zeus fell in love with her, and, to protect her from the wrath of Hera, changed her into a white heifer; according to Xeschylus in his *Supplices,* the metamorphosis was the work of Hera herself. Hera, having persuaded Zeus to give her the heifer, set Argus Panoptes to watch her. Zeus thereupon sent Hermes. who lulled Argus to sleep and cut off his head or killed him with a stone. But the wrath of Hera still pursued Io. Maddened by a gadfly sent by the goddess, she wandered all over the earth, crossed the Ionian sea (traditionally called after her). swam the strait known on this account as the Bosporus ("ox-ford") and at last reached Egypt. where she was restored to her original form and became the mother of Epaphus. She was thus identified with Isis, and Epaphus with Xpis. He was said to have been carried off by order of Hera to Byblus in Syria. where he was found again by Io. This fable connects Io with the Syrian Astarte (*q.v.*). Both legends reflect intercourse with the east and identification of foreign with Greek gods. She was a favourite subject among Greek painters, and many representations are preserved on vases and wall paintings.

IODINE, a chemical element belonging to the halogen group, was discovered in 1811 by B. Courtois, a manufacturer of saltpetre. He noticed a substance that corroded the copper vats in which he was using a water extract from burned seaweed. He treated the extract with suliuric acid, and the impurity was isolated as a black powder. When heated, this yielded a violet vapour and condensed in crystalline flakes. In corresponding with chemists to whom he sent samples of the unknown substance, he referred to it as "X". It was identified as an element by J. L. Gay-Lussac in 1815. Iodine at room temperature is a nearly black crystalline solid, vaporizing easily to the deep-violet vapour from the colour of which its name is derived (iodes, Greek for "violet").

The bactericidal property of iodine was first described by C. J. Davaine in 1873 However, tincture of iodine was being used widely to counteract infections, on an empirical basis. half a century earlier.

Potassium iodide is used in analytical chemistry, photography and medicine. In medicine, soluble iodides such as potassium and ammonium iodides have an important place in the treatment of many diseases, among which are syphilis, rheumatism and goitre. Arsenic iodide is employed in treating diseases of the skin. Many pharmaceutical preparations consist of iodides, either pure or mixed with other materials. Among the iodides employed in medicines are paraiodophenol, tetraiodopyrrole and thyroxin. As many as 200 diseases have been treated with compounds of iodine. Iodoform. CHI_3, made by electrolysis of a solution containing potassium iodide, sodium carbonate and ethyl alcohol, is employed as an antiseptic. Iodine as thyroxin is produced in the thyroid gland. and a small amount of iodine is essential in the diet. In most places the drinking water contains sufficient iodine, but in some localities goitre is prevalent because of the absence of iodine in the water supply. To insure against iodine deficiency a small quantity of iodide is frequently added to table salt.

Sources.—Iodine is never found uncombined. It is present in sea water as iodide, 1 part of iodide to 8,000 parts of chloride; it occurs in much animal and vegetable matter. generally in very small amounts, but most abundantly in seaweeds. Appreciable quantities are also found in many natural brines. The largest

source of iodine for commercial preparation is the nitrate deposits of Chile, from which saltpetre is prepared. iodine being present as sodium iodate. Iodine is estimated to account for 10^{-5}% of the earth's crust, and to be in 28th place in order of abundance.

For a long time in France and Great Britain and. more recently, in Japan, iodine has been recovered on a commercial scale from seaweed. The stages in the preparation are: drying and burning of the seaweed, leaching of the ash, release of the iodine by chemical reaction, and purification. The burning is done in large ovens at as low a temperature as possible to avoid volatilizing sodium iodide On extracting the ash with water a liquid containing 7–9 g. of combined iodine per litre is obtained. When cooled, considerable sodium sulfate and chloride crystallize, and the remaining liquid is concentrated by evaporation to a content of 30–100 g. of iodine per litre. The addition of sulfuric acid decomposes any sulfite and sulfide. Manganese dioxide added to the acidified liquor releases iodine, which is vaporized and purified by sublimation. In the modern French process, cuprous iodide, obtained by the reaction of cupric sulfate with the concentrated liquors, is the product instead of iodine.

Iodine from Chile nitrate deposits is a by-product of the preparation of Chile saltpetre. The mineral, containing 0.05% to 0.3% of iodine, is treated with hot water. filtered and cooled, precipitating most of the nitrate and leaving a liquor containing 6–12 g. of iodine per litre as sodium iodate. On the addition of a second liquid containing sodium sulfite and bisulfite, the iodate is reduced to iodine:

$$2NaIO_3 + 5NaHSO_3 = I_2 + 3NaHSO_4 + 2Na_2SO_4 + H_2O$$

The amount of bisulfite liquor must be carefully controlled since excess will reduce the iodine to iodide. The free iodine is purified by sublimation in retorts.

A more recently developed source of commercial iodine is the brine extracted from oil wells. In California some brines contain 30–60 parts per 1,000,000 of sodium iodide. Two methods have been employed to obtain the iodine. In one process, silver nitrate in 2%–3% solution is added, precipitating the iodine as silver iodide, accompanied by considerable ferric hydroxide. On acidifying with hydrochloric acid, the ferric hydroxide is dissolved, and the addition of scrap iron yields a solution of ferrous iodide and metallic silver which is recovered. The ferrous iodide is decomposed by chlorine, or by sodium dichromate and sulfuric acid, the iodine precipitating in granular form. The precipitated iodine is melted under concentrated sulfuric acid and drawn off in liquid state at as high as 99.8% purity. In a second method, sodium nitrite and sulfuric acid are added to the brine, setting free the iodine in dilute solution. The iodine is concentrated by adsorption on activated charcoal which, after it has become nearly saturated with iodine, is treated with sodium hydroxide to give a solution containing sodium iodide. The iodide solution is oxidized to iodine by acidified sodium nitrite, chlorine or chromic-sulfuric acid. The production of iodine from oil-well brines, while not amounting to more than a small fraction of the total world production. about 1930, caused a decline in the price of iodine, previously fixed at $4.65 per pound. By 1950 the price was about $2 per pound.

Physical Properties. — The atomic weight of iodine is 126.91, the atomic number 53 and the molecular weight 2j3.82. By mid-20th century, isotopes of masses 119–139 had been detected. Except for the natural iodine 127, these isotopes are radioactive and mainly short-lived. The radioactive isotopes are formed in the bombardment of tellurium and iodine with high-velocity particles and in the slow neutron fission of U^{235}. The electron configuration for the unfilled outer orbits (N and O) is: $4s^2$, $4p^6$, $4d^{10}$, $5s^2$, $5p^5$. The electron affinity of the gaseous atom is 3.22 ev. The molecules are normally diatomic but somewhat dissociated at high temperatures. Iodine has a density of 4.93 g. per millilitre at 20° C. The solid melts at 114° C., but has a sufficiently high vapour pressure to sublime readily at lower temperatures. The boiling point of liquid iodine is 183° C. The heat of fusion is 3,6jo cal. per mole, the heat of vaporization 9,970 cal. per mole at the boiling point, and the heat of sublimation 14,460 cal. per mole at the melting point. The specific heat of the solid is 0.0513, the liquid 0.0631, the vapour 0.0355 cal. per gram. The entropy of the solid at 25° C. is 27.9 cal. per mole per degree. Iodine dissolves but little in water; at 20° C. the saturated solution contains 0.00133 mole per litre of solution. In most non-aqueous solvents the solubility of iodine is greater; in carbon tetrachloride it is 85 times the solubility in water The solutions in water and alcohol are brown, in most other liquids. violet.

Chemical Properties. — In compounds the common oxidation states are minus one. plus five and plus seven. Iodine combines readily with most metals and some nonmetals to form iodides. With hydrogen, combination is incomplete since hydrogen iodide is unstable at temperatures sufficiently high for iodine and hydrogen to react. Iodine is reduced to iodide ion by reaction in solutions of hydrogen sulfide, sulfur dioxide and thiosulfate. In all these reactions iodine acts as an oxidizing agent but is the least active of the halogens in this respect. The formation of an iodide is accompanied by the evolution of less heat than is evolved in the formation of the corresponding bromides, chlorides and fluorides. The molal potential of the iodine-iodide electrode in aqueous solution at 25° C. is 0.535 v.

Iodine is the most readily oxidized of the halogens to an oxygen-containing compound. Potassium iodate is more stable than potassium chlorate. and iodine will react with the latter to go to the iodate. Iodine is oxidized to iodic acid by concentrated nitric acid and in basic solution to iodate by such oxidizing agents as chlorine.

Iodine reacts with aqueous ammonia to form nitrogen tri-iodide, $NI_3.NH_3$, which is highly explosive.

Iodine combines with iodides to form polyiodides. With aqueous iodide. the reaction, $I_2 + I^- = I_3^-$, accounts for the large solubility of iodine in solutions containing soluble iodides. A solution containing 100 g. KI in 100 g. of water dissolves 153 g. of iodine. Iodine at high concentration is poisonous and may cause serious burns; in dilute alcoholic solution (tincture of iodine) it is used as an antiseptic.

Hydrogen Iodide and Iodide Ion. — Hydrogen iodide is a colourless fuming gas with a sharp odour It is commonly prepared by the hydrolysis of phosphorus iodide. $PI_3 + 3H_2O = 3HI + H_3PO_3$. A solution may be prepared by the reaction of iodine with hydrogen sulfide in solution, $I_2 + H_2S = S + 2H^+ + 2I^-$. Hydrogen iodide liquefies at −36° C. and freezes at −51° C. The heat of formation at 18° C. is −5.91 kg. cal. per mole. The compound is not stable thermally, being 22% dissociated to the elements at 450° C. Iodine is liberated from hydrogen iodide by any of the other halogens. by oxygen or by concentrated sulfuric acid. Like the other hydrogen halides, the gas is very soluble in water, 250 vol. dissolving in 1 vol. of water at 20° C. The aqueous solution. known as hydriodic acid is a strong acid containing hydrogen and iodide ion. A constant boiling mixture containing 57% HI by weight. boiling at 127° C., of density 1.70, is formed.

Hydriodic acid may be used to prepare iodides by reaction with metals or their oxides, hydroxides or carbonates. and as a reducing agent in organic chemistry. The iodide ion is a strong reducing agent. the strongest of the halide ions. It is oxidized to iodine by chlorine. bromine, ferric ion, cupric ion and many other oxidizing agents. Because of the reducing ability of the iodide ion, certain metallic iodides cannot be prepared; *e.g.,* cuprous iodide rather than cupric iodide results on the addition of an iodide to a cupric solution. While the iodide ion is colourless. solutions of soluble iodides tend to acquire a brownish tint as a result of oxidation of the iodide to free iodine by atmospheric oxygen. Iodides are generally soluble in water. common exceptions being those of silver, cuprous. mercurous, and lead. Although silver iodide is less soluble in water than silver bromide or chloride. in nonaqueous solvents the iodides are generally the most soluble of the halides. The iodides of metals in general form ionic-type crystals in which the iodide ion has a radius of 2.16 A.

Potassium iodide, a white crystalline solid, melting at 682° C., of 3.12 specific gravity. is produced commercially to a greater extent than other iodides It is made by the reaction of ferrous iodide, prepared from iron and iodine, with potassium carbonate. $2FeI_2 + 2K_2CO_3 + \frac{1}{2}O_2 = 4KI + Fe_2O_3 + 2CO_2$, or by the reaction of

cuprous iodide with potassium carbonate, $2CuI + K_2CO_3 = 2KI + CO_2 + Cu_2O$.

Many organic iodides are useful in organic syntheses. Iodine enters organic molecules by direct addition at double bonds and by displacement of hydrogen. The latter reaction occurs less readily than with chlorine or bromine, and the iodine in organic compounds is in general more reactive than the other halogens. When used as a reducing agent in organic chemistry, hydrogen iodide is more effective in the presence of phosphorus, since the liberated iodine forms the more reactive phosphorus iodide.

Oxy Compounds.— Iodine is readily absorbed in alkaline solutions in which some hypoiodite is presumably formed, but since the hypoiodite is unstable, the product is a mixture of iodide and iodate, $3I_2 + 6OH^- = 5I^- + IO_3^- + 3H_2O$. This reaction is reversed in acid solution, with iodide and iodate forming iodine. With the addition of an oxidizing agent such as chlorine in alkaline solution. all of the iodine may be oxidized to iodate and solid iodates crystallized from solution. Iodate may also be formed by anodic oxidation of iodide solution and by the reaction of iodine on a chlorate. The iodates are the most stable of the series chlorate. bromate and iodate, and usually the least soluble. Potassium iodate melts at 560° C., and at higher temperatures decomposes to potassium iodide and oxygen. Acid iodates such as $KIO_3.HIO_3$ exist, although no bromate or chlorate of this type is known.

Iodic acid is a moderately strong acid. It may be formed in solution by acidifying solutions of iodates or by the oxidation of iodine by nitric acid. $I_2 + 10HNO_3 = 2HIO_3 + 10NO_2 + 4H_2O$. Iodic acid is much more stable than chloric and bromic acids. It is readily dehydrated at 110° C. to give the anhydride, iodine pentoxide, I_2O_5, a white solid which decomposes at about 300° C. without melting. The oxide readily recombines with water to give iodic acid. Treatment of iodic acid with concentrated sulfuric acid yields a different oxide, I_2O_4. The tetroxide is not an acid anhydride; with water it forms iodic acid and hydriodic acid.

The action of excess chlorine in alkaline solution will change iodide or iodate to periodate. A solution of periodic acid may be formed by acidifying a solution of barium periodate with sulfuric acid. Periodic acid is a stronger oxidizing agent in solution than perchloric acid although iodic acid is a weaker oxidizing agent than chloric acid. Periodic acid differs from perchloric acid also in that it is not always monobasic. Thus, not only such metaperiodates as KIO_4 and $AgIO_3$ but also mesoperiodates of which Ag_3IO_5 is an example, and paraperiodates such as Ag_5IO_6, are known. The existence of these salts may be attributed to the large size of the central iodine atom about which a larger number of oxygen atoms may be co-ordinated. Most periodates are but sparingly soluble; this property as well as the proportion of acid and base are factors in determining which of the possible periodates forms in the reaction of periodic acid with a given base or metal ion. In commercial preparation, the reaction of sodium iodate with chlorine in alkaline solution yields the disodium meso salt, $2Na^+ + IO_3^- + 3OH^- + Cl_2 = Na_2HIO_5 + 2Cl^- + H_2O$. Periodic acid, itself, crystallizes from solution as H_5IO_6, which may be dehydrated to HIO_4 by heating to 100° C. in a vacuum. Attempts to prepare the anhydride of periodic acid, I_2O_7, have not succeeded as oxygen is lost in further dehydration of the acid.

Analytical Chemistry.— Iodine is detected by the violet colour of its vapour or of its solution in carbon disulfide or carbon tetrachloride. In aqueous solution minute amounts of iodine in the presence of starch give a bright blue colour. None of the other halogens gives these colours. If present as iodide, the iodine is first set free by the action of an oxidizing agent such as chlorine water; or if present as iodate or periodate, by reduction with sulfurous acid. Iodine is determined gravimetrically by precipitation as yellow silver iodide. which is insoluble in nitric acid and ammonia. Volumetrically, iodine is titrated with a standardized solution of sodium thiosulfate, usually in the presence of starch as indicator. The iodine is consumed by reaction, $I_2 + 2S_2O_3^{-2} = 2I^- + S_4O_6^{-2}$, and at the end point the blue colour disappears, leaving a colourless solution.

The reaction of iodine with thiosulfate is of great importance in analytical chemistry. It is employed in the determination of many substances which have oxidizing properties. For example, dichromate may be determined quantitatively by first allowing the dichromate solution to react with excess potassium-iodide solution, $Cr_2O_7^{-2} + 6I^- + 14H^+ = 3I_2 + 2Cr^{+3} + 7H_2O$, and then titrating the liberated iodine with standard thiosulfate solution. Even substances with weak oxidizing powers may be determined in this way; *e.g.*, copper, by the reaction $2Cu^{+2} + 4I^- = 2CuI + I_2$. Some other determinations that may be made in this way are of chlorine, bromine, iodate, persulfate, hydrogen peroxide, nitrite, arsenate, ferricyanide, permanganate, manganese dioxide and ferric iron.

Many reducing agents may be titrated directly with a standard solution of iodine in potassium iodide using the starch indicator. In these titrations the iodine is reduced to colourless iodide; *e.g.*, with arsenite, $HAsO_3^{-2} + I_3^- + H_2O = AsO_4^{-3} + 3I^- + 3H^+$. Titrations of sulfite, sulfide, thiosulfate, ferrocyanide, stannous and antimonous ion may be made in this way. Determination of reducing and oxidizing agents in which iodine or iodide is employed are known respectively as iodimetric and iodometric determinations.

Iodine compounds are employed in other analytical procedures. A solution of mercuric iodide in excess potassium iodide, containing the complex ion HgI_4^{-2}, known as Nessler's reagent, is used in the determination of ammonia. with which it forms a yellow precipitate, $Hg_2NI.H_2O$. Small amounts of water in organic liquids are determined by titration with a pyridine solution containing iodine, sulfur dioxide and methyl alcohol. This solution is known as the Karl Fischer reagent. Potassium iodate and biiodate, $KIO_3.HIO_3$, are of importance as oxidizing agents in analytical chemistry. Potassium periodate is a valuable oxidizing agent in the determination of manganese. It will oxidize manganous ion to permanganate ion quantitatively in acid solution, the permanganate being determined colorimetrically.

The content of unsaturated compounds in oils is determined by measurement of the quantity of iodide absorbed. The per cent of its own weight of iodine which a sample of oil will absorb under certain specified conditions is known as the iodine number. Concentrated hydriodic acid is used in the Zeisel method for determination of methoxy groups.

Soluble iodides are employed in detection and estimation of alkaloids with which they form precipitates.

BIBLIOGRAPHY.—Leopold Gmelin, *Gmelin und Krauts Handbuch der anorganischen Chemie*, 8th ed. (1931); J. W. Mellor, *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, vol. ii, *16* vol. (1922–37); M. C. Sneed, J. L. Maynard and R. C. Brasted (eds.), *Comprehensive Inorganic Chemistry*, vol. iii (1954); Kirk-Othmer, *Encyclopedia of Chemical Technology*, vol. 7 (1951). (R. P. S.)

IODINE BUSH or PICKLEWEED (Allenrolfen *occidentalis*), a North American plant of the goosefoot family (Chenopodiaceae), native to moist alkaline clay soil from western Texas to central California. It is an erect, diffusely branched shrub, 2 ft. to 5 ft. high, with alternate. fleshy, green, apparently leafless, jointed branches, the leaves being reduced to minute pointed scales or wanting. The numerous small flowers are arranged spirally by threes in crowded cylindrical spikes, $\frac{1}{4}$ in. to $\frac{3}{4}$ in. long, borne in the axils of fleshy bracts near the ends of the branches. In appearance the plant is suggestive of a tall, much-branched form of the glasswort (*q.v.*) or samphire, to which it is closely allied.

IODOFBRM, formerly valued as an antiseptic, although now no longer widely used in medicine, was discovered by G. S. Sérullas in 1822. It can be prepared by the action of iodine and an aqueous base on ethyl alcohol, acetaldehyde, acetone, isopropyl alcohol or almost any other compound containing either the CH_3-CO-C or the CH_3-CHOH-C groups. For this reason, the "iodoform test." which consists in the formation of iodoform by the procedure described, is commonly employed in the chemical laboratory for establishing the presence of the stated groups.

Iodoform, CHI_3, crystallizes in yellow hexagonal plates melting at 119°–120° C., and is readily soluble in alcohol or ether, but insoluble in water. It has a characteristic odour and is volatile in steam.

IOLITE: see CORDIERITE.

ION OF CHIOS (*c.* 490–*c.* 422 B.C.), Greek poet and prose writer, competed perhaps ten times with tetralogies in Athenian dramatic contests, and one year was victorious in both tragedy and dithyramb. Athenaeus relates that in his delight. Ion gave every Athenian citizen a jar of Chian wine. Alone of Greek tragedians Ion also tried his hand at comedy (if the scholiast on Aristophanes' Peace 83j is to be trusted); elegy, epigrams, hymns, encomiums, prose memoirs and monographs on historical and perhaps philosophical subjects showed his remarkable versatility. The Alexandrian critics admitted him to their canon of the five best tragedians; the author of the treatise On *the Sublime,* however, pronounced his poetic style smoothly finished without genius. His most original achievement was his prose memoirs. *Epidemiai,* an anecdotal work which started a new literary genre.

BIBLIOGRAPHY.—For fragments *see* A. Nauck (ed.), *Trag. Gr. frag.* (1926); F. Jacoby (ed.), *Frag. Gr. hist.* (1923 *et seq.*); and Diels-Kranz, *Die Fragmente der Vorsokratiker* (1934–38). *See* also A. von Blumenthal, *Ion von Chios* (1939). (*A. M.* DE.)

IONA, an island of the Inner Hebrides, Argyllshire. Scot., 6½ mi. S. by W. of Staffa and 1¼ mi. W. of the Ross of Mull, from which it is separated by the shallow Sound of Iona. Pop. (1951) 173.

Iona is low-lying. The highest eminence is Dun I, which rises to a height of only 332 ft. above sea level. It is 3 mi. long and 1½ mi. wide, and at no time has it given accommodation to more than a handful of permanent residents. The island is 3.3 sq.mi.

The name of Iona, although originally a mistake for Ioua, has long established itself as the accepted representative of the ancient "I" found in the Gaelic name "I-Chaluim-Chille" or in the Anglicized form oi "Icolmkill," meaning "Island-of-Columba-of-the-Church" or "Cell." It was admirably suited to be the home of a small community of celibate clerics. Columba, in 563, when 42 years old, was glad to leave his native Ireland, then known as Scotia, because of certain church and state troubles in which he had been involved. Iona, readily accessible from Ireland by sea, formed an integral part cf the dominions of the Gaelic-speaking kings of Scottish Dalriada (*q.v.*). These rulers were near kinsmen of Columba, and one of them, King Conall, granted Iona to him. His career in Scotland till his death in 597 was very successful. He evangelized the Picts living in east and northeast Scotland, and by his religious propaganda prepared the way for the absorption oi the Picts into the evolving Scottish kingdom. He sent his missionaries through many districts of insular and mainland Scotland, achieving a wonderful degree of religious success. He was followed by an unbroken line of abbots until, with the increase of papal influence, the abbey was subordinated to the bishopric of the isles and ultimately amalgamated u-ith it.

Iona's fame led to its selection as the royal burial ground of Scotland for several centuries. Donald Monro, who visited Iona in 1549, stated that the *tumuli regum* or "graves of the kings" contained the remains of no fewer than 48 Scottish, 8 Norse and 4 Irish kings. In 795, pagan Norsemen first visited the islands in quest of plunder; they returned in 802 and again in 806. In 82; Blathmac and several fellow monks mere murdered by marauding Norsemen. Iona's growing insecurity led to the temporary transfer in 849 of the relics of Columba partly to Dunkeld in Perthshire and partly to Ireland. Ultimately in 878 all the relics were taken to Ireland and never restored to the Scots.

These Norsemen were gradually won over to Christianity and became firm supporters of Iona abbey, but insisted that it should acknowledge the supremacy of the archbishop of Trondheim. This supremacy terminated with the end of the Norse control over western Scotland about 1266. While the Norse power was declining, semi-independent Hebridean chiefs, such as Somerled, took an active interest in Iona. Somerled's son Reginald is believed to have founded in 1203 the Benedictine nunnery of St. Mary, of which his sister Beatricc was the first prioress. Somerled's descendants, the MacDonald lords of the Isles. were most generous to the abbey, granting various estates for its upkeep. With the forfeiture oi the last MacDonald lord in 1493, the former vassal clans became independent and lawless, and during periods of unrest diverted some of the abbey's revenues to their own private purposes. Although the impact of the Reformation was harmful to Iona at first, it is untrue that 300 Icna crosses were cast into the sea by Protestant vandals. Iona's subsequent ecclesiastical life coniormed to the prevailing pattern of Scottish church government, whether episcopalian or presbyterian, until presbyterianism finally prevailed. In 1899 George Campbell, 8th duke of Argyll, transferred to the Church of Scotland all the ecclesiastical buildings in Iona.

A religious brotherhood for the training of students, called the Iona community, was founded by George F. MacLeod in 1938. This organization undertook as a corporate task the restoration of the abbey of Iona, and the dormitory block was the first part to be rebuilt. (C. M. M.)

ION EXCHANGE, a process in which ions (see SOLUTIONS) attached to or incorporated within the molecular structure of insoluble substances, called ion exchangers, exchange with ions present in a surrounding solution. The process has also been called base exchange and exchange adsorption. Ion exchangers are essentially insoluble acids or bases, the salts of which are also insoluble. Ion exchangers may undergo exchange either with positively charged ions (cations) or negatively charged ions (anions). In the former case the process is referred to as cation exchange and in the latter as anion exchange.

Numerous substances, of both natural and synthetic origin, possess ion exchanging properties. These include proteins: synthetic resins, cellulose. bone, living cells, silicate minerals and soils. For commercial and laboratory uses the commonest types of inorganic ion exchangers include the natural zeolites, glauconite and greensand; but the most widely used inorganic exchangers are synthetic sodium aluminosilicates. The organic ion exchangers include the sulfonated coals and. most important of all, synthetic resins. The synthetic resins are plastics which may be chemically modified to impart or enhance their ion exchanging properties.

Since the discovery in 1935 of synthetic ion exchange resins, technical application has increased to the point where it is regarded as a unit operation along with processes such as distillation, adsorption: filtration and solvent extraction. Ever since it was proposed, in 1905, the major use of ion exchange has been in water softening. in nhich calcium and magnesium ions, largely responsible for the hardness of water because they form insoluble compounds (see WATER), are removed by a granular bed of cation exchanger and replaced by sodium ions from the cation exchanger. When the cation exchanger becomes exhausted, by no longer having sufficient amounts of exchangeable sodium left, it is regenerated by passage of an excess of a strong solution of sodium chloride through the bed thus removing the calcium and magnesium, which are usually discarded. Technical applications of ion exchange include the recovery of valuable metals from waste solutions, purification of antibiotics and antibodies, separation of mixtures of closely related substances and in acid-base catalysis. Medical applications include treatment of ulcers. diarrhea and removal of excess sodium ions from the body For further information on the uses of ion exchange, see below, *Applications.*

Historical Development.— In 1850, in separate publications by the English agriculturist Harry Stephen Meysey Thompson (1809–74) and the English chemist John Thomas Way (1821–84), the phenomenon of ion exchange occurring in soils uas recognized and systemically investigated. In 1935 two English chemists, I. B. A. Adams and E. L. Holmes, discovered the ion exchanging properties of synthetic resins.

In the early 19th century it was known that plants require nitrogen for growth and, further, that the ammonia given off by manure heaps nas taken up by the soil. Sulfuric acid or sulfate salts were often used to fix the ammonia by the formation of ammonium sulfate In 1845 Thompson, in collaboration with Joseph Spence. a chemist and druggist, conducted a series of experiments in order to test the extent to which soils could fix ammonia and "to ascertain whether it also extended to the sulfate, as if not, the use of sulfuric acid as a fixer, though preventing the escape of ammonia in a volatile form. would have been objectionable from its forming a highly soluble salt that would readily be washed down into the subsoil or carried off in drains." In one experiment a sample of soil forming a six-inch-high column was placed in a glass percolator The soil had been mixed previously with a known quantity of ammonium sulfate. When nater was passed through the column it was found to the experimenters' "complete surprise" that most of the ammonia nas retained by the soil, that it could not be removed by leaching nith water and that "this process was in some way connected with the presence of lime in the soil, as the sulfuric acid was mashed out in combination with lime." In other words, though Thompson was actually unaware of the correct explanation, the ammonium ion had exchanged with the calcium ion present in the soil. while the negatively charged sulfate ion was unabsorbed. The process can be written as:

$$Ca \cdot Soil + (NH_4)_2SO_4 \rightleftarrows 2NH_4 \cdot Soil + CaSO_4$$

In 1848 Thompson communicated a brief outline of his results to Way, nho had recently been appointed consulting chemist to the Royal Agricultural society of England. Way conducted a carefully designed series of experiments to elucidate the reaction of soils with metal ions. One of the most important conclusions Way drew from his investigations was that the cation exchange reaction was chemical in nature. He also pointed out that the displacing ability of individual cations from inorganic cation exchanging silicates was different but followed a reproducible order.

Way also demonstrated that the inorganic minerals in soil possessed marked exchanging properties. In fact he prepared the first synthetic cation exchangers of the aluminosilicate type having the approximate formula for the sodium form of $Na^+ AlSi_3O_8$ in which the Na^+ is exchangeable. The first successful commercial applications of ion exchange were initiated in 1905 with publications and subsequent patents by Robert Gans a German chemist. Gans obtained several patents for the preparation of synthetic hydrated aluminosilicates capable of softening water

One of the important disadvantages of the inorganic or siliceous type of cation exchangers is that their use is restricted to a narrow pH range near neutrality, because they eventually disintegrate in acid or highly basic solutions. Consequently their use is confined principally to aater softening. In 1930 it was found that the sulfonation of various types of coal converted them to cation exchangers which could function even in highly acid mediums; this made it practicable to exchange metal ions for hydrogen ions. The predominating exchanging group in the sulfonated coals was a sulfonic acid group ($-SO_3H$) in which the hydrogen is exchangeable.

An outstanding milestone was Adams and Holmes's discovery of the ion exchanging properties of synthetic resins. Both men were employed as chemists in the British government research laboratory at Teddington. Eng.; Adams was a specialist in the treatment of water, and Holmes had done considerable work on the synthesis of resins. Their joint efforts led to the synthesis of phenolic resins, resembling Bakelite. capable of undergoing cation exchange; and resins capable of anion exchange. The latter resins mere prepared from condensation of polyamines nith formaldehyde. Although these first resins were not very useful in themselves, their synthesis meant that chemists could now synthesize ion exchange resins with properties nearly as desired. For the first time practically all the ions could be removed from water by simple filtration without the application of heat as in distillation. Adams and Holmes were well aware of numerous other applications for utilizing ion exchange. The commercial production and improvement of synthetic resin exchangers soon followed. particularly by Holmes and I. G. Farbenindustrie. A major advance in resin development took place in 1942 when G. F. D'Alelio showed that remarkably efficient resins could be made by incorporating individual chemical groups possessing exchanging properties into preformed synthetic plastics which in themselves had no exchanging properties but were exceedingly stable.

Concomitantly with the development of greatly improved ion exchange resins went the discovery of new applications and techniques which greatly accelerated the introduction of ion exchange processes into numerous technological and laboratory operations. Three of the more important developments were: (1) Chemists of the Manhattan project (atomic bomb research program) demonstrated that by simple and rapid ion exchange processes, individual members of the chemical group known as the rare earths could be isolated (see RARE EARTHS). This finding led to the remarkably successful use of ion exchange to resolve highly complex mixtures. The purified materials included nucleic acids, amino acids. isotopes and several new elements. (2) In 1949 ion exchange resins mere first prepared in the form of sheets or membranes. While the use of membranes which permitted only ions of one sign to pass through had been known for many years, the commercial availability of more stable and effective membranes from the physically and chemically tough ion exchange resins greatly expanded the potential applications of a membrane system. In use, these membrane systems employ an electrical current to induce selective transport of ions, as explained below. (3) In 1953 chemists of the Dow Chemical company introduced a process utilizing ion exchangers to separate ionized substances from nonionized or slightly ionized substances in water solution. This process. called ion exclusion, made use of the fact that nonionized substances such as alcohols and sugars are free to diffuse unhindered into the water phase of the ion exchange resin, while ions are excluded because of their electrical charges. Inasmuch as the nonionized materials retained by the resin can be removed by additional water washes. the technique of ion exclusion made possible the deionization and separation of many products without the use of heat, electricity or chemical regenerants.

Ion Exchange Resins.—An ion exchanging resin consists of a polymeric organic network or backbone and ionized or functional groups which undergo exchange. A very effective organic network is formed by the polymerization of styrene in the presence of varying amounts of divinylbenzene, which serves to crosslink the long chains of styrene into a three-dimensional fish-net type of structure. Functional groups are introduced subsequently into the polystyrene or, in the case of other ion exchangers. may be part of the monomer. Common functional groups in the case of cation exchangers consist of acid groups such as carboxylic groups (R—COOH), sulfonic groups (R—SO_3H) and phenolic groups (R—OH); while anion exchangers contain basic amine groups such as quaternary ammonium groups (R—R'_3N—OH^-) and primary, secondary and tertiary amines (R—NH_2, R—R'SH, R—R'_2N), where R represents the organic network and R' represents organic radicals such as the methyl group (—CH_3). In a given resin the R' groups may be the same or different. Resins in which all the functional groups are identical are called monofunctional. Schematic diagrams of a crosslinked polystyrene strong acid and strong base ion exchanger are shown in fig. 1. These ion exchangers are prepared in the form of spheres or beads varying, from less than 0.04 mm. to 1 mm. in diameter. Larger-size beads tend to crack during the manufacturing process. The

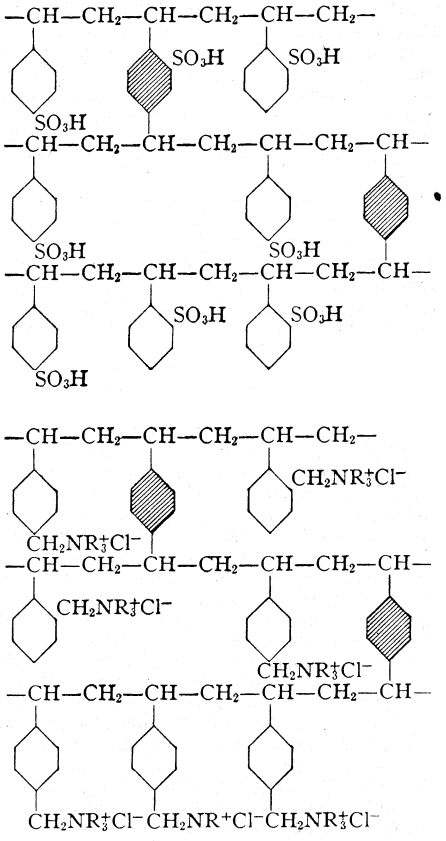


FIG. 1.— HYPOTHETICAL SCHEMATIC DIAGRAM OF A SULFONATED POLYSTYRENE CATION EXCHANGE RESIN CROSSLINKED BY DIVINYLBENZENE (TOP DIAGRAM) AND A STRONGLY BASIC QUATERNARY AMMONIUM ANION EXCHANGE RESIN (BOTTOM). THE CROSSHATCHED BENZENE RINGS SHOW THE DIVINYLBENZENE CROSSLINKAGE POINTS

commonest particle diameters used for water treatment are the range from 0.84 to 0.297 mm., but for certain difficult separations smaller sizes are used.

The type of ion exchange resins shown in fig. 1 are markedly resistant to chemical and physical attrition and are insoluble in all the common organic and inorganic solvents, including mineral acids and bases. High concentrations of oxidizing agents such as nitric acid can have deleterious effects by attacking the resins at a vulnerable point—the crosslinks. The salt forms of the cation exchange resins in contact with solutions can withstand temperatures up to about 140° C ; those of the anion exchange resins are stable up to about 90° C.

When immersed in water the ion exchange resins take up water and swell. The extent of swelling depends on the degree of crosslinkage—a quantity expressed by the percentage of divinylbenzene (DVB) used to prepare the resin. Thus a 10% DVB resin—the most commonly used—is made up of beads synthesized by the use of 90% by weight of styrene and 10% by weight of divinylbenzene. The extent to which a resin swells or shrinks depends on the salt concentration of the surrounding solution—the higher the concentration the less the suelling.

Ion exchange resins must have a crosslinked structure because the ionizable groups enhance the solubility and thus promote swelling. Too few crosslinks result in excessive swelling and reduced selectivity toward ions; while too many crosslinks so tighten the structure that the rate of the ion exchange reaction is too slow, since it depends on ionic diffusion. In practice a compromise must be effected in order to obtain a useful exchange resin. However, in special applications the ability to utilize resins of different crosslinkage is highly useful and sometimes indispensable. For example, when very large ions are to be taken up it is often desirable to use a low crosslinked resin so as to facilitate the entrance of the large ions into the "pores" of the resin.

Special resins are synthesized so as to contain functional groupings which have a specific or marked affinity for certain ions. Other special resins include types which undergo oxidation-reduction reactions. Instead of exchanging ions, these electron exchange polymers exchange electrons.

In the table a summary is given of some of the major types of available ion exchange resins, together with other pertinent information.

Principal Types of Ion Exchange Resins Available Commercially

Resin	Total capacity (Milliequivalents 1 g.)	Total capacity (Milliequivalents 1 c.c.)
Cation exchangers		
Strong acid (sulfonated polystyrene)	4.2	2.2
Carboxylic	4–10	1–4
Phenolic methylene sulfonic	1.3–2.5	0.5–1
Sulfonated coil	1.6	0.6
Aluminum silicate	1	—
Anion exchangers		
Strong base	2.3–2.5	1.0
Weak base	6–10	2–2.5

When the acid or hydrogen form of a cation exchanger is neutralized with sodium hydroxide, a plot of the cubic centimetres of base added against the pH yields a titration curve. Such curves are an important and convenient method of characterizing ion exchange resins. because they give information on the number of kinds of functional groups present, their acid or base strength and the capacity of the resin. The behaviour of a carboxylic acid resin of the type (R—COOH) closely parallels that of moderately weak acetic acid (CH_3—COOH), while the behaviour of monofunctional sulfonic acid resins resembles that of the strongly acid hydrochloric acid. On the other hand, the quaternary-ammonium-type anion exchange resins are nearly as basic as sodium hydroxide.

Techniques. — Contact between a solution and an ion exchanger involves either a batch or column process. In the batch process the resin is simply mixed with solution and agitated continuously or intermittently until equilibrium is reached—a period of a few minutes or several days depending on the resin and type of ions being exchanged. After equilibration the resin is removed by filtration. Batch techniques are infrequently employed for industrial purposes, but are often used in the laboratory for fundamental studies of the mechanism of ion exchange reactions.

Column methods generally involve fixed-bed operation, which refers to the use of a packed column of resin through which is passed the feed or regenerant solution. The resin is supported on a porous support while solution flows through by gravity or under pressure. The solutions are usually passed donn through the resin, though up-flow operation is not uncommonly employed, especially when it is desired to remove suspended particles from the resin bed during regeneration.

A fixed-bed cycle generally consists of the following steps: (1) saturation of the bed with solution until the desired or undesired ions break through to a predetermined level; (2) removal or elution of the retained ions by regenerant solutions; (3) rinsing of the bed free of regenerant so that the cycle can be repeated. Between cycles the bed may be backwashed by up-flow passage of water.

A less used but potentially important variation of column operation is the so-called moving bed or continuous countercurrent system. Here both the resin and solution are made to flow through the system.

An effective method for separating difficultly resolvable mixtures on the laboratory scale is by the technique of chromatographic elution. The ions to be separated are placed on the top of the resin bed and subsequently eluted stepwise with a solution containing ions capable of displacing the absorbed ions. The displaced ions move down the column as bands or zones at different velocities. If the column is long enough the bands may completely separate from one another. and the substance confined to each band is recovered in the outgoing solution, called the effluent.

Most applications of ion exchange involve column operation, because of the completeness of separation which can be obtained and the ease with which automatic instrumentation can be employed. Column techniques correspond to the use of a large number of batch operations in series, an analogy closely akin to fractional distillation processes.

Mechanism of Ion Exchange Reactions. — The equilibrium between monovalent exchanging ions. A^+ and B^+, for a cation exchanger can be written as a simple chemical reaction:

$$A^+ + BR \rightleftarrows B^+ + AR$$

where R represents the immobile resin anion with an assumed charge of −1. Ion exchange reactions show two important characteristics: (1) exchange of equivalent amounts of ions; and (2) preferential uptake by the exchanger of one ion over another. These properties are defined by the selectivity quotient, Q:

$$Q = \frac{[AR][B^+]}{[BR][A^+]}$$

where [AR/BR] is the molar ratio of the ions A^+ and B^+ in the resin phase in equilibrium with concentrations $[A^+]$ and $[B^+]$ in the solution phase. When $Q=1$ the resin shows no preference for A^+ over B^+. For easy separation it is important that Q be as far as possible from unity. When $Q>1$ then the resin shows preference for A^+ over B^+ and vice versa.

The selectivity quotient is not constant under varying conditions; it depends, for example, on the nature of the resin, the total concentration of the solution and the ratio of ions in the resin phase, and the nature of the ions. Inasmuch as the efficiency and hence the design of a column operation depend on the values of Q, it is apparent that the determination of Q is important. The greater Q differs from unity, then the shorter can be the column, the faster the flow rate and the sharper the separations.

In general terms and for dilute solutions, the affinity of an ion for an ion exchanger is governed largely by electrostatic forces and depends mainly on two factors—ionic charge and ionic size. Ions of higher charge are generally held more tightly, as in the series $Th^{+4} > La^{+3} > Sr^{+2} > Na^+$. For ions of the same charge the ion with the smallest radius in solution is held the

strongest. Thus for the alkali metals the order is: $Cs^+ > Rb^+ > K^+ > Na^+$; which reflects the fact that while Cs^+ has the largest crystal radius its hydrated radius is the smallest. That the hydrated radius is the important parameter is shown by the fact that in alcoholic solution where the ions become dehydrated, the affinity of the alkali metal ions for the ion exchanger is in the reverse order. The affinity of a cation exchanger for H^+ depends on the acid strength of the functional group.

A related and much-used quantity for evaluating separability is the distribution coefficient K_d, defined for a given ion in any ion exchange system, as for A^+, for example:

$$K_d^A = \frac{[AR]}{[A]} = \frac{\text{concentration } A^+ \text{ per unit weight resin}}{\text{concentration of } A^+ \text{ per c.c. of solution}}$$

The ratio $K_d^A/K_d^B = Q$ is called a separation factor.

Inasmuch as the functional groups of a resin are fixed. it is possible to formulate ion exchange reactions as a Donnan equilibrium. Consequently, for a reaction involving H^+ and Na^+:

$$Na^+ + HR \rightleftarrows NaR + H^+$$

and omitting activity coefficients (see SOLUTIONS), the equilibrium quotient, K, is

$$K = \frac{[NaR][H^+]}{[HR][Na^+]}$$

This equation is identical in form with one based on the law of mass action.

When the resin phase is treated as an ordinary aqueous solution, and the standard state is taken to be the same in both phases, then the value of K becomes unity when both phases are dilute. However, in the ordinary 10% DVB resin the internal concentration is about 6 molal; hence it is necessary to insert activity coefficients into the equation to take into account the marked effects of concentration changes on equilibrium. When resins of very low crosslink are used. the internal resin phase becomes more dilute; *i.e.*, the resin takes up more water. This serves to reduce the selectivity of the resin for one ion over another because the differences in activity become less.

When ions of unequal valences are exchanging, such as Ca^{++} and Na^+, the ion exchange reaction is

$$Ca^{++} + 2NaR \rightleftarrows CaR_2 + 2Na^+$$

and

$$K = \frac{[CaR_2][Na^+]^2}{[Ca^{++}][NaR]^2} = Q\left[\frac{Na^+}{NaR}\right]$$

From the definition of Q it is found that the selectivity of the resin for Ca^{++} relative to Na^+ is given by the expression

$$Q(Ca/Na) = \frac{K[NaR]}{[Na^+]}$$

When the concentration of Ca^{++} is very small relative to Na^+, then [NaR] remains nearly constant; and it is seen that the selectivity of the resin for the divalent cation is inversely proportional to the sodium concentration in solution. Thus in water softening, where a dilute solution of Ca^{++} and Na^+ salts is dealt with, the resin is very efficient in removing the Ca^{++}. However, in regeneration the use of a strong solution of sodium chloride is effective in eluting calcium. The use of greater concentrations of the ion of lower valence tends to reduce its relative affinity for the resin.

In very concentrated solutions, usually above 3 M (molar), the resins may have a greater affinity for ions of lower charge. This polyvalent ion effect also holds for anion exchange.

The resin phase must maintain electrical neutrality at all times. Because of the presence of a preponderance of nondiffusible "resinate" ions (R^- in the case of a cation exchange, and R^+ in the case of anion exchange) the penetration of ions of the same charge into the resin phase is hindered—a manifestation of the Donnan effect. Consider the case of the hydrogen form of a cation exchanger immersed in a solution of hydrochloric acid. In dilute solutions the concentration of Cl^- in the resin phases is nearly nil. However, as the external concentration of HCl increases, the concentration of Cl^- in the resin phase in the form of HCl increases and approaches that of the outside solution. Neglecting activity coefficients. the expression for the diffusion of HCl into the resin phase is:

$$\frac{[Cl^-]\text{resin}}{[Cl^-]\text{solution}} = \sqrt{\frac{1}{1+\frac{[R^-]}{[Cl^-]\text{resin}}}}$$

One gram of a 10% DVB resin, HR, contains about 5 millimoles of H^+ and R^- in roughly 1 c.c. volume; *i.e.*, it is roughly 5 M in H^+ and R^-. When immersed in a 0.1 M solution of HCI, the equation illustrates the fact that the ratio $[R^-]/[Cl^-]$ resin $= \frac{5}{0.1} = 50$, so that the concentration of Cl^- in the resin is very small; namely. about 0.014 M. When the concentration of HCl in solution is 10 M, the concentration of Cl^- in the resin is calculated to be about 8.1 Ill. This example shows that while the total exchange capacity of the resin nas only 5 millimoles. the actual concentration of H^+ in the resin was 8.1 M, 3.1 millimoles greater than the total exchange capacity.

Those ions which enter the resin as a result of Donnan effects can be leached out mith water, while those ions needed to neutralize the functional groups remain. In the case of uncharged substances, their concentration in the resin phase may actually exceed the external solution concentration because there exist no charge factors to exclude them and. in addition, the resin phase often acts to hold them selectively. This is the basis for the ion exclusion process described in the section *Historical* Development.

The rate nith which an ion exchange reaction reaches equilibrium does not depend on the chemical exchange reaction but rather on the rates of diffusion of the exchanging ions into and away from the ion exchanger. In a well-stirred solution. ion exchange kinetics is governed by one of two diffusion mechanisms: (1) diffusion of the ions through a hypothetical film of solution surrounding each ion exchange particle (F mechanism); or (2) diffusion of the ions through the exchanger particle itself (P mechanism). When both mechanisms are significant in an ion exchange reaction, one has the condition termed "intermediate" (I mechanism). It is helpful to know which diffusion mechanism is operativc because it gives both qualitative and quantitative information on how the rate varies mith changes in the particle size of the exchanger. concentration of the solutions, charge of the ions and manv other warameters, including the internal structure of the resin. Since column methods are usually operated under nonequilibrium conditions, kinetic information helps to predict the performance of a given column process and hence the design

The differences between ion exchange reactions governed by F or P rate mechanisms may be summarized in general as follows: (1) a P mechanism is independent of stirring or flow rates while the reaction rate of an F-mechanism-controlled reaction increases with increasing stirring or flow rates; (2) in the early stages a plot of the amount of exchange which has taken place against the square root of time gives a linear plot for a P mechanism: while an F mechanism gives a linear plot when the log of the amount of exchange is plotted against the first power of time; (3) at high concentrations in the surrounding solutions the rates tend to be governed by a P mechanism, and at low concentrations by an F mechanism; and (4) the rate constant varies inversely as the first power of the radius of the exchanger particle for an F mechanism, and as the square of the particle radius for a P mechanism.

Applications.— As noted previously, the softening of water is the most widely used ion exchange process. Water-softening units in individual homes find widespread use in the U.S.; home uses are being developed in Great Britain and in Europe. Some communities soften water before it reaches the home. Los Angeles, Calif.. softened about 80,000,000 gal. of river water a day in the 1950s and could. at full capacity, provide 200,000,000 gal. of softened water a day. Numerous industries soften water or provide deionized water in order to improve the quality of various products,

such as television tubes, storage batteries, drugs, sugar and paper.

One interesting technique increasingly used in water conditioning includes the use of mixed-bed units. In this technique, the cation and anion exchange resins are mixed so that complete

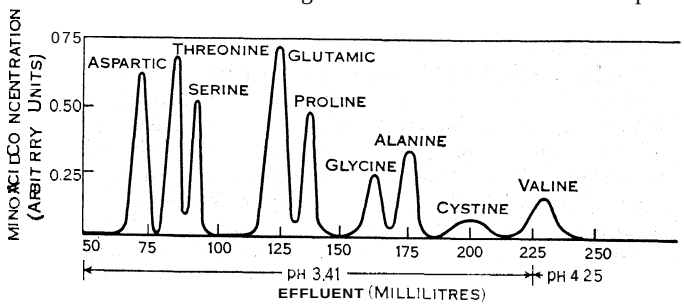


FIG. 2.—ION EXCHANGE SEPARATION OF AMINO ACIDS BY ELUTION WITH BUFFERS OF INCREASING pH FROM A STRONGLY ACID CATION EXCHANGE RESIN

The shapes of the curves, as those of other systems, vary depending on flow rate, concentrations of substances being separated, temperature, length of column and other factors

demineralization occurs in the passage of water directly, instead of the usual technique in which water runs through a series of alternate anion-resin-containing tanks. In a mixed bed the resins are regenerated separately by separation of the lighter anion resin by hydraulic classification. After regeneration the resins are mixed, compressed air being used for agitation.

The recovery of metals from industrial wastes and the purification of solutions for re-use are important applications of fixed-bed exchange. However, for such processes to be worthwhile, the recovered metal must have a relatively high economic value, or the savings resulting from the re-use of the solution must be high. The first large-scale use of ion exchange for metal recovery (copper from rayon spinning wastes) took place in Germany beginning about 1940. Deionization. of many organic chemicals such as gelatin. sorbitol and glycerine is achieved by ion exchange. Anion exchange resins are used successfully to remove formic acid from formaldehyde.

The isolation of materials present in small amounts is another successful ion exchange technique. Streptomycin is a large organic molecule which behaves as a cation. It is concentrated from fermentation broths by absorption on a cation exchange resin, and is recovered in high concentration by displacement with dilute acid.

The separation of complex mixtures of ions has found especially useful applications in scientific studies. Examples of two such processes are given because they illustrate important principles which are of great utility.

Rare earths are trivalent cations so similar in properties that ordinary ion exchange separation methods do not work with them. However, it is possible to convert the rare-earth cations into complexes by the use of complexing agents such as citric, lactic and other organic acids. These complexes are usually anions and as such are not absorbed by a cation exchange resin. The rare-earth cations are placed on the top of a bed of a cation exchanger, and elution is facilitated by the use of complexing solutions of suitable pH and concentration. Since the stability of the complex ions varies, the over-all differences in affinity of the individual rare earths for the resin are enhanced. Of further interest is the fact that under given conditions the rare earths are eluted in an orderly sequence based on atomic number. This behaviour led to the first positive identification and subsequent solution of element 61, named promethium. Similarly, the same complex or chromatographic elution technique led directly to the discovery of the elements curium, berkelium, californium, einsteinium and fermium.

Amino acids possess both acidic and basic groups so that they can be absorbed on either cation or anion exchange resins. By suitable variations in pH of an eluting solution, it is possible to obtain separations of individual amino acids, as is shown in fig. 2.

In medicine, weak base anion resins are useful in the treatment of ulcers. When taken orally in the form of a powder or in a capsule, they act to neutralize excess hydrochloric acid in the stomach. Cation exchange resins in the form of mixed potassium-ammonium forms are capable of removing excess sodium from the body, and thus reducing water retention believed to result from the water held by sodium ions.

It is possible only to mention the myriad of other uses of ion exchangers. These include the separations of peptides, nucleic acids, sugars, aldehydes and ketones, and the removal of calcium from blood to prevent coagulation. Since ion exchange resins are essentially acids or bases, they find considerable uses as catalysts in hydrolysis and esterification reactions. They have the advantage that as catalysts they can be removed from the reaction mixture by simple filtration and re-used after regeneration.

Many studies of a fundamental nature are carried out with ion exchange resins, since they serve as tools for measuring the stability of complex ions, determination of the state of an element in solution and measurement of activity coefficients. Ion exchangers are widely used in analytical chemistry and other branches of chemistry for the purification of reagents and the preparation of different salt forms of compounds. Salts of acids, when passed through the hydrogen form of a cation exchanger, liberate H^+ which can be titrated, thus yielding the concentration of the original salt. Electrochemical methods of utilizing ion exchange resins, particularly in the form of membranes, are used for demineralization of water and chemicals. In a simple three-compartment cell a cation and an anion exchange membrane divide a container into three regions. Upon application of a current, the cations present in the middle compartment move through the cation membrane, while the anions move into the anion compartment. Thus the middle compartment is demineralized. A series of such cells can be used in which water or other liquids passing continuously through the middle compartment are demineralized. Electrochemical operations become less economical as the salt concentration in solution increases; *i.e.*, current consumption becomes higher. It was found impractical, therefore, to demineralize salt water, but it did appear practical for reducing the salt concentration of brackish waters to render them fit for drinking or irrigation.

In summary, the most widely used industrial application of ion exchange is in water treatment (softening. demineralization, silica removal and reduction of alkalinity). Next in importance industrially is metal recovery, followed by removal of ash from organic chemicals, ion separation, recovery of acids and bases, and catalysis.

BIBLIOGRAPHY.—F. C. Nachod and J. Schubert (eds.), *Ion Exchange Technology* (1956); C. Calmon and T. R. E. Kressman (eds.), *Ion Exchangers in Organic and Biochemistry* (1957); O. Samuelson, *Ion Exchangers in Analytical Chemistry* (1953); H. Sobotka *et al., Ion Exchange Resins in Medicine and Biological Research,* Annals of the New York Academy of Sciences (1953); Society of Chemical Industry, London, *Conference on Ion Exchange: Ion Exchange and Its Applications* (1955); C. E. Marshall, *The Colloid Chemistry of the Silicate Minerals* (1940); articles on ion exchange in G. K. Rollefson (ed.), *Ann. Rev. Phys. Chem.* (annually); N. K. Hiester and R. C. Phillips, "Ion Exchange—Chemical Engineering Report," *Chem. Engng.* (1954).

(J. ST.)

IONIA, in ancient geography, the name given to a portion of the west coast of Asia Minor, adjoining the Aegean sea and bounded on the east by Lydia. It consisted of a narrow strip of land near the coast which, together with the adjacent islands, was occupied by immigrant Greeks (Ionians), and thus distinguished from the interior district, inhabited by the Lydians. According to the universal Greek tradition, the cities of Ionia were founded by emigrants from the other side of the Aegean (*see* IONIANS), and their settlement was connected with the legendary history of the Ionians in Attica, for the colonists were led by Neleus and Androclus, sons of Codrus. the last king of Athens. Modern thought tends to support the popular Greek idea that Ionia received its main Greek element rather late—after the descent of the Dorians and, therefore, after the Aegean period. Herodotus says (i, 146) that the colonists comprised settlers from many different tribes and cities of Greece (a fact indicated also by the local traditions of the cities) and that they intermarried with the native people.

The cities called Ionian in historical times were 12 in number—an arrangement copied, as it was supposed, from the constitution of the Ionian cities in Greece which had originally occupied

the territory in the north of the Peloponnesus subsequently held by the Achaeans. These were (from south to north)—Miletus, Myus, Priene, Ephesus, Colophon, Lebedus, Teos, Erythrae, Clazomenae and Phocaea, together with Samos and Chios. Smyrna (*q.v.*), originally an Aeolic colony, was afterward occupied by Ionians from Colophon and became an Ionian city—an event which had taken place before the time of Herodotus. But at what period it was admitted as a member of the league is not known. Like the Amphictyonic league in Greece, the Ionic was rather of a sacred than a political character; every city enjoyed absolute autonomy. and, though common interests often united them for a common political object, they never formed a real confederacy like that of the Achaeans or Boeotians.

Ionia was a mountainous country, 90 mi. long from north to south, with a breadth varying from 20 to 30 mi.; to this area must be added that of the peninsula of Mimas, together with that of two large islands. Among the outstanding peaks were Mimas and Corycus, situated on the peninsula which stands out to the west. facing the island of Chios; Sipylus, to the north of Smyrna; Corax, extending to the southwest from the Gulf of Smyrna, and descending to the sea between Lebedus and Teos. The strongly marked range of Mycale. a continuation of Messogis in the interior, forms the bold headland of Trogilium or Mycale, opposite Samos. None of these mountains attains a height of more than 4,000 ft. The district comprised three extremely fertile valleys: the Hermus in the north, flowing into the Gulf of Smyrna; the Cayster. which flowed under the walls of Ephesus; and the Maeander, which in ancient times discharged its waters into the deep gulf that once came up to the walls of Miletus, but which has been gradually silted up by deposits brought down by the river. In ancient times Ionia was considered the most fertile of all the provinces of Asia Minor.

The colonies naturally became prosperous. Miletus especially was at an early period one of the most important commercial cities of Greece; the mariners of Phocaea extended their influence to the shores of the western Mediterranean; Ephesus from an early period became a flourishing city.

History.—About the middle of the 7th century B.C., the Cimmerii (see SCYTHIA) ravaged a great part of Asia Minor, including Lydia, and sacked Magnesia on the Maeander, but failed to take Ephesus. About 700 B.C. Gyges, first Mermnad king of Lydia. invaded the territories of Smyrna and Miletus; and is said to have taken Colophon as his son Ardys did Priene. But it was not till the reign of Croesus (560–545 B.C.) that the cities of Ionia successively fell, under Lydian rule. The defeat of Croesus by Cyrus was followed by the conquest of all the Ionian cities. They became subject to the Persian monarchy with the other Greek cities of Asia. They continued to enjoy a considerable amount of autonomy, but were subject to local despots. It was at the instigation of one of these, Histiaeus (q v.) of Miletus, that in about 500 B.C. the principal cities broke out into insurrection against Persia. They were at first assisted by the Athenians, with whose aid they penetrated into the interior and burned Sardis, an event which ultimately led to the Persian invasion of Greece. But the Ionian fleet was defeated off the island of Lade. and the destruction of Miletus after a protracted siege was followed by the reconquest of all the Asiatic Greeks.

The Greek victories during the Persian war had the effect of enfranchising their kinsmen on the other side of the Aegean; and the battle of Mycale (479 B.C.), in which the defeat of the Persians was in great measure due to the Ionians, secured their emancipation. They henceforth became the dependent allies of Athens (see DELIAN LEAGUE), though still retaining their autonomy, which they preserved until the peace of Antalcidas in 387 B.C. once more placed them, as well as the other Greek cities in Asia, under the nominal dominion of Persia. They appear. however, to have retained a considerable amount of freedom until the invasion of Asia Minor by Alexander the Great. After the battle of the Granicus most of the Ionian cities submitted to the conqueror. Miletus, which alone held out, was reduced after a long siege (334 B.C.). From this time they passed under the dominion of the Macedonian rulers of Asia, but continued, with the exception of Miletus (*q.v.*), to prosper both under these Greek dynasties and as part of the Roman province of Asia.

Ionia was the home of the Ionian school of philosophy (*q.v.*); it led the way also for the brilliant artistic development of Athens in the jth century. Ionian art flourished in the 8th, 7th and 6th centuries, distinguished by fineness of workmanship and minuteness of detail. See GREEK ART.

IONIAN ISLANDS, the collective name for the Greek islands of Corfu (Kérkyra), Cephalonia (Kephallēnia), Zante (Zakynthosj, Santa Maura (Levkas), Ithaca (Ithakē), Cythera (Kýthēra) and Paxo (Paxoi) (*qq.v.*), with their minor dependencies. These islands, though often described as the *Heptanesus* ("Seven Islands"), have no geographical unity. The name Ionian is obscure, but is probably due to ancient Ionian colonies, for example in Corfu from Eretria. The political unity of the islands is comparatively modern; their independence lasted only seven years (1800–07). Pop. (1951) 228,597.

The Ionian islands consist almost entirely of Cretaceous and Tertiary beds, but in Corfu Jurassic deposits have been found. The oldest beds which have yet been recognized are shales and hornstones with Liassic fossils. These are overlaid conformably by a thick series of platy Viglas limestone, representing the rest of the Jurassic and the lower Cretaceous. Then follow dolomites and unbedded *Hippurites* limestones evidently Upper Cretaceous age. The Eocene beds are folded with the Cretaceous. Both occasionally assume the form of Flysch. Miocene beds are found in Corfu and Zante, and Pliocene deposits cover much of the low ground. (X.)

HISTORY

Mediaeval and Venetian **Periods.**—The beginning of Heptanesian history dates from the 9th century. Leo the Philosopher (*c.* A.D. 890) formed all or most of the islands into a distinct province of the Eastern empire under the title of the Thema of Cephallenia. Robert Guiscard captured Corfu (1081) and Cephalonia, but his early death prevented the establishment of a Norman dynasty. When the Latin empire was established at Constantinople in 1204 the Venetians received Corfu. After defeating the Genoese corsair Leon Vetrano, the senate granted fiefs in Corfu to ten noble families in order that they might colonise it (1206). The Greek "Despot" of Epeiros, however, captured the first Venetian colony in 1214, and a long period of Epeirote, Sicilian and Neapolitan-Angevin rule followed till in 1386 the people of Corfu made voluntary submission to the Venetian republic.

Paxo, created a barony, was treated as part of Corfu. The County Palatine of Cephalonia (with Zante), seized by Matteo Orsini in 1194, owned the suzerainty first of Venice, then of Achaia, to which it was annexed in 1324. In 1357 it was bestowed upon the Tocco family of Benevento, and was united with Santa Maura and Ithaca (called Val di Conspare) in the Duchy of Leucadia. In 1479 the Turks annexed these four islands. But they gradually became Venetian; Cephalonia and Ithaca 1483–85, and from 1500 onwards; Zante 1482 and from 1485, and Santa Maura 1502–03 and from 1684. Cerigo, a Venetian Marquisate of the Venier family from 1207, became a Venetian colony in 1363, but was parcelled out between Venice and the Venier in 1393.

The Venetians, who exacted heavy contributions from the islands, won the adherence of the principal native families by the bestowal of titles and appointments; the Roman Catholic Church was established, and the Italian and Greek races were largely assimilated by intermarriage; Greek ceased to be spoken except by the lower classes, which remained faithful to the orthodox communion. On the fall of the Venetian republic in 1797 the Treaty of Campo Formio annexed the Ionian islands to France; but a Russo-Turkish force drove out the French at the close of 1798; and in the spring of 1799 Corfu capitulated. By treaty with the Porte in 1800, the Emperor Paul erected the "Septinsular Republic," but the Treaty of Tilsit (1807) declared the islands an integral part of the French empire. They were incorporated with the province of Illyria (*q.v.*); but British forces under General Oswald took Zante, Cephalonia and Cerigo in 1809, and Santa Maura in 1810; Colonel (afterwards Sir Richard) Church

(*q.v.*), reduced Paxo in 1814; and after the abdication of Napoleon, Corfu, which had been defended by General Donzelot, was, by order of Louis XVIII. surrendered to Sir James Campbell. By the Treaty of Paris (Nov. 9, 1815) the contracting powers (Great Britain, Russia, Austria and Prussia) agreed to place the "United States of the Ionian Islands" under the exclusive protection of Great Britain.

British Protectorate. — The constitutions, voted by a constituent assembly in 1817 and applied in the following year, placed the administration in the hands of a senate of six members and a legislative assembly of 40 members; but the real authority was vested in the high commissioner, Sir Thomas Maitland ("King Tom") (1815). The successive British commissioners, General Sir Frederick Adam (1823), Lord Nugent (1832) and Sir Howard Douglas (1835–41) did much for the administration, justice, education and communications of the islands, but their firm, often despotic rule was resented by the natives, the principal exponent of the opposition being the historian Andreas Mustoxidi (d. 1861). A complete change of policy was inaugurated by Mr. Mackenzie (1841–43), and Lord Seaton (1843–49) was induced by the European disturbances of 1848 to initiate a number of important reforms. But the party in favour of union with Greece was rapidly growing. Serious insurrections of the peasantry, especially in Cephalonia, had to be put down by military force, and the parliament passed a resolution in favour of immediate union with Greece.

Cession to Greece. — Contrary to the expectations of the Greeks, Mr. Gladstone, who toured the islands as high commissioner extraordinary, did not propose the abolition of the protectorate, and his successor, Sir Henry Storks, seemed indifferent or blind to the popular feeling, but on the abdication of King Otho of Greece in 1862 the British Government declared to the provisional government of Greece that the selection of Prince William George of Gliicksberg would be followed by the cession of the Ionian islands. After the prince's election by the national assembly in 1863 the high commissioner laid before the Ionian Parliament the conditions of the cession. The rejection of one condition (the demolition of the fortifications of Corfu) led to a new prorogation, but on March 29, 1864, the plenipotentiaries of the five great Powers signed the treaty by which the protectorate was ended. Neutrality was confined to Corfu and Paxo. On May 3, 1864 Sir Henry Storks left Corfu with the British troops and men-of-war. King George made his entry into Corfu on June 6.

After their annexation to Greece the history of the Ionian islands was uneventful; their prosperity somewhat declined. Corfu with Paxo; Cephalonia; Santa Maura (Levkas) with Ithaca and Zante (Zacynthos) each formed separate monarchies or departments; Cerigo (Cýthera) formed part of the monarchy of Laconia. The islands retained the exemption from direct taxation which they enjoyed under the British protectorate; in lieu of this there was an ad *valorem* tax of 20½% on exported oil and a tax of 6% on wine exported to Greek ports; these commodities were further liable to an export duty of 1½% levied on all agricultural produce and articles of local manufacture. Axis troops occupied the islands in 1941.

See Lunzi, Περὶ τῆς πολιτικῆς καταστάσεως τῆς Ἑπτανήσου ἐπὶ Ἐνετῶν (Athens, 1856); Ansted, *The I.I.* (1863); Viscount Kirkwall, *Four Years in the I.I.* (1864) vol. i.; F. Lenormant, *La Grèce et les iles ioniennes* (1865); P. Chiotis, Ἱστορία τοῦ Ἰονίου κράτους (Zante, 1815–64); Mardo, *Saggio di una descrizione geografico-storica delle Isole* (Corfu, 1865) (mainly geog.); De Bosset, *Description des monnaies d'Ithaque et de Cdphalonie* (London, 1815); Postolakas, Κατάλογος τῶν ἀρχαίων νομισμάτων τῶν νήσων Κέρκυρας, Λευκάδος κ. τ. λ. (Athens, 1868); Wiebel, *Die Insel Kephalonia und die Meermuhlen von Argostoli* (Hamburg, 1873); Tsitselis, Γλωσσάριον Κεφαλληνίας (Athens, 1876); Ὀνόματα θέσεων ἐν Κεφαλληνίᾳ in the *Parnassus* i. 9–12 (Athens, 1877); Riemann, "Recherches archéologiques sur les Iles ioniennes" in *Bibliothèque des Écoles françaises d'Athènes et de Rome* (1879–80); Gregorovius, *Corfu: eine ionische Idylle* (Leipzig, 1882); J. Partsch, *Die Insel Corfu: eine geographische Monographie* (Gotha, 1887); *Die Insel Levkas* (Gotha, 1889); *Kephallenia und Ithaka* (Gotha, 1890); *Die Insel Zante* (Gotha, 1891); *Della condizione politica delle Isole Ionie sotto il Dominio Veneto* (Venice, 1858); *Storia delle Isole Ionie sotto il reggimente dei Republicani Francesi* (Venice, 1860); *Della Republica Settinscilare* (Bologna, 1863); G. E. Mavrogiennes, Ἱστορία τῶν Ἰονίων νήσων, 1797–1815, 2 vols. (Athens, 1899); E. R. Rangabé, *Livre d'or de la Noblesse Ionienne* (3 vols. Athens, 1925–27); A. M. Andreades Περὶ τῆς πολιτικονομικῆς διοικήσεως τῆς Ἑπτανήσου ἐπὶ Βενετοκρατίας (2 vols. Athens, 1914); A. M. Hidromenos, Ὁ ὑπὲρ τῆς ἐθνικῆς ἀποκαταστάσεως τῶν Ἑπτανησίων (Corfu, 1889); W. Miller, *The Latins* in *the Levant* (1908); *Essays on the Latin Orient* (Cambridge, 1921). (J. D. B.; W. M.; X.)

IONIAN MODE: *see* PLAINSONG.

IONIANS. This name was used in classical times for one of the four divisions of the Greek world, the remaining three being Aeolic, Doric and Arcado-Cypriote or Achaean. This is strictly a linguistic division, and the Greeks did not recognize it in an exact sense. Aeolian, Dorian and Ionian were well-marked divisions socially as well as linguistically. There was also a strong race antipathy between Dorian and Ionian, manifested particularly in the Peloponnesian War, in which Athens and Sparta were the protagonists. Each was inclined to regard the other as not fully Hellenic. The Ionians claimed that the Dorians were the descendants of non-Greek northern invaders commingled with an earlier Greek population of the Peloponnese. The Dorians asserted that the Ionians were pre-Greek or Pelasgian, standing much in the same relationship to true Greeks as do the Welsh and other Britons to the Anglo-Saxons.

Attica was the centre of Ionic culture on the mainland. Euboea and the Cyclades were also regarded as Ionic with the exception of the Dorian islands of Melos and Thera, but the name Ionia itself in classical times was confined to the tract of land on the coast of Asia Minor that contained the Ionic cities. This lay between Aeolis on the north and Doris on the south, and extended from Smyrna to Miletus. The twelve cities, while retaining their independence in true Greek fashion, formed a league for social and religious purposes, their central cult being that of Poseidon carried on upon Mt. Mycale. The Ionians claimed that this worship derived from Achaia in the Peloponnese, but it at least contained elements that were Anatolian in origin. The Ionian cities were energetic, thriving and opulent. Their wealth made them luxurious and they had a name for effeminacy. They were subdued by Croesus, king of Lydia, in the middle of the sixth century and passed at his subjugation under the Persian empire. In 500 they revolted but were conquered by King Darius and a higher tribute was imposed upon them. After the successful termination of the Persian wars they were set free by the Greeks of the mainland under the leadership of Athens, but later fell again under Persia when that empire recovered its strength. They remained nominally subject to Persia till its overthrow by Alexander the Great. There were various Ionic colonies on the coast of the Euxine and in Sicily and Magna Graecia.

The chief characteristics of the Ionic dialect to which Attic was closely akin were: (i.) the representation of an original long *ā* by *ē*, for example in the word *μήτηρ* for Doric, etc., *μᾶτηρ*, Lat. *mater;* (ii.) the lengthening of the vowel before a nasal or liquid that preceded a lost digamma, *e.g.*, *ξεῖνος*, *κούρη* for Attic *ξένος*, *κόρη*; (iii.) the nom. plur. of the personal pronouns in *-εις* instead of *-ες*, *e.g.*, *ἡμεῖς* for Doric *ἀμές*; (iv.) the termination *-ου* for pronominal adverbs of place (*ποῦ*, etc.) for West Greek *-ει*; the third person plural of certain aorist forms in *-σαν* (*ἔθεσαν*, *ἔδοσαν*) by analogy from an s-aorist; (v.) the very early loss of digamma, etc. Ionic-Attic with Aeolic formed loosely an eastern group of dialects as opposed to Doric and North-West Greek. The turning of the original dialect of the Homeric poems, Aeolic or otherwise, into Ionic where possible, *i.e.*, where the exigencies of the metre, vocabulary, and other considerations permit, produced the artificial Epic dialect.

The name Ionians had probably a more extensive use in early times than in historical. In the Pentateuch, in the 15th or 16th century B.C. (Gen. x. 2), Javan appears as a son of Japheth. To the Hebrews the name represented the whole Greek race. To the Persians the Greeks were known as Yauna. It does not follow from this fact that the Greeks knew themselves by this name, for the case may be parallel to the Italians and Illyrians later applying to them'the name of Graeci, that of the small Epirote trihe with whom they first came in contact. In view of the name of the

Ionian sea, which was ancient, it is possible that the mainland of Greece was once known as Ionia or its inhabitants as Ionians. No Ionian Greeks lived in historical times on the shores of the Ionian sea.

The Homeric Ionians were inhabitants of Attica (*Il.* xiii. 685). In the Hesiodic genealogies Ion was son of Xuthus and brother of Achaeus. According to Herodotus the original home of the Ionians was in north-east Peloponnese in the region around Troezen. Hence they were expelled by the Achaeans and occupied Attica, from which they later spread to the Cyclades and to Asia Minor. This traditional history of the Ionians is feasible and need not be dogmatically contradicted. We may perhaps regard the Ionians as pre-Achaean inhabitants of the Peloponnese disturbed by Achaean invaders from the eastern Aegean. This is the view of Kretschmer and of N. P. Nilsson, except that they bring the Achaeans as a second wave of Greek-speaking peoples from the north. Nilsson regards the Ionians as the foremost wave of Greek-speaking peoples to reach Greece and as the originators of the Mycenaean culture. Later came the Dorian invasion of the Peloponnese, consisting perhaps of two coincident elements, an irruption of Illyrian and Epirote tribes from the north-west and an invasion by sea from Crete. The Ionians when they emerge into history are a recognized integral part of the Greek world, distinguished like the Dorians by a well-marked dialect and a common cult. (See DORIANS; ACHAEANS: GREECE: *History.*)

BIBLIOGRAPHY.—Busolt's, Bury's and other Greek Histories. Kretschmer *Ionier und Achaeer,* in Glotta *I.* 9 ff. (1909); D. Hogarth, *Ionia and the East* (1909); Article *Iones* in Pauly's *Real-Encyclop.* d. *klass. Altertumwissenschaft IX.;* N. P. Nilsson, *Minoan Mycenean Religion* (Introduction) (1927). For the dialect see C. D. Buck, *Introduction to the Study of Greek Dialects* (1910) arid *The Language Situation in and about Greece in the second Millennium B.C.* in Class. Phil. XXI. 1926. (B. F. C. A.)

IONIAN SCHOOL OF PHILOSOPHY. Under this name are included a number of philosophers of the 6th and 5th centuries B.C. Mainly Ionians by birth, they are united by a local tie and represent all that was best in the early Ionian intellect. It is a most interesting fact in the history of Greek thought that its birth took place not in Greece but in the colonies on the west coast of Asia hlinor. But not only geographically do these philosophers form a school; they are one in method and aim. They all sought to explain the material universe as given in sensible perception; their explanation was in terms of matter, movement, force. In this they differed from the Eleatics and the Pythagoreans who thought in the abstract, and explained knowledge and existence in metaphysical terminology. In tracing the development of their ideas, two periods may be distinguished. The earliest thinkers down to Heraclitus endeavoured to find a material substance of which all things consist; Heraclitus, by his principle of universal flux, took a new line and explained everything in terms of force, movement, dynamic energy. The former asked the question, "What is the substratum of the things we see?"; the latter, "How did the sensible world become what it is; of what nature was the motive force?"

The first name in the list of the Ionian philosophers—and, indeed, in the history of European thought—is that of Thales (*q.v.*). He first, so far as we know, sought to go behind the infinite multiplicity of phenomena in the hope of finding an infinite unity from which all difference has been evolved. This unity he decided is Water. It is impossible to discover precisely what he conceived to be the relation of this unity to the plurality of phenomena. Later writers from whom we derive our knowledge of Thales attributed to him ideas which seem to have been conceived by subsequent thinkers. Thus the suggestion preserved by Stobaeus that he conceived water to be endowed with mind is discredited by the specific statement of Aristotle that the earlier physicists (*physiologi*) did not distinguish the material from the moving cause, and that before Anaxagoras no one postulated creative intelligence. Again in the De *anima* (i. 5) Aristotle quotes the statement that Thales attributed to water a divine intelligence, and criticizes it as an inference from later speculations. It is probably safest to credit Thales with the bare mechanical conception of a universal material cause, leaving pantheistic ideas to a later period of thought.

The successors of Thales mere Anaximander and Anaximenes, who also sought for a primal substance of things. Anaximander postulated a corporeal substance unlike any of the known substances. This substance he called "the Indeterminate" (τὸ ἄπειρον). He felt that all determinate things have emerged from primal unity (first called ἄρχη by him) into which they must ultimately return. Change, growth and decay he explained on the principle of mechanical compensation.

Anaximenes, pupil of Xnaximander, seems to have rebelled against the extreme materialism of his master. Perceiving that air is necessary to life, that the universe is surrounded by air, he was convinced that out of air all things have resulted. The process by which things grow is twofold, condensation (πύκνωσις) and rarefaction (ἀραίωσις), or, in other words, *heat* and *cold.* From the former process result cloud, water and stone; from the latter, fire and aether. This theory is closely allied to that of Thales, but it is superior in that it specifies the processes of change. Further, it is difficult not to accept Cicero's statement that Anaximenes made air a conscious deity; we are, at all events, justified in regarding Anaximenes as a link (perhaps an unconscious link) between crude Hylozoism (*q.v.*) and definitely metaphysical theories of existence.

We have seen that Thales recognized change, but attempted no explanation; that Xnaximander spoke of change in two directions; that Anaximenes called these two directions by specific names. From this last, the transition to the doctrine of Heraclitus is easy. He felt that change is the essential fact of experience and pointed out that any merely physical explanation of plurality is inherently impossible. The Many is of Sense; Unity is of Thought. Being is intelligible only in terms of Becoming. That which is, is what it is in virtue of its perpetually changing relations (πάντα ῥεῖ καὶ οὐδὲν μένει). By this recognition of the necessary correlation of Being and Not-being, Heraclitus is in a very real sense the father of metaphysical and scientific speculation, and in him the Ionian school of philosophy reached its highest point. Yet there is renson to doubt the view of Hegel and Lassalle that Heraclitus recognized the fundamental distinction of subject and object and the relations of mind and matter. Like the early Ionians he postulated a primary substance, fire, out of which all things have emerged and into which all must return. This elemental fire is in itself a divine rational process, the harmony of which constitutes the law of the universe. Human knowledge consists in the comprehension of this all-pervading harmony as embodied in the manifold of perception; the senses are "bad witnesses" in that they report multiplicity as fixed and existent in itself rather than in its relation to the One. This theory gives birth to a sort of ethical by-product whose dominant note is Harmony, the subordination of the individual to the universal reason; moral failure is proportionate to the degree in which the individual declines to recognize his personal transience in relation to the eternal Unity. From the same principle there follows the doctrine of Immortality. The individual, like the phenomena of sense, comes out of the infinite and again is merged; hence on the one hand he is never a separate entity at all, while on the other hand he exists in the infinite and must continue to exist. Moreover, the soul approaches most nearly to perfection when it is least differentiated from elemental fire; it follows that "while we live our souls are dead within us, but when we die our souls are restored to life." This doctrine is at once the assertion and the denial of the self, and furnishes a striking parallel between European thought in its earliest stages and the fundamental principles of Buddhism. Knowledge of the self is one with knowledge of the Universal Logos (Reason); such knowledge is the basis not only of conduct but of existence itself in its only real sense.

Thus far the Ionian philosophers had held the field of thought. Each succeeding thinker had more or less assumed the methods of Thales, and had approached the problem of existence from the empirical side. About the time of Heraclitus, however, there sprang up a totally new philosophical spirit. Parmenides and Zeno (*see* ELEATIC SCHOOL) enunciated the principle that "Nothing is

born of nothing." Hence the problem becomes a dialectical a priori speculation wherein the laws of thought transcend the sense-given data of experience. It was therefore left for the later Ionians to frame an eclectic system, a synthesis of Being and Not-being, a correlation of universal mobility and absolute permanence. This examination of diametrically opposed tendencies resulted in several different theories. It will be sufficient here to deal with Anaxagoras, Diogenes of Apollonia, Archelaus and Hippo, leaving Empedocles, Leucippus and Democritus to special articles. The latter three do not belong strictly to the Ionian School.

Anaxagoras (*q.v.*) elaborated a quasi-dualistic theory according to which all things have existed from the beginning. Originally they existed in infinitesimal fragments, infinite in number and devoid of arrangement. Among these fragments were the seeds of all things which have since emerged by the process of aggregation and segregation, wherein homogeneous fragments came together. These processes are the work of Nous (νοῦς) which governs and arranges. But this Nous or Mind, is not incorporeal; it is the thinnest of all things; its action on the particle is conceived materially. It originated a rotatory movement, which arising in one point gradually extended till the whole was in motion, which motion continues and will continue infinitely. By this motion things are gradually constructed not entirely of homogeneous particles (the homoeomerê, ὁμοιομερῆ) but in each thing with a majority of a certain kind of particle. It is this aggregation which we describe variously as birth, death, maturity, decay and of which the senses give inaccurate reports. His vague dualism works a very distinct advance upon the crude hylozoism of the early Ionians, and the criticisms of Plato and Aristotle show how highly his work was esteemed. The great danger is that we should credit him with more than he actually thought. His Nous was not a spiritual force; it was no omnipotent deity; it is not a pantheistic world-soul. But by isolating reason from all other growths, by representing it as the motor-energy of the Cosmos, in popularizing a term which suggested personality and will, Anaxagoras pave an impetus to ideas which were the basis of Aristotelian philosophy in Greece and in Europe at large.

In Diogenes of Apollonia we find a return to Anaximenes. Diogenes (*q.v.*) began by insisting on the necessity of there being only one principle of things, herein contradicting the pluralism of Heraclitus. This principle is that of the universal homogeneity of nature; all things are at bottom the same. or interaction would be impossible. This universal substance is air. But Diogenes went much farther than Anaximenes by attributing to air not only infinity and eternity but also intelligence.

Another pupil of Anaxagoras was Archelaus of Miletus (*q.v.*). His work was mainly the combination of previous views. except that he is said to have introduced an ethical side into the Ionian philosophy. "Justice and injustice." he said. "are not natural but legal." He endeavoured to overcome the dualism of Anaxagoras, and in so doing approached more nearly to the older Ionians.

The last of the Ionians whom we need mention is Hippo (*q.v.*), who, like Xrchelaus, is intellectually among the earlier members of the school. He thought that the source of all things was moisture. and is by Xristotle coupled with Thales (*Metaphysics,* A 3).

IONIC ORDER: see ORDER.

IONIC THEORY: see ELECTRICITY? CONDUCTION OF: Conduction in *Gases;* ELECTRICITY: *Ions.*

IONOSPHERE, an electrically conducting sphere completely surrounding the earth. The name is derived from the presence of ions and free electrons produced by the sun's ultraviolet radiation. The ionosphere exists in the earth's outer atmosphere. above the stratosphere and mesosphere and extends from heights of approximately So to 300 km. (50 to 200 mi.). (*See* ATMOSPHERE.) It was more commonly known as the "Kennelly-Heaviside layer" in the period 1901–30. The ionosphere makes possible all long-distance radio communications using high-frequency waves. since it reflects the signals back to earth. keeping them from being lost in space.

Before 1901 it was thought that wireless (radio) waves were useful only for short-distance communications. since they were known to travel in straight lines. like light. However, the success of Marconi's transatlantic tests in 1901 led to theories developed independently by A. E. Kennelly and **O.** Heaviside that radio signals were reflected back to earth from an electrically conducting region in the earth's outer atmosphere. A similar region had also been proposed by Balfour Stewart shout 1882, to explain systematic changes observed in the earth's magnetic field. (*See* GEOMAGNETISM.)

Direct measurements of the ionosphere were not made until 1925, when. in England. E. V. Appleton and M. A. F. Barnett reported an experiment based on a wave-interference technique. and. in the United States, G. Breit and M. A. Tuve recorded radio echoes using a new system of transmitting short pulses of radio waves and receiving their echoes. In the latter experiment it was noted that pulses transmitted vertically with frequencies below 1 or 2 mc. per second were either reflected or absorbed by the ionized layers. whereas frequencies ahove 15 or 20 mc. usually passed completely through the atmosphere and were lost to space. This is because the higher frequency radio n-aves required a greater electron density for reflection. The time required for a pulse to travel to the ionosphere and back was a measure of the height of the reflecting layer.

This pulse technique has been developed to the point where equipment to record automatically the effective height of reflection for each frequency from 0.j to 20 mc. is in wide use throughout the world. As a result. knowledge of how the distribution of free electrons changes with place, time of day, solar activity. etc., is quite complete.

The ionosphere contains two principal regions of free electrons. The lower (E-region) normally occurs at heights of go to 120 km. (j j to 75 mi.), while the upper (I;-region) is usually found from 150 to 300 km. (100 to 200 mi.) above the earth. Rocket observations and theoretical calculations have indicated that the so-called layers oi free electrons are. in fact, broad maxima of electron density, and that the ionosphere is highly ionized throughout. The daylight value for the E-region maximum is roughly 10^5 free electrons per cm.^{3}, while in the daytime the F-region often has two maxima, known as the F,- and F_2-layers. The F_2-layer, which is above the F_1-layer and is more persistent. may have about 10^6 electrons per cm.^{3}, though this is highly variable.

Characteristics of ionospheric layers change with time of day. season of year and geographical location. Variations in the normal E- and F_1-layers are generally small. but abnormal or sporadic ionization in the E-region is rather common in summer. Fluctuations in the F_2-layer are often relatively large and irregular, and such fluctuations are particularly pronounced during magnetic storms. The 11-year sunspot cycle and other forms of solar activity also influence ionospheric characteristics.

The ionosphere controls long-distance radio communication by establishing upper and lower limits of usable wave frequencies. The upper limit is determined hy i t reflecting properties and the lower limit by absorption in the lowest part of the ionosphere. called the D-region. During periods of solar activity the enhanced ultraviolet and X-radiation from the sun increases the ionization in the D-region. causing an increase in the absorption of radio waves. and this results in poor radio communication on those channels that depend on ionospheric reflections.

BIBLIOGRAPHY.—T. W. Bennington, *Radio Waves and the Ionosphere* (1944); J. A. Fleming (ed.), *Terrestrial Magnetism and Electricity* (1949), ch. IX on Ionospherr and ch. XIII for additional references; S. K. Mitra, *The Upper Atmosphere (1947).* (H. W. Ws.; W. W. K.)

IOPHON, Greek tragic poet. son of Sophocles. He gained the second prize in 428 B.C., Euripides being first. and Ion third. In the Frogs of Xristophanes (405) he is spoken of as the only good Athenian tragic poet. He wrote 50 plays, of which only a few fragments remain.

It is said that Iophon accused his father of being incapable of managing his affairs and that Sophocles was triumphantly acquitted. on reading the iamous chorus of *Oedipus at Colonus.*

I.O.U. ("I owe you"), a written acknowledgment of a debt. It usually runs thus:

To——. I. O. U.——

(Signed) ——. Date ——.

An I.O.U., if worded as above, or even if the words "for value received" are added, needs no stamp in Britain, as it contains no term of agreement. If any such words as "to be paid on such a day" are added it requires a stamp. An I.O.U. should be addressed to the creditor by name, though its validity is not impaired by such omission. Being a distinct admission of a sum due, it is prima-facie evidence of an account stated, but where it is the only item of evidence of account it may be rebutted by showing there was no debt and no demand which could be enforced by virtue of it. An I.O.U. is not negotiable in the technical sense. See NEGOTIABLE INSTRUMENT.

IOWA, popularly known as the "Hawkeye state," a north central state of the United States, is bounded north by Minnesota, east by the Mississippi river, which separates It from Wisconsin and Illinois, south by Missouri and west by the Missouri and Big Sioux rivers, which separate it from Nebraska and South Dakota. The state's total area is 56,290 sq.mi., of which 258 sq.mi. are water surface.

Various meanings have been ascribed to the word "Iowa": among the most common are "beautiful land" and "this is the place." It is commonly supposed that the name "Hawkeye" was that of an early Indian chief. The state is the 25th in size of the 50 states of the union. The state capital is Des Moines, and the state entered the union, Dec. 28, 1846, as the 29th state. The wild rose is the state flower and the eastern goldfinch the state bird. The state flag consists of three vertical stripes of blue, white and red. In the centre of the white stripe is depicted a spreading eagle which bears in its beak blue streamers. Inscribed upon the streamers is the state motto: "Our liberties we prize and our rights we will maintain" and the word "Iowa" is in red letters below the streamers.

PHYSICAL GEOGRAPHY

Physical Features.—Iowa lies wholly in the prairie plains region between the extremes of approximately 40° 22' and 43° 30' N. and 90° 08' and 96" 38' W. Since its surface was overrun by one or more of the great ice sheets of the glacial epoch, the largest portion of the state is prairie tableland. The lowest elevation, 480 ft. above sea level, is at Keokuk in the southeastern part of the state. From this point the land rises in gentle swells to the point of highest elevation, (1,675 ft.,) in Osceola county in the northwestern part of the state. The greatest departures from the prairie surface are in the northeast and southwest. In the northeast—the so-called driftless area of Iowa—cliffs rise almost vertically from the banks of rivers to heights of from 300 to 400 ft. From the summit of such cliffsto the crest of a divide, usually a few miles distant, is another ascent of 300 ft. or more, which terminates occasionally in knob-topped hills crowned with small cedar trees. In the west, southward from the mouth of the Big Sioux river, a line of moundlike bluffs rises abruptly to a height of from 100 to 300 ft. from the flood plain of the Missouri river. Because of glaciation, the northern half of the state is more broken and irregular and has more shallow lakes and ponds than the southern half.

A broad watershed, extending in a southerly direction from Spirit lake on the northern border, divides the state into two drainage systems. That to the east, comprising about two-thirds of the whole area, is drained by tributaries of the Mississippi, of which the Des Moines, the Skunk, the Iowa (and its tributary the Cedar) and the Wapsipinicon are the largest. These streams have long courses and moderate slopes. The region to the west of the watershed is drained by tributaries of the Missouri, such as the Big Sioux, the Little Sioux, the Boyer and the Nishnabotna.

Climate.—Iowa has a climate of great extremes. The mean annual temperature is 49° F.; the average range of extremes per year is about 135° F. The average mean annual temperature at Sibley in the northwest is 44°, while at Keokuk in the southeast it is 52.4°. Des Moines, located nearer the centre of the state, has an average mean annual temperature of 50.9°.

Rainfall is very unequal in its distribution throughout the year, as between the same periods of different years and as between the different parts of the state. While the mean annual precipitation is 31.44 in., about 71% of this falls during the six months from April 1 to Oct. 1. May, June and September are generally the wettest months. Within any one year the precipitation is usually less in the western part of the state than it is in the eastern part; the western part also has a greater percentage of its rain in the spring and summer than has the eastern part. Though the average frost-free growing season is from May 2 to Oct. 7, killing frosts may occur later or earlier. Injury to crops from drought and hot winds occurs infrequently, but harmful effects from excessive rainfall, hailstorms and prolonged excessive heat are more common.

Soil.—The fertile soil of Iowa, because of its depth and porous nature, is capable of withstanding the extremes of wetness and dryness remarkably well. Perhaps no other state in the union has such superior soil for agriculture; no other state has so many acres of grade A land or so large a proportion—from 85%–90%—of its land suitable for cultivation.

The soil is of four kinds: till (or drift), alluvial, loess (or bluff) and geest (or gravelly earth). Dark drift, composed chiefly of clay, sand, gravel, boulders and lime, is both the soil and subsoil of the greater part (about 66%) of the state and is especially predominant in the north and northwest. Alluvial soil, composed of material washed from other soils and decayed vegetable matter, covers about 6% of the surface of the state. This type of soil is found in the river bottoms, particularly in the valley of the Missouri, and varies much in fertility. Loess soil, chiefly a mixture of porous clay and carbonate of lime, forms the bluffs bordering the bottom lands of the Missouri and is common in the northeast. In fertility loess is not inferior to the better drift. Geest is found particularly in the northeast, but it covers less than 1% of the area of the state.

Vegetation and Animal Life.—When the first settlers came to Iowa they found the rolling prairies covered with deep, coarse grasses, berries and wild flowers. Forests of birch, maple, hickory, oak, elm, walnut, ash and cottonwood trees grew in the river valleys and in scattered areas. The Cedar river derives its name from the red cedar, the only evergreen native to the area. Native grasses and the original timber, except in a few places, have been destroyed; yet, trees and plants, some native and some immigrant, grow in profuse variety. The prairie rose, aster, honeysuckle, primrose, shooting star, violet, blue phlox, trillium, bloodroot and many types of ferns are common.

Situated along the Mississippi and Missouri flyways, Iowa is a haven for birds of many types. The robin, eastern goldfinch, starling, junco, blue jay, chickadee, red-winged blackbird, woodpecker, crow and meadow lark are frequently seen. The wild turkey, once plentiful, is almost extinct; the ring-necked pheasant, imported into the state, is now a major game bird. Owls and hawks are the principal birds of prey.

Wolves were once numerous in the region, but they have since disappeared. Except for the white-tailed deer, large game animals are rare. Among the small wild animals found are the beaver, muskrat, raccoon, skunk, jack rabbit, cottontail rabbit, ground hog, gopher and chipmunk. Although more than 100 kinds of fish have been seen in the area, the most common are the catfish, bullhead, carp, buffalo, sucker, walleyed pike, smallmouthed bass, rainbow, brook and brown trout, crappie and bluegill. There are about 25 varieties of reptiles, of which three (all rattlesnakes) are poisonous.

State Parks and Historical Sites.—The state conservation commission has jurisdiction over state parks, reserves and monuments; state forests and forestry; and state waters. Providing for the protection, propagation and preservation of fish, game and fur-bearing animals is an important function of the conservation commission. It maintains more than 120 wildlife refuges comprising about 35,000 ac. and more than 160 public hunting grounds totaling approximately 91.000 ac. Nearly 100 lakes, artificial and natural, are also the responsibility of the commission.

State parks include Backbone (near Strawberry Point); Dolliver Memorial (near Fort Dodge); Geode (near Burlington); Lacey-Keosauqua (near Keosauqua); Lake Ahquabi (near Indianola); Lake Darling (near Fairfield); Lake Macbride and Palisades-Kepler (both near Cedar Rapids); Lake Wapello (near Ottumwa); Ledges (near Boone); Nine Eagles (near Leon); Pike's Peak (near McGregor); Pilot Knob (near Forest City); Rock Creek Lake (near Kellogg); Springbrook (near Guthrie Center); Stone (near Sioux City); Waubonsie (near Sidney); and Wild Cat Den (near Muscatine).

Various historical sites attract thousands of visitors annually. Among these are the Amana colonies, which were established in 1855 as experimental religious communities; the Old Capitol, which is now the administrative office of the State University of Iowa; Plum Grove farm, at Iowa City, the home of Robert Lucas, Iowa's first territorial governor; Effigy Mounds National monument, at Marquette (established 1949), which contains burial mounds of prehistoric Indians; Fort Atkinson State park; former Pres. Herbert Hoover's birthplace at West Branch; the grave of Julien Dubuque at Dubuque; and the Anton Dvorak monument at Spillville.

HISTORY

Early Inhabitants. — The name "Iowa" was taken from the tribal name of a group of Siouan Indians who occupied the area when it was first seen by white men — the Frenchmen, Father Jacques Marquette and Louis Jolliet, in 1673, and Father Louis Hennepin, in 1680. In the century following the visits of these early travelers, explorers and missionaries did little to disturb the Indians of the region. During those years, however, the Ioway tribe was pushed westward and largely supplanted by the tribes of Sauk and Fox, who had previously been driven from Michigan by the French.

First White Settlements. — No permanent white settlement had been established in Iowa when the French, who had held it since 1682, relinquished control to the Spanish in 1762. During the period of Spanish control, there was some penetration and exploitation of the area. The lead mines near the Mississippi river were a major attraction, and to these mines came a French Canadian, Julien Dubuque, who in 1788 obtained an Indian grant giving him the right to carry on mining operations near the present site of the city which today bears his name. Although Dubuque received confirmation of his grant from the Spanish governor, the wealth he sought eluded him and he died bankrupt in 1810. Louis H. Tesson in 1799 and Basil Giard in 1800 also received Spanish grants in Iowa, but were similarly disappointed.

Iowa was retroceded to France in 1800 and, as part of the Louisiana Purchase in 1803, became United States territory. During 1804–05 it was a part of Indiana territory; it was made a part of Louisiana territory from 1805 to 1812. Indian hostility forced the abandonment of the first American post in Iowa, Ft. Madison, near the mouth of the Des Moines river, during the War of 1812. After the conclusion of peace in 1815 the Sauk chief, Black Hawk, nourished a bitter hatred toward settlers, and in a final attempt to recover lands in Illinois, he instigated a war against the United States in 1832. Black Hawk's defeat resulted in the cession of nearly 9,000 sq.mi., the first of many Indian land cessions between 1832 and 1851. From 1812 to 1821 Iowa was a part of Missouri territory; from 1821 to 1834 it was a part of the unorganized territory of the U.S. After Black Hawk's war, settlers began to pour into Iowa. In 1834 it was a part of Michigan territory; in 1836 it was a part of Wisconsin territory. Government land surveys were not begun until 1836, making the first settlers technical trespassers on the public domain. Ostensibly to protect their holdings, the settlers formed voluntary associations or "claim clubs." Although proceedings of the associations relating to land claims were later recognized by U.S. authorities, they were often dominated by speculators rather than farmers.

Statehood and Early Problems. — Iowa was separated from Wisconsin in 1838 and the question of applying for admission into the union as a state was voted on as early as 1840. The measure was defeated then and again in 1842 by those who wished to avoid an increase in taxes. Finally, in 1844, a convention was held at Iowa City, a constitution framed and application for admission to the union made. Congress, however, rejected the application because it disagreed with the proposed boundaries of the new state. A second constitutional convention was called at Iowa City in 1846; it drew up the present boundaries of the state and prohibited the organization of banks of issue. Congress approved the second constitution and Iowa was admitted to the union in 1846, being paired with Florida, a slave state, to maintain the balance of power between the North and the South.

Burlington had served as temporary capital of the territory until 1839. In that year, Iowa City was designated as the capital city but was replaced by the present capital, Des Moines, in 1857.

Statehood by no means solved all problems faced by Iowa pioneers. The Spirit lake massacre of 1857, in which about 40 settlers were killed, provided grisly proof that Indians were still a danger to isolated settlements. Elsewhere, lawless elements defied regularly established authorities, and as a result vigilance committees were formed. From 1846 to 1860 there were approximately 45 lynchings in which 70 victims were summarily put to death. Sectional feeling, running rampant over the nation, also created problems in Iowa, resulting in a shifting of political allegiances. Although the Democratic party had been in power since statehood, the state supported the Republican party after the latter's formation in 1854. The American Civil War claimed the lives of more than 12,000 Iowans.

Issues and Reforms. — Economic expansion characterized the years following the American Civil War. From 1860 to 1910, for example, more than 9,000 mi. of railroads were constructed in Iowa. Yet there was considerable agrarian discontent during this period, as some of the farmers felt that they did not share adequately in the general prosperity. Thus, farmers' organizations and third parties, such as the Patrons of Husbandry (the Grange). the Greenback party and the Populist party, developed significant follonings. Though not markedly successful in electing candidates, such movements forced the major parties to adopt reform programs and to enact progressive legislation.

Particularly important issues in Iowa were tariff reform, railroad-rate regulation and the prohibition of the manufacture and sale of intoxicating liquors; but the reformers in these areas had indifferent success. The tariff question split the Republican party when its more progressive members supported the "Iowa Idea"; *i.e.*, the expansion of trade through tariff reciprocity and downward revision of rates. Advocates of railroad-rate regulation were never able to accomplish all their aims, although a railroad commission was established as a result of their efforts. Prohibition was steadily debated from 1882, when it was attempted unsuccessfully. until the repeal of the prohibition (18th) amendment to the U.S. constitution in 1933. In that year the general assembly passed laws legalizing the sale of beer with 3.2% alcoholic content and established a state monopoly for the sale of intoxicating liquors, with a state liquor control commission in charge.

Reformers in Iowa achieved their most important victories in the field of welfare legislation. In 1913 the general assembly passed an employers' liability and workmen's compensation act and a mothers' pension act. The Perkins law of 1915 provided free treatment for crippled children of indigent parents. In 1917 a child welfare station for the study of children's problems was established at Iona City.

The depression of the 1930s had the same effects in Iowa that it had in other areas, and the demand for relief legislation was met on both a state and national level. Concern for the aged found expression in a system of old-age pensions begun in 1935. In 1936 the Iowa employment security commission was created to encourage industry to provide more stable employment, maintain a free public employment service and grant benefit payments to those unemployed. A large-scale construction project to provide a system of dams for the upper Mississippi river was begun in 1931 and continued throughout the following decade. The agricultural program of the New Deal was a response to distress in the farm belt of which Iowa is such a significant part. The Iowa state planning board was created in 1937 to deal with vari-

ous problem areas, and it continued in service until 1939.

The state contributed more than 260,000 men and women to the services during World War II; of these, more than 8,200 lost their lives. The first women's army corps training camp was established at Ft. Des Moines, and navy fliers were given training at Ottumwa and Iowa City. In 1948 voters approved a bonus for veterans of World War II.

GOVERNMENT

Iowa's present constitution was adopted in 1857, the constitution of 1846 having been superseded chiefly because it prohibited banking corporations. The constitution may be amended by an affirmative vote of both houses of two successive legislatures, followed by a majority vote of the electors of the state voting on the proposed amendment. Suffrage is granted to all citizens of the United States (except idiots, insane persons and those convicted of an infamous crime) who are at least 21 years of age, have resided in the state for six months and in one county for 60 days preceding an election. The franchise was conferred on Negroes by an amendment adopted in 1868, and on women by the federal amendment adopted in 1920.

The supreme executive authority in Iowa is the governor. Other elective executive officials are: the lieutenant governor, secretary of state, treasurer, auditor, attorney general and secretary of agriculture. All officers must be citizens of the United States and have the age and residence qualifications of voters. The governor and lieutenant governor must, in addition, be at least 30 years of age and must have resided in Iowa for at least two years preceding election. All are elected for two-year periods.

The governor has extensive appointive power, oversees the making of the budget and may veto acts of the general assembly, although such acts may be passed over his veto by a two-thirds majority of both houses. The lieutenant governor is ex-officio president of the senate and takes the office of governor in case of the death, resignation or removal from office of the chief executive. The governor, secretary of state, auditor, treasurer and secretary of agriculture make up the executive council. This ex-officio board canvasses state election returns, supervises the incorporation of building and loan associations, appoints the board of mine inspectors, allocates space in the capitol and other buildings used by the state government to the various offices and departments and has other supervisory duties.

In addition to the elective offices a number of subordinate administrative offices have been created by the legislature. These offices, filled by appointment, include those of the adjutant general, the commissioner of public health, the superintendent of public instruction, the commissioner of insurance, the industrial commissioner, the labour commissioner, the commissioner of public safety, the superintendent of banking and the comptroller.

Much of the administrative work of the state government is performed by boards or commissions, usually bipartisan. Except for the commerce commission and the state board of public instruction, to which members are elected, membership on these boards is appointive. Among the other administrative boards are the state highway commission. the board of parole, the conservation commission, the board of control of state institutions, the Iowa development commission, the liquor control commission. the employment security commission, the real estate commission, the board of regents, the state tax commission and the department of social welfare.

The state legislature, called the general assembly, is composed of a senate and house of representatives which meets in odd-numbered years. Senators, who must be at least 25 years of age, are elected for a term of four years, one from each of the 50 senatorial districts, the terms of half of the members expiring every two years.

Representatives are elected for a term of two years, one from each of the 99 counties, with an additional one from each of the counties (not exceeding nine) having the largest population. The ratio of representation and the apportionment of the additional representatives from the larger counties are fixed by the general assembly.

The judiciary consists of a supreme court of 9 judges, and a district court of 70 judges, with 1 to 6 judges in each of the 21 districts. The supreme court has original jurisdiction in certiorari and mandamus cases, and appellate jurisdiction in cases sent to it from the lower courts. It also has the power to pass on the constitutionality of state laws. The district court has general, original and exclusive jurisdiction in all civil, criminal and probate matters not expressly conferred on an inferior court, and may hear appeals from inferior courts, boards or officers. Supreme court judges are elected for terms of six years and district judges for four years.

Each of the 99 counties has its own administrative boards and officers. The boards of supervisors consist of not more than seven members who are elected for three-year terms and have the care of county properties and the management of county business, including highways and bridges. The boards also fix the rate of county taxes within prescribed limits and levy the taxes for state and county purposes. Other county officers are: auditor, treasurer, clerk, recorder, sheriff, attorney, engineer, coroner, assessor and superintendent of schools.

The relationship between municipalities and the state government is unitary; there is no real "home-rule." Although four cities. Camanche, Davenport, Muscatine and Wapello, were given special charters prior to 1857, all municipal governments have only the powers given them by the general assembly. Cities are of two types: those with a population of more than 15,000 and those with a population of from 2,000 to 15,000. All other incorporated places, except the special-charter cities, are classified as towns. Local adoption of the commission-manager plan of municipal government was authorized by the general assembly in 1915.

Finance and Taxation.— In 1929 a state tax commission was established for the purpose of centralizing the tax structure. Although the commission worked toward an integrated system, taxation has remained, in large part, a series of semi-independent levies. The tax sources for the state, with the percentage of total revenue in the second half of the 20th century, were: motor vehicle license, motor carrier and gasoline tax (38%); sales and use tax (34%); income tax: individual and corporation (13%); liquor profits and beer tax (5%); cigarette tax (3%); insurance premiums (2%); inheritance tax (2%); and miscellaneous taxes (2%). The state's revenue from all sources was about $350,000,000 annually. Of this amount, about one-sixth was derived from the federal government and about 70% from state tax sources. The state's expenditures totaled approximately $355,000,000, but there was no state debt. In the second half of the 20th century approximately 25% of the state's revenues was appropriated for education, nearly 38% was allocated to highways, more than 13% to public welfare and slightly more than 5% to health and hospitals. The state's income at this time was about three and one-half times as great as it had been prior to World War II; expenditures had increased at about the same rate. Iowa's per capita income ranked it 24th among the states in 1950 but it fell to 27th place toward the end of the next decade. It was only slightly below the national average, however.

Iowa has not levied a general property tax for the financing of the state government since 1941. There are, however, property taxes levied on a local level. This revenue is used primarily for schools, roads, municipal and county government and various local projects.

POPULATION

The population of Iowa in 1850, four years after it had obtained statehood, was 192,214. Its population ranked 27th among the 37 states and territories that then composed the union, and was classified as nearly 95% rural. The previous decade had been the period of the most rapid growth in Iowa's history—the population increased almost 346% from 1840 to 1850. At the beginning of the 20th century, the state had advanced to 10th in rank of population with a total of 2,231,853 persons by the 1900 census. The state was still largely rural in character: about three-fourths of the people were classified as nonurban dwellers. The next

ten years saw an actual decline in the state's population—the 1910 census showed a drop of 0.3% from the census of 1900. The 1950 population indicated a total of 2.621.073 persons lived within the state, making it the 22nd in size of population among the states. The rural population was slightly more than 52% of the total at that time. Of the 1960 population. 1.462.512 or 53% lived in incorporated places of 2.500 or more. as compared with 46 9% in 1950. when these places constituted the urban area. The urban population, under a new definition set up in 1950. included also the thickly settled suburban area, or "urban fringe," adjacent to Des Moines. Sioux City, Davenport, Cedar Rapids. Dubuque. Omaha and Waterloo (standard metropolitan statistical areas). By 1960 these areas housed 33.2% (915,762) of the total population. In 1960 Iowa had a population of 2.757.537, an increase of 136,464 or 5.2% over 1950, and ranked 24th in population.

*Iowa: Places of 5,000 or More Population (1960 Census)**

Place	Population				
	1960	1950	1940	1920	1900
Total state	2,757,537	2,621,073	2,538,268	2,404,021	2,231,853
Algona	5,702	5,415	4,954	3,724	2,911
Ames	27,003	22,898	12,555	6,270	2,422
Atlantic	6,890	6,480	5,802	5,329	5,046
Bettendorf	11,534	5,132	3,143	2,178	—
Boone	12,468	12,164	12,373	12,451	8,880
Burlington	32,430	30,613	25,832	24,057	23,201
Carroll	7,682	6,231	5,389	4,254	2,882
Cedar Falls	21,195	14,334	9,349	6,316	5,319
Cedar Rapids	92,035	72,296	62,120	45,566	25,656
Centerville	6,629	7,625	8,413	8,486	5,256
Chariton	5,042	5,320	5,754	5,175	3,989
Charles City	9,964	10,309	8,681	7,350	4,227
Cherokee	7,724	7,705	7,469	5,824	3,865
Clear Lake	6,158	4,977	3,764	2,804	1,706
Clinton	33,589	30,379	26,270	24,151	22,698
Council Bluffs	54,361	45,429	41,439	36,162	25,802
Creston	7,667	8,317	8,033	8,034	7,752
Davenport	88,981	74,549	66,039	56,727	35,254
Decorah	6,435	6,060	5,303	4,039	3,246
Des Moines	208,982	177,965	159,819	126,468	62,139
Dubuque	56,606	49,671	43,892	39,141	36,297
Estherville	7,927	6,719	5,651	4,699	3,237
Evansdale	5,738	3,571	—	—	—
Fairfield	8,054	7,299	6,773	5,948	4,689
Fort Dodge	28,399	25,115	22,904	19,347	12,162
Fort Madison	15,247	14,954	14,063	12,066	9,278
Grinnell	7,367	6,828	5,210	5,362	3,860
Independence	7,069	4,865	4,342	3,672	3,656
Indianola	7,062	5,145	4,123	3,628	3,261
Iowa City	33,443	27,212	17,182	11,267	7,987
Iowa Falls	5,565	4,900	4,425	3,954	2,840
Keokuk	16,316	16,144	15,076	14,423	14,641
Knoxville	7,817	7,625	6,936	3,523	3,131
Le Mars	6,767	5,844	5,353	4,683	4,146
Maquoketa	5,909	4,307	4,076	3,626	3,777
Marion	10,882	5,916	4,721	4,138	4,102
Marshalltown	22,521	19,821	19,240	15,731	11,544
Mason City	30,642	27,980	27,080	20,065	6,746
Mount Pleasant	7,339	5,843	4,610	3,987	4,109
Muscatine	20,997	19,041	18,286	16,068	14,073
Newton	15,381	11,723	10,462	6,627	3,682
Oelwein	8,282	7,858	7,801	7,455	5,142
Oskaloosa	11,053	11,124	11,024	9,427	9,212
Ottumwa	33,871	33,631	31,570	23,003	18,197
Pella	5,198	4,427	3,638	3,338	2,623
Perry	6,442	6,174	5,977	5,642	3,986
Red Oak	6,421	6,526	5,763	5,578	4,355
Shenandoah	6,567	6,938	6,846	5,255	3,573
Sioux City	89,159	83,991	82,364	71,227	33,111
Spencer	8,864	7,446	6,599	4,599	3,095
Storm Lake	7,728	6,954	5,274	3,658	2,169
Urbandale	5,821	1,777	1,083	298	—
Washington	6,037	5,902	5,227	4,697	4,255
Waterloo	71,755	65,198	51,743	36,230	12,580
Waverly	6,357	5,124	4,156	3,352	3,177
Webster City	8,520	7,611	6,738	5,657	4,613
West Des Moines†	11,949	5,615	4,252	3,631	1,700
Windsor Heights	5,906	1,414	—	—	—

*Populations are reported as constituted at date of each census. †Name changed from Valley Junction in 1938.

Note: Dash indicates place did not exist during reported census, or data not available.

The population per square mile in 1960 was 49. as compared with 49.7 for the U.S. as a nhole. By 1960 the urban population was increasing. Distribution by colour and nativity, according to the 1950 census. was as follon s: 96% native white: 3 2% foreign-born white; and 0.8% nonnhite. Along with the rest of the U.S. the percentage of persons 65 years old or over was increasing. being 10.5% in 1960. The percentage of the population 14 years old and over that was in the labour force (54.8% in 1950) was steadily decreasing.

EDUCATION

History and Administration.— The first schools in Iowa were private. In 1830 a private school was opened in the Half-Breed tract. now Lee county. In 1834 free tax-supported schools were legally authorized for the area and by 1838 there were more than 40 schools established. When the Iowa territory was formed (1840) a law was passed defining the means of establishing free schools. The educational system has as its basis a law passed by the state legislature in 1858. Education was made compulsory by the general assembly in 1902. Since that time. legislation has extended the school year to at least 24 consecutive weeks for children betneen the ages of 7 and 16 unless they have completed the eighth grade or are over 14 and employed. In 1911 the legislature authorized large, centrally located, consolidated schools to replace small, scattered ones. Part-time schools for employed children between 14 and 16 were provided for in 1919. In the second half of the 20th century Iona had the distinction of having the lowest percentage of illiteracy in the union. At that time. the state was spending $299 annually per pupil or slightly more than the U.S. average. This represented almost three times as much per pupil as had been spent prior to World War II.

At the head of the Iona system of public schools is the state superintendent of public instruction, assisted by the state board of public instruction. The superintendent is, by law, the executive officer of both the board of educational examiners and the board of vocational education. The county administration is in the hands of a popularly elected board of five officers who, in turn, appoint a county superintendent of public instruction for a three-year term. Each school district has its separate board of education or trustees.

School revenue is derived from the state's permanent school fund. which grew out of land granted to the state by the federal government and from local or district taxation.

Colleges and Universities.— Iowa has about 50 institutions of higher learning. which are governed by the state board of regents. This nine-member board is appointed for six-year terms by the governor with the approval of the senate. Schools supported by the state include the State University of Iowa (Iowa City), Iowa State University of Science and Technology (Ames) and State College of Iowa (Cedar Falls).

The State University of Iowa was established by an act of the legislature in 1847. Instruction was begun in the spring of 1855. The law department was added to the college of liberal arts in 1868, the medical department in 1870. the dental department in 1882 and the department of pharmacy in 1885. All these later became colleges. The graduate college was added in 1900 and the college of engineering in 1905. The school of education. created in 1907. became the college of education in 1913; and a school of commerce, established in 1914, became the college of business administration in 1959.

In addition to these nine colleges, a preparatory department was maintained from the founding date of the university until 1879: a homeopathic medical department, later a college, from 1876 to 1919; andacollegeof fineartsfrom 1911 to 1915. Within the college of liberal arts are the schools of fine arts. journalism, religion and social nork. In 1949 the school of nursing became the college of nursing.

The extension division was organized in 1913, the Iowa child welfare research station in 1917, the institute of hydraulic research in 1931, the institute of public affairs in 1949, the bureau of labour and management in 1950; the institute of gerontology in 1951 and the institute of agricultural medicine in 1955.

The central building of the university campus is the Old Capitol, which was turned over to the university when Des Moines became the state capital in 1857. The medical centre includes general. children's and psychopathic hospitals; the hospital-school for severely handicapped children; medical laboratories and the medical research centre.

Among the privately supported educational institutions in Iowa are: Briar Cliff college (Sioux City, Roman Catholic. 1930); Buena Vista college (Storm Lake. United Presbyterian Church in the U S.A., 1891); Central college (Pella, affiliate of Reformed Church in America, 1853); Clarke college (Dubuque, Roman Catholic, 1843); Coe college (Cedar Rapids, affiliate of United

Presbyterian Church, 1851); Cornell college (Mount Vernon, affiliate of the Methodist Church, 1853); Drake university (Des Moines, related to the Disciples of Christ, 1881); Grinnell college (Grinnell, nonsectarian, but related to Congregational Church, 1846); Iowa Wesleyan college (Mount Pleasant, affiliate of Methodist Church, 1842); Loras college (Dubuque, Roman Catholic, 1839); Luther college (Decorah, affiliate of Evangelical Lutheran Church, 1861); Marycrest college (Davenport, Roman Catholic, 1939); Morningside college (Sioux City, Methodist, 1889); Parsons college (Fairfield, affiliate of United Presbyterian Church, 1875); St. Ambrose college (Davenport. Roman Catholic, 1882); Simpson college (Indianola, affiliate of Methodist Church, 1860); University of Dubuque (Dubuque, affiliate of United Presbyterian Church, 1852); Upper Iowa university (Fayette, nonsectarian, 1857); Wartburg college (Waverly, American Lutheran Church, 1865); Westmar college (Le Mars, affiliate of Evangelical United Brethren Church, 1900); and William Penn college (Oskaloosa, Friends, 1873).

HEALTH AND WELFARE

The Iowa department of public health, established in 1924, is headed by a commissioner, who is required to be a physician with special training in public hygiene and sanitation. The department is concerned with the major causes of sickness and death, mental health and the prevention and control of communicable diseases. Major health programs are administered by the division of maternal and child health, the division of dental hygiene, the division of cancer control, the division of gerontology, heart and chronic diseases, the division of public health engineering and industrial hygiene, the division of public health nursing and the division of public health education.

The charitable, penal and reformatory institutions of the state are supervised by a board of control of state institutions which has three members appointed by the governor. The institutions include: a soldiers' home at Marshalltown; a school for feebleminded children at Glenwood; a hospital for epileptics and school for the feeble-minded at Woodward; four hospitals, or mental health institutes, at Clarinda, Independence, Mount Pleasant and Cherokee; a juvenile home for destitute, neglected or homeless children at Toledo; the Annie Wittenmyer home for children at Davenport; a training school for delinquent boys at Eldora; a similar institution for girls at Mitchellville; a men's reformatory at Anamosa; a women's reformatory at Rockwell City; and a state penitentiary at Fort Madison. The state also maintains a school for the deaf at Council Bluffs, one for the blind at Vinton and a combination school and hospital for handicapped children at Iowa City.

In 1907 the general assembly passed a law that established the indeterminate sentence for certain criminal offenders. The governor appoints a board of parole of three members, one of whom must be an attorney, and of which not more than two may be members of the same political party. A bill calling for the sterilization of certain mental defectives was passed in 1929. The provisions of the bill are carried out by an ex-officio board of eugenics.

In 1937 a state department of social welfare was created to administer old-age assistance, aid to the needy blind, aid to the disabled (since 1950), child welfare and the care of dependent children and general relief in the state. The state board supervises the county boards of social welfare. The employment security commission manages a system of old-age and retirement insurance, which went into effect in 1946.

THE ECONOMY

Agriculture. — The superior quality of the soil and the warm, moist months of spring and summer make Iowa one of the foremost states of the union in the production of corn (maize), oats, hay and soybeans. Much of the produce is utilized in the further production of poultry, hogs, dairy cattle and sheep. Of the total farm acreage of approximately 35,000,000 ac., more than 60% was under actual cultivation in the second half of the 20th century. The average size of farms was about 185 ac., and the average value of farm land per acre was nearly $200. There was a pronounced trend toward larger holdings.

In the second half of the 20th century, cash receipts from farm marketings and government payments averaged more than $2,000,000,000 annually, more than $1,500,000,000 of which came from livestock and livestock products, and about $375,000,000 from crops of all kinds. Corn is the most important crop, and Iowa ranks first among the states in corn production with almost half the cultivated area of the state devoted to its culture. In the quarter-century after 1935 the total average annual yield was increased almost 400%. After corn, the most important Iowa crops are oats, barley, soybeans and hay.

By the second half of the 20th century the value of Iowa livestock was greater than that of any other state and twice as great as the valuation in 1920. Hogs, cattle, sheep and lambs are the principal types of stock raised. Dairy products and poultry are also vital parts of the state's agricultural program. The average egg production during 1950–60, for example, exceeded 4,000,000,000 eggs per year; Iowa farmers sold 1,500,000,000 lb. of whole milk annually in the same period and the state was first in the amount of cream sold.

Industry. — Although Iowa is famous for its agriculture, a considerable amount of industry has been attracted to the state by the Iowa development commission. During the second half of the 20th century Iowa industries employed more than 160.000 persons and paid more than $600,000,000 annually in salaries and wages. The estimated total value added by industry in a typical year of the 1950s was 3.81 times as great as that of 1929.

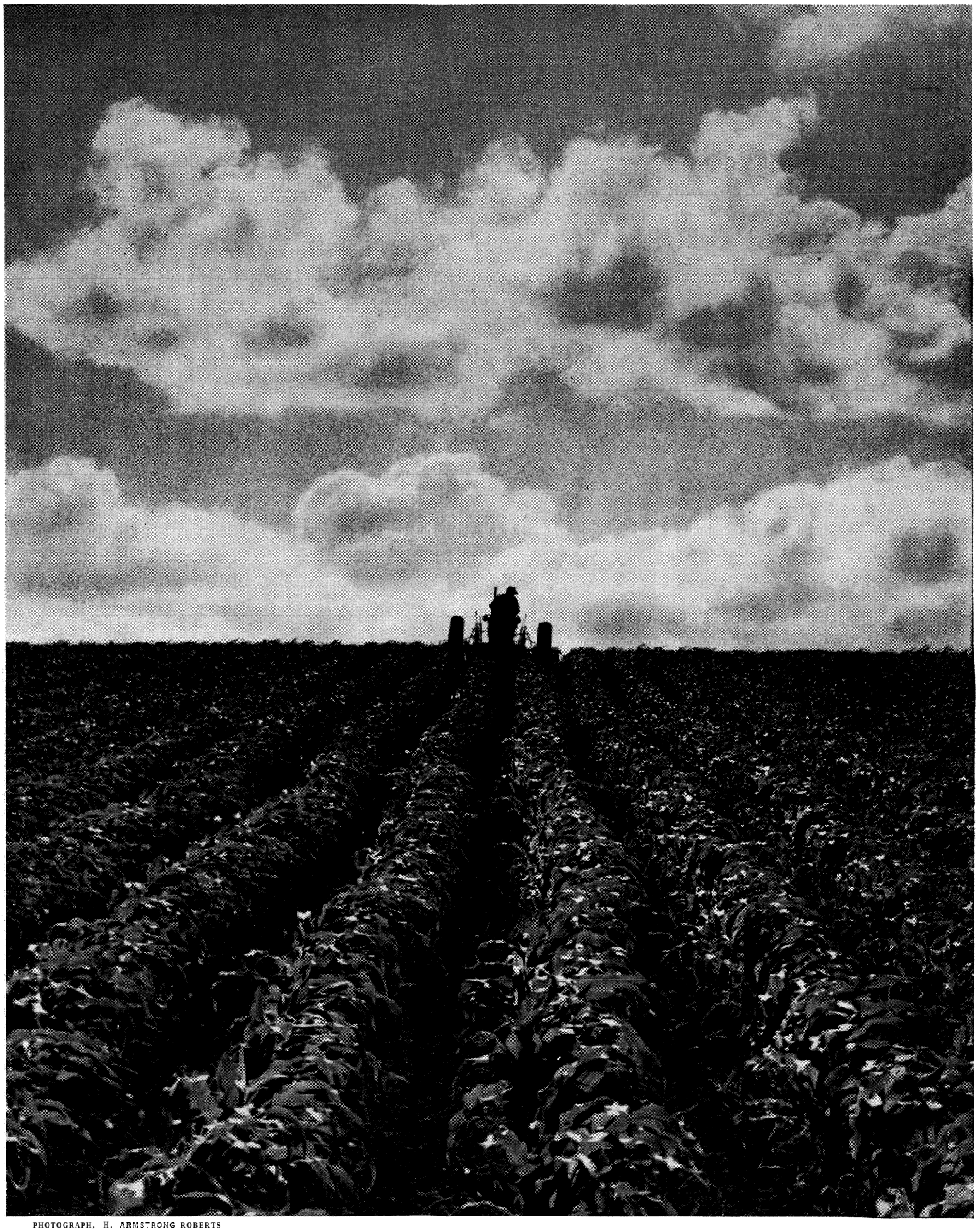
Most of Iowa's industrial plants are engaged in the processing of foods of various kinds. Meat-processing plants are the most important, the largest pork-processing plant in the United States being located in Iowa. Of secondary importance are dairy products-processing establishments and poultry-processing plants. Machinery manufactured in the state includes tractors, combines, corn-pickers and hay-balers. The largest aluminum-rolling mill in the United States is located at Davenport and the nation's largest manufacturer of fountain pens is at Fort Madison. Des Moines, Cedar Rapids and Waterloo are the state's leading industrial centres.

Mineral **Production.**—Iowa's first settlement was a mining camp, but this event proved to be no index to future mineral production. The early lead and zinc mines around Dubuque are little worked, and these products are of small significance in comparison with the state's total mineral output. During the second half of the 20th century, Iowa was among the first ten states in its production of gypsum and cement, but ranked 29th among the states in the value of all of its minerals (1958).

Transportation. — From the close of the Civil War to 1920, the railroad was Iowa's most important means of transportation, although river traffic was of considerable importance during the 19th century. It was in those years that the "Big Four" railroads (the Chicago, Burlington and Quincy; the Chicago and North Western; the Chicago, Milwaukee, St. Paul and Pacific; and the Chicago, Rock Island and Pacific) established control over almost three-fourths of the railroad mileage (about 8,900 mi.) in the state. Since 1920, however, the railroads have steadily declined in favour of motor vehicles and airplanes.

Iowa has long had a state highway system, but it was not until 1919 that highways were classified as primary and secondary. In 1925 the state highway commission began its control of the primary road system. By the second half of the 20th century there were about 8.700 mi. of highway in the state primary system. Motor vehicle registrations increased from 437,000 in 1920 to more than 1,200,000 by 1960. Iowa was receiving about $35,000,000 in federal funds annually under the national highway program initiated in 1956.

The creation of the Iowa aeronautics commission by the general assembly in 1945 testified to the increasing importance of air travel. The number of licensed pilots increased from 1,882 in 1940 to more than 16,000 after World War II; more than 1,600 privately owned planes were registered with the aeronautics commission and there were more than 200 airports and five commercial

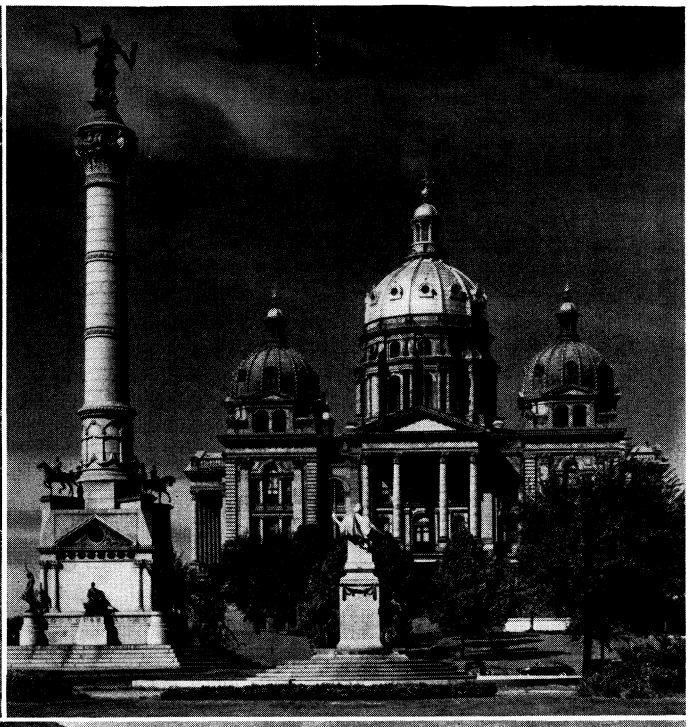


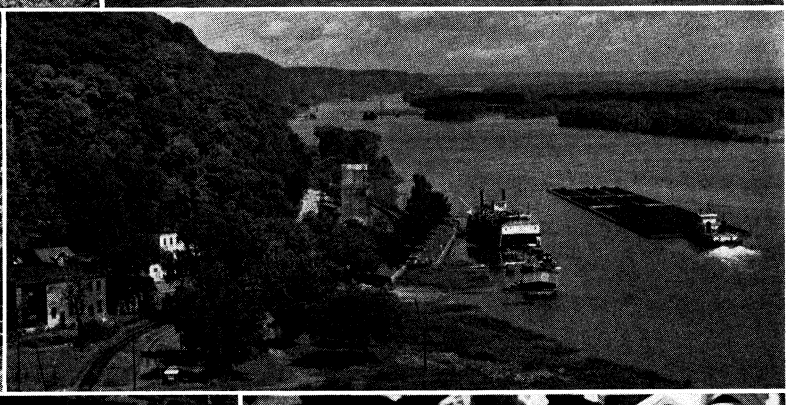
PHOTOGRAPH, H. ARMSTRONG ROBERTS

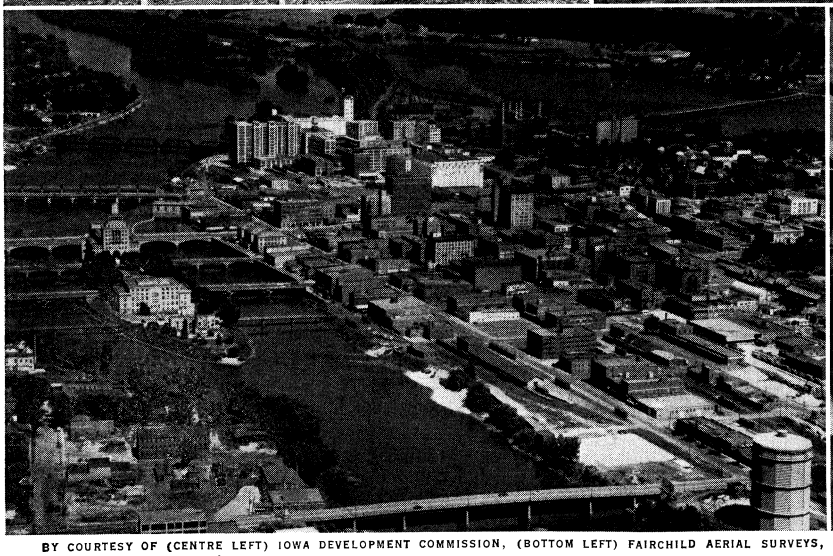
IOWA'S LAND

Farmer cultivating young corn plants. Iowa is the nation's leading corn-producing state, with about one-half of its cultivated acreage devoted to the crop

IOWA







BY COURTESY OF (CENTRE LEFT) IOWA DEVELOPMENT COMMISSION, (BOTTOM LEFT) FAIRCHILD AERIAL SURVEYS, INC.; PHOTOGRAPHS, (TOP LEFT) WIDE WORLD, (TOP RIGHT) JOSEF MUENCH, (CENTRE RIGHT) LORD FROM MONKMEYER, (BOTTOM RIGHT) ELLIOTT ERWITT

SCENES IN IOWA

Top left: Farmers at a hog sale. Iowa is the leading hog-producing state in the U.S.

Top right: The state capitol at Des Moines completed in 1882. The gilded dome, resembling that of the Hotel des Invalides, Paris, Fr., is 275-ft. high

Centre left: House at West Branch where Herbert Hoover, former president of the U.S., was born

Centre right: Coal barges on the Mississippi river at McGregor. Coal mining is a major industry of the state

Bottom left: The city of Cedar Rapids from the air. Municipal Island (on the left), originally a squatter's settlement, was bought by the city in the early 1900s and made into a civic centre

Bottom right: Iowans watching a horse-pulling contest at the state fair

airlines doing business in the state.

BIBLIOGRAPHY.—Alice Marple, *Iowa Authors and Their Works* (1918); Frank Luther Mott, *Literature of Pioneer Life in Iowa* (1923); William J. Petersen, *The Story of Iowa,* 4 vol. (1952), *Two Hundred Topics in Iowa History* (1932); Clarence R. 'Aurner, *History of Education in Iowa,* 5 vol. (1914–20); Cyrenus Cole, *A History of the People of Iowa* (1921), *Iowa Through the Years* (1940); Ruth A. Gallaher, *The First Hundred Years* (reprinted from the *Iowa Journal of History and Politics,* Oct. 1933); B. F. Gue, *History of Iowa from the Earliest Times,* 4 vol. (1903); *Iowa Applied History Series,* 6 vol. (1912–30); Earle D. Ross, *History of Agriculture in Iowa* (1950); Russell Ross, *Government and Administration of Iowa* (1957); Benjamin F. Shambaugh, *The Constitutions of Iowa* (1934); WPA Federal Writers' Project, *Iowa: A Guide to the Hawkeye State* (1938); *Reports* of the U.S. Bureau of the Census; Periodicals relating to Iowa include the following: the *Annals of Iowa* (1863–74); the *Annals of Iowa* (1903 *et seq.*); *Iowa Historical Record* (1885–1902); the *Iowa Journal of History and Politics* (1903 *et seq.*); the *Palimpsest* (1920 *et seq.*).

Current statistics on production, employment, industry, etc., may be obtained from the pertinent state departments; the principal figures, together with the current history, are summarized annually in the *Britannica Book of the Year,* American edition. (P. W. GL.)

IOWA, STATE UNIVERSITY OF, an institution of higher learning. in Iowa City, Ia., was organized by an act of the legislature in 1847. *See* IOWA: *Education.*

IOWA CITY, a town on the Iowa river in east central Iowa, U.S., 57 mi. W. of the Mississippi river, the seat of Johnson county. Founded as the capital of Iowa territory in 1839 and incorporated as a town in 1353, Iowa City lost the state capital to Des Moines in 1857 but retained the state university and historical society. The university buildings, including the Old Capitol, now dominate the centre of the community. Iowa City was an important immigrant dispersal point during the late 1850s; from there in 1856 about 1,300 European Mormons proceeded to Utah, carrying their baggage in handcarts. Ohio, Pennsylvania and New York provided the largest number of early settlers, including Amish and Mennonite groups which in the mid-20th century still maintained their identities. By 1900 there were 2,622 Bohemians and Germans present and foreign born or their children made up 50% of the population; this proportion then declined. (For comparative population figures *see* table in Iowa: *Population.*)

Iowa City has a council-manager government, in effect since 1951. The residents mainly serve the needs of the state university, the university hospitals, a veterans hospital, Mercy hospital, Oakdale tuberculosis sanatorium and the hog, cattle and corn agriculture of the county. Aside from a toiletries plant and a brush factory there is little local industry. Lake Macbride State park and the Herbert Hoover birthplace lie to the north and east.

(A. G. Bo.)

IPECACUANHA (IPECAC), an expectorant and emetic, is obtained from the dried roots of *Cephaelis ipecacuanha* (Rio or Brazil ipecac) or of *Cephaelis acuminata* (cartagena. Nicaragua or Panamá ipecac). The former is indigenous to Brazil but also grows in Colombia, while the latter is obtained mainly from Colombia and Nicaragua.

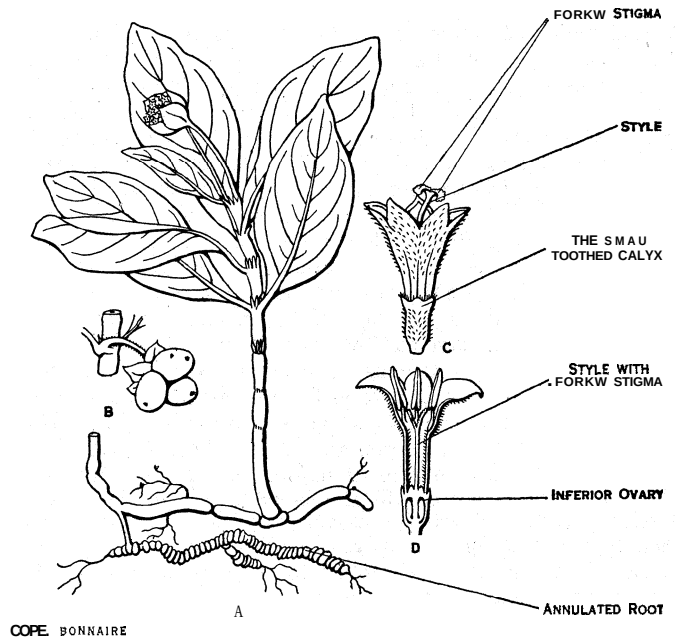
The *United States Pharmacopeia* recognizes both species. while the *British Pharmacopoeia* recognizes only *Cephaelis ipecacuanha.*

Ipecacuanha root occurs in pieces about two or three lines in thickness, of a grayish-brown or reddish-brown tint externally, having a ringed surface and exhibiting a white or grayish interior and a hard wiry centre. It has a faint, rather musty odour and a bitter taste. Cartagena ipecac differs from Rio ipecac only in its larger size and in being less conspicuously ringed. Ipecacuanha owes its emetic properties to the presence of the alkaloids emetine and cephaeline, which occur mainly in the cortical portion of the root.

Emetine is a white amorphous substance, which has a bitter taste. no odour, and turns yellow when exposed to air and light. Besides a number of other alkaloids of no known medicinal value, a substance known as ipecacuanhic acid. a mixture of several glucoside tannins! has been isolated from ipecac.

Ipecac is used in large doses as an emetic (it may be poisonous in excessively large doses) and in smaller doses as an expectorant and diaphoretic. Dover's powder contains 10% each of ipecac and opium. The active alkaloid, emetine, was formerly the mainstay in treating amoebic dysentery, but it has been largely replaced by synthetics and antibiotics.

Other plants to which the name of ipecacuanha has been popularly applied are American ipecacuanha *(Gillenia stipulacea).* wild ipecacuanha (*Euphorbia ipecacuanha*), bastard ipecacuanha (*Asclepias curassavica*), Guiana ipecacuanha *(Boerhaavia decumbens),* Venezuela ipecacuanha (*Sarcostemma glaucum)* and ipecacuanha des Allemands (*Vincetoxicum officinale*). All these possess emetic properties to a greater or less degree.



IPECACUANHA (CEPHAËLIS IPECACUANHA)
A. Plant showing annulated root
B. Fruits
C. Long-styled. flower
D. Longitudinal section through a short-styled flower

IPEK (properly PEĆ), a town in Kosovo-Metohija, Serbia, Yugos. Pop. (1961) 28,297. Peć was formerly the centre of the Serbian Church, the archbishop having been raised to the patriarchate by Stephen Dushan (1331–55). It was suppressed in 1459, restored in 1557 and finally abolished by the Turks in 1767. On the heights above the town stands the 13th-century monastery, the seat of the patriarchs until 1690, and the church, which dates from the 16th and 17th centuries, After the fall of Belgrade in 1521 many of the inhabitants migrated to Hungary, and in 1690 there was a second migration there led by the patriarchs.

IPHICRATES, Athenian general, son of a shoemaker, flourished in the earlier half of the 4th century B.C. He is chiefly known for the use he made of lightly armed troops (peltasts); he increased the length of their weapons, and improved their mobility by reducing their defensive armour. He also paid special attention to discipline, drill and manoeuvres. With his peltasts Iphicrates seriously injured the allies of the Lacedaemonians in the Corinthian War, and in 392 (or 390) dealt the Spartans a heavy blow by almost annihilating a battalion of hoplites (Diod. Sic. xiv. 91; Plutarch, *Agesilaus,* 22). He was later transferred from Corinth to the Hellespont, where he was equally successful. After the peace of Antalcidas (387) he assisted Seuthes, king of the Thracian Odrysae, to recover his kingdom. About 378 he was sent with a force of mercenaries to assist the Persians to reconquer Egypt; but a dispute with Pharnabazus led to the failure of the expedition (Diod. Sic. xv. 29–43). On his return to Athens he commanded an expedition in 373 for the relief of Corcyra, which was besieged by the Lacedaemonians (Xenophon, *Hellenica,* vi. 2). On the peace of 371, Iphicrates returned to Thrace, and fought for Cotys in a war against Athens for the Chersonese. The Athenians soon pardoned him and gave him a joint command in the Social War. He and two of his colleagues were impeached because they had refused to give battle during a violent storm.

Iphicrates was heavily fined. He died about 353.

IPHIGENEIA, daughter of Agamemnon (*q.v.*); not mentioned in Homer, but by some absurdly identified with the Iphianassa of II ix, 145, who was alive and well some ten years after Iphigeneia's supposed death. As she is constantly represented as connected in some way with Artemis, and as Iphigeneia ("mightily born," *i.e.*, "great princess") is a title of the goddess; as, moreover, she has substituted for her one of Artemis' beasts (see below), it is in no way impossible that originally she was a by-form of the goddess herself; but the question is obscure. Agamemnon had vowed to sacrifice to Artemis the fairest thing that should be born in a certain year, meaning the handsomest beast; but in that year Iphigeneia was born. Another story is that he or Menelaus had offended Artemis in some way. As a result, Artemis stayed the Greek fleet at Aulis on its way to Troy, by calm or contrary winds, and Calchas discovered that only the sacrifice of Iphigeneia would appease the goddess. Iphigeneia therefore was sent for on pretence of marrying her to Achilles; at the last moment the goddess relented and substituted a hind, bear, or bull for the victim, whom she spirited away to the land of the Tauri (Crimea). Here she became priestess of Artemis and as such had to sacrifice all strangers. At last Orestes (*q.v.*) and Pylades arrived; by a stratagem, she fled with them taking the image of Artemis, which Orestes had been sent to fetch. They left it somewhere in Greece; among places claiming to have the true statue and some remnant of the old rites of human sacrifice were Brauron in Attica, where a pretence was made of cutting a man's throat before the goddess, and Sparta, where boys were beaten till the blood came, in the ritual of Artemis Orthia. Ipnigeneia was variously said to have died and been buried at Brauron or Megara, and to have been transported to Leuce, where she was wedded to Achilles, or even to have been transformed into the goddess Hecate (*q.v.*).

See Stoll in Roscher's *Lexikon* (bibl.); *L.* R. Farnell *Greek Hero-Cults* (1921); H. J. Rose *Handbook* of *Greek Mythology* (1928).

I-PIN (SUI-FU; SÜCHOW), a Chinese river port at the junction of the Min and Chin-sha (upper Tangtze) rivers in southwest Szechwan (Ssuch'uanj province and head of navigation to small steamers on the Yangtze. Pop. (19j3) 177,500. It is the site of the Yangtze river crossing projected for the railroad being built in 1959 to connect Szechwan with Yünnan in the south. A highway runs northward to the salt centre of Tzekung (Tzu-kung). With its transportation facilities, it acts as the collection centre and export port for products of the Yünnan and Tibetan uplands, such as medicinal herbs and extracts, musk and metals, and as the dissemination point for salt, cotton and other manufactures to the surrounding mountain peoples. It is the nearest large city to the Liang Mountains Ti Peoples Autonomous Region inhabited by Yi (Lolo) tribesmen. A unique product collected at I-pin from the Lo-shan (Chia-ting) region up the Min is the lac produced by the exudation of a species of insects feeding upon the lac trees. (H. J. Ws.)

IPIRANGA, GRITO DO, the "cry of Ipiranga" (Ypiranga), so-called because Brazil's independence was proclaimed at this place by Dom Pedro on Sept. 7, 1822. Sentiment for independence had been growing since the preceding year when King Jodo VI returned to Lisbon, leaving his son Pedro as regent. When the Portuguese parliament limited the powers of the regency, the action was interpreted as an effort to reassert Portuguese rule in Brazil. A messenger sent to intercept the young regent returning to the capital from São Paulo met him on Ipiranga hill, where he vowed: "Independência ou morte!" (Independence or death!). He was proclaimed Pedro I, emperor of Brazil, Oct. 12, 1822. (R. E. P.)

IPOMOEA, a large genus of mainly climbing herbs or shrubs of the convolvulus family (Convolvulaceae, *q.v.*), with about 400 species. It includes the sweet potato (I. batatas), cultivated morning glory (I. *purpurea*) and manroot (I. *pandurata*).

IPSUS, BATTLE OF, 301 B.C. This, named "the battle of the kings," was the great clash in the wars of Alexander the Great's "Successors," which shattered Antigonus's attempt to reconsolidate the Macedonian empire. Hard-pressed in Thessaly by Demetrius, the son of Antigonus, Cassander turned the tables by a stroke of true genius. Keeping only a minimum of force, he despatched his ally, Lysimachus, to invade Asia Minor and arranged with Seleucus to advance from Babylon on Antigonus's rear. The combination and concentration against the heart of the opposing power succeeded, and forced Demetrius to evacuate Greece and sail home to his father's aid. The armies of Antigonus and Demetrius met the armies of Lysimachus and Seleucus at Ipsus in Phrygia. Antigonus had 70,000 foot, 10,000 horse and 75 elephants; the allies only 64,000 foot, 10,500 horse, but 480 elephants. At the outset of the battle Demetrius with the cavalry charged and dispersed the opposing cavalry, but, pressing the pursuit too far, found himself cut off by the enemy's elephants. But instead of assaulting Antigonus's army, thus stripped of his cavalry, Lysimachus demoralized it by threat of attack and by fire until it began to melt—part going over to the allies. Then only did Seleucus launch a strong body at the position occupied by the enemy's command.

Borne down by this charge, Antigonus died, crying vainly "Demetrius will come and save me." If the victory is memorable in military history as an outstanding triumph of the war elephant, its greater political consequence was to ensure the disappearance of any central power and the dismemberment of the Greco-Macedonian world.

IPSWICH, a city of Stanley county, Queensland, Austr., on the Bremer river, 23½ mi. by rail W. by S. of Brisbane. Pop. (1954) 38,953. It is the centre of a rich and populous agricultural>mining and manufacturing district. Coal outcrops on the surface and is worked on the banks of the river. Ipswich is the chief coal field in Queensland; and there are about 50 mines, which produce about 1,000,000 tons a year. There are woolen factories, saw-mills, foundries and large railway workshops at North Ipswich.

The first settlement, based on the presence of limestone, was made there in 1829; the town was incorporated in 1860. It grew considerably during the first half of the 20th century.

IPSWICH, a municipal, county and parliamentary borough and county town of Suffolk,Eng., 69 mi. N.E. of London by road. Pop. (1961) 117,325. Area 13.7 sq.mi. It is an ancient market town and port at the head of the Orwell estuary, and an important farming and industrial centre. Above the town the river is called the Gipping; the old name of Ipswich was Gipeswic. Ipswich harbour extends domnstream to Shotley point; there is a large wet dock and, excluding private constructions, the commissioners control more than 4,000 ft. of quayage. Imports are principally grain, sugar, timber, petroleum and caal; exports are agricultural machinery, railway supplies, grain, flour, fertilizers and oil cake. Ipswich is well known for its manufacture of agricultural implements and fertilizers, and a variety of other industries give it an unusually well-balanced economy.

It has many historic buildings: Christchurch mansion (16th century), in its park, is an art gallery and museum; Sparrowe's or the Ancient house (1567) has a pargetted facade; Wolsey's gateway (1536), a Tudor brick building, is the only remnant of the cardinal's foundation to supply scholars to his great college (Cardinal's college, now Christ Church) at Oxford. The Great White Horse hotel was the scene of one of Mr. Pickwick's adventures. Ipswich was the birthplace of Cardinal Wolsey and from 1747 to 1759 Thomas Gainsborough lived and painted there.

The older churches are all towered flintwork structures, wholly or mainly Perpendicular in style, with the exception of St. Peter's, which is principally Decorated, with a Norman font of Tournai marble. The grammar school, dating at latest from 1477, was refounded by Queen Elizabeth I in 1565. There is an Anglican bishopric of St. Edmondsbury and Ipswich. The parliamentary borough returns one member.

Prehistoric finds include a Roman villa and a Saxon settlement. In 991 the town was sacked by vikings. In 1200 King John granted the burgesses their first charter, the town to be held at fee-farm, with a guild merchant; the burgesses were definitely incorporated in 1464 and reincorporated in 1665 under a charter which remained in force up to its modification by the Municipal Corporations act of 183j. The cattle market and provision market are the prescriptive right of the corporation.

IPSWICH, a town of Essex county, eastern Massachusetts, U.S., 28 mi. N.N.E. of Boston, on both sides of the Ipswich river and fronting on Ipswich bay. (For comparative population figures *see* table in MASSACHUSETTS: *Population;* there are in addition about 2,000 summer residents)

The town was settled under the name of Agawam in 1633 and was incorporated in 1634 as Ipswich, being named for the English town. During the early days of the colony it was little inferior to Boston in wealth and influence, and frequently took an opposing position on public questions. Ipswich was the home of several of the leading writers of the colonial period, including Nathaniel Ward (1578–1652) and Anne Bradstreet (1612–72). Nearly 40 houses built before 1725 are still standing. The John Whipple house (1640) contains the collection of the Ipswich Historical society. The Choate bridge, built in 1764, is the oldest stone arched bridge in the U.S.

Ipswich has a selectmen-executive-secretary form of government in effect since 1955. (K. S. T.)

IQUIQUE, a city and port of Chile, capital of the province of Tarapacá (q *v*), 75 mi. S of Arica and 820 mi. N. of Valparaiso. Pop. (1960) 51.468. The Pacific coast runs due north and south and the city is built on a narrow level plain between the sea and bluffs, the latter rising steeply 2.000 ft. to the level of the desert plain of Tarapacá, celebrated for its rich deposits of nitrate of soda, which gives nay to the Atacama desert (*q.v.*). Facing the city is the low barren island of Serrano, which is connected with the mainland by a stone causeway 1,500 ft. long and shelters the anchorage from southerly storms. A mole extending from the northeastern end of the island affords further protection.

The city is laid out on the rectangular plan, with broad streets and large squares. Water is brought by pipes from the oasis-town of Pica. 50 mi. inland. Iquique is a city of commercial importance and is provided with banks, substantial business houses, newspapers, clubs. schools, railways. tramways, electric lights, telephone lines and steamship, air and cable communication with the outside world. It exports iodine and immense quantities of nitrate of soda obtained from the adjacent desert region.

A large number of vessels are engaged in the nitrate trade, and Iquique ranks as one of the two leading ports of Chile in the aggregate value of its foreign commerce. It is connected by rail with the inland town of Tarapacá and various mining centres. and through them with the ports of Pisagua on the north and Patillos on the south.

Iquique was an insignificant Peruvian fishing settlement until 1830 when the export of nitrate began. In 1868, the town was nearly destroyed by an earthquake, in 1875 by fire, and again in 1877, by earthquakes, a fire and a tidal wave. It was occupied by the Chileans in 1879 in the war between Chile and Peru, and was ceded to Chile by the treaty of Oct. 20. 1883

IQUITOS, Amazon river port in northeastern Peru, and capital of Loreto department, located 3° 45′ S. at an elevation of about 350 ft.. 2,300 mi. upstream from the Atlantic ocean. It is 640 mi. N N.E. of Lima. Pop. (1958 est.) j4.286. The climate is equatorial with an average rainfall of 103 in , but temperatures are not so high as in the middle latitudes—the warmest month (February) averages 78.3" F., and the coldest month (July), averages 74.1° F. The humidity is high, especially in the early morning hours.

Iquitos was founded as a Peruvian settlement in 1863 at a place occupied previously by an Indian village The Peruvians became interested in the region during the rubber boom of the late 19th century. and Iquitos became the chief shipping port for this part of the norld. In spite of the great distance from the Atlantic. ships draning 14 ft. can reach this place even at lon nater. The most prosperous period of rubber production was between 1906 and 1912, after which production dropped to only a fraction of nhat it had been. Population declined and for a long time this remote jungle region and the city which was its commercial centre remained stagnant.

Since 19jo there has been a renewed interest in the economic development of eastern Peru. Highways from Lima. including the Lima-Pucallpa highway, reach navigable water east of the Andes, and airplanes make the trip over the mountains in a fen hours. Iquitos has started to grow again in response to the increased settlement and production in its tributary area

The products, most of nhich continue to move out by steamer, include small amounts of rubber, balata, chicle, medicinal plants. tagua nuts, cabinet woods, cotton, rice, coffee, tobacco and hides. (P. E. J)

IRAKLION (HERAKLEION or CANDIA), the largest city in Crete, lies on the north coast, northeast of the central Mt. Psiloriti (Ida), and derives its name from the ancient Heracleum (Ἡράκλειον) which probably occupied the same site. Pop. (1961) 64,492. The town gained much importance as a trading centre after the construction of the new harbour, the airport and a number of motor roads. The chief exports are grapes, sultanas, olives and olive oil, nine, carobs, citrus fruit, almonds, soap and leather.

The Saracens, who captured the island between 823 and 828, made the city their capital, but they were defeated and massacred in 961 by Nicephorus Phocas. In 1204. after the capture of Constantinople by the crusaders. Crete was sold by King Boniface to Venice, but was occupied by the Genoese and only became Venetian territory in 1210. Most of the extensive Venetian walls of Iraklion still survive.

In 1669 the city was ceded to the Turks after a long siege. Francesco Morosini, later doge of Venice, commanded the defenders, and the finely sculptured fountain he erected still remains, though his loggia has been pulled down and the surviving Venetian churches have been desecrated. There is a modern cathedral, Armenian and Roman Catholic churches and also the interesting old church of St. Menas. A modern museum contains the finest collection in the world of Minoan antiquities from Knossos, 3 mi. S E., and from other Cretan sites, and there are interesting remains of later dates in the new historical museum. The Turkish mosques have been destroyed or converted to other uses. A monument commemorates Dhaskaloyannis, flayed alive there after the rebellion of 1770.

In a massacre that followed the Cretan rebellion of 1897, 17 British sailors were killed there, and Adm. Sir Gerard Noel forced the Turks to surrender the city. With the rest of Crete, after a period as a protectorate, Iraklion passed to Greece in 1912. During the German invasion in 1941 the city suffered heavily from aerial bombardments.

Iraklion is the capital of the department of Temenos; this department consists of the hilly country round Mt. Iuktas on the east and the valley of the Kairatos on the west, opening out into a coastal plain, perhaps the most fertile land in Crete except that of Messara. *See* also CRETE. (R. W. Hu.)

IRAN, the great plateau between the plain of the Tigris in the nest and the valley of the Indus in the east, the Caspian sea and the Turanian desert in the north and the Persian gulf and the Indian ocean in the south. surrounded on all sides by high mountain ranges with a great salt desert in the centre. The modern name Iran (in Middle Persian. Eran) is derived from the ancient *Aryana,* "the country of the Aryans." Eratosthenes limited the name of Ariana to the southeastern part of Iran. and excluded Persia. Media and Bactria, and therein he is followed by Strabo (ii, 78, 130, xv. 720 ff.; Pomp. Mela i. 3).

The term "Iran," having always been used by native Persians to designate their indefinitely bounded country, became current in western usage after 1927 as the name of the kingdom proper in recognition of its reinvigorated life and nenly asserted independence.

For the ethnography and history of .Iran *see* PERSIA.

IRANIAN LANGUAGES. The Iranian languages, of which the Persian branch is the most important, belong to the Indo-European family, within nhich Old Iranian and Sanskrit form the Aryan group (the terms "Aryan" and "Iran" having a common origin). How close Old Iranian is to Sanskrit may be judged from the translation into Sanskrit of the Avestan phrase *yō vō āpō vaβuhīš yazāitē ahurāniš ahurahe vahištābyō zaoθ-rābyō* ("he nho worships you, the good waters, the Ahurian [daughters] of Ahura, with the best libations"), which becomes *yō vō āpō vasvīṣ yajātē asurānīs asurasya vasiṣṭhabhyō hōtrā-*

bhyō; and the original Avestan words. undisguised by the alphabet, would be still nearer to the Sanskrit.

The principal phonetic distinctions of Iranian from Indian are: (1) original *s* becomes h in Iranian; (2) to Indian voiced and voiceless aspirates correspond respectively Iranian voiced stops or spirants; (3) Iranian has *z,* absent in Indian; (4) Iranian diphthongs ai, nu are found in Indian as *ē, ō,* etc. Compare the examples shown in the table.

Sanskrit	Avestan	Old Persian	Modern Persian
Sindhu (Indus)	*Hindu*	*Hindu*	*Hind*
Asura Medhās	*Ahura Mazdāh*	*Ahuramazdā*	*Hurmuzd*
bhūmī (earth)	*būmī*	*būmī*	*būm*
kratu (insight)	*xratu*		*xirad*
hasta- (hand)	*zasta-*	*dasta-*	*dast*
açva- (horse)	*aspa-*	*asa-*	*asp*

Later on the two branches, Iranian and Indian, diverged widely.

Three successive stages in the history of the Iranian languages —Ancient, Middle and Modern, in Persian. the principal branch of the group—correspond with epochs of national vicissitudes. Old Persian was used on the monuments of the Achaemenid dynasty (6th–4th centuries B.C.) destroyed by Alexander the Great. Middle Persian is known from the Parthian or Arsacid period (2nd century B.C.–3rd century A.D.) and even more from Sassanian times (C. A.D. 224–651), terminated by the Arab conquest and domination. With the Persian renaissance (9th century A.D.) Modern Persian appears, from which time it survives: with some unsubstantial changes: as a living language. Other Iranian idioms passed through stages similar to those of Persian.

Ancient Iranian Languages.—Of the Median language is known only one word (σπάκα, dog), preserved by Herodotus (i, 110) and several personal names. Of the Old Saka-Scythian group of languages (Scythian and Sarmatian) only personal names in Greek inscriptions, found in south Russia, have come down. The only ancient Iranian languages really known are Avestan and Old Persian.

The former is the language of the Zoroastrian sacred books. By early European scholars it was improperly called Zend, which term designates only the commentary to the Avesta, written in Middle Persian (see below). The age of the Avesta is dubious. Two parts of it are clearly distinct: the so-called Gathas are more or less at the same linguistic stage as the most ancient Vedic hymns of Old Indian. These archaic poems composed by the prophet of Iran, Zoroaster (*q.v.*), are authentic documents of his religious reform. The greater part of the Avesta, the so-called recent or younger Avesta, is a collection of texts of varying antiquity and is characterized by a gradual simplification and a lax use of the grammatical forms. At the time of its codification (4th–6th centuries A.D.) Avestan had long been a dead language known to the priests alone. In its present state the Avesta has the size of the *Iliad* and Odyssey put together. The original home of Avestan is uncertain but must no doubt be sought in eastern Iran. It was long taken for the language of Bactria, but later arguments were advanced for localizing it in ancient Khwarizm (Khiva). The Avestan alphabet was evolved from the late Pahlavi script (see below); before this, the Avestan texts are thought to have been transmitted orally.

Old Persian was used in the cuneiform inscriptions of the Achaemenid kings. The text is usually accompanied by translations into Elamite and Akkadian (Assyro-Babylonian). The most important document is the famous inscription of Darius the Great (522–486 B.C.) on the rock of Behistun. near Kermanshah, which was first read and published by Sir H. Rawlinson in 1846–47.

Middle Iranian.—This term describes the state of Iranian languages from the 3rd to the 10th century AD.. although in the case of Persian the transition from the Middle to the Modern phase had been completed by the 8th century. The Middle Iranian languages are Parthian, Middle Persian, Khwarizmian, Sogdian and Saka. Linguistically all except the second are closer to Avestan than to Old Persian.

Parthian was the official language of the Xrsacid period but is attested chiefly in later Sassanian inscriptions and Manichaean texts. The Parthian hymn cycles, composed by the Manichaean missionary Mar Ammo in the second half of the 3rd century A.D., rank among the highest literary achievements of the Middle Iranian period.

Middle Persian, the official language of the Sassanians. is found in their inscriptions as well as in Manichaean and Zoroastrian books. Of the former by far the most important is the great inscription of Shapur I (*c.* A.D. 262), a historical record of the war against the Romans, with parallel versions in Parthian and Greek.

The Middle Persian Manichaean literature (3rd–10th centuries) shares with the Parthian and Sogdian Manichaean texts the advantage of being written in an easily readable Aramaic alphabet, whereas the Zoroastrian books (largely commentaries on the Avesta and treatises on religious subjects, composed down to the 9th century) are nritten in the highly ambiguous Pahlavi script and abound in Semitic ideograms. The extant Pahlavi literature has been computed to amount to 628,000 words (E. W. West). The Manichaean texts, discovered in central Asia at the beginning of the 20th century, are much less numerous but have shed much light on the reading of Pahlavi books.

Khwarizmian is found only in glosses and sentences embedded in mediaeval Islamic lam books. The language may be a descendant of Avestan (see above).

Sogdian, the native language of the province centred on Samarkand, is available in three distinct Semitic alphabets, one being employed for lay documents and for Buddhist texts; one for Christian and the third for Manichaean literature. Each group, moreover, is characterized by dialectal variations. Sogdian traders and missionaries. travelling and settling in colonies along the route connecting Sogdiana with China, raised their language to the status of a lingua franca of central Asia between the 4th and the 10th centuries. A great deal of Sogdian literature was still awaiting publication in the middle of the 20th century.

Saka is known in two varieties. One, richly attested, was once the language of the kingdom of Khotan in Chinese Turkistan and hence is known as Khotanese. The other (of which only one Buddhist fragment survives) was connected with Tumshuq (Chinese Turkistan). From the end of the 8th century B.C. nomadic tribes of Sakas periodically emerged from central Asia into what is now south Russia (the Black sea coastal area. the Don basin and the northern Caucasus), the Scythians being the earliest-known wave of these invasions. Phonologically, the Iranian language which is closest to Khotanese is the present-day Wakhi in the Pamirs. A special affinityhas been noted between Khotanese, Ossetic, Khwarizmian, Sogdian and Pushtu (see below). The amount of Khotanese literature that has been recovered (largely Buddhist, but including some documents of lay content) is hardly less than what has survived in Pahlavi. The language is permeated with Indian elements. The study of Khotanese, still in its initial stage in the 1950s, seemed bound to have a profound effect on philologists' understanding of Iranian in all its branches.

Modern Languages.—A11 Iranian languages in actual use in the 20th century display in different degrees a tendency toward an analytic stage (simplification of the sounds and, in morphology, the use of new auxiliary tenses, etc.). Of these languages by far the most important is the literary Persian, as found in the extensive Persian literature and in the present-day speech of the more educated classes of the Persian-speaking countries.

Modern Persian is a direct descendant of the southern forms of Middle Persian, but has borrowed many words in the northwestern form and nymerous Arabic and Turkish elements. It is written in Arabic characters. Though Modern Persian is one and the same language, local variations, spoken in Persia, Afghanistan, India and Russian Turkistan (Tajiki), are considerable.

Parallel to literary Persian, special dialects are in use in most Persian towns and villages. The dialects of Fars, Luristan, Khurasan and Kerman belong to the same southern group as the literary Persian. On the other hand, numerous and different vernaculars represent the remains of former northwestern idioms.

Such are the local dialects of the Caspian provinces, the language of the Kurds (spread over a vast area and sporadically found in northern Syria and even close to Ankara in Asia Minor),

the language of the Baluchis and of isolated groups (as those of Kashan, Siinnan, etc.).

Among Modern Iranian languages of the "eastern" group are the Afghan language (Pushtu, *q.v.*), the various dialects of the Pamir group (Shughni, Wakhi, Munjani, etc.), Yaghnobi (a modem descendant of Sogdian) and Ossetic (spoken in the heart of the Caucasian mountains south of Vladikavkaz, a survivor of the once powerful Sarmatian group of Saka spoken in south Russia).

BIBLIOGRAPHY.—Detailed monographs on the Iranian languages, with a bibliography complete to the end of the 19th century, will be found in vol. i of *Grundriss der iranischen Philologie,* ed. by W. Geiger and E. Kuhn (Strasbourg: part i, 1895–1901; part ii, 1898–1901; supplement on Ossetic, 1903). Later Important works are: C. Bartholomae, *Altiranisches Wörterbuch* (Strasbourg, 1904) and *Zum altiranischen Worterbuch* (Strasbourg, 1906); A. Meillet, *Grammaire du vieux perse,* ed. by *E.* Benveniste (Paris, 1931); and R. G. Kent, *Old Persian* (New Haven, 1950). Middle Persian and Parthian texts have been edited by W. B. Henning from 1932 onward; *see* also A. Ghilain, *Essai sur la langue parthe* (Louvain, 1939); and Mary Boyce, *The Manichaean Hymn-Cycles in Parthian* (London, 1954). For Shapur's inscription *see* M. Sprengling, *Third Century Iran, Sapor and Kartir* (Chicago, 1953). For the relation of Khwarizmian mith Avestan *see* W. B. Henning, *Zoroaster* (Oxford, 1951; New York, 1952); and A. A. Freiman, *The Khorezmian Language* (in Russian) (Moscow and Leningrad, 1951). Sogdian texts have been published by F. W. K. Müller, W. Lentz, R. Gauthiot, E. Benveniste, W. B. Henning and O. Hansen; *see* Ilya Gershevitch, *A Grammar of Manichean Sogdian* (London, 1954). Khotanese texts have been edited chiefly by E. and M. Leumann, S. Konow and H. W. Bailey; *see* for instance S. Konow, *Primer of Khotanese Saka* (Oslo, 1949); and H. W. Bailey (ed.), *Khotanese Buddhist Texts* (London, 1951) and *Khotanese Texts 11* (Cambridge, 1954). For the languages spoken in Afghanistan and the Pamirs *see* G. A. Grierson, *Linguistic Survey of India,* vol. x (Calcutta, 1921); G. Morgenstierne, *An Etymological Vocabulary of Pashto* (Oslo, 1927) and *Indo-Iranian Frontier Languages,* 2 vol. (Oslo, 1929, 1938); and I. I. Zarubin's numerous studies, in Russian, on the Pamir languages. On Ossetic *see* V. I. Abayev, *Ossetic Language and Folklore* (in Russian) (Leningrad, 1949). For Modern Persian and Kurdish dialects *see* V. A. Zhukovsky, *Materials for the Study of the Persian Dialects,* 3 vol. (in Russian) (St. Petersburg, 1888–1922); V. F. Miller, *Tati Studies* (in Russian) (Moscow, 1905–07); O. Mann and K. Hadank, *Kurdisch-persische Forschungen,* 7 vol. (Berlin, 1906–30); A. Christensen, *Contributions à la dialectologie iranienne,* 2 vol. (Copenhagen, 1930–35); B. V. Miller, *The Talyshi Language* (in Russian) (Moscow, 1953).

The best theoretical grammar of Modern Persian is C. Salemann and V. A. Zhukovsky, *Persische Grammatik* (Berlin, 1889). More practical are D. C. Phillott, *Higher Persian Grammar* (Calcutta, 1919), and Ann K. S. Lambton, *Persian Grammar,* 2 parts (Cambridge, 1952–54). Dictionaries include: J. A. Vullers, *Lexicon persico-latinum,* 2 vol. and an annex (Bonn, 1855), complete and important for research work; Baron J. Desmaisons, *Dictionnaire persan-français,* 4 vol. (Rome, 1908–14); S. Haim, *New English-Persian and Persian-English Dictionary,* 4 vol. (Tehran, 1930–36). (V. F. M.; IA. G.)

IRANIAN RELIGION: see AVESTA; ZOROASTER.

IRAQ or AL-'IRAQ), a former kingdom (proclaimed a republic on July 14, 1958), formed out of the three Turkish provinces (vilayets) of Basra. Baghdad and Mosul after World War I. The boundaries between Iraq and its neighbours Syria, Jordan. Turkey, Iran (Persia), Kuwait and Saudi Arabia were gradually settled between 1922 and 1937. The northern frontier is crossed only by difficult tracks; the eastern frontier is crossed by only one easy route over the Paitak pass to Kermanshah; south of the mountain zone passage is hindered by soft desert and marshes. The southern and western frontiers offer no obstacles other than those of desert conditions.

PHYSICAL FEATURES

Geographically Iraq may be divided into three regions which correspond mith the geological structure of the land: the southern and western deserts ending at the Euphrates escarpment; the central lowland, comprising the delta lands south of Baghdad and the Jazira (*i.e.,* island) between the Tigris and Euphrates north of Baghdad with the northeastern plain and foothills; and the mountainous region of Iraqi Kurdistan. The frontiers with Kuwait, Saudi Arabia and Jordan are in the desert region. That with Kuwait follows for 60 mi. the Batina. a narrow depression which extends right across the Arabian peninsula. Elsewhere these frontiers follow a line of wells or are arbitrarily traced over featureless desert. In this desert region are three main divisions: the Dibdiba, a gently undulating steppe desert with a slightly sandy surface extending in a southeasterly direction from Abu Ghar wells across the Batina into Kunait: the Hajara, the "stony desert." to the northwest; and the Wadiyan to the frontiers with Jordan and Syria, a series of long wadis with a stony or gravel surface. The only notable oases are at Rahhaliya and Shifathah (or Shithathah) about 30 mi W. of Karbala. Fifteen miles southeast of Shifathah is an imposing ruin, Qasr Ukhaidhir, dating probably from the 6th century A.D. A metalled road nith a bitumen surface crosses the Wadiyan from the Jordan frontier via Rutba wells (where there is an Iraqi police fort and travellers' resthouse) to Ramadi. This road was constructed in 1941 but the route had been in general use for motor traffic between Baghdad and Damascus since 1923. The Iraq Petroleum company's pipelines cross from Haditha on the Euphrates to the Mediterranean.

The central lowland includes tracts with varying characteristics; lower Mesopotamia from Basra to Baghdad; the Jazira, a preponderantly desert area from the right bank of the Tigris to the Syrian and Turkish frontiers; and the "Assyrian" plain and foothills betaeen the Tigris and the mountainous region to the east and north. From Falluja (nhere the two rivers are no more than 50 mi. apart) the Euphrates follows a generally southerly course to Shinafiya. 150 mi. below in a direct line Hence it turns east to join the Tigris below Qurna. The northern part of this region is irrigated by canals from both rivers; the southern is a vast area of marshland and lakes. The Jazira—most of ahich is included in the new province named al-Badiyat al-Jazira (the Mesopotamian desert)—is the southeastern part of the almost wholly desert region between the Tigris and Euphrates south of the southern foothills of the Turkish mountains. In the north are occasional low ranges of hills of which the most prominent are the Jabal Sinjar nest of Mosul and the Jabal Mak-hul, an extension of the Jabal Hamrin west of the Tigris and parallel to its course. Rainfall from these and other hills is collected in streams which flou into the Tigris or into the depression known as the Wadi Tharthur which runs parallel with the Tigris for the full length of the Jazira. This depression receives Tigris floodnaters as part of a scheme of flood control and water storage. Hatra (Hadhr), an interesting Parthian ruin, lies 55 mi. S.S E of Mosul. Narrow belts of cultivation are found along the banks of both rivers. East of the Tigris the central lowland north of Baghdad is divided into four regions by the Jabal Hamrin and the Little and Great Zab rivers. South of the Jabal Hamrin is desert traversed in a north-south direction by the Adhaim river nhich is dry for eight months of the year. The Khalis canal takes off the Diyala river about 30 mi. K.E. of Baquba, and the land commanded by it and its subsidiaries is extensively cultivated. There are belts of cultivation also along the Tigris and the Diyala to Baghdad.

The Jabal Hamrin rises to about 1,500 ft. above sea level at the Fatha gorge. uhere the Tigris divides it from the Jabal Makhul, and loses height to about 700 ft. near the Diyala. The main pass, which takes the main road between Baghdad and Kirkuk, is the Injana or Abu Ghuraib, 6 mi S.E. of the break made by the Adhaim. The railway crosses at the Kurderuz pass 10 mi. E. of Deli Abbas which carries also the main road into Iran. The Khanaqin plain on the left bank of the Diyala is fertile and well watered. The roughly rectangular region between the Jabal Hamrin, the Diyala river, the Kurdish foothills and the Little Zab river is broken by numerous ravines and by tributaries of the Diyala and the Adhaim, but there are cultivated areas and stretches of good grazing. Northnest of Kirkuk is an area bare of vegetation beneath which are the oil fields.

Between the Little and Great Zab rivers is the Arbil (Arbela) plain all of which is cultivated with wheat and barley. To the southwest is the Jabal Qara Chauq and between it and the Tigris a formerly prosperous triangle nhich is now sparsely populated grazing land. The Mosul-Xrbil road crosses the Great Zab hy a steel bridge at Eski Kellek. The Mosul plain between the Great Zab and the foothills north and east of Mosul has a rich soil and is well cultivated; except in the extreme northwest cultivation is dependent entirely on rainfall. Iraqi Kurdistan forms a moun-

tainous crescent on the northeast through which the frontiers with Iran and Turkey are arbitrarily traced. It is a region of rugged mountains, impassable gorges and fertile valleys and plains, watered by the Great and Little Zab, the Khabur, the Diyala (known as the Ab-i-Sirwan on both sides of the Iranian frontier) and their tributaries. Many of the mountain slopes are well wooded and summer grazing is plentiful. Passage throughout the region is difficult. A motor road connects Kirkuk with Sulaimaniya (Suleimaniye) via the Tasluja pass and extends to Halabja in the south and to the edge of the Pizhdur country in the north, crossing the Little Zab at Dokan. An ancient route from Arbil to Ruwandiz and the Iranian frontier was made fit for motor traffic in 1932 after four years of work. There are also passable roads from Mosul to Dohuk with branches to Zakho and Amadiya.

Climate. — There are three climatic regions which are identical with the geographical regions mentioned above: the southern and western deserts, the central plains and the mountainous districts of the north. Throughout the country there are two pronounced seasons, the summer and the winter. Summer begins in May and lasts until October. During these months the sky is cloudless, the atmosphere dry and rain extremely rare. The prevailing northwest wind, the shamal, brings relief because of its dryness. In Baghdad the average mean maximum temperature exceeds 100° F. during June, July, August and September; but at night during those months it drops to between 69° F. and 76° F. In Mosul the nights are somewhat cooler. The highest recorded absolute temperature was 125° F. at Shaiba near Basra and at Diwaniya, both in August, which is normally the hottest month. The highest recorded temperature in Baghdad, however, was 121° F. on July 21, 1943; in Mosul 124° F. on July 21, 1937. Winter comes suddenly and lasts from November to April. Northwest winds prevail but are frequently interrupted by depressions from the Mediterranean; with the southeast winds which blow in front of them come cloudy skies, rain and cold Frosts may occur in any of the five months from November to March except perhaps in the extreme south; Shaiba has only once recorded 32° F. in November. The lowest recorded temperature in Baghdad was 18° F. on Jan. 5, 1942; in Mosul 12° F. on Jan. 3, 1925. Almost the whole rainfall occurs in the winter and spring. December, January and February are the wettest months, but, except in the north, the mean of each of these three months nowhere reaches 2 in. Precipitation in the mountains is considerably higher than in the plains, and an average of 40 in. has been recorded at several stations there. In Baghdad, the average over the period 1937–48 was just over 6 in. a year; in Mosul (1923–48) nearly 16 in. a year. Snow falls every year in the Kurdish mountains, and continuous snow cover down to 3,500 ft. has been noted in January, as a-ell as deep snow on sheltered plateaus at 5,000 it. Elsenhere in Iraq snow is rare; the average days on which snow fell in Mosul from 1923 to 1948 mas 0.6 per annum. In Baghdad, for the period 1937–48, it was o 3 days per annum.

Dust storms may occur at any time of the year; the light alluvial soil is easily broken up into fine dust when the ground is dry. Thus they are more frequent in southern and central Iraq than in the north. In the western desert, where the surface is harder. they are infrequent.

Autumn is more marked in the north than in the south, but is short everywhere. Spring, uhich occurs in April, lasts for less than a month and is noticeable for a slight rainfall, generally accompanied by thunder.

Flora and Fauna. — Biogeographically Iraq is usually included in the Mediterranean region, a term which has been used to cover not only countries of the Mediterranean basin but those as far east as Iran. The flora and vegetation of a few areas of Iraq have been studied in some detail, but other areas have never been touched by botanists. The most convenient botanical divisions are: (1) the western and southern desert; (2) the marshes, riverbanks and canals; (3) the plains of lower Iraq; (4) the submontane area; and (5) the Kurdish mountains.

In the driest parts of the desert there is almost complete sterility, and no hydrophytic vegetation is found west of the Euphrates. The depressions are generally saline and support a halophytic vegetation. Most of the persistent perennials in the desert are low, bushy shrubs or subshrubs, much branched and compact. Their prevailing gray colour is caused by a protective covering of gray hairs. Some have an impermeable surface of tough cuticle, often with a hairy covering as well. The rnarshes and riverbanks support dense communities of rushes, reeds and reed grasses. Willows and poplars are found on the riverbanks and, as an undergrowth, in addition to numerous annuals, grasses and sedges, there often occurs a species of tamarisk. The tamarisk may extend a long distance from the margins of streams. A shrubby member of the pea family (Prosopis *stephaniana*) is very common and in places forms dense thickets 7 ft. high. It is found everywhere in Iraq and extends to the Kurdish valleys. The licorice plant is common. From 34° N. lat. southward to Basra there are many areas, cultivated in the past, which are now neglected; the vegetation there can be regarded as only seminatural. Such areas become covered fairly densely with *Prosopis* and the gorselike camelthorn. Licorice may also be present where water is close at hand; and in the spring grasses and other low annuals sprinkle the ground. Saline areas are common, and some halophytes may occur which afford valuable grazing. Farther north salinity is less common; and the plain from Hillah to Samarra, including the region around Baghdad and the Diyala river, though treeless and muddy, develops a spring vegetation bright with flowers and green grass.

Climatic conditions become more favourable toward the north, but generally the vegetation of the desert lands varies according to the soil. In saline districts it is poor in species; where there is a calcareous substratum it is richer and of a different constitution; another type appears where sand predominates. The submontane district, with its longer winter and greater rainfall, has a steppelike vegetation often dominated by tufted perennial herbs and prickly plants, with a dense covering of annuals and small perennials in spring. In the Kurdish mountains altitudinal zones are clear. Between 2,000 ft. and 6,000 ft. is a forest zone with oaks as the common species. The Aleppo pine also occurs in restricted localities. The ground vegetation is varied and rich. Above the tree limit (6,000 ft.) many interesting plants are found, some forming compact thorn cushions and others being aromatic herbs.

The lion, once common in Iraq, appears to have become extinct about 1910. The oryx, wild ass and ostrich were once common, but their decrease or disappearance, like that of the lion, follon ed the introduction of the breech-loading rifle. The jungle cat and the smaller eastern wildcat, hyenas and jackals are not uncommon. The small Persian mongoose is widely spread in the southern areas. The common otter is not rare. At least six species of gerbils (desert rats) have been found. The brown and eastern black rat are found in Basra, but only the latter extends upcountry. The eastern house mouse is common. The Iraqi hare. a pale-coloured animal, is widely distributed. Marica's gazelle is found in the deserts and drier parts.

Large numbers of birds pass through Iraq. The resident birds include babblers, bulbuls, scrub warblers and sand grouse. In the hilly country the seesee, a miniature partridgelike game bird, is fairly common; and in thick scrub or cultivation the black partridge abounds. The houbara is widely spread, but the great and little bustards are confined to the northern districts. There are many birds of prey, including several eagles and two vultures. Geese winter in the marshes, and large flights of ducks come to Iraq for the cold weather. Several species of snakes are found, but only three, so far as is known. have poison fatal to man. There are numerous varieties of lizard. The true fresh-water fishes of the Tigris and Euphrates are dominated by the carp family. The Tigris salmon, one ot the small-scaled forms, is recorded as attaining the aeight of 300 lb. The lower reaches of the rivers are invaded by marine species. The Ganges shark has been found as high as Baghdad. (K. C. B.)

HISTORY

For the earlier history of what is now Iraqi territory see MESOPOTAMIA. See also, for its history in relation to the many empires of ahich it has formed a part, BABYLONIA AND ASSYRIA; CALIPHATE; PERSIA; and TURKEY.

Nationalist Movement. — Throughout the 19th and early 20th

centuries, Iraq remained as when first conquered by the Turks—a neglected outpost of the empire, governed by successive Turkish pashas for the benefit of themselves and the central government at Constantinople. Almost continuous misrule and maladministration, relieved only by the vigorous but futile attempts of Midhat Pasha (governor of Baghdad vilayet from 1869 to 1872) to bring order and a renewal of prosperity, added fuel to the slowly rising fires of Arab nationalism. The nationalist movement in Iraq, while lagging behind similar movements in the Arab nationalist centres of Damascus and Beirut in Syria. received additional stimulus when the Young Turks failed to live up to the hopes which they had aroused among the Arabs by the revolution of 1908. In the increased agitation for autonomy, or for decentralization, between 1908 and 1914, important roles were played by local Arab leaders, including Talib Pasha an-Naqib of Basra and Mohammed al-Gailani of Baghdad, and by the Arab army officers who dominated the secret Arab societies, particularly al-Ahd (the League). with affiliations in Egypt, Syria and Constantinople. Although the nationalists in Iraq were handicapped by the isolated position of the country, by the lack of educational facilities and of a middle class and by the existence of personal rivalries and religious antagonisms, the Arab movement was firmly established in Iraq at the outbreak of World War I.

British Military Occupation.—On Nov. 6, 1914, following the declaration of hostilities between Great Britain and Turkey, the Anglo-Indian expeditionary force "D." under Brig. Gen. W. S. Delamain, landed at Fao. This Turkish fort at the southernmost part of Iraq was speedily captured.

In sanctioning the capture of lower Iraq and eventually Baghdad and all of Iraq, British policy was never clearly defined nor worked out in advance and the decision to dispatch the expeditionary force was reached, with some misgiving—particularly about Indian Moslem reactions to war with the sultan-caliph—only after intensive consultations between London and Delhi. Its objectives were to reassure the sheikhs of Nuhammareh and Kuwait, to counter the threats of German and Turkish penetration of Persia with consequent danger to India and to protect the south Persian oil fields.

By Nov. 22, 1914, the Anglo-Indian forces had reached Basra and were firmly established on the Shatt al-Arab, thereby ensuring the safety of the refinery of the Anglo-Persian Oil company on the island of Abadan, Persia. (A detailed account of the advance to Baghdad and beyond, following the extension of the original objectives of the expedition, appears under MESOPOTAMIA, OPERATIONS IN.) Baghdad was occupied on March 11, 1917, by Sir Stanley Maude. The conquest of the remainder of the country was undertaken by Lieut. Gen. Sir William R. Marshall, who assumed command on the death of Sir Stanley Maude from cholera. The Euphrates was occupied up to Ramadi by late Nov. 1917 and up to Ana by March 1918. When the Russian troops withdrew from northeastern Iraq after the collapse of Russia, British forces pushed northward, occupying Khanaqin in Dec. 1917 and Kifri in April 1918. Kirkuk was taken in May 1918. The armistice of Mudros, Oct. 30, 1918, by which Turkey dropped out of the war, found General Marshall's forces 14 mi. from Mosul. Cnder orders received from the war office and on the authority of clauses vii and xvi of the armistice, General Marshall continued to push on. Mosul was occupied on Nov. 7, in spite of the indignant protest of the Turks.

British Policy and Iraqi Nationalism.—Arab nationalism in Iraq during the war flickered feebly as a result of the rigours of Turkish military rule, of the uncertainty about British policy and of fears that, whatever the outcome of the Mesopotamian war, the Turks might return.

The end of the war, nevertheless, brought encouragement to the nationalists. The promises that alien institutions would not be imposed and that participation would be accorded them in their civil affairs, which had been made in the proclamation of March 19, 1917, issued in General Maude's name after the capture of Baghdad, had then been assessed as the exuberance of wartime propaganda. When, ho ever, the Anglo-French declaration was published in Baghdad an Nov. 8, 1918, after the defeat of the Turks, the nationalists took heart. This declaration stated in part: "France and Great Britain have in view . . . the establishment of national Governments and Administrations drawing their authority from the initiative and free choice of indigenous populations . . . ."

The principal effect of the declaration, magnified by the fact of its appearance close upon the publication in the Iraqi press on Oct. 11 of Woodrow Wilson's fourteen points, withheld until that date by official orders. was that it apparently confirmed the promises in Maude's proclamation, in David Lloyd George's speech of Jan. 5, 1918, and in the Allied propaganda associated with the Arab revolt. Expectations ran high that national aspirations were about to be realized.

Such pronouncements were at variance with the earlier policies of the British government as expressed in the conversations in 1915–16 between the amir Husain of the Hejaz and Sir Henry MacMahon, the high commissioner in Egypt and in the Anglo-French (Sykes-Picot) agreement of 1916, the existence of which was unknown to the Arabs until the Bolsheviks revealed it in Dec. 1917. By this agreement Mosul was recognized as being in the French sphere of influence.

If the end of the war thus found British policy confused, the ensuing months were not fruitful in bringing order to the complexity of interests, aspirations and problems. In Iraq, Sir Arnold Wilson, acting civil commissioner during the absence in Tehran of Sir Percy Cox, felt obliged to formulate policies which would counteract the British government's indulgence of the nationalist aspirations. Such tendencies. which he held to be dangerous to the best interests both of the British empire and of the inhabitants of Iraq, could, in his opinion, be offset by fixing the patterns of administration and by maintaining British control with gradual participation of qualified Iraqis. This administration, although it brought greater efficiency, honesty and order than ever known before in Iraq, had no great welcome; it was too ambitious, and it was alien. Moreover, the plans for future government as proposed by Sir Arnold were held to be insufficient by the nationalists when measured against the promises of the British government and against their own aspirations.

These aspirations had continued to expand. A plebiscite, proposed by Sir Arnold and sanctioned for the spring of 1919 by the British government, not only failed to give the expected support to Sir Arnold's point of view but gave new stimulus to Iraqi self-determination. The establishment of an Arab government under the amir Faisal in Damascus with British support encouraged Iraqi officers of the Sharifian army to look across the desert to Iraq. In the name of the amir Abdullah ibn Husain whom they had elected king of Iraq on March 8, 1920, at Damascus, they supported with arms, men and money the local demands for Arab government at Baghdad. In Iraq, anti-British sentiment and local discontent of every variety in the towns and religious centres and among the tribes, landlords and unemployed former officials were skilfully stimulated and pressed into the service of the nationalists. Publication in Baghdad on May 3, 1920, of the news that Britain had accepted the mandate for Iraq was cited as a further proof that Great Britain could not be counted on to keep its promises.

By the time an announcement was made in Baghdad, June 20, 1920, concerning the establishment of an Arab government with British advisers, the moment had passed when the nationalists could have been restrained by a statement. An outbreak of lawlessness at Rumaitha, June 30, became the signal for a general rising.

The Rebellion.—In face of the rebellion which spread the length of the Euphrates and to the Baquba, Diyala and Kifri areas, but not to Mosul or Arbil, the restoration of peace and order was the first necessity. Reinforcements, numbering 4,883 British and 24,508 Indian troops, together with an air squadron, were brought from India. By Oct. 1, when Sir Percy Cox landed at Basra as high commissioner, the rebellion had been broken, although it did not finally collapse until late October. The rising, costly in lives and money for both sides, had a profound effect on Iraq's political life. To Iraqis it became a national war of independence, although

the immediate policy of the British government was not changed and its future policy was altered more in method of application than in objective. Iraqis who lost their lives in the rising became heroes and martyrs, while participation became the basis of later political preferment. To Sir Percy, on the other hand, the rebellion was a blow to the speedy realization of the self-government promised in June. By Nov. 11, however, he was able to announce the formation of the provisional Arab government for Iraq with the revered and aged religious dignitary, Abd ur-Rahman al-Gailani, naqib of Baghdad, as head of the council of state, with a membership representing all classes and sects. The provisional government gave its attention to the immediate pacification of the country; to the repatriation of Iraqi officers from Syria and the Hejaz; to administrative reorganization; and, as steps toward the creation of a permanent government, to the drafting of an electoral law and the inauguration of an assembly.

Faisal's Coronation.—As the head of this permanent government, the amir Faisal, expelled in July 1920 from Syria by the French authorities, became the preferred candidate, supported by the returned Iraqi officers, by Gertrude Bell, who had become oriental secretary in Baghdad, and by Winston Churchill, secretary of state for the colonies. The final stamp of approval was given him at the Cairo conference, called by Churchill (March 12 to 24, 1921) with the principal British political and military officials of the middle east in attendance.

On June 23, 1921, Faisal arrived at Basra, accompanied by three aides-de-camp, by Col. (later Sir) Kinahan Cornwallis, his personal adviser, and by a party of Iraqi notables. Three weeks later, on July 11, the council of state passed a unanimous resolution declaring Faisal to be king of Iraq on the condition that his government should be "constitutional, representative and democratic and limited by law." The high commission asked for a referendum to be carried out by the ministry of the interior. It was accordingly announced that the votes, which were cast by organized groups, were 96% in favour of Faisal. Kirkuk voted against Faisal, while Sulaimaniya took no part. The coronation took place at Baghdad, Aug. 23, 1921. Abd ur-Rahman al-Gailani became the first prime minister.

Facing the new king were a multitude of problems: consolidation of his position against considerable opposition, especially from the Shi'ite divines and the pro-Turks; establishment of the proper balance between the ardent nationalists and his British patrons; reconciliation of the bitter mutual antagonisms between townsmen and tribesmen, between the Shi'ite and Sunnite sects and between Arabs and Kurds; the settlement of frontiers with Turkey and Saudi Arabia; and, above all. the clarification of Iraq's relations with Great Britain through the negotiation of an Anglo-Iraqi treaty.

The Treaty of 1922.—Both the king and the British government had referred to the treaty before and after Faisal's coronation. It was soon clear, however, that a treaty did not mean the same thing to both sides.

In Iraq the fact had been obscured that the mandate was to be continued. The announcement, however, of H. A. L. Fisher before the League of Nations, Nov. 17, 1921, that the treaty was not "intended as a substitute for the mandate" renewed the anti-British and antimandate agitation. By early Aug. 1922 the agitation showed such virulence as to convince the high commissioner that both the peace of the country and the success of British policy would be imperilled if nationalist activities were not checked, a step which the king appeared unable or unwilling to take. Accordingly, when King Faisal was suddenly stricken with a dangerous attack of appendicitis on Aug. 24, the day following an anti-British demonstration at the palace, Sir Percy Cox gathered the reins of power into his own hands. He immediately issued a proclamation outlining the circumstances and serving notice that further sedition would be severely punished. The leading agitators were deported to Hinjam in the Persian gulf. Two of the Shi'ite clergy were induced to depart for Persia. By the time the king was able to resume his duties in early September, the crisis had passed. On Oct. 10 the council of state ratified the treaty, affirming the previous resolution of June 25 that it must be approved by the national assembly.

Consequently, ratification of the treaty, with the four subsidiary agreements governing the employment of British officials, military assistance and judicial and financial controls, did not take place until 1924 when, after the repeatedly postponed elections, the constituent assembly was opened March 27. In the debate which began immediately on the treaty and the agreements, it was apparent that because of the resurgence of nationalist activities and the heavy financial burdens imposed by the agreements, even the protreaty deputies would be reluctant to vote for its approval. The British government. therefore, after giving assurances that certain of the financial obligations would be reconsidered after ratification, announced that if the treaty was not approved by June 10, the day before the question of Iraq was to be considered by the League of Nations, the treaty would be regarded as having been rejected. The regular session of the assembly on June 10 adjourned without taking action. Then the prime minister, Jafar al-Askari, fully apprised of the issues at stake, gathered the deputies in a special session. Before midnight, after stormy debate, the treaty was ratified by a vote of 37 to 24, with 8 deputies abstaining. The organic law or constitution received unanimous approval on July 10. The assembly was dissolved on Aug. 2, after approving the electoral law on the same day.

The treaty was accepted on Sept. 27, 1924, by the League of Nations as regulating future Anglo-Iraqi relations. Ratifications were exchanged between Great Britain and Iraq during the winter of 1924.

The Treaty of **1926.**—The protocol of April 30, 1923, which had been attached to the treaty of 1922, had provided that the treaty should expire upon Iraq's becoming a member of the League of Nations and in any case not later than four years from the ratification of peace with Turkey. A new situation arose, however, when the League of Nations undertook to settle the Turco-Iraqi frontier dispute as the final step in establishing peace with Turkey. Under the terms of the peace treaty of Lausanne, Switz., July 24, 1923, when Turkey refused to abandon its claims to the Mosul area, the dispute had been referred to the League. On receiving the report of the special commission which it dispatched to Mosul (January–March 1925) to investigate the rival claims, the council of the League decided, on Dec. 16, 1925, in accordance with the decision of the Permanent Court of International Justice on Nov. 21, 1925, and subject to certain conditions, that Mosul vilayet south of the Brussels line (so-called because drawn by the council at Brussels, Belg.. Oct. 29, 1924) should be awarded to Iraq.

The most important of these conditions provided that a new treaty should be negotiated, ensuring continuance of the mandatory regime for 25 years or until Iraq had entered the League. While public opinion in Iraq did not oppose the extension of the treaty in exchange for the retention of Mosul, the rise of a strong demand for amendment to the subsidiary agreement and for periodic reviews of Iraq's fitness to join the League resulted in the inclusion of these conditions in article iii in the new treaty. The treaty, after signature on Jan. 13, 1926, was approved by the Iraqi parliament on Jan. 18 and by the British parliament on Feb. 18.

The Treaty of 1927.—In the autumn of 1927 the king sought in London British recommendation of Iraq for membership in the League and a new treaty ameliorating the obligations of the subsidiary agreements, in accordance with article iii of the 1926 treaty. The British government was unresponsive. The advent of the second Labour government in Great Britain facilitated a change in policy. On Sept. 14, 1929, Air Vice-Marshal Sir Robert Brooke-Popham, acting high commissioner following the death of Sir Gilbert Clayton, informed King Faisal that he had been authorized to announce that the British government was prepared to support Iraq's candidature for admission to the League in 1932, would not proceed with the treaty of 1927 and expected to negotiate a new treaty of alliance to regulate Anglo-Iraqi relations after the admission of Iraq into the League.

The Treaty of 1930.—The declaration, published on Sept. 19, evoked both approval and an immediate demand that the treaty be negotiated forthwith. Negotiations began on April 1, 1930. The treaty was approved by the ministers on June 28 and signed on

June 30, after a new judicial agreement and various annexes had been initialled.

The new treaty provided for "a full and frank consultation in all matters of foreign policy" which might affect common interests. Each party undertook not to adopt a policy inconsistent with the alliance or which might create difficulties for the other (article i).

In the event of war, each of the contracting parties was to come to the other's assistance. The aid of Iraq would "consist in furnishing to Great Britain on Iraq territory all facilities and assistance . . . including the use of railways, rivers, ports, aerodromes, and means of communication" (article iv). Air bases were to be leased to Great Britain on the terms set forth in the annexure (article v). All responsibilities previously assumed by the British government with respect to Iraq were to devolve upon the Iraqi government (article viii). The treaty was to come into force only when Iraq entered the League of Nations and was to continue for a period of 25 years from the date of its admission to membership.

The substance of the new relationship was, as in the previous treaties, contained in the subsidiary documents. The annexure regulated the leasing of the air bases and provided for the continuance of military assistance to Iraq. It gave Great Britain the right to move troops and supplies by all possible means across Iraq.

The first of the notes signed and exchanged on the same day, June 30, assured to the representative of the British government precedence over representatives of other powers at the court of the king of Iraq. The second note provided for a separate financial agreement, while the third stipulated that Iraq should normally engage British subjects for posts requiring foreign officials. The fourth note stated the intention of the Iraqi government to ask for a British advisory military mission.

The judicial agreement abolished the special judicial regime established in 1924 but guaranteed the employment of British legal experts in important specified posts.

Admission to the League of Nations.—The League in considering the candidature of Iraq evinced some doubt as to Iraq's administrative, political and social progress. Concern was also expressed for the future of minorities. When Great Britain, however, authorized its representative, Sir Francis Humphrey, high commissioner at Baghdad, to accept responsibility for the future conduct of Iraq, the council of the League agreed on Jan. 28, 1932, to admit Iraq, subject to the condition that it give a declaration guaranteeing minority rights, the administration of justice, international law and other safeguards. The declaration was signed on May 30, and on Oct. 3, 1932, Iraq was admitted to membership in the League as the first of the A mandates to achieve statehood as envisaged under article 22 of the covenant of the League.

By the time the mandate had been legally terminated, the transfer of administration into Iraqi hands had already largely taken place, having been accelerated from the end of 1929. Nevertheless, British officials continued to hold responsible advisory positions in various ministries.

Reign of Ghazi I.—The sudden death of King Faisal at Berne, Switz., on Sept. 8, 1933, brought the accession of his 21-year-old son as Ghazi I. The young king came to the throne on a wave of popular approval engendered by his open support of the Iraqi army's part in the Assyrian incident of Aug. 1933 in upper Iraq, in which nearly 600 of the Assyrians were slain. Yet it was not Ghazi's fortune to possess the experience, discipline, statesmanship and vigour which had stood his father in good stead. Nor did Ghazi become, as had his father, the common rallying point for the many diverse groups of the new state. Under King Ghazi, the existing trend toward political instability increased, marked by the new factor of interference from the army, which held not only that the government's policy toward the army was unsatisfactory but also that the discrepancy between the progress made by Turkey under Mustafa Kemal Atatiirk and that made by Iraq was the result of Iraq's lack of a strong leader.

The first of such interventions occurred in the coup d'état of Oct. 1936 when Gen. Bakr Sidqi, after bombing Baghdad and assassinating Jafar al-Askari, forced the resignation of the cabinet and the appointment of Hikmat Sulaiman as his prime minister. Bakr Sidqi was assassinated by a soldier on Aug. 16, 1937, after which Jamil al-Midfai came into office. The latter was replaced by Nuri as-Said after a bloodless coup carried through by army officers on Dec. 24–25, 1938. Nuri as-Said was obliged to suppress an alleged coup by an army group on March 21, 1939, and another on Feb. 20–21, 1940.

Notwithstanding the deterioration of order and of administrative efficiency, progress in a number of directions could be observed in the five and a half years of King Ghazi's reign. The Kut al-Amara irrigation barrage, begun in 1934, was pushed to completion. Development programs, for which oil royalties had been earmarked, were carried out. Pipelines from the Kirkuk oil fields to the Mediterranean were opened in Jan. 1935. The railroads were purchased from Great Britain and the construction begun of the Baiji-Tell Kiichiik section, the only missing railway link between Iraq and Europe. More schools were built, and larger numbers of students were sent abroad. Commerce improved generally over that of preceding years.

In foreign relations, the long-standing boundary dispute between Iraq and Persia was terminated and demarcation initiated for the Iraqi-Saudi Arabian boundary. The Syro-Iraqi boundary was amicably altered to include Jabal Sinjar within Iraq. Iraq, with Turkey, Iran and Afghanistan, signed the pact of nonaggression and consultation, at Saadabad in Iran on July 8, 1937. Arab solidarity was stressed in the nonaggression treaty with Saudi Arabia (1936) to which the Yemen later adhered, and by participation in the London round-table conference on Palestine in early 1939.

World War II.—The accession of the four-year-old son of King Ghazi, as King Faisal II, following his father's death at Baghdad in a motor accident on April 4, 1939, brought uncertainty at a time when internal and external crises required a strong hand. The regent, Abd ul-Ilah, uncle of the king, and Nuri as-Said as prime minister, supported the alliance with Great Britain on the outbreak of World War II in 1939, severing diplomatic relations with Germany. Nevertheless, the rapid growth of anti-British feeling, stimulated by axis successes and pervasive axis propaganda, caused the situation to deteriorate rapidly in 1940 and early 1941. Many Iraqis were convinced that in British military reverses lay the long-awaited opportunity to free Iraq of the remnants of British control. British policy in Palestine had long been opposed by most Iraqis, and Haj Amin al-Husaini, mufti of Jerusalem, who had taken refuge in Iraq, lost no opportunity to keep the opposition alive. Army officers, dominated by four colonels calling themselves the Golden Square, were particularly anti-British, not merely because of their antagonism to British policies in the Arab world but also because the Iraqi government, which they held to be under the thumb of the British, did not grant sufficient precedence to army demands for arms and reorganization. Rashid Ali al-Gailani, personally ambitious and convinced that his way to power and wealth was barred by the British, attached his fortunes to the army group and with it to the axis. On April 7, 1940, under pressure from the four colonels, the regent dismissed Nuri and appointed Rashid Ali in his place.

The army officers showed their hand in late Jan. 1941, when the regent sought to secure, in view of Rashid Ali's connections with the axis and his reluctance to break relations with Italy, his resignation as prime minister. The attempted coup d'état was checked, and, on Jan. 29, Rashid Ali was obliged to give way to Taha al-Hashimi. The army, however, encouraged by axis successes in the Mediterranean and by promises of assistance, maintained its pressure. On April 2 the regent, faced with an army demand to reinstate Rashid Ali, fled from Baghdad. The army group assumed control, appointing Rashid Ali premier.

Sir Kinahan Cornwallis, who had been named ambassador to Baghdad on Feb. 26, had hoped to solve the crisis without the use of force. On April 7, however, a higher national defense council was set up. The replacement of Abd ul-Ilah as regent by as-Sharif Sharaf by the parliament, under threat of force, followed on April 9. On the same date Rashid Ali formed his new cabinet with members known to possess axis connections.

Notified by his government of the dispatch of troops, the ambassador thereupon informed Rashid Ali that the British government intended to call upon Iraq to carry out provisions of the

treaty of 1930 by providing transportation from Basra across Iraq for British troops to meet the threatening military situation in the near east. Although Rashid Ali acquiesced, objections were raised when the troops began to arrive and an announcement was made that a second group was to be expected. Iraqi troops with artillery were concentrated about the British air base at Habbaniya on April 29–30 as a precautionary measure. When the commander of the Iraqi troops presented the local British commander with an ultimatum, the latter ordered the royal air force into action on May 2 and, though facing very considerable odds, forced the enemy to raise the siege by May 7. Axis aircraft and arms arrived by way of Syria, but in insufficient quantities. A small British mobile force then crossed the desert. Rutba was reoccupied on May 9, Falluja on May 20 and Baghdad on June 1, after the request for an armistice on May 30, when Rashid Ali and a number of his associates had fled from Baghdad. The regent Abd ul-Ilah returned to Baghdad on June 1, setting up a new government on June 3, with Jamil al-Madfai as premier. In Oct. 1941 the latter was succeeded by Nuri, who remained in power until June 1944.

Throughout the remainder of the war, Iraq not only observed the terms of the Anglo-Iraqi alliance but also actively participated in the war. Over its communications systems, expanded by military construction, considerable quantities of materials were sent to the U.S.S.R. Its resources of food and material were also drawn upon, with adverse effects on its own internal economy. Diplomatic relations with Vichy were broken off on Nov. 16, 1941, as were relations with Tokyo on Nov. 18. 1941. War was declared on Germany. Japan and Italy on Jan. 16. 1943. On the same day, Iraq signified its adherence to the United Nations declaration. Previously, on May 1, 1942, Iraq had been declared eligible for lend-lease. A constitutional amendment in 1943 attempted to prevent a repetition of the political unrest which had characterized the years 1936–41 by empowering the crown to dismiss a prime minister. Before this, a government could be dismissed only by a vote of no confidence in the chamber, and no election had been free enough to establish a chamber independent of the cabinet. In 1943 Nuri circulated a confidential memorandum in which he proposed the merging of Syria, Lebanon, Palestine and Transjordan into a Greater Syria, to be linked with Iraq. His subsequent discussions with the Egyptian government led to the formation in 1945 of the Arab league (*q.v.*).

After World War II.—Iraq emerged from World War II with its financial position improved. The country, moreover, possessed all that was needed for raising the standard of living, but the Sunni Arab group of politicians that entrenched itself in government was not particularly efficient. By 1946 there had been 32 cabinets in 25 years recruited from about 50 persons. In Nov. 1946 Nuri as-Said accepted his ninth term as premier. The ban on political parties, imposed in 1937, was lifted, and in Feb. 1947 elections were held.

Salih Jabr, the first Shi'ite Arab to become premier, went to England to sign at Portsmouth, in Jan. 1948, a 20-year treaty under which Great Britain might continue using the air bases at Shuaiba and Habbaniya until peace treaties with all former enemy countries had come into effect and might subsequently maintain technical staffs and equipment there. But under nationalist and Communist pressure this treaty was denounced, and the government resigned. A "caretaker" government sent Iraqi troops to join in the Arab league's intervention in Palestine (May). Muzahim Amin al-Pachachi became premier after the elections in June but was succeeded in Jan. 1949 by Nuri as-Said. Nuri withdrew the Iraqi troops from Palestine and was now supposed to be sponsoring the "fertile crescent" plan for union with Syria (as opposed to Greater Syria); and during his government the doubling of the Kirkuk-Tripoli pipeline was completed. Two coalition governments followed his resignation (November); the second, in March 1950, authorized Iraqi Jews to renounce their nationality and emigrate (see Area *and* Population, below); in May it adopted plans for building a pipeline from Kirkuk to the Syrian port of Baniyas. In Sept. 1950 Nuri formed yet another government; this, in Aug. 1951, concluded an agreement with the Iraq Petroleum company and its subsidiaries, under which Iraq was to get 50% of the companies' profits (see Petroleum, below). Mustafa al-Umari's government, which succeeded Nuri's in July 1952, had to resign in November when riots broke out in Baghdad after four of the five political parties pressed for replacement of the two-stage electoral system by direct voting. Gen. Nureddin Mahmud, whom the regent asked to form a government, declared martial law, arrested 200 Communists and then abolished the two-stage system. A general election in Jan. 1953, in which every male over 20 years had a vote, gave an absolute majority to Nuri's supporters in the parliament, and Jamil al-Madfai formed a government with Nuri as minister of defense. On the following May King Faisal II attained his majority and assumed the royal prerogatives. In September. on the government's resignation, a new cabinet was formed by Fadil Jamali. This government lifted the martial law that Nureddin Mahmud had imposed; but Jamali had to resign in April 1954. In August Nuri formed a government again. He dissolved the 135-seat chamber of deputies and at the Sept. 12 general election won 113 seats.

All political parties were dissolved on Sept. 22 and measures were taken to deprive the Communists of citizenship pending deportation.

On Feb. 24, 1955, a Turkish-Iraqi treaty of mutual defense was signed at Baghdad. joined on April 4 by Great Britain (thus terminating the Anglo-Iraqi alliance of June 30. 1930), by Pakistan on Sept. 23 and by Iran on Oct. 12. On Nov. 21–22 the allies set up a permanent council, with its secretariat in Baghdad, a permanent military committee and a permanent economic committee. The U.S. maintained a close association with the organization through political and military observers. From Nov. 1956 to May 1957 Iraq was under martial law introduced during the Suez canal crisis. In June 1957 Ali Jawdat al-Ayubi succeeded Nuri as premier, and was in turn succeeded by Abdul Wahab Marjan in December. On Feb. 14, 1958, a union between Iraq and Jordan was proclaimed. Revolt broke out in July of that year and King Faisal II was killed. A republic was established with Gen. Abdul Karim Kassem, revolutionary leader, at its head. The new government quickly dissolved the Iraq-Jordan union.

(P. W. I.; X.)

AREA AND POPULATION

The country's total area is 171,599 sq.mi., including 91,112 sq.mi. for 14 settled provinces (liwas) and 80,487 sq.mi. for 3 desert provinces. The Jazira desert is a roughly triangular area between the Tigris and Euphrates and the Syrian frontier; the Northern desert (Badiyat ash-Shimaliya) extends from the Euphrates along the Syrian frontier to Jordan's frontier up to the latitude of Najaf; the Southern desert (Badiyat al-Janubiya) lies between the Euphrates and Saudi Arabia.

The census of 1957 gave the total population as 6,538,109, including the 14 settled provinces, the desert provinces, those not registered, and those abroad.

Iraq possesses a variety of peoples and religions. In 1947 4,251,680 (88.3%) of the population was Moslem, divided between the Sunni and the Shi'a sects in the proportion of about 5 to 8. There were 149,653 (3.1%) Christians (Nestorians, Chaldaeans, Syrian Orthodox and Catholics, Armenian Gregorians and Catholics, Greek Orthodox and other Uniates and Protestants), Yezidis, Sabians and Jews. The Jewish community of 118,099, of whom 77,542 were in Baghdad, was reduced to about 15,000 by emigration to Israel. In northern and central Iraq and on the upper Euphrates the Sunnites outnumber the Shi'ites by about six to one; in the middle Euphrates, lower Tigris and lower delta the Shi'ites outnumber the Sunnites by about ten to one. Of the Christian population, 62% is found in the Mosul province and 21% in Baghdad city.

The Moslems are Arab, Kurdish. Turkish or Persian, with a small number of Indians. The non-Moslems are Assyrians, Yezidis, Sabians (Mandaeans), Chaldaeans, Armenians or Jews. The Arab population comprises all the inhabitants of southern Iraq with the exception of several thousand Persians (many of whom are found in the holy cities of Najaf, Karbala and Kadhimain); in northern Iraq Arabs form a minority confined to the Jazira, the

riverain strip of the Tigris and the Mosul plain. The patriarchal organization of the nomadic tribes (*badu'*) persists among both seminomadic and settled rural Arabs, although the extensive development of pump irrigation has done something to break down the system. It has been estimated that about one-quarter of the total population of Iraq live in towns, one-tenth are truly nomadic and the remainder are either settled or semisettled cultivators.

The Kurds inhabit the mountainous crescent to the north and east, divided from their fellow Kurds in Syria, Turkey and Iran by Iraq's frontiers with those countries. To the west they have penetrated from their mountain home far into the plains, particularly in the provinces of Kirkuk and Arbil where Kurds and Kurdish ways dominate a region formerly held by Arabs and Turks. The total Kurdish population was estimated at about 800,000 in 1955. The tribal system remains strong in the remoter mountain districts. although even there there is some fragmentation. In the plains and the broad valleys around Sulaimaniya there are considerable areas where the tribal organization has been abandoned. Some tribes no longer make their seasonal migration, although the shepherds of the plains and foothills are seminomadic. The Kurds have never taken kindly to administrative control, and their traditional impatience with authority finds its excuse in their situation as a minority in the Arab state of Iraq.

The Turks (about 80,000 in 1955) are distributed in a number of small towns and villages along the old trade route from Baghdad through the plains and the northern Jazira to Turkey.

The majority of the Assyrians (Nestorians) in Iraq entered the country as refugees in 1918, having been driven from their homes in the Hakari district after revolting against the Turks. The exclusion of this district from Iraq in the frontier settlement of 1925 created a serious resettlement problem. By 1955 probably about 16,000 were left near Amadiya and Ruwandiz, in villages around Mosul or working in the big towns.

The Yezidis live in the Jabal Sinjar and the Shaikhan district north of Mosul. They, like other non-Moslem communities, have a tradition of autonomy dating from Ottoman days and cannot reconcile themselves to becoming citizens of a modern state, fearing particularly a weakening in the hold of their esoteric religion.

The Christian communities, although recognized by the government as possessing competence in matters of personal status, are, with the exception of the Assyrians and the Armenians, almost entirely Arabized. The majority are town dwellers, but there are many villages of Chaldaeans and other Christians intermingled with Moslem Arabs and Kurds in the Mosul plain and in the Dohuk and Amadiya districts. The Assyrians and Armenians preserve their language and traditions, but those in the towns are bilingual.

The official language of Iraq is Arabic, spoken throughout Iraq by the Moslem and Christian Arabs and by many Kurds and other minorities of the northern provinces. Kurdish, an Indo-European language akin to Persian, is spoken by all Kurds; in the mountainous parts of Kurdistan they have no other language except, in some districts, Persian. The Kurmanji dialect of Kurdish is spoken along the Great Zab river; south of it two closely allied dialects, the Sorani and the so-called Sulaimani; and Gorani by the unorthodox communities of Sarlis, Kakais and Shaveks and by some of the southernmost tribes. Syriac is spoken by Assyrians and Chaldaeans, but most of these people speak Arabic or Kurdish also. Persian is largely spoken in Najaf, Karbala and Kadhimain. The Turks speak Turkish.

Education. — In 1953–54 there were 1,451 state and 98 private elementary schools with, respectively, 258,333 and 22,045 pupils and 8,819 and 702 teachers; 134 state and 63 private secondary schools with, respectively, 34,810 and 11,653 pupils and 1,720 and 959 teachers; 11 vocational schools with 1,874 pupils and 90 teachers; 11 teachers' training colleges with 1,744 students and 78 teachers. There were also 12 institutions of higher education with 5,255 students and a teaching staff of 234. The percentage of illiterates amounted in 1947 to 91.5%.

GOVERNMENT AND ADMINISTRATION

Constitution. — Until the 1959 revolution Iraq was governed under the constitution of 1924, as amended in 1925 and again in 1943. The constitution provided for a hereditary monarchy, vested in the heirs of Faisal I, a council of ministers and a parliament. The king was head of the state, confirming laws and supervising their execution. He chose the prime minister and, if it was in the public interest, dismissed him. Parliament consisted of the senate and the chamber of deputies. Members oi the senate were appointed by the king for a period of eight years, one-half retiring or being reappointed every four years. Their number could not exceed one-quarter of the number of deputies. Members of the chamber of deputies were elected on the basis of 1 to every 20,000 male Iraqi subjects. The non-Moslem communities had to be represented in the chamber. The cabinet consisted of at least seven members, including the prime minister on whose recommendation the king appointed the other ministers. The ministries were those of foreign affairs, finance, the interior, social affairs, defense, justice, education, economics, communications and works, and development.

There were four kinds of courts of justice. civil, criminal, religious and tribal. The religious (Shari') courts dealt with matters of personal status affecting marriage, dowry, divorce, etc., and some matters affecting religious endowments (*waqf*) Shari' courts, both Sunnite and Shi'ite, existed wherever there were civil courts. The spiritual councils of the Christian and Jewish communities provided analogous courts for them The government, following the example of the former mandatory power, recognized tribal custom and gave official status to it, so that in the tribal areas tribal arbitration and tribal courts, convened by an administrative official, took the place of law courts.

Iraq was divided into 14 settled provinces (liwas) and 3 desert provinces. Each *liwa* was administered by a *mutassarif* who, apart irom being the chief executive officer oi the liwa under the minister of the interior, was also the agent and representative of the other ministers In each *liwa* there was an administrative council under the chairmanship of the *mutassarif* Each liwa was divided into two or more *qadhas* under a *qaimmaqam* and each *qadha* into two or more *nahiyas* under a mudir.

Defense. — By 1955 Iraq had three combat divisions, three operational tank battalions and six air squadrons, two of them jet. In April 1954 the United States agreed to provide Iraqi armed forces with modern weapons and equipment in order to modernize its existing units and to create a new mechanized division.

ECONOMIC CONDITIONS

Agriculture. — Iraq is primarily an agricultural and pastoral country. Agriculturally it may be divided into two zones: the rainfall zone, corresponding roughly with the higher-lying northern area; and the irrigation zone beginning south of the Jabal Hamrin, in which crops depend upon irrigation by flow or lift.

The agricultural land in 1952–53 amounted to 6,384,400 ha., 27% of the settled area; i.e., excluding the deserts. This land was divided into 125,045 holdings; there were 66,042 holdings of less than 10 ha., 25,982 holdings from 10 ha. to 25 ha., 28,747 holdings from 25 ha. to 200 ha., 3,345 holdings from 200 ha. to 1,000 ha., 825 holdings from 1,000 ha. to 5,000 ha. and 104 holdings of more than 5,000 ha. Of the agricultural land about two-fifths (2,520,000 ha. in 1952–53) was cultivated annually.

There are two flood periods: December–March, caused by winter rains, and March–May, caused by the melting of the snow in the upper reaches of the rivers. There are correspondingly two cropping seasons, winter (*shitwi*) and summer (*saifi*). The winter crops, sown in the autumn and watered by the winter rains or by irrigation, are harvested in the early summer. Summer crops are sown in spring and harvested in late summer. The principal winter crops are wheat, barley and some oilseeds; the summer crops are rice, cotton, sesame, maize and millet. Cotton has long been grown for local purposes and its cultivation for export received the encouragement of the department of agriculture and of the British Society for the Cultivation of Cotton. The principal cotton areas are in the Baghdad, Diyala and Hillah canal zones, around Kut on the Tigris and, on a smaller scale, on irrigable lands in the Mosul *liwa*. Tobacco is grown in the Sulaimaniya and Arbil *liwas*. The most important date-producing area is a strip 120 mi. long and 3 mi. wide along the Shatt al-Arab, which produces more than half of the total crop. Other important growing areas are on the lower and middle Euphrates (al-Qurna to Nasiriya and in the Hillah and Diwaniya *liwas*); around Karbala, with the desert oases of Shifatha and Rahhaliya; along the Tigris in the Baghdad *liwa;* in the Diyala area; and around Badra and Mandali, where the choicest variety is grown. Iraq produces about 80% of the world's supply of dates. Fruit and vegetables are grown mainly in the Diyala area and in the north, though there is local production throughout Iraq. The Baquba area is renowned for the quality oi its oranges. Beans and other leguminous plants are fairly widely cultivated, but there is no surplus for export. The production of the principal crops according to the government's statistical abstract is shown in Table I.

Three types of sheep are bred in Iraq; all are fat-tailed. Goats are bred throughout the country, but the majority are found in the north. Many sheep and goats range in mixed flocks with the nomadic or seminomadic tribes, moving from winter pastures in the plains or desert to the mountains or riverain areas for the summer. Cattle are kept in the riverain areas where there is permanent pasture. Two breeds are common, of which the southern is superior both in size and in milk yield. In the marshlands of the lower Tigris and Euphrates

TABLE I.—*Agricultural* Production
(in 000 metric tons)

Crops	1934–38	1950	1951	1952	1953	1954	1955
Winter:							
Barley	575	851	839	652	1,111	1,239	768
Wheat	478	545	488	480	762	1,160	483
Summer:							
Rice	205	242	84	127	163	180	98
Cotton	2.0	1.9	9.0	8.0	2.7	2.3	...
Maize	...	21	8.8	7.9	7.6	4.4	...
Millet	...	19	8.0	6.7	27.5	19.9	...
Sesame	...	10	8.7	12.2	16.2	15.8	...
Dates	260	305	350	370	350	350	...

and elsewhere in southern Iraq the water buffalo is kept both as a draught animal and for its milk. Camels, mostly bred by the nomads of the desert, are of the single-humped variety. They are kept for their milk, hair and for transportation and are exported to Egypt for slaughter. Donkeys are common throughout the country and are used everywhere as pack or riding animals The usual breed is black or dark brown but a large white riding donkey of Tejdi origin is often seen. Thoroughbred Arab horses are raised by several tribes. Horses of inferior breed are used to pull carts and carriages. In the Kurdish districts ponies and mules are used, the latter mainly for pack transport. In 1954 the following estimates of livestock were published: sheep 10,000,000; goats 3,000,000; cattle 1,510,000; buffaloes 718,000; horses 300,000; mules 500,000; asses 1,000,000; camels 362,000.

Irrigation. — Although yields of the principal crops fluctuated in response to weather conditions, floods and attacks by locusts and other pests, an extension of acreage under crops was steadily maintained both by greater mechanization and by increased irrigation. In 1954 disastrous floods occurred which emphasized the urgency of completing irrigation and flood-control works planned earlier and undertaken through the six-year development scheme,?1951–57 *(see* below). Under this scheme ten dams were to be constructed on the Euphrates and on the Tigris and its affluents which would control floods by storing surplus rvater to be used for irrigation. The total area thus irrigated by the schemes on the Tigris and its tributaries was estimated at 1,224,000 ha. and that of the Euphrates schemes at 552,000 ha., an increase of about 70% in the cultivated area. On April 2, 1956, the Wadi Tharthur scheme on the Tigris was inaugurated at the Samarra barrage, providing in addition access across the river to a projected hydroelectric plant. On April 5 the Habbaniya system on the Euphrates, begun in 1912, was completed by the inauguration of the Ramadi barrage. Almost immediately this was put to the test by an unexpected flooding of the river on April 17, brought under control within a few hours.

Development Plan. — In 1950 a Development board was established to prepare a general economic and financial plan for the development of the resources of Iraq and to raise the standard of living of the people. The board of eight members was constituted under the chairmanship of the premier. In 1953 a ministry of development was set up and the minister became the board's representative on the council of ministers. It had its own budget and its revenues, originally the total revenue received from the oil companies, were amended in 1952 to 70% plus such other sums as might be allotted by parliament and the proceeds of any loans, domestic or foreign. A distinction was made between capital and small projects, the latter being financed by the board but carried out by the appropriate ministry. The six-year plan, 1951–57, based on a report of a mission from the International Bank for Reconstruction and Development which envisaged an expenditure of 168,500,000 Iraqi dinars, was superseded in 1954 by a five-year plan, 1955–60. The latter called for an estimated expenditure-of 303,306,100 Iraqi dinars.

Industry. — A law of 1929 designed to encourage industry by exemptions from customs and taxes was superseded in 1950 by a law which granted important privileges to factories which were power-operated, employed 90% or more of local workers, cost at least 5,000 Iraqi dinars to erect and used more than half Iiaqi capital. But Iraqi industry, in spite of substantial expansion between 1946 and 1954, remained small. The presence of deposits of copper and copper pyrites, of iron ore, chromite and magnesite had been indicated but no use was made of them by mid 20th-century and the raw materials of industry were almost entirely agricultural products. Factory employment was concentrated in and around Baghdad with 31,600 workers in 1954 out of an estimated 70,000. Three cotton ginneries established before World War II continued to operate and a spinning and weaving factory went into production in 1947. One factory in Mosul produced rayon cloth from imported yarn. Three factories produced about 500,000 metres of woollen cloth which was all used locally. Boots and shoes were produced by hand but there were several factories using electrically operated machinery. Other important industries were: jute spinning and weaving and the manufacture of jute gunny bags, tanning, soapmaking and the manufacture of tobacco products, beer, alcohol and alcoholic drinks (arrack from grapes and dates), bricks and cement (200,000 tons a year). One factory made spun-concrete pipes by a modern process. The amount of electricity used in industry increased from 9,000,000 kw hr in 1946 to 88,000,000 in 1954 exclusive of that used in the petroleum industry. Total production of electricity in 1954 amounted to 390,034,000 kw.hr., including 246,948,000 kw.hr. at the Kirkuk oil fields but excluding about 70,000,000 kw.hr. consumed by the pipeline stations.

Petroleum. — The existence of oil in Iraq has been recorded since ancient times (Gen. vi, 14). Modern development may be said to date from 1914 when the Ottoman government granted a concession in Iraq to an Anglo-German group which formed the Turkish Petroleum company. After World War I this concession was divided between British, U.S., Dutch and French interests, which took equal shares of 23.75%, and the Armenian agent C. S. Gulbenkian, who took 5%. This company, later named the Iraq Petroleum company, was granted a concession for 75 years by the Iraqi government in 1925. Oil was struck at Baba Gurgur, near Kirkuk, in 1927. In 1931 the terms of the concession were revised and the I.P.C. was granted sole rights to exploit petroleum in regions east of the Tigris (except the transferred territories) covering an area of 32,000 sq.mi. In return the company agreed to construct a pipeline to the Mediterranean with a capacity of not less than 3,000,000 tons per annum. This was opened in 1935; it bifurcates at Rutba to Haifa in Israel and Tripoli in Lebanon. Flow in the Haifa branch was cut off by the Iraqi government in 1948. A new 30-in. pipeline from the Kirkuk fields to Baniyas in Syria was completed in 1952. When the I.P.C. concession was revised the British Oil Development company was granted a concession over land to the west of the Tigris. The oil found was both too viscous and too high in sulphur content for profitable exploitation by the original company, and the concession was transferred to the Mosul Petroleum company, a subsidiary of the I.P.C., in 1936. A third company, the Basra Petroleum company, also associated with the I.P.C., obtained a concession for 75 years from 1938 covering the old Basra vilayet, and a pipeline to Fao from Zubair (Zobeir) was completed in 1951. A fourth company, the Khanaqin Oil company, a subsidiary of the Anglo-Iranian Oil company, operated the Naft Kaneh field about 30 mi. S. of Khanaqin. The output is largely consumed in Iraq, being refined at Alwand, 3 mi. from Khanaqin. The total output of all fields in Iraq amounted to 4,298,000 metric tons in 1938; it was 4,680,000 tons in 1946 and 6,479,000 tons in 1950; by 1954 it rose to 29,784,000 tons and was estimated at 33,700,000 tons in 1955.

The oil royalties in 1955 amounted to 73,700,000 Iraqi dinars.

A new agreement with the I.P.C. of Feb. 1952 stipulated that the government would receive its equal share of profits determined, before deduction of foreign taxes, on the basis of fixed values and costs of petroleum. This agreement was further modified in Iraq's favour in March 1955. The enormous increase in government revenue from this source (*cf.* 5,350,000 Iraqi dinars in 1950) reflected these more favourable terms as well as the great increase in production. As part of the 1952 agreement the government was entitled to take 12.5% of crude oil produced and to develop its own export market.

Foreign Trade. — The chief exports of Iraq (excluding petroleum and products) are barley, wheat, rice, dates, wool, hides and skins, and cotton. Quantities and values fluctuate somewhat with the size of the crop but there was a generally upward tendency after World War II to the mid-1950s. Imports showed a more striking rise, the increase being marked in iron and steel, machinery and vehicles, chemicals and pharmaceuticals, tea and sugar. Table II gives values of imports and exports, excluding petroleum and products.

TABLE 11. — Foreign Trade
(in 000 Iraqi dinars)

Item	1938	1948	1949	1950	1951	1952	1953	1954
Imports	9,361	45,523	40,501	37,595	50,871	61,795	68,709	74,111
Exports	3,690	8,662	12,426	21,603	28,927	19,965	19,866	18,580

Finance. — The unit of currency is the Iraqi dinar, at par with the pound sterling. Currency circulation in March 1955 amounted to 43,400,000 Iraqi dinars (4,600,000 Iraqi dinars in 1938). Principal sources of income, other than oil revenues, are indirect taxes. In 1952–53 the main items of revenue were: customs and other indirect taxes (32.9%), oil revenues (42.7%), taxes on land and produce (7.6%) and direct taxes on income and wealth (5.9%). The principal items of expenditure were: defense (30.9%), police (7.4%), education, non-elementary (5.0%) and public health (6.3%). Allocation of funds from the oil revenues to the Development board was noted above. A summary of revenue and expenditure is given in Table III.

TABLE III.—*Budgets*
(in 000 Iraqi dinars)

Item	1945–46*	1951–52*	1952–53*	1953–54*	1954–55†	1955–56†
Revenue	20,219	37,534	50,543	47,721	48,510	50,970
Expenditure	21,080	44,480	50,157	57,610	51,550	

*Actual. †Estimated

Communications. — Basra, which lies about 85 mi. up the Shatt al-Arab, is the only port of Iraq. The river is of sufficient depth for large ocean-going vessels. Major improvements in the facilities of the port were made during World War II. The Tigris is navigable between Basra and Baghdad for vessels drawing not more than four

feet. In 1954, 484 ocean-going ships totalling 1,541,434 n.r.t. entered Basra, unloading 475,101 metric tons and loading 746,896 tons of merchandise.

Iraq State railways were operating three main lines in 1950 totalling 1,698 km. The standard gauge from Baghdad to the Syrian frontier at Tell Küchük follows the original trace of the Berlin-Baghdad railway as planned by the Germans before World War I. However, the first passenger train left Baghdad for Haydarpasa (Istanbul) only on July 17, 1940.

The metre-gauge line from Baghdad to Kirkuk, which was extended to Arbil (269 mi.) in 1949, serving the important wheat-growing area in the northern plains, has an extension of 18 mi. from Jalula (Jalawla; formerly Qaraghan) to Khanaqin, 5 mi. from the Iranian frontier. The metre-gauge line irom Baghdad to Basra (353 mi.), originally built as a military railway by the British between 1915 and 1918, has branch lines from Hindiya to Karbala (32 mi.) and from Nasiriya to Ur (10 mi.). A rail and road bridge at Baghdad, connecting the two metre-gauge systems, superseded the train ierry over the Tigris in 1950. The traffic on Iraqi railways amounted in 1955–56 to 676,000,000 passenger-kilometres and, for goods, to 837,000,000 ton-kilometres.

In 1955 Iraq had about 19.300 km. of roads of which a quarter was hard-surfaced. In 1957 there were 25,900 licensed passenger motorcars and 14,390 commercial vehicles.

Iraq lies on one of the main air routes between Europe and the iar east. Baghdad and Basra have modern airports which are used by British, U.S., French, Dutch, Swedish and other air lines. In 1954 a total of 6,991 aircraft landed at the Baghdad and Basra airports.

In 1954 Iraq had 203 post and telegraph offices, 225 telephone exchanges and 115,000 mi. of telegraph and telephone line. Radiotelephone communication is available to most countries in Europe and to the United States. A broadcasting station operated by the government is at Baghdad. (K. C. B.)

BIBLIOGRAPHY.—P. W. Ireland, *Iraq: a Study in Political Development* (New York, London, 1938); Overseas Economic Surveys, *'Iraq* (H.M.S.O., London, 1949); Sir Ernest Dowson, *Land Tenure and Related Questions* (London, Baghdad, 1931); Doreen Warriner, *Land and Poverty in the Middle East* (London, 1948); E. B. Worthington, *Middle East Science* (H.M.S.O., London, 1946); Royal Institute of International Affairs, *The Middle East* (London, 1950); Henry Field, *The Arabs of Central Iraq; Their History, Ethnology, and Physical Characters* (Chicago, 1935); A. H. Hourani, *Minorities in the drab World* (London, 1947); A. Safrastian, *Kurds and Kurdistan* (London, 1948); S. H. Longrigg, *Four Centuries of Modern Iraq* (Oxford, 1925), *Iraq, 1900 to 1950* (Oxford, New York, 1953); G. Antonius, *The Arab Awakening,* 2nd ed. (London, 1946); Sir A. Haldane, *Insurrection in Mesopotamia* (Edinburgh, 1922); Lady F. Bell (ed.), *Letters of Gertrude Lowthian Bell,* 2 vol. (London, 1927); Sir A. T. Wilson, *Loyalties; Mesopotamia, 1914–1917* (London, 1930), *Mesopotamia, 1917–1920* (London, 1931); P. Q. Wright, *Mandates Under the League of Nations* (Chicago, Cambridge, 1930); *Paiforce: the OfficialStory of the Persia and Iraq Conzmand, 1941–1946* (London, 1948); Majid Khadduri, *Independent Iraq* (London, 1952); Government of Iraq, *Statistical Abstract, 1954* (Baghdad, 1955). (P. W. I.; X.)

IRBIL, also known as Arbil, Erbil or Arbela. an important foothill town in northeast Iraq, about 48 mi. E.S.E. of Mosul in 36° 15' N. and 44° W.; pop. (1957) 34.73'1. largely Kurds. The long unbroken history of Irbil, attested by the accumulation of building debris which forms the high citadel mound, is explained by its position as a centre of communications and by the fertility of the countryside, which is for the most part adequately watered and produces good cereal crops. It is the commercial and administrative centre for the *liwa* (province) of the same name, bounded west by the Tigris, north and south by the Great and Little Zab rivers, and east by the Iranian frontier.

The city was known to the Sumerians in the 3rd millennium B.C. as Urbillum, and later, as Arba'ilu, ranked among the principal cities of Assyria; it housed a famous shrine of Ishtar (*q.v.*), and Sennacherib (*q.v.*) dug a canal, partly underground, to supply it with water from the Great Zab. In Achaemenid times it lay on the royal road through Nineveh from Sardis to Susa and Alexander the Great defeated the last Achaemenid, Darius III, on this road about 31 mi. W. of Irbil *(see* GAUGAMELA [ARBELA], BATTLE OF). Under the Parthians, Arbela became the capital of the petty kingdom of Adiabene, approximately the modern *liwa* of Irbil; the city apparently retained its religious importance: since many Parthian kings were buried there. In the late Xbbasid period it was a considerable town and a fine minaret of this era still stands in the plain below the deserted citadel, whose western side is skirted by the older part of the town; more modern buildings now extend across the plain. A tarmac road from Mosul to Kirkuk and Baghdad passes through Irbil, whence there is a branch through the Rawanduz gorge to the Iranian frontier. A metre-gauge railway runs from Irbil through Kirkuk to Baghdad.

(E. E. D. M. O.)

IRELAND, JOHN (1838–1918), **U.S.** Roman Catholic prelate, was born at Burnchurch, County Kilkenny, Ire., on Sept. 11, 1838. In 1849 he was taken to the United States by his parents, who settled at St. Paul, Minnesota Territory. After being educated in France for the priesthood, he returned to the United States in 1861; he was ordained at St. Paul and in the following year he accompanied the 5th Minnesota Volunteer Infantry south as chaplain. Subsequently he became rector of the cathedral at St. Paul. His appointment in 1875 as bishop of Nebraska was changed at the urgent request of Bishop Thomas Langdon Grace so that he might remain at St. Paul as bishop-coadjutor with the right of succession; at the same time he was made titular bishop of Maronea.

His liberal views gave him a wide influence and reputation both within and without the church, and he came to be looked upon as a leader of the "American" as distinguished from the "Roman" party in the clergy. Several of his administrative acts, notably his plan for the partial taking over of control of the parochial schools by the local authorities, were strenuously opposed. He was prominently identified with the planting of Catholic communities or colonies in the northwest, with the establishment of the Catholic university at Washington, and with the Catholic total abstinence movement. He published *The Church and Modern Society* (1896). He died at St. Paul on Sept. 25, 1918.

IRELAND, JOHN (1879–), English composer, was born at Bowdon, Cheshire, on Aug. 13, 1879, the son of Alexander Ireland, editor and proprietor of the *Manchester Examiner.* He studied at the Royal College of Music. His pianoforte trio (1908) was followed by the sonatas in D minor and A minor for violin and piano and a second trio in one movement. In 1913 appeared an orchestral work, *The Forgotten Rite.* His piano works include *Decorations* (1914), *Rhapsody* (1915), four preludes (1911) and a series entitled *London Pieces* (1917–20). Other works include three trios (1908–38), *A London Overture* (1936), *Overture Satyricon* (1946) and songs and church music.

IRELAND, WILLIAM HENRY (1777–1835), forger of Shakespearian manuscripts, born in London. was the son of Samuel Ireland, an engraver and author, and dealer in rare books and curios. In 1794 young Ireland, with his father, visited Stratford, where he met John Jordan, a local poet who had forged the will of Shakespeare's father. Seeing his own father's credulous interest, Ireland copied, in ink which had all the signs of age, Shakespeare's style and handwriting, and produced leases, contracts with actors, notes, receipts, a profession of faith and even a love letter to Anne Hathaway with an enclosed lock of hair, to the delight of his unsuspecting father, and the deception of many scholars. Ireland invented an ancestor "William Henrye Irelaunde," to whom the documents had been bequeathed by Shakespeare in gratitude for rescue from drowning. At last the discovery of a whole new play named *Vortigern* was announced. Sheridan purchased it for Drury Lane theatre, and an overflowing house assembled on April 2, 1796, to sit in judgment upon it. But its one representation was greeted with shouts of laughter. Samuel Ireland the elder had published in 1795 the *Miscellaneous Papers and Legal Instruments under the Hand and Seal of William Shakespeare; including the Tragedy of King Lear and a small jragment of Hamlet* (dated 1796). He had the fullest belief in their authenticity, but the hostile criticism of Edmund Malone and others, and the unsatisfactory account of the source of the papers, made him demand a full disclosure from his son. Ireland at last confessed his fraud, and published (1796) an *Authentic Account of the Shakespearian MSS.,* and in 1805, a more elaborate *Confession,* entirely exculpating his father and making a full admission. The disgrace seems to have hastened the elder Ireland's death (July 1800). Ireland died on April 17, 1835.

The more interesting publications on the Ireland forgeries are: *Inquiry into the authenticity of certain Papers, etc., attributed to Shakespeare, by* Edmund Malone (1796); the elder Ireland's *Vindication of his Conduct* (1796); *An Apology for the Believers in the Shakespeare Papers* (1797), and a *Supplemental Apology* (1799), both

by George Chalmers. *Vortigern* was republished in 1832. The elder Ireland's correspondence with regard to the forgeries is preserved in the British Museum, with numerous specimens of his son's talent.

IRELAND, an island to the west of Great Britain, extending from lat. 51° 26′ to 55° 21′ N., and from long. 5° 25′ to 10° 30′ W. The 100-fathom line lies only a little way beyond its western coast, thus showing it to be "the last outpost of Eurasia against the oceanic depths of the Atlantic" (G. A. J. Cole). Its minimum distance from Great Britain is 13½ mi. between the Mull of Kintyre (Scotland) and Torr head. The narrowest crossings of St. George's channel are about 50 mi. in the south and 70 mi. in the north. Of its two political divisions, the Republic of Ireland has an area of 27,136 sq.mi. and a population of 2,814,703 (1961); Northern Ireland has an area of 5,459 sq.mi. and a population of 1,425,462 (1961). There are separate articles on IRELAND, NORTHERN and IRELAND, **REPUBLIC** OF.

PHYSIOGRAPHY

Geological Structure and Physical Features. — The common description of Ireland as a basin or saucer-shaped island is misleading. It is true that the central areas are low and that the main upland masses are marginal, but the interior is not a true plain and the uplands are far from forming a continuous rim around it. The main highland areas are evident extensions of similar features present in Great Britain. The northwest highlands of Donegal have the same northeast to southwest trend as the Scottish Highlands, the uplands of the Newry axis repeat many of the features of the southern uplands, and the Leinster chain is clearly akin to the highlands of north Wales. Similarly the Kerry-Waterford ranges belong to the east-west system which can be traced in south Wales and Exmoor, is deeply buried across southern England but reappears in Belgium. The three great series of earth movements that determined the relief of Europe all affected Ireland. The southwesterly trend in Donegal, Newry and the Leinster chain is due to the older Caledonian folding which created the now much-reduced mountain masses of Scotland and Scandinavia. The east-west uplands of the south and many of the hills of the so-called plain are the results of the later Armorican folding. The great Tertiary disturbances which produced the alpine folds of southern Europe and the gentler folding of the English weald showed themselves in Ireland as in western Scotland in the volcanic activity which created the basalt plateau of Antrim. They also probably effected the separation of Ireland from Great Britain. The minor surface features over much of the country are products of the Ice Age. The most striking geological difference between Ireland and its larger neighbour is in the absence of rocks of post-Carboniferous age. The New Red Sandstone beds, so prominent a feature of the English midlands, the chalk and the still more recent clays of southeastern England are represented only by very thin and localized deposits in the northeast.

The western Caledonian areas of Donegal and Connaught consist largely of low plateaus from which rise higher areas with isolated peaks (west Connaught) or ridges (Errigal range in Donegal) separated by deep valleys. The plateaus are usually peat-covered moorlands. The granite uplands are sharply distinguished by their smooth, rounded outlines from the bare, steep and conical peaks eroded from the quartzites. At the coast the quartzite beds form the most magnificent cliffs in Europe, 2,000 ft. high on Achill Island and Slieve League. The eastern Caledonian regions of Newry and Leinster, though of the same age, differ in character. The former, stretching from Dundrum bay almost to the Shannon, is a region of low hills except in the granitic Mourne mountains. The Leinster chain is a range 70 mi. long and rising to more than 2,000 ft., the most continuous highland area in Ireland. Its granite core is cut by deep, glaciated valleys such as that of Glendalough.

The Armorican areas of the southwest consist of simple folds, the resistant Old Red Sandstone forming parallel ridges with softer Carboniferous rocks flooring the valleys between. They include the whole region from the valley of the Barrow west to the Kerry coasts. Lower ridges of the same character cross the southern parts of the central lowland. The lowland itself has a rock floor of almost undisturbed Carboniferous beds, covered with drift of varying thickness. In the north, drumlins, low rounded humps of drift shaped beneath the ice sheets, occur in a wide belt from Belfast lough and Dundalk to Sligo bay and again in an area behind Clew bay. Eskers, long winding ridges of gravel, moulded by streams of melt water from the ice sheets, are found south of the drumlin belt. Most of the lowland drift is either compact boulder clay or gravelly clay with many limestone fragments. The latter type weathers into the most fertile soil of the plain. To the west, in Clare and Galway, considerable areas have little or no drift cover.

The basalt plateau of the northeast has steep edges, cut into attractive coastal glens in east Antrim and with the well-known columnar cliffs of the Giant's Causeway on the north. The depressed central area forms the basin occupied by Lough Neagh and the valley of the Bann. The Irish rivers are generally sluggish streams wandering through marshes and lakes across the drift-covered surface of the central lowland. As they approach the sea they become more vigorous as their rate of fall increases. The hydroelectric station at Ardnacrusha utilizes the power thus generated in the 16 mi. of the Shannon above Limerick. The station at Ballyshannon on the lower Erne has a similar situation. In southern Ireland the river courses are more obviously related to the underlying structure of the country. The Bandon, Lee and Blackwater follow the axes of the downfolds. The curious right-angled bends in their lower courses appear to be reminders of an older river system with a north-south direction, such as is still followed by the Barrow. Underground streams are widely developed in the limestone areas of the west, the hidden connection of loughs Mask and Corrib being a notable example.

Climate. — The dominant factors in the climate of Ireland are its insular position and the prevalence of southwesterly winds. These together account for its low temperature range (15°–20° F.), its abundant and frequent rains and the general decrease of both temperature and rainfall from southwest to northeast.

Mean winter temperatures are around 45° on the west coast and 42° on the east, summer temperatures about 60° in the southwest and 57° in the northwest. The hours of sunshine average more than 6.5 on June days in the southeast but less than 5.5 over all the west. These variations though slight are sufficient to affect agricultural practice. The check to winter growth is less in the west than the east, and lack of sun restricts wheat and barley growing to the southeast, ripening being uncertain elsewhere.

Rainfall is generally ample, if not excessive. Less than one-sixtieth of the country has a mean annual rainfall of less than 30 in. and about one-fifth has more than 50 in. The highest rainfalls are of course recorded in the western coastal mountain regions (both Kerry and Connaught record more than 90 in.). A marked feature of Irish rainfall is its frequency. The number of days with rain ranges from 175 to 250, but the showers are usually interspersed with sunny periods. From the agricultural standpoint the raininess of the early autumn is a great handicap, frequently delaying the harvest for weeks. This factor is mainly responsible for the prominence of potatoes, oats and grass in Irish farming. On the other hand, outdoor grazing is available for stock throughout the country for at least ten months. (T. HER.)

Flora and Fauna. — The absence from Ireland of many plants and animals found in Great Britain and farther east has three possible explanations. They may never have reached there, the British-Irish land bridges having disappeared before the British-continental one; they may have died out, as some certainly did during the Ice Age and as others at the limit of their geographical range probably have since; or they may be undiscovered, which is unlikely except for a few small creatures. The variety of Irish vegetation is only about three-fifths that of the British, while among animals the most conspicuous absentees are the dormouse, common and water shrews, five species of bat, the nightingale, all reptiles and amphibians except the brown lizard, smooth newt, natterjack toad (a relict species) and common frog (which was probably introduced). Animals endemic to Ireland are the Irish stoat and hare, the Irish jay, Irish coal tit, dipper and red grouse, six species of char and three of pollan (Lough Neagh, Lough Erne

and the Shannon). Endemic plants include mosses and liverworts and two marsh orchids.

There have probably been two land bridges at various periods joining Ireland to Great Britain, one across the southern part of the Irish sea and one joining Donegal to the Scottish isles. Across the southern one came species from the continent which comprise the Lusitanian-Mediterranean element now growing most luxuriantly in the west, especially in Kerry. There oak forest is found on sheltered hillsides with *Arbutus*, *Ilex*, etc. *Pinguicula grandiflora* (not found in Great Britain) and *Euphorbia hiberna* (found only in Devon) are very abundant, and there is an immense quantity and variety of ferns and mosses giving the vegetation an almost subtropical appearance. There too are the only stations of the natterjack toad and the Kerry slug *(Geomalacusmaculosus)*, and the district is very rich in insects. *Melampyrum sylvaticum*, *Ranunculus fluitans* and a species of snail, all now confined to the northeast, were perhaps among the latest forms to cross the northern land bridge. From America, via the Bering strait, came North American forms; *e.g.*, *Spiranthes romanzoffiana*, now found only round Lough Neagh, *Sisyrinchium angustifolium*, now only in the west, and a kind of fresh-water sponge.

After the warmth of the Pliocene period, when possibly the Lusitanian and American elements existed, the climate became cooler and the polar ice caps descended, driving plants and animals before them. The mammoth, spotted hyena and giant deer or Irish elk inhabited Ireland in late glacial times, and remains of reindeer, brown bears, wild boars, lynxes, arctic foxes, European wildcats and lemmings have also been found. Red deer are now protected in the Kerry mountains, the wolf was not exterminated until about 1786, and the fox, badger, otter, Irish hare, pine marten and Irish stoat were all present when man arrived in Mesolithic times or before. During one of the warm periods which interrupted the Ice Age, spruce, silver fir and Scotch pine were dominant, and a heath and rhododendron belonging to the Lusitanian element were widespread. ,The native spruce, silver fir and rhododendron are now extinct, and the Scotch pine died out in Neolithic times but has been replanted, with other conifers. At a late stage in the Ice Age when the ice did not cover the southern quarter, a northern flora dominated the country, containing among others *Astragalus alpinus* (now extinct), *Juniperus communis* (now in the north and west only) and *Arenaria ciliata* (now confined to limestone hills in Sligo and not found in Great Britain). When the final mountain glaciation took place the dwarf willow, now only on the mountains, was abundant in the lowlands, and *Dryas octopetala*, which dominates the Burren at sea level, grew at 300 ft. Many arctic-alpine plants died out as the climate became warmer. Later remains show that *Naias flexilis*, an American plant, was widespread, but it is now found only in the west. There the three elements reach their best development and are most markedly mixed on the Burren, where frost never touches the bare limestone hills and humidity is high.

The alder succeeded the Scotch pine in dominance. During the Atlantic period peat was formed over vast areas. Many woodland insects and other animals were destroyed then. The oak followed the alder and is still the chief tree of the woods. The forest plants and animals have mostly retreated to the glens, where pine martens and squirrels (exterminated in the mid-17th century and reintroduced at the beginning of the 19th) are still to be found. The vast grasslands of the east and centre have been reclaimed from forest. Everywhere the hedgehog, lesser shrew and field mouse are common, but the rabbit (introduced in the 13th century) and the brown rat (in the 18th century) are now pests. At higher levels the natural cover of the flat or sloping impermeable soils is blanket bog, while where the ground is well drained heath and scrub predominate with oakwood on sheltered slopes. A typical lowland bog is composed mainly of *Sphagnum*, cotton grass, beak rush, bog bean, sundew, etc., in pools and hollows, and *Calluna* with bilberry, cross-leaved heath, *Scirpus caespitosus* and often *Rhacomitrium* on the hummocks. Curlews, gulls, certain kinds of beetle and other insects are the most conspicuous animals of the limited bog fauna. On the mountains, isolated patches of alpine plants can be found, and hares, badgers, ring ouzels, ravens, choughs and peregrines are the chief mountain animals. The great auk, capercailzie and eagle are extinct. Many sea birds as well as choughs, ravens and peregrines breed on the cliffs and on the islands, and the Atlantic seal is familiar round the coasts. The common seal is less often seen, but various whales, the common porpoise and dolphins occur round the shores. The basking shark is seen off the west coast in spring. Several kinds of wild duck and other birds nest round the lakes. Salmon, trout and other fish are abundant in the rivers and the lakes contain char and other species. (X.)

ARCHAEOLOGY

While the broad outlines of Irish archaeology have been reasonably well established, much of the detail of the various phases of its prehistory still had to be worked out at mid-20th century. Systematic excavations were helping to fill in the gaps in knowledge, but many minor points of chronology and problems of the derivation of a number of cultural features from outside the country and their development within it were still matters for speculation and debate. Despite these uncertainties on smaller issues, however, the conspicuous place in Europe occupied by Ireland in Bronze Age and early Christian times is well attested. During the Bronze Age the initiative and skill of the native metalworkers is shown in weapons and implements of bronze and ornaments of gold, many examples of which were traded to Great Britain and the continent of Europe. In early Christian times metalworking again achieved extraordinary distinction in the production of objects for secular and ecclesiastical use, while there was a parallel growth of manuscript illumination of equal merit. This period also witnessed the flowering of sculpture, exemplified chiefly by a series of great stone crosses erected at ecclesiastical sites all over the country. A second revival of the craft of the metalworker, which appears to have suffered a temporary decline during the viking raids from the 8th to the 10th centuries, took place in the 11th century, and the contemporary fashion of enshrining the relics of the native saints left a large number of beautiful shrines in silver and bronze.

Another aspect of Irish archaeology which deserves special mention is the extraordinary wealth of field monuments of every kind scattered over the countryside. Although many must have been destroyed in the course of ages the proportion of the original number surviving is still very high, mainly because of a traditional respect for ancient things and traditional fear of disturbing them. These monuments include great numbers of megalithic remains: tombs of many types, ranging in size from small dolmens to enormous passage graves, and stone circles and other structures which are probably ritual in origin. From later times the defended dwelling place, whether taking the form of the stone-built cashel or the earthen ring fort, is still to be counted by tens of thousands. Remains of an explicitly Christian character—monastic settlements, churches, inscribed slabs and crosses—are also abundant. When to this rough inventory is added a host of miscellaneous monuments of all periods it will be evident that there is an almost unlimited field for survey, excavation and research.

The Mesolithic Age.—The human occupation of Ireland does not begin until a late date in the prehistory of Europe. The island seems to have been uninhabited throughout the whole of the Ice Age; at least, no trace of an interglacial colonization has been found anywhere within its borders. The earliest relics of man appear in the remains of a culture of Mesolithic affinities, evidence of which has been found at Cushendun, Larne, Rough Island and other places on the northeast coast of the country and, later, at further coastal sites in County Louth and County Dublin. This culture has been divided into two phases called Early and Late Larnian after the type site at Larne, County Antrim. As the majority of the sites associated with the culture are secondary and as most of them are on beaches, the relics they have yielded consist entirely of implements of stone and flint.' Early Larnian is characterized by microliths, scrapers and blades allied to those of the Mesolithic cultures of the adjacent areas of Britain, and its descent is probably to be traced to the British Upper Palaeolithic. It existed at a period when the northern land bridge connecting

the two islands was still intact and may be roughly dated to 6000 B.C. Late Larnian is regarded as a local evolution of this culture developing after the severance of the land bridge, and its equipment of flint tools tends to be of a more massive type. The people of both these phases were dependent for subsistence chiefly on hunting and fishing, supplemented by minor food collecting activities such as seasonal visits to the seashore for shellfish. It would seem that groups of these people survived in lakeside and riverside settlements until the coming of the Neolithic agriculturalists and pastoralists sometime before 2000 B.C.

The Neolithic Age.—Neolithic culture elements appear in the country in a variety of associations, and their discovery and recognition has been the fruit of comparatively recent excavation and field work. The most important of these elements is the pottery found both in funerary and habitation sites. In its most widely distributed form it appears as wide-mouthed, round-bottomed bowls, closely related to the contemporary Neolithic A ware of Britain but showing local developments of rim form and ornament. Of this type is the funeral pottery which is found in the first megalithic tombs erected in Ireland, the "horned cairns" which are found over the northern part of the country, and also occurs in graves of other types in the south. It was discovered in large quantities at a remarkable earthwork at Lyle's hill, County Antrim, and in a series of habitation sites at Lough Gur, County Limerick. At the latter place houses, round and rectangular in plan, were revealed, and evidence pointed to an economy based largely on cattle raising supplemented by a limited amount of agriculture. Another strain in Irish pottery is related to the Neolithic B wares of Britain and has an ultimate Baltic origin. It probably reached Ireland from Scotland and has been found mainly in northern areas. A third pottery type, which makes its first appearance in Neolithic but survives into Bronze Age times, is a flat-bottomed pot of coarse fabric. It appears in quantity at Lough Gur, is known from some other districts, and is probably related to the "grooved ware" of Britain.

As has been mentioned already, the megalithic graves which are so widespread and numerous in Ireland had their beginnings in this period in the horned cairn group which extends over the greater part of the territory north of a line from Carlingford lough to Blacksod bay. A typical tomb of this class consists of a narrow corridor formed of large upright stones and normally subdivided into a series of chambers by pairs of jambstones having sill stones set in the ground between them. The corridor was roofed with a line of lintels and the tomb was approached through a semicircular forecourt formed by the two curving arms of a façade of upright stones. The whole was probably originally covered by a low cairn, wedge-shaped or oval in plan. Some of the western examples (*e.g.*, Creevykeel, County Sligo) have circular, open courts enclosed within the structure of the tomb itself. These tombs were generally situated on high ground, but their builders, unlike those of the later passage graves, did not favour hilltop positions. Cremation was the usual burial rite in them. Although none so far excavated has produced metal objects, tanged-and-barbed arrowheads and other finds from some indicate that this type of tomb continued in use into Bronze Age times. Although the immediate continental locality from which these graves were derived is still undecided, there can be no doubt that they must be ultimately traced to a Mediterranean origin.

Apart from the pottery the artifacts associated with the Irish Neolithic culture are chiefly implements and weapons of flint and stone. Characteristic of these are leaf-shaped flint arrowheads which are often of extremely fine workmanship. Another implement which appears to be typical of certain settlements by inland waters is a pointed flake of flint or chert, widening toward the base, where it is provided with a rudimentary tang. Since it is the type implement of a number of stations situated in the valley of the lower Bann river, County Antrim, it has been named the "Bann flake," and it seems to have evolved from the Mesolithic Larnian of the same region.

It is apparent that during the Neolithic phase of Irish prehistory a number of diverse cultural influences were in operation in the country, but the actual time covered by the period was probably relatively short and the phase is best regarded as a brief preface to the Bronze Age into which it shades imperceptibly.

The Bronze Age.—The early Bronze Age, which began soon after 2000 B.C., was a continuation of forces already at work in the

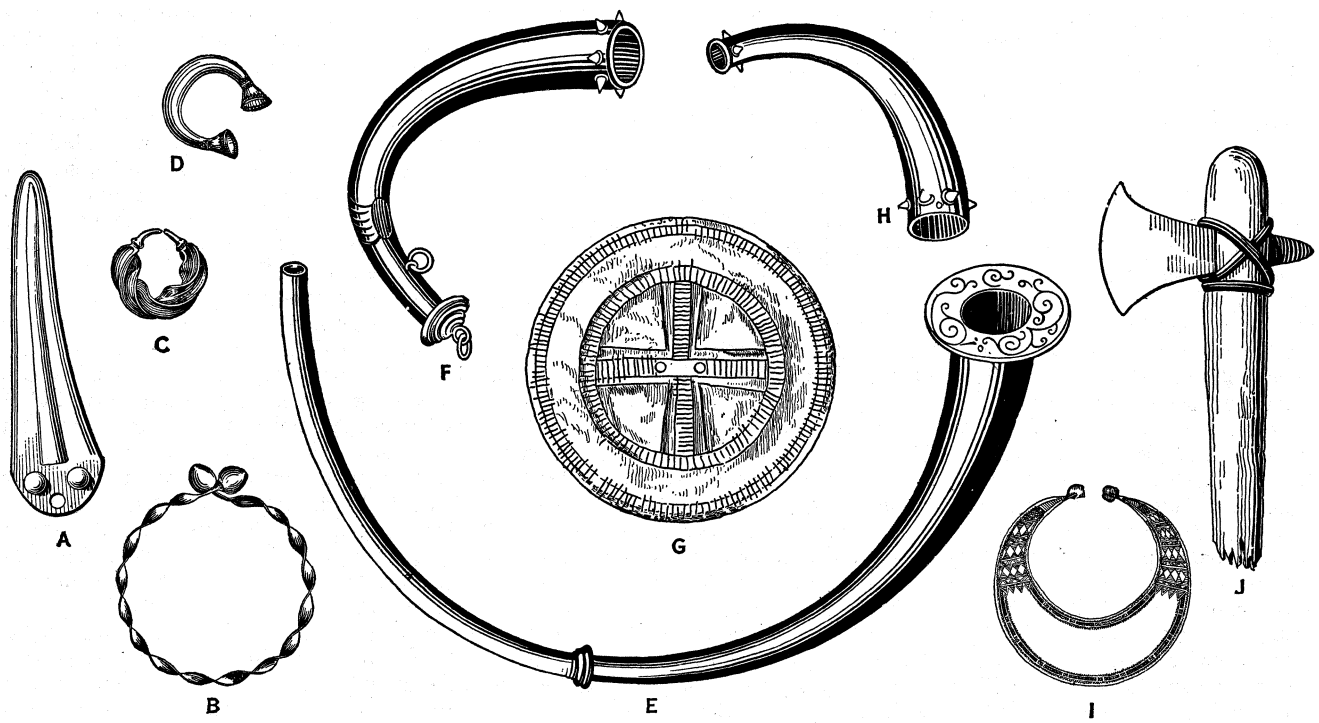


FIG. 1.—METAL ORNAMENTS AND IMPLEMENTS OF THE BRONZE AGE IN IRELAND

(A), Copper halberd blade, a characteristic weapon of the early Bronze Age; (B) gold torque, evidently a neck ring; (C) one of a pair of gold earrings formed of four flat narrow fillets joined at their inner edges in torque pattern; (D) gold open ring of the type probably used as currency; (E) bugle-horn shaped trumpet made in two portions soldered together; (F) cast trumpet, 34⅝ in. on concave side; (G) circular gold plate or "sun disk," probably worn on breast; (H) trumpet, 24 in. along curved edge; (I) gold lunula or "moon disk" worn around the neck; (J) copper hatchet, secured to a wooden handle by strings of hide or gut

preceding period, strengthened by fresh ones which made their appearance about that time. Of the latter, one of the most important is the Beaker culture which was formerly thought to be wholly unrepresented in Ireland. However, the Lough Gur site, already mentioned in connection with the Neolithic, produced considerable quantities of the very distinctive pottery of the culture, and other finds of it have been made in megalithic graves in Derry, Tyrone, Sligo and Dublin. The beakers found are of mixed British and continental affinities and their presence presumably indicates an immigration of people the extent of which cannot yet be gauged.

One of the chief determining influences which gave Ireland its important position during the Bronze Age was the gold in which at the time the alluvial gravels of certain parts of the present County Wicklow must have been very rich. The metal was probably obtained from the gravels of the mountain streams of the area for no evidence of ancient mining has been found there and the parent auriferous vein has never been discovered. Gold in commercially remunerative quantities is no longer to be found in the district. But the large number of early gold ornaments found in Ireland proves that in the first stages of the Bronze Age there was a considerable store of the metal at the disposal of its inhabitants; and the wide dispersal of gold ornaments of Irish provenance over the continent of Europe showed that this metal formed an important material of trade.

The chief gold ornaments that have come down from the early stages of the Bronze Age are crescents and disks of thin gold sheet, with a slight geometrical ornament engraved or embossed upon them. These are of Irish origin, wherever found. At a later stage in the Bronze Age, when Ireland had become a receiver rather than a giver in the matter of culture, the twisted torque was introduced—a collar consisting of a bar or ribbon of metal, twisted into a screw and curved into a loop, the ends being drawn out and bent abruptly so as to hook into one another. Later still, as the Bronze Age was drawing to its close, a peculiar form of ornament of a problematical kind came into use. This is in the shape of an open ring with the ends terminating in disks, or in expanding solid or hollow conical knobs. Various conjectures have been made as to the use of these objects; one of the most probable is that they were used as currency.

Of the Bronze Age implements many types are similar to those found elsewhere in northern Europe, but some have distinctive character. The flat copper hatchet is probably indigenous to the country, from which it spread over the continent. The copper halberds are especially remarkable. They are a kind of dagger-axe, being in essence triangular dagger blades mounted at right angles at the end of a long handle. These show an evident connection with Spain, where this form of weapon reappears. About the middle of the Bronze Age Ireland seems to have lost its initiative in civilization; the later types of hatchet-heads, etc., were imported into the country, rather than exported abroad. To the last, however, the Irish metallurgists of the Bronze Age retained their skill and their appreciation of beauty and symmetry; some of the late spearheads, for example, are of admirable workmanship. For one class of objects Ireland was the source of supply for Europe till the end of the Bronze Age—the horn-shaped trumpets, made by the *cire* perdue process, which are found in many places on the continent; there is one represented as lying by the side of the well-known statue of the "Dying Gaul," often erroneously called the "Dying Gladiator," by the Greek sculptor Epigonus.

Megaliths.—As we have seen, the first megaliths to be built—the "horned cairns"—were constructed in the Neolithic period, but the full development of the megalithic idea is to be found in the Bronze Age. Of the tombs, the passage graves, while not the most numerous, comprise some of the most impressive antiquities in the country, and there can be little doubt that they are the result of direct influences from Brittany and the Iberian peninsula. They are generally grouped in cemeteries on hilltops, the most noteworthy of these concentrations being those beside the river Boyne and at Loughcrew, both in County Meath, and at Carrowkeel in County Sligo. The largest and the most famous tomb is the enormous tumulus of Newgrange, one of the Boyne group. It covers an acre of ground and encloses a great cruciform chamber built of corbelled slabs of stone, many of which are richly decorated with a geometric ornament of spirals, chevrons and lozenges. The chamber is approached by a lintelled passage of massive stones, and the whole mound, which is about 40 ft. high, is surrounded by a continuous curb of great stones laid end to end. The mound was originally encircled by a ring of large pillar stones, most of which have, unfortunately, been destroyed. The Boyne group includes two other great tumuli which approach Newgrange in dimensions. Of these, that of Dowth possesses two independent chambers the stones of which bear decoration similar to that found in Newgrange, while the other mound, called Knowth, has its curb profusely ornamented with a wide variety of patterns of this peculiar art, which seems to have served a magico-religious purpose. Further examples of the art occur in the Loughcrew cairns, at Knockmany and Sess Kilgreen, both in County Tyrone. and in a grave at Fourknocks, County Meath, near the Meath-Dublin border in the neighbourhood of Naul.

Other megalithic tombs take the form of gallery graves and dolmens, both of which are found in great numbers.

In all these tombs the dead are generally cremated and the commonest funeral pottery is a small, elaborately decorated bowl or vase called a food vessel, since it is thought to have contained food offerings for the dead. Irish graves of all types tend to be very poor in grave goods in comparison with those of some other European countries, but stone beads and pendants, flints and an occasional metal object sometimes accompany the interments.

Toward the end of the Bronze Age the typical grave consists of a small rectangular cist composed of four upright slabs covered by a capstone, the whole sunk in the ground to a short distance below the surface. Here, too, cremation is the usual burial rite, a large urn of coarse and poorly baked clay being often inverted over the pile of burned bones.

The few human bones found in Irish Bronze Age sites indicate that the population of the country during this period belonged to the Mediterranean race—a relatively short, dolichocephalic (long-headed) and dark-complexioned people, to be seen today in their fullest purity in Spain. This population was apparently dominant all through the Stone and Bronze Ages, for the few skulls of round-headed individuals that have been found are to be taken as those of casual wayfarers. Of the language of this people we are absolutely ignorant. Some of the river names, which cannot be explained with the aid of Celtic, may belong thereto; and a few inscriptions in the Ogham character, found in the Pictish regions of Scotland, may possibly preserve some words of this tongue or of a cognate dialect. These inscriptions have defied all attempts to decipher them.

Scandinavian and other foreign objects of the late Bronze Age found in Ireland speak of an oversea trade with eastern and southern Europe; the centre of activity shifted eastward in the course of the Bronze Age. We may assume that the technical skill displayed in the bronze objects which have survived was likewise shown in the objects in wood and in textiles, which no longer exist. Here, as elsewhere, because of the decay of organic materials, only a very incomplete picture of ancient civilization can be reconstructed. The Bronze Age was illiterate, so that no literary documents have survived, even indirectly; though it is very likely that there is a considerable body of Bronze Age material embedded in the vast body of Irish literary and oral tradition.

The **Iron** Age.—The early inhabitants remained in undisturbed possession of the country till about 400–350 B.C. It is possible that there were occasional immigrations such as a gold-producing country would naturally attract; but if so these became absorbed in the aboriginal population and cannot now be isolated. But in the 4th century a much more formidable immigration took place, doubtless only one phase of the movements of peoples in central Europe, of which the Gaulish sack of Rome in 390 B.C. and the attack on Delphi about 100 years later were outstanding incidents. The Celtic people seem to have had their origin in the regions between the headwaters of the Rhine and the Danube. There they developed their peculiar linguistic characteristics, language being the chief if not the only common mark of Celticism in the modern world. They seem early to have become acquainted with

the ironsmith's craft, and with the aid of their iron weapons they subdued one by one the petty peoples of the area of Europe north of the Alps. Over these peoples they spread a veneer of Celticism; they Celticized them in speech, in religion and in organization, but could not make any very great modification in their racial affinities. This explains the racial diversity which underlies the superficial unity of the Celtic peoples and which makes it difficult to determine to what people the term "Celtic" most fittingly belongs. (See CELT.)

A community — or more probably, several communities — of this people effected an entrance into Ireland about the middle of the 4th century B.C. They were probably few in numbers, but they had the advantage of a superior military organization and, especially, of iron weapons. In time they effected a complete revolution in the life of the country. Their Celtic speech completely ousted the aboriginal tongue. New gods and new methods of government, new arts and new crafts were introduced. The aborigines were reduced to vassalage, which, though mitigated with the establishment of Christianity, was never completely terminated until conqueror and conquered alike were subdued by the Norman. It is possible that the newcomers were a tall, fair people of Nordic extraction who contrasted physically with the aborigines. The contrast was maintained, as we cannot doubt, by restrictions on intermarriage.

In the literature which a little later began to come into being, an aristocratic product, the distinction between fair and dark people is of paramount importance. Every person who is spoken of with respect, save for a number of individuals of exceptional character who "prove the rule" much more clearly than in most cases of the kind, is described as being tall and fair, with long, flowing locks. Every person who for any reason is spoken of with disdain is described as being short, dark and with close-cropped hair.

The culture which the newcomers brought into the country belongs to the later stage of the iron culture of Europe, which goes by the name of La Tène (*q.v.*). The earlier phase of the European iron culture, called Hallstatt, is not represented in Ireland save by a few stray objects which came in by way of trade or by mere accident and do not indicate a permanent settlement. This enables us to assign a date to the Celtic invasion with tolerable exactness. The legends of the landing of the invaders, attracted by the country's store of gold, may at least be historical in that they represent the landing as taking place in the southeast corner of the island, the place where the gold-bearing gravels are to be found.

The actual remains of the pagan Iron Age in the country are, comparatively speaking, scanty. They include a number of types of bronze objects, some peculiar to Ireland and several of very problematical use; some spearheads and other objects of iron; and, most remarkable of all, a few large stones, probably sepulchral gravemarks, bearing sculptured ornament of the geometric-floral type associated with the art of La Tène period. In other respects the pagan Iron Age was of very great importance in the history of Ireland. At this time the literature began to come into being, though the documents which transmit it to our time are of much later date and show clear evidence of editorial manipulation. The oldest written relics are the Ogham inscriptions, which preserve early forms of the Irish language not otherwise illustrated. Such of the inscriptions as have been deciphered contain nothing but names, with words denoting relationship linking them together. The Ogham alphabet is a cipher, based upon an abbreviated form of the Roman alphabet and doubtless originally intended not for writing at all but for secret communication by means of the fingers. The letters are combinations of strokes, in number from one to five (representing the fingers), disposed in various positions around a central line. (See OGHAM SCRIPT.)

Probably many of the numerous ancient fortifications are also to be attributed to this period. These are as a rule circular enclosures, surrounded by one, two or three ramparts of earth or of stone. Others, however, are much more complex in their plan. Very little is known of these enclosures, which are common everywhere. Some of them are as early as the Bronze **Age;** others, certainly, are quite late in date (perhaps A.D. 700–1000), for inscribed stones are used as building material in their construction. Some are burial enclosures; some, perhaps, sanctuaries; others cattle pens and the majority fortified steadings. Probably many were erected as defenses against wolves. They are often in positions strategically worthless and show a singular carelessness with regard to facility of water supply if they were expected to stand a siege.

Christian Remains. — We may safely date the beginning of Christianity as a power in Ireland at somewhere about A.D. 350–400. There probably were individual Christians even before this date, but they cannot have made much impression on the life of the community. But after about three centuries we begin to find definite traces of a specific Christian art. The earliest church buildings, and for a long time the most important ones, were built of wood, not of stone, and these have all disappeared through fire and decay. Stone building was in a rudimentary stage of development throughout the country; the extensive forests supplied the most obvious and the most easily worked building material. Probably also carved wooden plates did duty for sepulchral memorials; wooden tomb "stones" are still to be seen in some of the country graveyards. Early remains very likely lie hidden in some of the monastic sites, but these are effectually sealed from the excavator by modem interments. The viking raids of the 9th and 10th centuries must be responsible for the disappearance of many of the earliest works of art.

The only remains of wooden constructions are the fragments of framed houses found in some of the lake dwellings (commonly called in the country "crannogs")—artificial islands made by piling earth and stones on the bottoms of the shallower lakes and, after securing them with a revetment of stones or wattlework, erecting a dwelling house in the middle. These structures began in the Bronze Age, were much in use (to judge by the remains found within them) about the 7th century, and were not wholly abandoned until about the end of the 16th century. The fragmentary structures which they bear are insufficient for us to gauge fairly the skill of the ancient builders in wood. Certain features of the earliest stone churches are evidently translations, so to speak, of constructional details proper to wood into stone, where they are merely otiose. The arch is not used for the larger openings in the earliest structures, though its use for small windows shows that its principle was understood from the first. The stones are set without mortar or at most in mud. There is much variety in the character of the masonry, but this depends on the skill of the local masons and on the materials at their disposal and is of no chronological significance. After the Irish missions to the continent began, the stone building in the country began to improve notably. The Romanesque style was introduced and successfully practised; some very remarkable buildings were produced especially in the 12th century, such as King Cormac's chapel at Cashel, the nunnery church at Clonmacnoise and the cathedral of Clonfert.

There has been much controversy about the round towers found in many places, but it has been generally decided that they do not possess the historical or architectural importance once attributed to them. They are simply the detached campaniles of the churches with which they are invariably associated; they were erected during the time of the Scandinavian raids, when watchtowers and keeps were as necessary as belfries to the churches which had treasures to guard.

The *scriptorium* was one of the busiest centres of industry in an ancient monastery. A sufficient number of manuscripts survives to prove the nature of the work there carried on. The oldest manuscript completely in the Irish language, Lebor *na Huidre* (The Book of the Dun Cow) (so called from the animal from whose hide its vellum was said to have been manufactured), was written at Clonmacnoise some time before A.D. 1106 but is founded on much earlier exemplars, now lost. These literary manuscripts however concern us less than the illuminated books, of which a considerable number was produced; those that survive date from the 7th century to the 11th. The documents thus enriched are psalters, service books and, especially, Gospels. The enrichments

consist not so much in miniatures as in an artistic treatment of the letters of the text itself; these are worked with great ingenuity into fantastic knots and monograms and decorated with applied ornament of great beauty. In the Book of Kells (probably of the early part of the 9th century) the art attains its high-water mark; some pages of this manuscript, especially the monogram of the name of Christ at the beginning of the Gospel of St. Matthew, rank among the finest illuminations in existence.

The art of these illuminations is one with the art of the metalworker and the sculptor, differing only in the medium employed. It is a provinciai phase of the great decorative art practised by Celtic and Teutonic peoples alike, though with differences of idiom, in the 6th to the 12th centuries. It consists of devices founded on such geometrical devices as spirals and interlacements and on figures of animals or parts thereof, often conventionalized almost out of recognition.

Like the art of illumination, that of the metalworker was almost wholly devoted to the service of the church, save for ornamental pins and brooches, of which a number of very fine specimens have survived. Of these the best-known is the (falsely so called) Tara brooch, a work probably of about A.D. 800. It was found on the seashore at Bettystown, south of Drogheda, and is now preserved in the collection of the Royal Irish academy. On the reverse side is elaborate chasing, founded mainly on spiral forms; on the face are sunk panels filled with ornament in extremely delicate filigree.

The more specifically ecclesiastical works in metal may be classed under the headings of bells, shrines, chalices and processional crosses. The bells used by the early Irish ecclesiastics were adaptations of cattle bells, like those in Switzerland and elsewhere. They are rectangular, not round, in horizontal section. The earlier specimens, including the famous bell of St. Patrick at Belfast, are of iron (sometimes brazed on the surface); the later are cast bronze. Bells are usually without ornament, save occasional decorative treatment of the handle; a few specimens are engraved with simple decoration. One is inscribed, and can be dated A.D. 908.

The shrines are of several different varieties, depending upon the nature of the object to be enshrined. Caskets for bones were made in the form of the ordinary church building of the time (understood to be the form in which the Temple of Solomon had been designed); or else in the shape of the part of the body from which the bone came. The best-known example of the latter type is the shrine of St. Laichtin's forearm, in the Royal Irish academy's collection, a work of the 12th century. Those meant for books were flat, square boxes of the size and shape of the volume which they were intended to contain. The books were not preserved in these shrines for perusal; they were holy relics and were not meant to be taken from their receptacles. Had they not been thus preserved they would have perished, for the book which had belonged to a notable saint was accredited with miraculous powers; strips were cut from it to make amulets, water was poured over it to acquire healing virtues and, according to Bede, books from Ireland were in especial request in England, for scrapings from their pages were a remedy against snake venom. Shrines for bells and crosiers, again, took the form of the object enclosed within them.

The solitary decorated chalice which has survived from the days of Celtic Christianity far surpasses the best of these objects in artistry. It was found near Ardagh, County Limerick, and is now in the Royal Irish academy's collection. It is richly decorated with bands of chased and filigree panels, and its beauty is enhanced by the use of enamel, crystal, mica, glass and amber. It is a worthy companion to the Book of Kells, with which it is probably contemporary.

The one processional cross that has survived is the so-called Cross of Cong, made at Roscommon in or about 1125 to enshrine a fragment of the true cross and now in the National museum, Dublin. Its late date is reflected in the character of its ornament; the pure interlacements and other geometrical decoration of the Ardagh chalice give place to patterns founded on contorted animal figures. The cross head, which alone remains, is about 2 feet high. It rises from the jaws of a foxlike animal head. The surface is covered with bronze plates, enriched with silver and enamel, and with applied panels of openwork or what may be called false filigree representing animal figures in fantastic knots. In the centre of the face is a large crystal, behind which it may be presumed that the relic, or what is left of it, is still lying. On the sides are inscriptions in Latin and in Irish, explaining the purpose of the cross and asking for prayers for all those concerned in its manufacture. The back had an inlaid saltire, presumably of gold, which some sacrilegious thief has picked out.

Numerous remains of sculptured ecclesiastical art in stone exist in Ireland, beginning about the middle of the 8th century. They take the form of sepulchral slabs, carved crosses and the sculptured decoration of church buildings. At Clonmacnoise there is a valuable series of slabs commemorating inmates of the monastery. These sometimes bear the names of persons known from other sources and are therefore datable; it has been found possible to determine a sequence of styles from these, extending over four centuries. Of much greater importance are the standing crosses, erected in various important ecclesiastical centres. These are in some cases memorials of individuals, such as the fine cross erected at Clonmacnoise by Abbot Colman in memory of his friend and patron Flann, king of Ireland, who died in A.D. 914. Others seem to mark the limits of the monastic enclosure. Others are dedicatory, erected, perhaps, in fulfilment of vows; among these is the Cross of Patrick and Columba at Kells, County Meath. The earliest standing crosses are perfectly simple, being merely stones carved into a cross form. But about the beginning of the 10th century a much greater elaboration began. The so-called Celtic cross had by now been evolved—a Latin cross with a circular wheel surrounding the centre, probably an attempt to suggest a halo of glory. The surface of the shaft and head of the cross is usually divided into panels, each containing either ornamental devices or else figure subjects. The great majority of the latter which have been identified represent biblical scenes, chosen for their homiletic value—the fall of man, the sacrifice of Isaac and so forth. A few scenes which cannot be identified may possibly represent local events familiar at the time of the erection of the monument but now forgotten.

Foreign Influences.—Two important foreign influences profoundly affected the life of Ireland during this period. The first was that of the Scandinavians, who began their piratical raids in the latter part of the 8th century. For more than 200 years they continued their depredations and did incalculable damage to the material welfare and to the morale of the country. But on the other hand they imported their own peculiar variety of north European art, and from this and the native style there sprang a hybrid which produced works of great beauty: the Cross of Cong is one of these. Nevertheless, despite the hold which the Scandinavians had upon the country, comparatively few objects of definitely Scandinavian type have been found there. Only one Scandinavian cemetery has been discovered, and the number of runic inscriptions is far less than analogy with other Scandinavianized countries would lead us to expect.

Beginning in 1170 came the Anglo-Norman invasion, which completely overturned the traditional life of the country. From that date onward foreign methods and ideas impressed themselves with increasing intensity. The immediate result of the invasion was the total extinction of the traditional arts. Typical of the resultant chaos is that strange product, Irish Gothic architecture. There is nothing like it anywhere else. It is a curious jumble of styles and periods, and the mouldings, which in English Gothic afford an infallible guide to chronology in ambiguous cases, are either totally absent or else share in the general eccentricity. The Romanesque style had been voluntarily adopted and had a healthy natural growth in the country; the Gothic style was violently forced on the country from without and was never assimilated.

More prominent and characteristic remains of mediaeval Ireland are the numberless castles. At first wooden towers (*bretesche*) erected on earth mounds (motte), these developed along lines parallel to those followed by castles in England. They are thus hardly monuments of Irish archaeology pure and simple, but of

the archaeology of an extension of England. Naturally none of the temporary wooden towers survives, though the place name Brittas, which is not infrequent, preserves a reminiscence of them, "Brittas" being a corruption of bretesche. There are numerous *mottes* still in existence, however, such as the splendid example at Castletown Geoghegan, County Westmeath. The castles of Ireland are of all sizes and dates, from the great structure at Trim, founded in 1173, down to the humble "peel towers" — small square structures of two or three stories — some of which are not earlier than the 17th century. The history of Ireland after the Norman invasion is a history of decay and degeneration, and it is vividly reflected in all the remains of antiquity that have come down out of those troubled centuries.

BIBLIOGRAPHY. — R, A. S. Macalister, *The Archaeology of Ireland,* 2nd ed. (London, 1949), and *Ireland in Pre-Celtic Times* (Dublin and London, 1921); H. L. Movius, *The Irish Stone Age* (Cambridge, 1942); G. Coffey, *The Bronze Age in Ireland* (Dublin and London, 1913); S. P. ORiordain, *Antiquities of the Irish Countryside* (Cork, 1943); Joseph Raftery, *Prehistoric Ireland* (London, 1951); Françoise Henry, *La Sculpture irlandaise pendant les douze premiers siècles de l'ère chrétienne,* 2 vol. (Paris, 1933), and *Irish Art in the Early Christian Period* (London, 1940); A. K. Porter, *The Crosses and Culture of Ireland,* 2nd ed. (1935); E. H. L. Sexton, *Irish Figure Sculptures of the Early Christian Period* (1946); Adolf Mahr (ed.), *Christian Art in Ancient Ireland,* vol. i (Dublin, 1932), vol. ii (Dublin, 1941); Lord Dunraven, *Notes on Irish Architecture,* vol. i (London, 1875), vol. ii (London, 1877); A. C. Champneys, *Irish Ecclesiastical Architecture* (London and Dublin, 1910); H. G. Leask, *Irish Castles and Castellated Houses* (Dundalk, 1941).

Periodicals: Royal Irish Academy, *Transactions and Proceedings* (Dublin, 1788–); *Journal of the Royal Society of Antiquaries of Ireland* (1849–); *The Ulster Journal of Archaeology* (Belfast, 1892–); *Journal of the Cork Historical and Archaeological Society* (Cork, 1892–); *Journal of the Galway Archaeological and Historical Society* (Galway, 1901–); *Journal of the County of Louth Archaeological Society* (Dundalk and Drogheda, 1904–); *North Munster Antiquarian Journal* (Limerick, 1936–).

(R. A. S. M.; A. T. Ls.)

HISTORY

Earliest Inhabitants — The earliest-known remains of human habitation in Ireland are assigned by archaeologists to the period of the transition between the early and the late Stone Age. This period, it is held, was preceded by intense glacial conditions, covering the whole island and extending also over Britain as far south as the estuaries of the Severn and the Thames. The Neolithic and early Bronze periods which follow are well represented in Ireland, but their data belong rather to archaeology than to history. The later Bronze Age in Ireland, though it has no documents, native or extraneous, has left evidences sufficiently abundant and vivid to be considered historical. To it belong numerous tombs of massive structure, surmounted by great tumuli of earth or stones, the stone slabs in some of them being carved with a great variety of designs, symbolic or ornamental — evidence of a settled population under opulent rulers. Bronze was abundant. There were rich copper mines, but no tin mines, and the tin which was needed to make bronze must have been an article of import, no doubt from Cornwall, during the whole of the Bronze Age and later. The distinctive feature of this period in Ireland was the production of native gold, of which it is certain that there were comparatively rich deposits in the Wicklow mountain region. Irish gold ornaments of the Bronze Age have been found in various parts of Britain, in northern France and in Luxembourg, Hanover and Denmark. In Ireland the principal finds have been in districts far away from the gold-producing region. Finds of the ancient apparatus of bronze founding are likewise recorded in places far away from copper mines and from seaports through which tin could be obtained. The facts point to a development of commerce, internal and external.

To the Celts of Gaul, and through them to the Greeks, the ancient inhabitants of Britain and Ireland appear to have been known by the common name of "Pretani." The two islands, Albion and Iverna, are called in Greek the Pretanic Islands. In Latin and first, so far as is known, by Julius Caesar, the name "Brittani" (becoming later Britanni and Brittones) is substituted for Pretani and used distinctively of the people of the larger island, to which the name "Brittania" (Britannia) was given. "Pretani," represented in early Irish by "Cruithin," was the name of the people who in later times are known as Picti, Picts. Hence it may be inferred that during the Bronze Age the Picts were the chief people of Ireland as well as of Britain, and this inference is amply confirmed by ancient Irish traditions.

Celtic Colonization. — Such archaeological evidence as we have seems to indicate that the earliest Celtic migrations to Ireland took place during the 4th century B.C. In the absence of skeletal material, no positive statement as to the racial characteristics of these early migrants can be made. That is, no one from the then-literate part of the world saw them, and there is no indirect evidence available since they cremated their dead. The language they spoke formed one group within the Indo-European family, to which the Germanic, Italic, Slavic and other groups also belong.

Later Celtic immigrants introduced the La Tène stage of the Iron Age culture into general use in Ireland. They are likely to have arrived in small colonies, settling first in maritime districts and along the larger rivers.

The Celts established small states, the nucleus of each state (tuath) being a convenient place of assembly to which the freemen could resort, like country people to a local market, without having to lodge away from home. The chief who presided over such an assembly was entitled king. He also performed the functions of judge and leader in war. Besides the common assembly of freemen (oinach), there was a curia or senate (aireacht) of nobles, which met in the king's house. The nobles who composed it were known as the companions (celi) of the king — they may be compared with the king's hetairoi in Homer. In ancient theory, a tuath provided an armed levy of 3.000 men, but in the period of contemporary documents much smaller states are indicated. Each tuath formed a separate jurisdiction. A freeman was a citizen *(urrad)* in his own *tuath,* but a noncitizen (deorad) in any other tuath, having, however, a legal status which did not belong to a foreigner *(allmurach, muirchuirthe).* Common jurisdiction (cairde) for legal proceedings could be made operative by agreement between states. It was the tendency of these small states to group together under hegemonies, the king of one state of the group having a certain authority over the kings of the other states. Such groups could become permanent. The chief salient feature of the early Celtic regime is the division into five major groups of states, the five fifths of Ireland, so firmly fixed in tradition that in later times, when the country was divided into four provinces, these were called and are called at present by the Irish word meaning "fifths." The five fifths were:

Ulster (Coiced Uloth, "the fifth of the Uluti"), extending on the west as far south as Loch Boderg on the Shannon, on the east as far south as Drogheda; it was thus much larger than the later province. Its capital (*i.e.,* the seat of the chief king) was Emain, "the Navan," close to the city of Armagh.

North Leinster (Coiced Lagan Tuad-Gabair, "the fifth of the Lageni north of Gabair"). Capital: Temuir (Tara).

South Leinster (Coiced Lagan Des-Gabair, "the fifth of the Lageni south of Gabair"). Capital: Dinn Rig, on the Barrow.

Munster (Coiced Muman, "the fifth of Muma"), nearly coextensive with the counties of Limerick, Cork and Kerry, with part of Waterford. Capital: Temuir Erann, near Ardpatrick, County Limerick.

Connaught (Coiced Connacht, "the fifth of the Connachta"), including the present Clare but not extending east of the Shannon. Capital: Cruachain (Rathcroghan), in County Roscommon,

Social Order. — The population consisted of free, unfree and slaves. The freemen in the main were the freeholders of land, but their franchise extended also to the men of certain professions and skilled crafts. In the early Christian period, all ecclesiastics and all who received education in the schools of Latin were free. From this and from Caesar's statement of the immunities of the Gallic druids and their pupils, it may be inferred that the Irish druids and their pupils were freemen. The unfree were tenants of land, labourers and craftsmen of inferior kinds. Among the landed freemen, the nobles were distinguished by a higher measure of wealth and by having a sufficient number of clients (*celi,* "com-

panions"). The nexus between chief and client was formed by a personal contract which was terminable by either and was terminated by the death of either, differing thus from the hereditary connection of feudal lord and vassal. The clients were freeholders and retained their ownership of land. The chief advanced capital, usually in the form of cattle, to the client, protected his interests in court or assembly and was his leader in war. The client repaid the capital with large interest, attended on the chief at the assembly, followed him to war, supplied him with labourers for certain works and rendered him certain reliefs and fixed dues of hospitality. There were two classes of clients, free (*soercheli*) and subject (doercheli). A subject client received from the chief, in addition to an advance of capital, his own "honour price" (that is, the legal valuation of his franchise or status) and so ceased temporarily to be a freeman; he paid a tribute in meat, vegetables and malt for the support of the chief's house.

FIG. 2—ANCIENT IRISH HISTORY. THE "FIVE FIFTHS"-OF IRELAND ABOUT THE BEGINNING OF THE CHRISTIAN ERA

Ancient Ireland was divided into fifths, each ruled by its own king: Coiced Uloth (Ulster), with Ernain Macha as capital; Coiced Connacht (Connaught), with Cruachain as capitai; Coiced Lagan Tuad-Gabair (North Leinster), with Ternuir (Tara) as capitai; Coiced Lagan Des-Gabair (South Leinster), with Dinn Rig; and Coiced Muman (Munster), with Temuir Erann as capital

Normally, each freeman was a member of a fine or joint family, consisting of descendants of the same great-grandfather—in other words, extending to second cousins. For some purposes a wider extension of the joint family, as far as fourth cousins, was recognized. If a man died without issue, his property was divided in regulated shares among the members of his *fine*. In case of homicide, the compensation fixed by law was divided in like manner. A fine could be made liable for the undischarged liabilities of any of its members. When a kingship became vacant, any man whose father, grandfather or great-grandfather had been king was eligible to succeed. The power of election belonged to the freemen in assembly, but it seems to have been usual for them to accept a choice made first by a meeting of the nobles.

The Druids.—Druidism, known only in Transalpine Gaul, Britain and Ireland, but not recorded in Britain outside Anglesea, and the northern Pictland, is likely to have originated in Ireland. J. Pokorny's view, supported by Irish tradition, is that among the pre-Celtic inhabitants there existed a class of seers and sorcerers from which, under the Celtic regime, the druids were developed. The druids may be described as an association of professional wise men, philosophers in the early Greek sense, claiming to be experts in all the higher branches of knowledge. They professed special knowledge of the gods, the other world, the future life, the form and measurement of the earth, the movements of the heavenly bodies, the history of men; and they were accepted as authorities in matters of religion and law. They also claimed occult and prophetic powers. In the Roman world, after their suppression by the state, and in Ireland, after its conversion to Christianity, they were chiefly remembered as prophets and magicians. The notion that they were the priests of a particular religion is of modern growth. In Christian Ireland the druids continued to exist, but with a change of name and with limited scope. They were called filid, a name which in time became restricted to the meaning of poets (see IRISH **LITERATURE**: Gaelic) but which originally, signifying seers, denoted one of the functions of the druids. They no longer had authority in matters of religion but they long continued to practise occult rites of divination. In matters of learning they were displaced from the ground covered by the Latin teaching of the ecclesiastical schools. They remained the authoritative exponents of the national history, literature and law. In Gaul, notwithstanding the division of the country into so many independent states, the druids formed a single society, with annual conventions and an elected president. In Ireland the filid did not present this organized form, but they maintained an effective unity through a long course of centuries. They provided a single code of law for the whole country. They followed a common literary usage in writing and in minutely regulated rules of prosody which they all accepted. What Caesar tells of the long course of education of the Gallic druids and of the instruction given orally and in verse is paralleled in the filid. Like the druids, they enjoyed civil immunities. Their persons were sacred. The influence of druidism remains operative and distinctive in Irish history throughout mediaeval times. It can be traced in the conversion of the Irish to Christianity, in the development of the monastic schools, in Irish law, in the form and content of Irish literature, in lasting pedantic tendencies, but chiefly in a sense of national unity not dependent on political coherence.

Origin of the Monarchy.—The sagas of the Ulster cycle point to a rivalry for the hegemony of Ireland between the Ulster and the Connaught kings. In time the Connaught dynasty gained ground. Its kings crossed the Shannon and occupied Uisnech, dominating the fertile midland plain, probably in the and century. In the 3rd century they annexed the Boyne valley and made Tara their capital. These conquests broke up the pentarchy and gave a decided headship to the kings of Tara. Of them the most celebrated in tradition is Cormac, perhaps the first clearly historical personal figure in Irish history, reigning between the years 250 and 300. About this time, taking advantage of the disorder of the Roman empire, the Irish undertook plundering incursions into Roman Britain. A panegyric of Emperor Constantius in 290 speaks of the Britons as being already "accustomed" to Irish raids. Contact with the Roman military power had effects in Ireland. In imitation of the Roman walls in northern Britain, the Ulster kings protected their diminished territory by a massive earthwork, of which the remains are traced extending, with intervals of lake and forest, across the island from Dundalk bay to Donegal bay. A great quadrangular earthwork called the Dorsey, anciently *Doirse* Emna (the Gates of Emain), built no doubt in imitation of a Roman legionary camp, guarded the main road leading from Tara to the Ulster capital. The Roman military organization seems to have led to the formation of the *fiana*, permanent bodies of professional soldiers, peculiar in Ireland to this period. In the earlier heroic tradition there is no military organization. Later, the Irish law does not recognize the military profession, and no permanently formed Irish military forces are seen until the introduction of the galloglasses from western Scotland in the 13th century (see below). About A.D. 350, the Connaught-Tara dynasty captured Emain and annexed the greater part of Ulster. It reached the height of its power under Niall of the Nine Hostages at the beginning of the jth century. His sons took possession of the western part of Ulster, and their kindred now ruled all the northern half of Ireland except the eastern strip from the mouth

of the Bann to the mouth of the Boyne. The chief kings of this kindred, Dal Cuinn, were recognized as kings of Ireland until 1002.

The high kingship or monarchy was an acknowledged primacy, symbolic of the sense of national unity, rather than a politically operative institution. Its powers are nowhere found defined. It claimed no tributes from the suffragan kings except from the kings of Leinster, who denied the legality of the claim and yielded the tribute only to superior force. The assembly over which the high kings presided was held annually at Tailtiu, in the Boyne valley, and was regarded in a sense as national, but there is no instance recorded of its acting as legislative or administrative authority for all Ireland, in the manner in which the assembly of Carman, for example, acted for all Leinster.

In Munster the 4th century saw the rise of a strong dynasty, of the Eoghanacht sept (clan), whose traditions indicate a relatively late immigration from Gaul. Under its rule, the bounds of the older fifth were pushed out and reached in the 5th century an extent approximately the same as the modern province of Munster.

From the 5th century onward, the five major kingdoms of earlier tradition were replaced by seven. Of these, the older Ulster formed three—the kingdom of Ailech on the west, the kingdom of Airgialla (Oriel) in the middle and the kingdom of the Ulaid (Ulidia or Ultonia) on the east. The others were Connaught and Munster, both nearly coextensive with the modern provinces; Mide (Midia, Meath), comprising the greater part of older North Leinster and a small part of Ulster; and Leinster, consisting of the remainder of the two ancient Lagenian fifths. This division subsisted with little change down to the 11th century and is described in detail in the Book of *Rights* (10th century). The grouping, however, was in some particulars theoretical rather than actual. Eastern Ulster is to be regarded as containing three kingdoms of equal status—Dalriada, of which the kings ruled also in Scotland; Ulaid, the successor of the ancient Uluti; and Dal Araidi, a kingdom of the Picts. Osraige (Ossory), nominally in Leinster, does not appear subject to the king of Leinster. In each major kingdom or group kingdom, the component states or petty kingdoms were of two kinds, tributary and nontributary. The nontributary states were those whose kings were of the same sept as the superior king, though their pedigrees may have branched apart for centuries. In Munster, for example, about half the number of component states were ruled by kings of Eoghanacht lineage, and these were not tributary to the king of Munster, who was also of that lineage. Distributed all over the country were remnants of ancient subjugated tribes, the *Aithech-thuatha,* made tributary and held in political subjection.

Oversea Raids and Migrations.— From about the middle of the 3rd century, Latin writings bear constant evidence of Irish raiding expeditions, and the older Latin name Hiberni or Iverni is almost wholly replaced by a new name, Scotti, which appears to be a Celtic word meaning "raiders." Linked with the Scotti are found the Atecotti, also a Celtic word meaning "the very ancient folk," and probably distinguishing the Irish of pre-Celtic origin from the dominant Celts. Toward the end of the 4th century, large bodies of Atecotti were enlisted in the Roman service under Emperor Honorius. Irish tradition fully reflects the evidence of Latin writers. As the Roman power weakened in Britain, Irish raids were followed by migratory settlements. There is abundant evidence of Irish settlers all along the western seaboard of Britain from Argyll to Devon. Irish dynasties sprang up in Wales and lasted there for centuries. In the jth century, the kings of Dalriada, a small kingdom in the northeastern angle of Ulster, extended their power over the Irish settlers in Argyll and the neighbouring islands, their descendants ultimately, in the 9th century, becoming kings of Scotland. Crimthann, king of Munster, is said to have held a fortress in Britain. Branches of his sept settled in Wales and Cornwall. Niall of the Nine Hostages, who was high king at the end of the 4th century, is identified by W. Ridgeway with "the Scot" who, in Claudian's poem, "mobilized all Ireland" against Roman Britain. In his reign, St. Patrick was carried to Ireland as a captive and with him in the same raid, as his confession says and his epistle repeats, "so many thousands of men." At the head of a later expedition, Niall was killed at sea by a Leinster prince. His successor, Nath-i, heading another raid, died on the continent.

THE MIDDLE AGES

Introduction of Christianity.— There is evidence of Irish Christians, apart from the thousands of enslaved Christian captives, before the first Christian mission to Ireland. In 429, at the instance of Palladius, deacon of the Roman church, St. Germanus, bishop of Auxerre, was sent by the pope, St. Celestine, to combat the Pelagian heresy in Britain. It was doubtless in answer to an appeal made through Germanus that, in 431, "Palladius was sent, their first bishop, to the Scots believing in Christ." After a short stay in Ireland, Palladius passed over to northern Britain, where he died soon after his arrival. In 432 Patrick, a disciple of Germanus, was sent as bishop to Ireland. He was a Briton, son of a decurion under the Roman government, and probably a native of Gwent in Monmouthshire. He was carried off as a captive in the reign of Niall and became a slave in northeastern Ulster. After six years he escaped. His birth may be dated in 385, his capture in 401, his escape in 407. His mission in Ireland succeeded rapidly. In 438 he was favourably received at the court of the high king, Loiguire, son of Niall. In 439, doubtless in answer to a request sent to his patron Germanus, three bishops were sent to his assistance, Secundinus, Auxilius and Iserninus, the last also a disciple of Germanus. Patrick chose for his own see Armagh, beside the ancient Ulster capital. Secundinus had his church near Tara, the seat of the high king; Auxilius, near Naas, also a royal seat in Leinster; Iserninus, driven out at first by Enda, king of Leinster, was restored later by Enda's son Crimthann, a Christian convert, and fixed his see at Aghade, near Rathvilly, where Crimthann lived. There is evidence that Patrick chose Baislex (Basilica Sanctorum), near Cruachain, the capital of the kings of Connaught, as the see of a bishop for that kingdom.

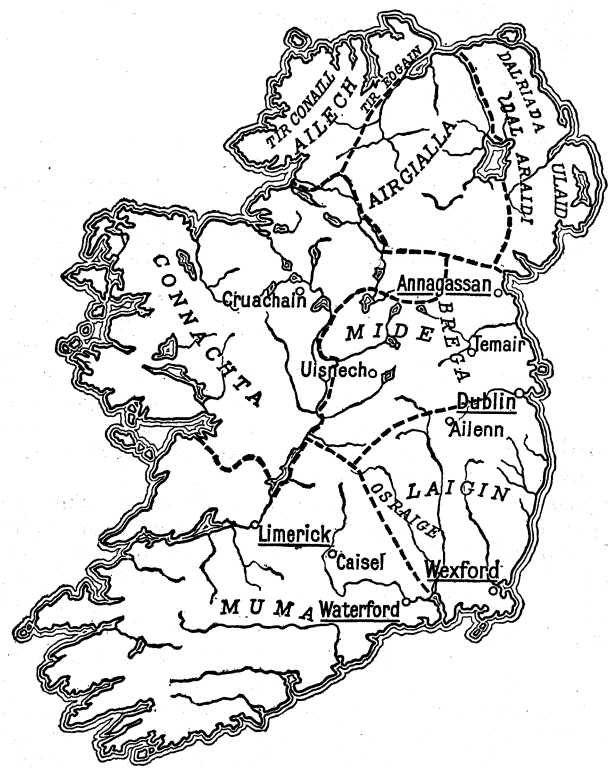


FIG. 3.— MAP OF THE SEVEN MAJOR KINGDOMS OF IRELAND, A.D. 500–900
These were Allech (Donegal); Alrglalla (Londonderry, Arrnagh and Monaghan); Ulaid (Antrim and Down); Connachta (Connaught); Murna (Munster); Mide and Brega (Meath); and Laigin (Leinster)

In the story of St. Patrick's reform of Irish law one might see an influence transformed by tradition into an event. A druid fore-

told to Loiguire: "He shall free slaves, he shall raise up men of lowly kin." In the written laws, two centuries later, a slave class no longer exists. St. Patrick's epistle condemns the enslavement of Christians. The earlier racial distinctions between conquerors and conquered, between Pict and Celt, survive only in antiquarian tradition, and all become known by the common name Goidel (Gaels) or Fir Erenn (Men of Ireland).

The Ascendancy of the **Ui Neill.**—The descendants of Niall, Ui Neill, acquired territories in the regions annexed by conquest to their ancestral kingdom, Connaught. The other branches of their kin remained in Connaught. Loiguire was succeeded as high king by Aillill Molt of a Connaught branch. Niall's descendants combined against Aillill, who was defeated and killed in the battle of Ocha, A.D. 483. Thenceforward, until 1002, the high kingship was held exclusively by the line of Niall. One group of his descendants, the "northern Ui Neill," held western Ulster. Another group, the "southern Ui Neill," dominated Mide, the main part of the old North Leinster fifth. In 563 the Pictish territory west of the Bann river was annexed by the northern Ui Neill. In 575 the high king, Aed, son of Ainmeri, held an assembly at Druim Ceta, on the border of that territory, and decisions were adopted limiting the privileges of the *filid* and regulating the relations of the kingdom of Dalriada in Ireland to the kings of Dalriada in Scotland and to the kings of Ireland. In 637 Domnall, king of Dalriada, invaded Ireland from Scotland. He was defeated in the battle of Mag Roth (Moira) by Domnall, king of Ireland.

After the battle of Ocha, the high kingship passed without any regularity from one branch to another of the Ui Neill, being held by descendants of five of his sons. In 734 Flaithbertach, of the line of Conall, son of Niall, was deposed by Aed Allan, of the line of Eogan, son of Niall. Thenceforward the succession was confined to two branches, the kings of Ailech, descendants of Eogan, and the kings of Mide, descendants of Colman, these being, respectively, chief kings of the northern and southern Ui Neill, and the high kingship was held by the kings of Ailech and Mide in a regular alternation, interrupted only twice, by the reigns of Congalach, king of Brega, 944–956, and of Brian Boroimhe (Boru), 1002–14.

Development of Monastic and National Culture.— The great development of Latin learning and of the monastic schools takes its origin from St. David's school of Menevia in Wales about A.D. 500. The kingdom of Dyfed (Demetia), in which this school was situated, had originated as an Irish colony and remained in close intercourse with Ireland. St. David was partly of Irish ancestry and his school attracted many from Ireland. Among its earliest pupils was St. Finnian, who founded the monastery and school of Clonard about 520. Clonard became the parent of other noted monasteries, notably Clonmacnoise and Bangor, and, through its most famous pupil, St. Columba, of Derry, Durrow, Kells and other foundations in Ireland, as well as of Iona.

The language of these schools was Latin. The Latin classics were held in high esteem and in some instances survived because of Irish zeal. When Theodore set up the teaching of Greek in Canterbury, he was beset by students from Ireland "like a wild boar surrounded by a troop of furious wolves." Scribes were continually at work providing copies of books. In the decoration of the more precious books, the art of illumination was highly developed. On the humanistic side, monastic learning was influenced by the traditions of druidism. In the 7th century a fusion of the two cultures came about. In its early years a monastic chronicler introduced a framework of Irish history into his redaction of the Chronicle of Eusebius. A young noble, Cennfaelad, of the line of Niall, wounded in the battle of Moira (637), became a student in Tuaim Regon, where schools of the monks and the *filid* existed side by side. He broke away from the old druidical tradition by writing down the mnemonic formulas of Irish law. Cennfaelad, who died in 679, also wrote a number of poems on historical events and a short tract on the grammar of Irish. During the 7th century an Irish written literature in prose and verse was extensive.

The Irish Missionaries.— In 563 Columba, then 43 years of age, a descendant of Niall and a pupil of Clonard, having already founded the monastery of Derry on the site of the present city, ied a colony of monks to the island of I (Iona), granted to him by the king of Dalriada. This was the beginning of the Irish missions overseas, the "surplus product" of the monastic schools. The work of Irish missionaries among the Picts, Angles and Saxons belongs to the history of Britain. The continental missions began with Columban of the monastery of Bangor in Ulster, who, with a few companions, arrived in France about 574. Their range extended in time over a large part of France, the Netherlands, Germany, Austria, Switzerland and Italy.

The early missionary movement had its natural sequel in the sphere of learning. The part taken by Irishmen in the Carolingian revival of learning belongs to Irish history inasmuch as it exhibits the mental training given in Irish monastic schools and the scope and character of their studies. Clement the grammarian had a kno ledge of Greek. Dicuil wrote a geography of the world in which he shows that his countrymen had travelled as far as Egypt and had discovered Iceland. Dungal, theologian and grammarian, wrote for Charlemagne an explanation of the solar eclipse of 810. Virgilius taught the existence of the Antipodes. Eriugena, for his knowledge of Greek and the boldness of his philosophical speculation, is the most prominent intellectual figure of his time. At Glastonbury, under Irish masters, St. Dunstan studied arithmetic, geometry, astronomy and music. Irish monasteries, in Ireland and abroad, were also prominent in the cultivation of music.

The Paschal Controversy.— The Irish church, in the dating of the Easter festival, followed a method introduced by its founders. Irish missionaries abroad found a different method under papal authority. About 631 the Roman computation was introduced in the southern parts, in northern Ireland somewhat later. Iona held out longest for the Irish tradition. even in opposition to its abbot, the celebrated Adamnan, and did not adopt the Roman Easter until 716, 12 years after his death.

Rural Economic Development.— The Irish laws point to a large development of rural industry in the period in which they were first written, preceding the Norse incursions. They deal minutely with the enclosure, subdivision and fencing of lands for tillage, the measurement and valuation of land, the management of crops and domestic animals, and innumerable details of husbandry, including milling. dyeing, spinning and weaving, dairying, malting, meat curing, etc. The principal crops were wheat, barley, oats, flax and hay. Dyestuffs were grown. Irish hounds were in high repute. St. Patrick, in his escape from captivity, joined a company of Irish traders whose chief merchandise was hounds. Watermills were owned and worked jointly by landholders.

Norse Invasions and Settlements.— The first appearance of the Norsemen on the Irish coast is recorded in 795, their first inroad in 807. Thenceforward there were frequent plundering raids, sometimes far inland. By degrees the Norsemen took possession of all the islands of Scotland, of Caithness, Argyll, Galloway and of the Isle of Man. In 841 they seized and fortified two ports, at Annagassan, between Dundalk and Drogheda, and Dublin. About the same time a fleet under Thorgest passed up the Bann to Lough Neagh. He afterward sailed round to the Shannon and took possession of Lough Ree in like manner. Thorgest was captured in 845 and put to death by Mael-Sechnaill, king of Mide, who in 846 became king of Ireland. Large invading forces were defeated in 847. The turning point of these invasions was reached in the reign of Aed Findliath, high king from 862 to 879, who forced the Norsemen to abandon all their stations in the northern parts of Ireland. At the same time the Norse kings of Dublin reached the height of their power, waging war in England and Scotland, and so nearly dominating Ireland that in 873, 876 and 878 the high king was unable to hold the assembly of Tailtiu. Waterford in 914 and Limerick in 920 were occupied by the Norsemen without opposition. In 917 Niall Glundub, high king, endeavoured to dislodge them from Waterford but they defeated a Leinster army coming to his assistance and forced him to withdraw. In 919 Niall led an army against Dublin, and in a battle where the Phoenix park now lies he was defeated and killed. The permanence of the Norse settlements in Dublin, Waterford and Limerick became assured. Landed colonies spread out from Dublin and Waterford. Without quite abandoning piracy, the

vikings became traders in close intercourse with the Irish, and their commercial towns formed a new element in the life of the country, typified in Wexford, which did not appear in warfare until the siege of 1169. The combination of war and commerce led to a recrudescence of slavery, and imported slaves are mentioned in the Book of *Rights* (about A.D. 900).

About 964 Mathgamain, king of Dal Cais, one of the petty kingdoms of Munster. became king of Munster, displacing the ancient Eoghanacht line. In 968 he defeated the Norse of Limerick and captured their city. In 976 he was captured and put to death by two Eoghanacht princes, one of whom, Mael Muaid, became then king of Munster. In 978 Mael Muaid was defeated and put to death by Brian, brother of Mathgamain. Brian, having gained the kingdom of Munster, steadily increased his power. His claim to suzerainty over Leinster forced the Leinster king into close alliance with the Norse of Dublin. In 999 their united forces were defeated by Brian at Glen Mama, near Dublin, and they agreed to become his allies and supporters. In 1002 Brian became king of Ireland by the submission of the high king Mael Sechnaill II. The Irish and Norse accounts agree in bearing witness to the high character and good government of Brian. The kings of Dublin and Leinster, however, chafed under his suzerainty. In 1013 Sigurd, earl of the Orkneys, had for a Christmas guest the Norse king of Dublin, Sigtrygg, and a compact was made between them. Sigurd was to gather from all parts the greatest possible host of Norsemen and to bring them before Easter to Dublin, where they were to be joined by the forces of Dublin and Leinster to give battle to Brian; if they were victorious, Sigurd mas to have the kingdom of Ireland. Brian learned of these preparations and met the Norse army at Clontarf, near Dublin, on Good Friday, 1014. He was joined by the deposed high king, Mael Sechnaill. The Norsemen and their Leinster allies were defeated and Earl Sigurd was slain, but a viking chief, who had taken refuge in a wood, sallied out in the rear of the Irish army and killed Brian in his tent.

Though the battle of Clontarf removed the prospect of a Norse conquest, it brought a period of unsettlement. All the chief dynasties had lost their prestige, and, except in Connaught, new rivalries and fresh pretensions to power, based on force and careless of tradition, arose everywhere. Brian's son Murchad, who had already gained a reputation hardly less than his father's, had fallen in the battle. Of the sons who survived, none was able to sustain Brian's power. Mael Sechnaill was restored to the high kingship and held it until his death in 1022. After him for half a century there was no acknowledged king of Ireland.

Then followed the period of the high kings "with opposition"; *i.e.*, not acknowledged by a minority of the provincial kings: Toirdelbach, grandson of Brian, 1073–86, and his son Muirchertach, 1086–1114, kings of Munster; in opposition were Domnall Ua Lochlainn, king of Ailech, who died in 1121; Toirdelbach Ua Conchubair, 1118–56, king of Connaught; Muirchertach Ua Lochlainn, 1156–60, king of Ailech; and Ruaidri Ua Conchubair, 1166–74, king of Connaught. The centralized feudalism established in England by William the Conqueror had an apparent influence on the policy of these kings. One after another they sought, for the most part without success, to set aside the ancient tradition of local autonomy and to exercise direct authority outside their hereditary jurisdictions. Thus Toirdelbach Ua Conchubair in 1118 divided Munster into two coequal kingdoms; in 1125 he deposed the king of Mide and appointed three kings in his stead; in 1126 he made one of his sons king of Dublin and Leinster; and in 1129 he built the first castle in Ireland, commanding the passage of the Shannon at Athlone.

The last effort to establish Norse domination was made by Magnus, king of Norway. who in 1098 arrived with a strong fleet and restored the Norwegian sovereignty over the Scottish islands, Cantire and the Isle of Man. In 1102 Magnus, then in Man, threatened an invasion of Ireland but agreed to a year's truce. In 1103 he landed on the Ulster coast, where he mas killed.

The period of political ferment which followed the success of Brian over the ancient chief dynasties was also a period of new growth in religion, literature and the arts. The movement for religious reform, mainly in the direction of a Catholic uniformity and the removal of abuses in matters of ecclesiastical discipline and observance, was led by Gillebert, bishop of Limerick, and Cellach (Celsus), bishop of Armagh and primate, in the beginning of the 12th century, and by the successor of Cellach, Maelmaedoc Ua Morgair, better known as St. Malachy. The outstanding feature of the abundant literary output of this time is enthusiasm for ancient national tradition. It became customary to compile tomes, each forming a kind of library of traditional lore, comprising sagas, poems, genealogies, etc. A number are still extant.

(E. MacN.; JA. Hn.)

The Anglo-Norman Invasion.— As early in his reign as 1155, Henry II of England had through his envoy, John of Salisbury, received from Pope Adrian IV the grant of Ireland "as an inheritance," on condition that he should reduce to order the Irish church and state. The so-called "bull," *Laudabiliter*, which defines this grant, rests on the sole authority of Giraldus Cambrensis; how far it is genuine is one of the puzzles of history. but the general submission of the Irish to Henry later would imply that some such papal privilege was in the air.

Henry had to put his project aside for the time, and, when the invasion came, it was a feudal one and directed from south Wales, which was full of Norman adventurers. The first invaders, Maurice Fitzgerald, Robert Fitz Stephen, Raymond "le Gros" de Carew and others, were sons or grandsons of the famous Welsh princess Nesta and vassals of Richard FitzGilbert de Clare, earl of Pembroke, called "Strongbow" in Irish tradition.

Their opportunity came when Dermot MacMurrough, king of Leinster, expelled by his enemies, decided to seek aid in England and arrived in Bristol with his beautiful daughter Eva (Aoife) in Aug. 1166. He was referred to Henry, found the king in France, was graciously received and given permission to raise forces in Britain. Returning to Wales, he won FitzGilbert over by the offer of his daughter's hand with apparently the succession to Leinster. He also enlisted "the sons of Nesta" in his cause, and they found volunteers among the Welsh and Flemings of south Wales and Pembroke. Returning to Leinster, where his son Donal Kavanagh, whom Giraldus calls illegitimate, was holding out for him, he held his ground until successively Fitzgerald, Fitz Stephen, Raymond and finally Lord Richard himself arrived, the latter landing at Waterford in Aug. 1170 with 200 knights and 1,000 men-at-arms.

The successes of Dermot, backed by these professional fighters, were rapid; Danish Waterford was taken, the marriage of Eva and the earl celebrated, and by a rapid march Dublin also was captured and a relieving force under the high king scattered, late in 1170. Leinster and Ossory were reduced, but the death of Dermot the following May made the situation difficult. The Irish regarded his son Donal as the true heir, but FitzGilbert considered himself king of Leinster, and anyway in feudal theory was, in virtue of his wife. lord of the province. But he was hemmed up in Dublin in midsummer by a national levy raised by Roderick (Ruadri, or Rory O'Connor), king of Connaught, and though this attack was repelled it was uncertain whether he could hold his own. Therefore when Henry, fearful lest a new Norman state should arise across the Irish channel, resolved to come to Ireland, Strongbow placed his conquests at his suzerain's feet.

Henry landed near Waterford on Oct. 17, 1171, with an imposing army, but a conquest in arms was not necessary, and in fact the peaceful submission of the Irish leaders was prompt and widespread. The king marched to Lismore and Cashel and finally to Dublin, where he spent the winter, leaving Ireland on April 27, 1172. In this short period he managed to set up the rough essentials of a government. At Dublin and elsewhere he received the homage of all the kings of Ireland except those of Connaught and Ulster. To Strongbow he granted the land of Leinster; he confirmed the Geraldines and others in their fiefs, and annexed to the crown the Danish kingdom of Dublin. He gave the capital to "the men of Bristol," took the Ostmen under his protection and appointed Hugh de Lacy governor of the colony. He did not scruple to confer on De Lacy the whole of Meath, though its native king, O'Melaghlin, had recently submitted, and the grant illustrates the inevitable clash of feudal and Irish law. Meanwhile during

the winter the Irish bishops met at the synod of Cashel and, after enacting various reforms, declared (according to Giraldus): "Divine offices shall be celebrated according to the forms of the Church of England, for it is just and right that as Ireland has received her lord and king from England, she should accept reformation from the same source." This of course was an inspired assurance of the task with which the papacy had commissioned Henry. The submission of the church was complete, nor was it a packed assembly, for though Christian, bishop of Lismore and papal legate, seems to have been on Henry's side, Laurence, archbishop of Dublin, and the native prelates of Cashel and Tuam were present. Thus Ireland was presented to the English crown as a papal fief; such was the basis of its authority till 1541, and the Irish themselves accepted the fact.

Meanwhile the adventurers were attacking Desmond, though its king had submitted to Henry; De Lacy was organizing Meath, and John de Courci conquered in Antrim and Down a principality for which he could show no royal patent. Strongbow enfeoffed Leinster deeply with Normans, giving the barony of Naas, for instance, to Maurice Fitzgerald. Strongbow died in 1176, leaving only a daughter, who later married William, the earl marshal, and brought to him "the land of Leinster." Ulster and Connaught were unconquered, and in 1175, by the treaty of Windsor, Henry acknowledged Rory O'Connor as king of Connaught under him.

English Overlordship.— At the Council of Oxford in 1177 Henry created his son John *Dominus Hibernie* and granted Desmond to Robert Fitz Stephen and Milo de Cogan. Eight years later (1185) John himself visited Ireland. A fresh series of grants was made, and William de Burgh and Theobald Walter "le Botiller" got wide lands in north Munster and Theobald de Verdun about Dundalk. The resentment of the Irish was shown in the assassination of Hugh de Lacy, and the lesson was taken to heart later in John's reign when Cathal Crovderg O'Connor, brother of Rory, was confinned in the kingdom of Connaught and Donnchad O'Brien in that of Thomond west of the Shannon.

Under John the lordship of Ireland was united with the English crown, and to this king belongs the credit of first establishing a civil government at the expense of the conquistadors. He dispossessed De Courci and gave the earldom of Ulster to Hugh, brother of Walter de Lacy, earl of Meath; but he soon repented of making this family too great, and in a personal campaign in Ireland in 1210 expelled them both. During his short stay in Dublin he organized a permanent government under a justiciar, and "with the common consent of all men of Ireland ordained that the laws and customs of the realm of England should be kept therein."

After his defeat over Magna Carta, John had to restore the De Lacys, and the feudal caste under Henry III bent its energies upon the subjection of Ireland. When Richard de Burgh got a grant of all Connaught despite the claims of Felim O'Connor, conquered it and divided it among his followers (1235), and Maurice Fitzgerald acquired a claim to Tyrconnell, a complete conquest seemed probable. But during this period two great native dynasties arose in Ulster, the O'Neills and O'Donnells, and they repelled the Norman attacks, finding a new and potent weapon in those professional fighters, the galloglaigh or galloglass (a word meaning "foreign soldiers"), Hebrideans of mixed Gaelic-Norse blood who now began to flock into the north. On Connaught, however, the De Burghs kept firm hold, leaving to the O'Connors only a few cantreds of Roscommon. The power of this family was increased when in 1264, after the extinction of the De Lacys, Walter de Burgh was created earl of Ulster. The native Irish, though only partly successful, now broke the spell of Norman victory. Brian O'Neill was elected high king and raised a Gaelic confederacy, but was defeated and slain at Downpatrick in 1260. But the next year the MacCarthys overthrew a colonial army at Callan and thenceforth ruled undisturbed over southwest Munster, their chief taking the name MacCarthy More. So when Edward I, in 1276, granted to Thomas de Clare the "land of Thomond," Turloch O'Brien took up arms, and the De Clares were finally expelled in the war which ended in 1318.

In the early years of Henry III the central government was steadily built up. Magna Carta was sent over, the whole framework of English law was introduced, and Ireland had an administration under the justiciar and a parliament of peers and prelates, while the county organization was extended over the planted areas.

Great numbers of the Gaels had fallen under Norman lords, and, while some were already villeins *(betaghs)* under the old system, and remained so on the new manors, many of the colonists tried to reduce all Irishmen to the same level. Those living among the English and suffering from a denial of English law strove to procure it, but though the government was not unwilling the colonists opposed emancipation. The Irish who lived under brehon law (*q.v.*) had less desire to exchange it for English law, but under the pressure of the new domination they naturally aspired to have its legal advantages. The chiefs especially sought to have their tenures legally established under the crown, a benefit which, except in a few minor cases, had been denied them. The royal government was to blame for not embracing the Irish within the law by edicts rigidly enforced, but, indeed, to reconcile and blend two peoples so far apart in language and tradition was a huge task which only a resident monarchy could have achieved.

Under Edward I a second attempt was made to create a real central authority, and a series of justiciars, of whom John Wogan, viceroy from 1295 to 1307, was the ablest, extended the area of common law and did something to reduce the feudal liberties. The baronial interest, however, was too strongly entrenched, and Edward had to placate it, so he added to the ranks of the magnates by giving "the land of Decies and Desmond" to Thomas, head of the Munster Fitzgeralds. Wogan's greatest achievement was to summon a parliament in 1297 in which knights and the common clergy were included and nine shires and five liberties sent representatives. In 1310 the towns also sent deputies, and thus Ireland received a legislative body which lasted till 1800. It was an Anglo-Irish assembly in which the native people had no spokesmen.

A series of disasters now shook the ill-founded state to its very base. Fresh from his victory at Bannockburn, Robert Bruce dispatched his brother Edward to win the crown of Ireland, which a league of Irish chiefs under Donal O'Neill, *Rex Ultonie,* offered to him. When Edward Bruce landed with an army of veterans near Larne in May 1315, almost all the natives rose in arms, and not a few of the older stock of the Englishry joined him. He defeated Richard, the "red earl" of Ulster, at Connor. On May day, 1316, he was crowned king of Ireland on a hill near Dundalk, "the Gaels of Erin proclaiming him king of Ireland," says the *Annals of Loch Ce.*

The English cause was at last saved; Bruce failed to take Dublin, Felim O'Connor, at the head of a great Irish confederacy, was defeated and slain by a colonial levy at Athenry in Aug. 1316, and a new viceroy, Roger Mortimer, put spirit and energy into the government. Bruce himself was overwhelmed at Faughart, near Dundalk, by an army under John de Bermingham, and fell in the battle (Oct. 1318). The Scottish fire was thus quenched and Edward II recovered a kingdom he deserved on every count to lose. Little or no vengeance was taken, and Mortimer was instructed to admit the aggrieved Irish to English law and liberty, an edict again without much effect.

The Irish Revival.——For a time all seemed fair, and the peerage between 1316 and 1329 was strengthened by the creation of new earldoms—that of Kildare, given to John, head of the Leinster Geraldines; that of Desmond, given to Maurice, head of the Munster Geraldines; and that of Ormonde, given to James Butler. In Ulster, the true key of the colony, the power of the earls now covered the whole coast from Carlingford to Derry. But an element of discord was found in the older colonists, who resented the dominance of the great lords, claimed that succession should go to heirs male instead of heiresses who conveyed lands to English absentees, and began to form clans of their own *(naciones et cognomina)*. In 1333 the young earl of Ulster, William, was murdered by his own tenants, the Mandevilles, near Belfast, leaving only a daughter who later was married to Lionel, duke of Clarence. The O'Neills became supreme in mid-Ulster and the

greater part of Antrim and Down, where they founded a new state, Clandeboy.

Connaught was at the same time lost to the English interest. Two cousins of the murdered earl, Ulick and Edmund de Burgh, seized on the family lands and founded, respectively, the Burkes of Clanricarde and Mayo, known to the Irish as MacWilliam Uachtair, "the upper MacWilliam," and MacWilliam Iochtair, "the lower MacWilliam." Though they maintained a certain English tradition of law and land tenure, spoke French and boasted their continental descent, they were obliged amid so Irish a population to speak Gaelic and marry Irish wives.

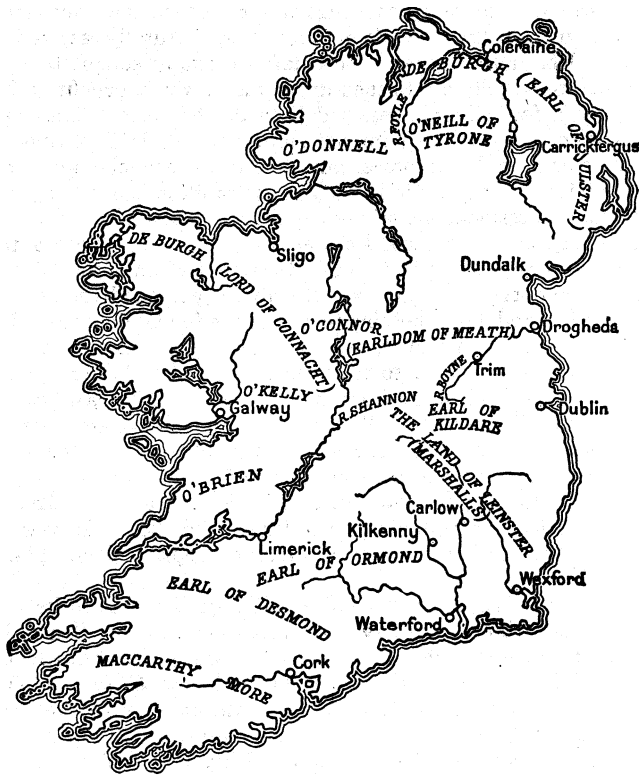


FIG. 4. — MAP OF MEDIAEVAL IRELAND, SHOWING THE LANDS OF THE RULING FAMILIES WHEN THE ENGLISH POWER WAS AT ITS HEIGHT, *c.* 1330 In addition to the counties governed directly from Dublin, several great earldoms had been created at this date; but that of Meath, belonging to the Lacya, had, owing to the extinction of this family, fallen into two portions, that of W. Meath (De Verdun) and that of Trim (Mortimer)

As a result of such events an Irish revival alike in arms, language, law and civilization displayed itself in every part of the island, and the Gaels recovered large parts of Ulster, the midlands, Connaught and Leinster. Even in the latter province the MacMurroughs became the terror of the lowland English, and the descendants of Donal Kavanagh resumed the title "king of Leinster." Absenteeism there had left the lordships of Carlow and Wexford open to Irish attack.

Efforts to Restore English Lordship.--Only a great army led by the king in person could have reconquered Ireland, and the young Edward *III* had thoughts of going there, but he soon abandoned Ireland for Scotland and France. The colony dwindled, and an Anglo-Irish parliament at Kilkenny in 1341, summoned without leave by the earl of Desmond, expressed its resentment against "the English by birth" who misgoverned Ireland, and complained of the decay of the revenue and the loss of a third of the land to the Irish. The capacity of this "middle nation," "Irish to the English and English to the Irish," to turn into temporary rebels was often to puzzle England.

Finally a royal prince was sent, and Lionel, duke of Clarence, ruled as viceroy for six years (1361–67). The Statutes of Kilkenny are the one memorial of his rule. These enactments defined the "English" or "obedient" land as the counties and liberties of Louth, Meath, Trim, Dublin, Carlow, Kildare, Kilkenny, Wexford, Waterford and Tipperary. The decay of the colony was attributed to a general lapse into Irish language, law and usage, to intermarriage and fosterage and to the maintenance of Irish bards. Therefore the English were forbidden to make such alliances with the Irish or to use brehon or "March" law, and, along with the Irish who dwelt peaceably among them, were ordered to take English surnames, speak English and follow English law and custom.

The purpose of these statutes was to preserve as large an area as possible for England at the cost of abandoning the rest. The king's sovereignty over the whole island was not renounced, but the independent Irish were thenceforth treated as "Irish enemies," outside the pale of English law and loyalty and unable to plead in or profit by the civil courts, to marry or to purchase, possess or inherit land among the English. Up to the end of the 16th century the chiefs were held to have no right to their lands except by prescription and usurpation.

But nothing could recall the "degenerate English" from friendly intercourse with the *meri Hibernici.* The old Gaelic civilization, badly shattered in the 13th century, recovered much of its strength in the 14th, and, with its music and poetry, the charm of its language and its women and the aptness of its law, laid an irresistible spell on the older Englishry.

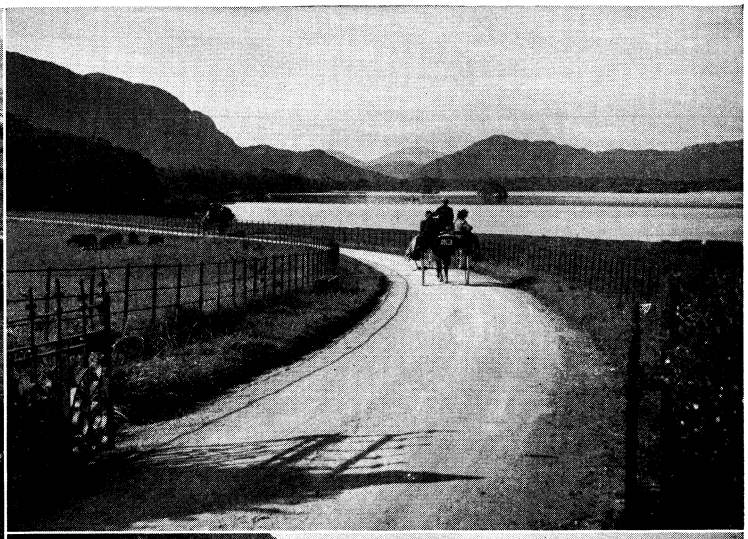
The marriage of Lionel's only daughter to Edmund Mortimer, earl of March and lord of Trim, carried to him the earldom of Ulster, and this great lord went to Ireland as viceroy in 1380, but died prematurely. Buying off the more powerful Irish chiefs by paying them "black rents" to keep the turbulent clans in order was now the poor device of the colonists, whose most dreaded foe was Art MacMurrough, king of Leinster. More than anything else, this chief's activities brought about the first royal visit since 1210. Richard II arrived at Waterford in Oct. 1394 with a large army, attended by Roger Mortimer and other peers, and stayed in Ireland till May 15, 1395. His general policy for the "Irish enemies" was to secure their homage and confirm them in such lands as they had not "usurped," but with one exception; Art MacMurrough and his Leinster *urraghts* or vassals were to be induced to evacuate Leinster for other parts of Ireland and leave the province open to a new English plantation. This was achieved in both cases on paper; almost all the ruling chiefs, headed by Niall O'Neill, *Princeps Hibernicorum Ultonie,* came in and did, liege homage and entered into indentures with the king.

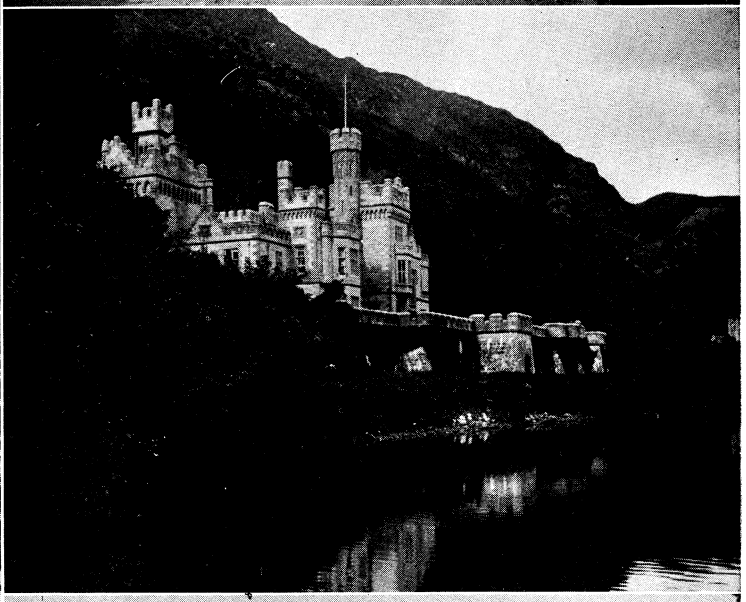
But on Richard's departure MacMurrough refused to fulfil his extraordinary bargain. Robert Mortimer, left behind as viceroy, was slain by the Wicklow Irish in 1398, and Richard in fury hurried over to Ireland again in 1399. His armies could do nothing against the light-armed Irish in their forests, and the king returned to England.

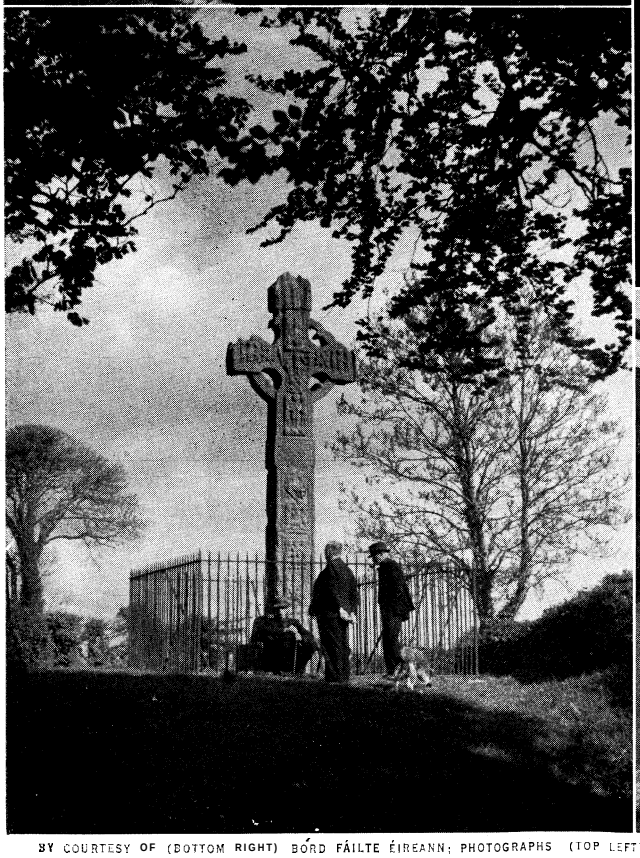
There is little of importance to record of the dwindling "English land" during the Lancastrian period. An occasional strong viceroy, such as John Talbot, afterward the famous earl of Shrewsbury, could do little against the "Irish enemy," the "degenerate English" and the "English by blood," who resented government from Westminster. A hope of uniting the Celts and Englishry was found in Edmund Mortimer, now earl of Ulster, who went to Ireland as viceroy and received the homage of O'Neill and other chiefs but died of the plague in 1425. The old English and the Gaels transferred their affections to his nephew, Richard, duke of York, and in the wars of succession in England were almost to a man for the White Rose.

The Great Earls. — In reality three great earls now ruled Ireland. The greater part of counties Limerick, Cork, Kerry and Waterford with their towns had come under the absolute rule of the earls of Desmond; James "the White," 1st earl of Ormonde, had extended the power of the Butlers in Tipperary and Kilkenny; and the earls of Rildare were dominant in Leinster. The three families worked together, dominated the Dublin government in spite of an "English interest" headed by Talbot, took the lead of an Anglo-Irish home rule party and built up a rampart of feudal independence that later took the Tudors almost a century to break down.

"Aristocratic home rule" may till 1495, and indeed till 1532,





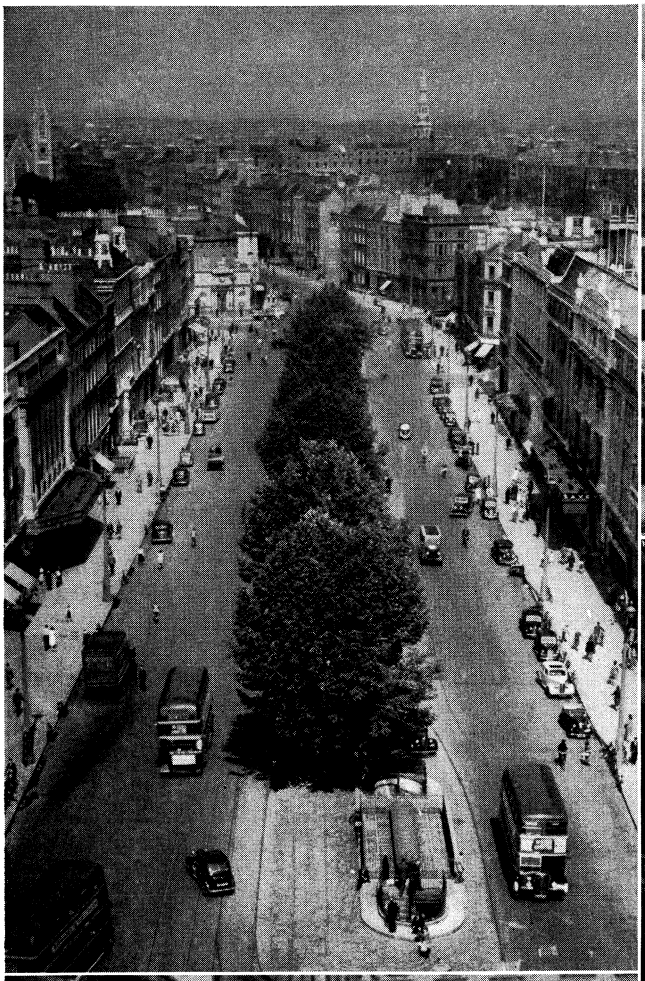


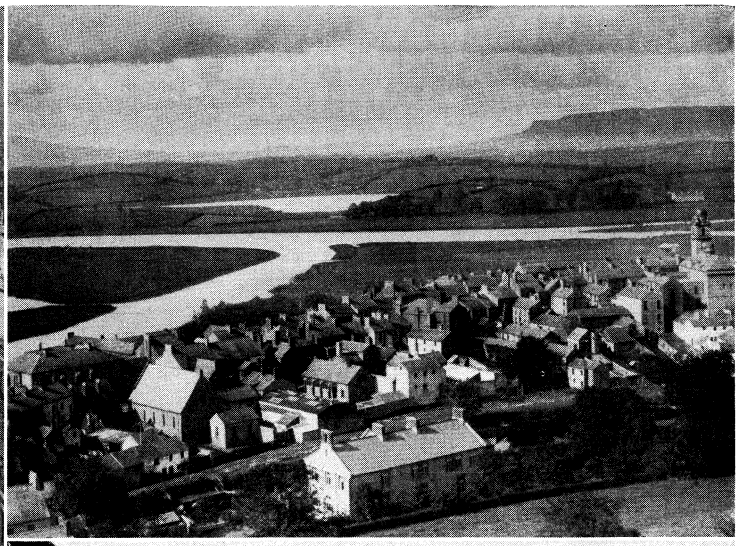
BY COURTESY OF (BOTTOM RIGHT) BÓRD FÁILTE ÉIREANN; PHOTOGRAPHS (TOP LEFT) EWING GALLOWAY, (TOP RIGHT, CENTRE RIGHT) BURTON HOLMES FROM EWING GALLOWAY, (BOTTOM LEFT) TIERS FROM MONKMEYER

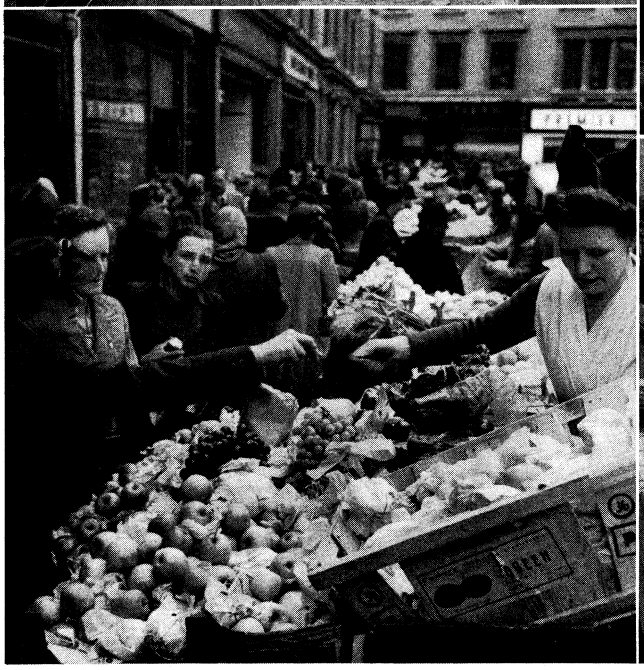
THE IRISH COUNTRYSIDE

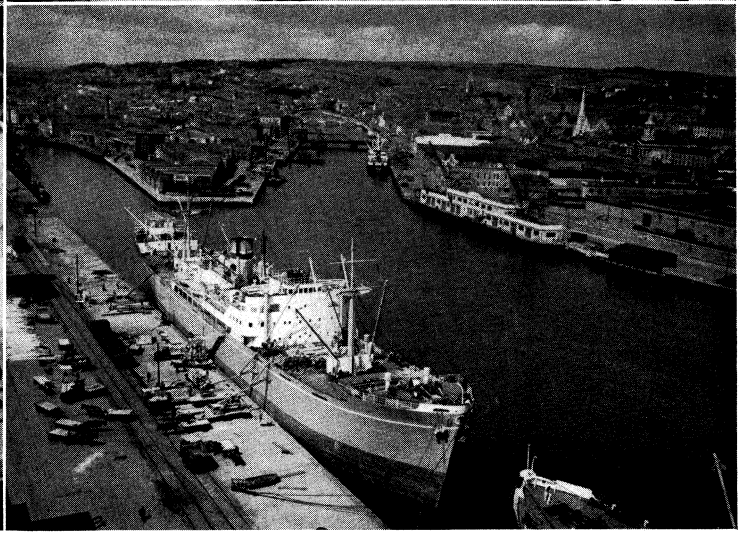
Top left: **Thatch-roof farmstead**
Top right: **View of Muckross road along the Lakes of Killarney**
Centre right: **Kylemore abbey, on one of the lakes of Connemara, County Galway**
Bottom left: **Arboe cross, County Tyrone, Northern Ireland, remnant of a Celtic monastery**
Bottom right: **Stable boys leading horses out for exercise, national stud farm, County Kildare**

IRELAND









BY COURTESY OF (TOP LEFT. BOTTOM RIGHT) BÓRD FÁILTE ÉIREANN; PHOTOGRAPHS. (TOP RIGHT) BURTON HOLMES FROM EWING GALLOWAY, (CENTRE RIGHT) EWING GALLOWAY, (BOTTOM LEFT) KOSTI AUOHOMAA FROM BLACK STAR

CITIES OF IRELAND AND NORTHERN IRELAND

Top left: View of O'Connell street from Nelson pillar, Dublin
Top right: Enniskillen, N.Ire., a market town on an island and ancient stronghold of the Maguires
Centre right: Shipauay gate and, beyond, the Guildhall, Londonderry, N.Ire.
Bottom left: Market scene, Dublin
Bottom right: City of Cork, showing docks along the river Lee

be written over Anglo-Irish history. The Wars of the Roses were to the old English an occasion to secure colonial independence. Richard, duke of York, who became lord lieutenant in 1449, played up to the enthusiasm that was at once displayed for his person and name. All Ireland believed him to be the true heir to the English crown and greeted with enthusiasm the hereditary claimant, who in return was expected to rule Ireland by Irish ideas. Hence, when he arrived as a defeated refugee in 1459, the Irish parliament greeted him almost as a king, but proceeded to declare that the land of Ireland was bound only by the statutes of its own estates. When his son Edward ascended the English throne, Ireland seemed to have the king of its choice, and the earldom of Ulster was merged in the crown. James, earl of Ormonde, taking the Lancastrian side, was executed after Towton, and his house attainted. His two brothers, successively earls, spent their lives in England, and a junior branch of the Butlers took practical possession of the Ormonde lands.

King Edward had little love for an oligarchy which ruled Ireland under the guise of Yorkist loyalty, and all Ireland was appalled when a new viceroy, John Tiptoft, earl of Worcester, got Thomas, earl of Desmond, attainted "for treasons, alliances and fosterages with the Irish enemies" and had him beheaded (1468). But Edward was not in a position to go further; after this exhibition of bloodletting, the government had to be left to the Anglo-Irish, and Thomas, earl of Kildare, ruled as deputy till his death in 1477.

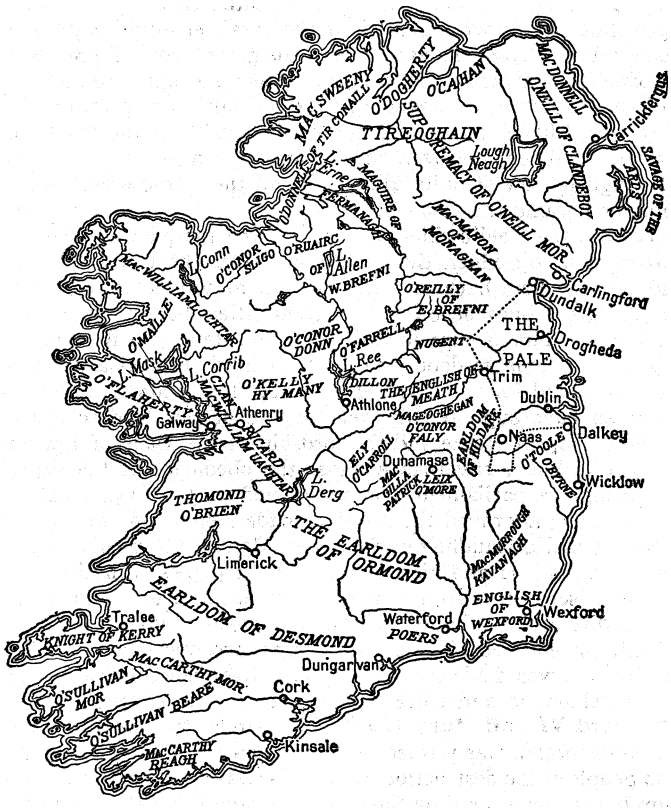
Under his son, Gerald, called by the Irish "Garret More" (the Great), the Kildare supremacy reached an almost royal height. Although only deputy for English princes who bore the empty titles of lords lieutenant, Gerald was, in effect, actual ruler of Ireland. The old English were for him, his sister was wife to the Irish chief Conn O'Neill, various daughters of his married Irish chiefs, and the Dublin parliament was at his beck and call. He had the revenues of Ireland and the appointment to offices; these went to his supporters and Irishmen ruled Ireland. So things stood when Richard III fell at Bosworth.

ENGLISH DOMINATION, 1485-1800

The Kildare Supremacy, 1485–1534.—To the Ireland of 1485 the victor of Bosworth seemed a pure usurper, and a Plantagenet restoration was long hoped for. But by 1499 Henry was strong enough to attack the Anglo-Irish oligarchy. He removed Kildare and sent as deputy, in Oct. 1494, Sir Edward Poynings, who had Kildare attainted in a parliament at Drogheda and then proceeded to the task of restoring the royal power. The Acts of the Irish Estates of 1460, which proclaimed the legislative autonomy of Ireland, were annulled, and in their stead was passed the famous measure known to history as Poynings' law, enacting that no parliament might meet in Ireland till the king, notified by the Irish council of the necessity and the measures proposed, gave his approval under the great seal of England.

Among other acts of the parliament of Drogheda, one directed a ditch to be made around the nearer parts of Meath, Dublin, Kildare and Louth. Within this "Pale" alone, and in the towns and a few strips of coast elsewhere, were English law, speech and loyalty regarded as secure. Outside were the great earldoms, the "degenerate English" and the "Irish enemy." To break the power of the first, to recall the second to their allegiance and to conquer or conciliate the third was to be the threefold task of the Tudors in Ireland. But it could not be undertaken yet. When Poynings departed in 1496, Kildare was restored and a general pardon was issued.

"This people of Ireland," said a later observer, "did ever, both English and Irish, love to be ruled by great persons." Garret More, who ruled Ireland till his death in 1513, was such a personage. As deputy he controlled Dublin and the Pale, his earldom made him supreme in Leinster, and by vassalage, fee or marriage he attached numbers of Irish chiefs to him, of whom the greatest were Conn O'Neill and Hugh O'Donnell. But his loyalty was dubious, and in his later years he was intriguing with Scotland against the young Henry VIII. His son Gerald, called "Garret Oge" (the Younger), succeeded to this hereditary power, but to maintain it became an ever-harder task. To the hostility of the Butlers was added that of Thomas Cardinal Wolsey, who urged Henry against so overgrown a subject as "the king of Kildare." Gerald was again set aside, and the earl of Surrey went to Ireland as lord lieutenant for two years, in 1520–22. His reports, backed by such tracts as D'Arcy's *Decay* of *Ireland,* told the same tale: Kildare, "using the sword the king had committed to him to extinguish the fame and honour of any other nobleman within the land"; the Irish speech and habit universal, even in the Pale; the "March English" everywhere imposing on their tenants coynye



FROM CURTIS "HISTORY OF MEDIAEVAL IRELAND"

FIG. 5.— IRELAND. CIRCA 1500. AS DIVIDED AMONG THE CHIEF LORDS. ENGLISH AND IRISH. THE PALE, OR AREA OF ENGLISH GOVERNMENT. IS INDICATED BY A DOTTED LINE

and livery, quarterings of kern and galloglass and other such "Irish exactions"; the Irish, independent under their chiefs. Though Gerald was restored once again, the Butler-Wolsey alliance grew more dangerous, and when the divorce question began and Henry conferred the vacant earldom of Ormonde on Sir Thomas Boleyn, grandson of the last earl, and made Sir Piers (the Red) Butler earl of Ossory, it seemed impossible for him to escape. Yet so astute a man might have weathered through even yet but for a young and foolish son. Recalled to London in 1534, Gerald instructed his heir, Thomas, Lord Offaly (called "Silken Thomas"), to be ruled by the wise heads of the council. The Butler faction spread the rumour that Kildare had been done to death, and Offaly at once flew to arms. His father did, indeed, die in the Tower, but with mortification and dismay; a new deputy, Sir William Skeffington, arrived, and Thomas, while barring himself from pardon by offering Ireland to the emperor and declaring himself of the pope's sect against the heretic Henry, finally had to surrender at discretion, and in 1535 was executed at Tyburn with five uncles.

Settlement Under Henry VIII.—The new policy in church and state could now be carried through, and thenceforth English viceroys and obsequious Anglo-Irish officials directed the government. Lord Grey "managed" the parliament of 1536–37, which declared Henry supreme head of the church and voted the dissolution of the abbeys. It is certain that almost no desire for such reformation existed in Ireland; lords and chiefs might accept bribes of monastic lands, but even at the end of the reign scarcely any

abbeys had been dissolved outside Leinster, and not till 1607 could those of Ulster be confiscated. Within the region of the Pale the abbeys were centres of English education, speech and civility; outside, they were the home of Gaelic culture, and civilization in general suffered by their extinction. George Browne, an Englishman, was sent over as archbishop of Dublin to preach the royal supremacy and, before the end of the reign, about 14 or 15 of the older bishops temporized and accepted it, in the belief that the church was still Catholic.

On its civil side the new policy had much support, not only from Piers Butler, who was at last created earl of Ormonde in 1536, but from great numbers of the rural tenantry, desirous of being released from the exactions of the great lords. To recall the old English to their natural allegiance was no insuperable task, and had the Tudors never abandoned the old faith it is probable that they would have commanded the entire loyalty of the "first conquerors." When, however, the Reformation began in earnest the old English grew steadily alienated, and the introduction of new colonies became the royal policy.

Toward the Gaelic chiefs Henry adopted the plan of surrender and regrant, by which they could surrender the lands they held and receive them back on tenure of knight service to the crown. To the great ones he offered to grant titles, but in return they must accept him as supreme in church and state. Sir Anthony St. Leger, who came as deputy in 1540, pointed out that a new title must be found for the crown in Ireland, "for of long continuance Irishmen have supposed the regal estate of this land to consist in the bishop of Rome and the lordship of the kings of England here to be but a governance under the obedience of the same." Accordingly a parliament was summoned in June 1541, and six Gaelic chiefs approved the act that made Henry king of Ireland.

By the skilful handling of St. Leger, Manus O'Donnell accepted Henry as his lord and king, renounced the pope's authority, consented to serve the deputy with an agreed number of horse and foot and to accept whatever title the king should give him. Conn O'Neill surrendered his ancestral claims, accepted Henry as king and in 1542 was made earl of Tyrone; Murrough O'Brien became earl of Thomond and Ulick Burke earl of Clanricarde.

Edward VI and Mary (1547–58).—Under the two Protectors the Reformation was pushed on apace, and the anger of the common people at the destruction of monasteries and the plunder of the church was now shared by the great. George Dowdall of Armagh, though one of Henry's bishops, defended the mass, and only five Protestant bishops held their ground, of whom the most active was the Englishman John Bale of Ossory, a Genevan reformer.

On her accession, the Catholic Mary retained the title of queen of Ireland, but had to leave the abbey lands to the grantees. St. Leger became deputy again, Dowdall returned and, as a part of the general reconciliation, the exiled Gerald was restored to the earldom of Kildare. But in spite of religious unity, there was little peace. Henry had begun the policy of trying to rule the further provinces through the new earls, but these were opposed by the vested interests of those who preferred the old order, in which the O'Brien or MacWilliam was but an elected captain of his "nation," holding for life, not a hereditary official landlord. This was especially seen in the north, where Shane O'Neill, claiming to be Conn's eldest legitimate son, came out as champion of the old Gaelic order, preferred being "the O'Neill" to any English title, and opposed his brother Matthew, baron of Dungannon, whom he declared to be a bastard. The conflict of state feudalism and Gaelicism became general. In Leix and Offaly, where Gila Patrick O'More and O'Connor Faly were sovereign, a determined stand was made against the extension of English law, and after a long border war the government decided to annex and partly plant these areas. Lord FitzWalter, afterward earl of Sussex, replaced St. Leger in 1556, and with him a policy of confiscation and plantation was adopted. The two lands were shired as king's and queen's counties and divided into an eastern, more fertile area, in which Englishmen were to be planted, and a western area, which was to be left to the natives holding by common law tenure.

The Elizabethan Settlement.—Elizabeth succeeded to the throne in Nov. 1558, and under the earl of Sussex the state religion was established by law. In a parliament of 1560, which represented ten counties and 28 towns, the Acts of Supremacy and Uniformity were passed and recusancy fines were imposed. Outside Dublin the supporters of the established church were a handful, and it soon became clear that the old English were even more determinedly Catholic than the Irish. As loyal subjects their position was strong, and a constitutional resistance was successfully waged by the lawyer class, which was strong in the commons, the town corporations and even the government.

Ireland, with its feudal and Gaeiic lordships, was a standing offense to a centralizing monarchy, and to extend the shireland and introduce sheriffs, garrisons and English law became the avowed object of the government. But every such extension, which had to proceed piecemeal, met the opposition alike of the chiefs and the old English lords; the resistance of the Gaelic population was the more deadly of the two, for its military resources were greater, its native civilization was dearly cherished and its hatred of the Saxon was deeply rooted. The greatest of these captains, Shane O'Neill, was, in native eyes and almost in fact, king of Ulster. From the four counties, Tyrone, Derry, Armagh and Antrim, where he was overlord, his ambition was to rule the whole province, and after Matthew, baron of Dungannon, had fallen in an affray, and his son Hugh was taken to be educated with the earl of Leicester and in Elizabeth's court, Shane had the field to himself. He proceeded to subject O'Donnell on one hand and the Scots of Antrim on the other, and, having been invited to the English court in 1562, he so flattered the queen with his Irish tongue that he returned in triumph as "the lord O'Neill" When Sir Henry Sidney arrived as deputy in 1565 the power and influence of Shane overshadowed all Ireland, but in a rash attack on Hugh Duv (the Black) O'Donnell, chief of Tyrconnell, he was routed at Farsetmore, and, flying to his enemies, the MacDonnells, was murdered by them in 1567.

The Desmond *Wars.*—Desmond was an old English regality as Tyrone was a Gaelic state. The new earl, Gerald, was deeply suspicious of the "forward policy" which menaced his palatine authority. He and Thomas, earl of Ormonde, were hereditary enemies, and after a pitched battle at Affane, in 1564, they were summoned to London, where Desmond spent many years of semi-captivity till 1573. The Geraldines, therefore, took as captain the earl's cousin, James Fitzmaurice Fitzgerald, who planned a league which should defend at once the earl's liberties and the Catholic faith. Exclusion from office under the oath of supremacy alienated the Catholic English of the Pale. Catholic services were maintained by the friars while Jesuits and secular priests, trained in seminaries on the continent — later to grow into the Irish colleges in Spain, France and the Netherlands — returned to Ireland in increasing numbers. The bull of Pius V excommunicating Elizabeth and releasing her subjects from obedience gave sanction to rebellion. It was unfortunate that at such a time the government allowed Sir Peter Carew, a Devon gentleman, to get legal possession of wide lands in Carlow and Cork by virtue of very musty pedigrees. With him began the age of the adventurers and land speculators, the Raleighs and the rest, and old English and Irish felt that even their property was insecure. Fitzmaurice was accordingly able, in 1569, to kindle a widespread revolt in Munster and Leinster, which Sir Philip Sidney, Carew and Sir Humphrey Gilbert stamped out with a severity that set the note for future "pacifications." Fitzmaurice submitted in 1573.

Six years later he was the leader of a new war in Munster. The continental side of it was organized by the Spaniard Matthew de Oviedo, later titular archbishop of Dublin, but, though the pope offered spiritual assistance, Philip gave little or no material aid. and Fitzmaurice had only a small band with him when he landed in Kerry in 1579. With him was the English Jesuit Nicholas Sanders, who proclaimed a plenary indulgence for all who would fight against "Elizabeth, pretended queen of England." There was a widespread rising, but the only man who could have made it formidable disappeared when Fitzmaurice fell in a petty affair at Castleconnell. The earl himself was driven into rebellion, and 800 Italians, sent by the pope, were besieged at Smerwick by the deputy and, after surrender, pitilessly massacred. Desmond was

hunted down and killed and the south was pacified by the usual methods. Confiscation was thenceforth to follow the horrors of war, and while the earl and his chief followers were attainted, about 600,000 ac. were declared forfeit. In the end about 200,000 ac. were granted to newcomers like Sir Walter Raleigh.

Ireland was now so "pacified" that even in the year of the Armada it scarcely moved. Sir John Perrot, deputy from 1584 to 1588, encountered in the parliament of 1585 a strong and well-led Recusant party, but though Archbishop Adam Loftus urged enforcement of the penal laws, the astute and politic viceroy refused to test men's consciences. He mas empowered by this parliament to make, with the chiefs and gentry of the west, "the composition of Connaught," by which they were confirmed in their immediate demesnes with rents from the rest of their "countries" in lieu of feudal and Irish regalities, on condition that they serve in arms, pay rent to the crown and hold by English tenure. The result was that Connaught, under its Gaelic and Norman proprietors, remained, on the whole, loyal up to 1640.

The Tyrone War.—One of the last acts of Perrot was to have the young Red Hugh (Aodh Ruadh) O'Donnell kidnapped and sent to Dublin castle as a hostage for the loyalty of his father, Hugh Duv. The results were disastrous; up to now, the O'Donnells had been allies of the state, but the alliance was now shattered. After five years Red Hugh escaped to become the O'Donnell and the hero of Gaelic Ireland. Ulster was the last stronghold of the Celtic order which the state had determined to extirpate, and the northerners had always been the proudest and most warlike of the Irish. When, therefore, under the new shiring order, a sheriff was set over Fermanagh, it was not long before his firm methods drove Hugh Maguire into revolt, whereupon this chief was proclaimed traitor.

Red Hugh was naturally for Maguire, but it was uncertain what part Hugh O'Neill, now earl of Tyrone, would take. He, too, had to fear the extension of English order, which would menace his hereditary lordship; he resented the religious and civil oppression of his country, and when, finally, he threw in his lot with O'Donnell in 1594, the government had to face the greatest opponent and the most formidable rising it had yet met. Tyrone and O'Donnell talked mainly of their ancestral rights and of religious tolerance, but at the same time they wrote to Philip asking for 6,000 men and begging that an archduke might be sent as king.

Finally, the victory of the Yellow ford on the Blackwater, in Aug. 1598, over Sir Henry Bagenal, made O'Neill a hero of the Counter Reformation. While Red Hugh overran Connaught, Tyrone descended into Munster, the new colony vanished like a dream, and a league of Irish and old English, under James Fitzgerald, the so-called sugan (straw-rope) earl of Desmond, took the field (see FITZGERALD). In 1599 the earl of Essex went to Ireland with a large army but failed to restore order. In 1600 the insurgents throughout all Ireland were reckoned at nearly 20,000, but O'Neill knew they could not take cities or hold the sea without Spanish aid.

Charles Blount, Lord Mountjoy, finally proved the Scipio to the Irish Hannibal, and the tide was turned less by battles than by devastation and massacre. At last Don John d'Aquila arrived with 4,000 men, the Ulster chiefs marched to meet him, and the issue was decided at Kinsale. A rash attack by O'Donnell ended in the rout of the Irish; D'Aquila surrendered, O'Donnell, sailing to Spain for more aid, died there, and O'Neill cut his way back to the north. Finally he submitted to Mountjoy in April 1603, and going to court was pardoned and restored by the new monarch, James I, while Rory O'Donnell, brother of Hugh, was created earl of Tyrconnell. (See O'NEILL.)

With this fight Celtic and Norman Ireland passed. A new Irish nationality had emerged, Catholic by conviction, a blend of English and Irish in origin and, in the upper ranks, English-speaking. How to reconcile this with a Protestant government was the problem.

James I, 1603–25.—On the religious question the policy of James was a guarded toleration. The royal prerogative was still supreme, especially in Ireland, and a series of viceroys, such as Arthur, Lord Chichester (1605–IS), exercised it in the interests of that large majority which it seemed now almost hopeless to convert. The opposition of the Catholic party, led by the lords of the Pale and the lawyers, was constitutional and loyal; it was impossible to debar recusants from parliament, even if the oath of supremacy barred them from government, and in the older towns this party was so strong that up to 1624 every one had a Catholic mayor. Could James and this moderate element have had their way all might have been well, but the ultramontane spirit on one hand and the Puritan on the other made plain sailing difficult. The established church in Ireland was for strong measures, and, on the other hand, when James proposed a simple oath of allegiance for recusants, by which they should repudiate the supposed right of the papacy to depose heretic kings, two papal briefs in 1606 declared the proposed oath unlawful for Catholics.

There was also Roman Catholic opposition to the new university at Dublin, founded by Elizabeth in 1591. A centre of disinterested learning would have been a force for reconciliation, but that it was not so intended was generally understood; it was spoken of as "the college of the heretics near Dublin," and though at first there were no tests, Catholics preferred to seek education abroad. The statutes of Archbishop William Laud confined its advantages to members of the established church, and, though a few Catholics frequented it, disabling tests till 1793 barred them from fellowships and degrees. Trinity college became, however, an active centre of learning.

The Plantation of Ulster.—Though the earls of Tyrone and Tyrconnell had been restored in 1603, their new position was full of difficulties; Ulster was now shireland, subject to sheriffs and garrisons hateful to its ancient lords, and Tyrone, involved in disputes with bishops, officials, grantees and his former vassals, complained that strong forces at Dublin were against him. At last the aged chieftain resolved to quit the field. Whether he and O'Donnell were guilty of plots to raise a new rebellion cannot be proved. In Sept. 1607, along with Tyrconnell and nearly 100 more chiefs of the north, he left Ireland forever. The "flight of the earls" was a mortal blow to the Catholic interest and the old Gaelic tradition. Celtic Ulster was now to become the most British of the provinces, and the lament of the Four Masters over the passing of the earls is indeed the swan song of the Gaelic world. With these devoted scholars, who laid down their pens in 1616, were silenced also the voices of the Gaelic brehons, poets and historians, and by 1700 only the Irish language, which the gentry was then forsaking, remained a visible memorial of a world that went back 2,000 years.

A plantation of Ireland was now urged on the ground that, without a strong Protestant population, neither would the state be safe nor the state church have congregations. The earls and their adherents were found guilty of treason, and by legal processes six counties were declared escheated. By the final plan (1609) the escheated lands were divided between undertakers, servitors and natives. Undertakers, mainly English, were to lease only to English and Scottish tenants and to take the oath of supremacy. Servitors, mainly Scots, might take Irish tenants, but if so their rents to the crown were increased. Native Irish grantees were to pay quitrents twice as large as the undertakers, but need not take the oath. Of these a good number received grants of thousands of acres, and several junior branches of the O'Neills and Magennises, etc., survived as large landlords, though no longer as Irish chiefs. But the colonists entered upon the best lands, and the lesser ranks of Irish were reduced to the position of tenants at will, for Sir John Davies, the solicitor general, found, by a most iniquitous decision, that they had had no freehold rights under their attainted lords. The town of Derry was given to the City of London, and the London companies received grants which gave them practically all that county.

The practical success of the plantation was great, and for the first time a large part of Ireland was not merely owned by Saxon landlords but was tilled and farmed by Scottish and Protestant farmers. The Irish population was numerous in the mountainous parts, and its natural disaffection was kept alive by hopes that Tyrone or another would return, but on the surface, at least, the Irish seemed no longer a danger.

The success of the Ulster scheme led to plantations in north Wexford, Longford, Leitrim and eisewhere, where, though the natives were treated with more equity, again the object of the crown lawyers was to find that most of the Irish were not freeholders but tenants at will. The new English were dominant; adventurers and speculators such as Richard Boyle, earl of Cork, and other moneyed men displaced the old aristocracy; 39 new boroughs, carefully rigged, could be counted to cffset the old towns, and several of the old Irish, such as the earl of Thomond, had become Protestant.

In the parliament of 1613–15, summoned by Chichester to ratify the Ulster plantation, the government engineered a small majority, partly through the new close boroughs, but the minority could claim that it spoke for 21 counties and 28 ancient boroughs in this first general representation of the kingdom. After failing to get its choice as speaker, the opposition petitioned the crown, and James saw a deputation of old English peers and commoners who complained of religion, the new boroughs and the rigging of elections. James thoroughly enjoyed himself and declared, "What if I had created 40 noblemen and 400 boroughs?—the more the merrier," and, as regards religion, "the pope is your father in *spiritualibus* and I *in temporalibus* only; you are but half-subjects and therefore only entitled to half privileges." The upshot was that 11 boroughs were disfranchised; James spoke some fair words and continued the *laissez faire* policy on religion; and parliament voted a large subsidy. The recusants, though called "old English Irelandized," were, in fact, loyalists with a religious grievance, but they had their left wing, and this veered steadily toward armed protest. The continent of Europe was full of Irish exiled soldiers and priests, and among these both the old English and the old Irish had their heroes. In spite of its troubles, Ireland benefited economically from a period of peace. Agriculture recovered; the settlers brought in their skill and enterprise; and the manufactures started by men like the earl of Cork made Ireland something of an industrial country.

Charles I, 1625-49.—With the second Stuart came the idea of raising men and money in return for religious concessions. The deputy, Lord Falkland, was allowed to promise various concessions, known as "the graces," such as that Catholics might practise at the bar and that where land titles, like those of the Connaught gentry under the Composition of Connaught, were lacking in legal confirmation 60 years' possession was to be held good against the crown. From agents of the Catholic party Falkland secured a pledge of subsidies amounting to £120,000. But when the agents reached London they found a strong antipapist spirit there, under pressure of which Charles gave way. He dropped "the graces" but exacted the subsidies, though no parliament was called to ratify them.

To make Ireland first prosperous and then to use it in the royal interest against Puritan opposition was the idea of Thomas Wentworth, later earl of Strafford, viceroy from 1633 to 1640. He set himself to break the power of the great and the monopolists, making the Court of Castle Chamber into a star chamber for Ireland. While he wrested power from the anti-Irish clique in Dublin, he had no sympathy with Irish or Catholic complaints and looked on religious concessions merely as policy. Similarly, his aim in making Ireland rich and prosperous was that out of a surplus revenue he might enrich his royal master, and the first-rate army that he raised largely from Catholics and natives was destined, if need be, to serve in Britain. Among the strongest measures of this satrap were extracting subsidies of £50,000 from parliament and then denying all but the least important of "the graces"; forcing the juries of Connaught to find a title there for the king, with a view to a fresh plantation; and attacking the London companies. But the policy of "Thorough," as Strafford called it, ultimately failed, and when he was assailed in England all the interests he had offended in Ireland joined in the general impeachment that brought him to the scaffold in May 1641. His army was disbanded and the control of the government passed under Puritan lords justices.

A rising in Ulster was inevitable. The Irish there had local leaders of the old stock, such as Sir Phelim O'Neill, and still more abroad, where Owen Roe O'Neill, nephew of Tyrone, was in Spanish service. In the south the native party found a leader in Rory O'More, who planned a union of the old English, with their religious grievances, and the Irish who had lost vast estates. A plot to seize Dublin castle failed, but the rising in Ulster was general (Oct. 1641) and thousands of colonists were murdered, died of ill treatment or fled.

For the suppression of the Irish war the English parliament at once voted an army, but in order to find the money offered to the adventurers or subscribers of £1,000,000 the pledge of 2,500,000 ac. of profitable lands which were to be confiscated. Naturally, the dread of confiscation, coupled with a belief that the Puritans meant to extirpate their religion, drove more and more Irish to arms. A Catholic confederacy was formed at Kilkenny in May 1642 "to defend religion and the king against sectaries, and establish the Catholic religion as fully as at any time since Henry VII"; soon Richard Preston, earl of Desmond, and Owen Roe arrived from abroad, the first to lead the confederate armies, the second the Ulster forces.

The story of the next seven years is a complicated one. Though the confederation of Kilkenny organized a Catholic parliament and government, it did not succeed in welding together the parties of which it was composed. So while the Irish, whose chief figure was Owen Roe O'Neill, commanding an Ulster army, and the old English, supported by Preston, commanding a Leinster army, debated at Kilkenny, parliamentary armies operated in the north and south and Dublin was held by James, marquess of Ormonde, commanding an army of Protestant royalists. The confederation gained some recognition abroad, and in 1645 John Baptist Rinuccini, archbishop of Fermo, arrived as an accredited papal nuncio. Ormonde, who could count on some sympathy from the old English, sought to hold Ireland for the king and the Protestant interest by fomenting dissension among the confederates and by offering agreements on behalf of the king, which he had neither the power nor the intention of honouring. The nuncio used all his influence to hold the confederates together and to support the Irish, the stronger party, particularly after O'Neill had smashed the parliamentary army under Sir George Monroe at Benburb in 1647. By now the king's cause was already lost and Ormonde, preferring "to surrender Dublin to English rebels than to Irish ones," handed over the capital to Col. Michael Jones, the parliamentary commander, and left Ireland in 1647. After the execution of the king Ormonde returned to recover Dublin for the young Charles, but he was defeated by Jones. The papal nuncio left Ireland in Feb. 1649. O'Neill died in November. Oliver Cromwell's campaign of indiscriminate massacre broke the back of Irish resistance, though it lingered till 1652.

The Cromwellian Regime.—Ireland had been conquered by an English faction to which Irish Catholics were odious, and now it had to pay for its own conquest. Not only the adventurers but also the conquering army were to be paid in Irish land. Under the rule of Charles Fleetwood and by an act of settlement ten counties were appropriated to soldiers and adventurers. Later others were added. The English parliament, which disavowed any intention to "extirpate that whole nation," divided the population into ten classes, of which the first five were excepted from pardon for life or estate; even those who could prove their innocence and loyalty to the Commonwealth found it hard to retain more than a portion of their estates. But such a plan involved a removal of the occupiers, and by a scheme of transplantation the former landowners with their families and retainers were ordered to move into Connaught, where land was provided for them, generally though not always of inferior quality. The chief effect of the Cromwellian plantation was to impose a new English and Puritan landlordry on Ireland.

Charles II and James II, 1660–88.—The monarchy was restored in Ireland by the Cromwellians Roger Boyle, earl of Orrery (previously Lord Broghill) and Sir Charles Coote, and this gave the keynote to the resettlement. The Irish had lost all at the hands of sectaries and republicans and supposed that theirs would be the favoured side, but the real division was now between English and Irish, and Charles had to say to them, "My justice I must

afford to you all, but my favour must be placed upon my Protestant subjects." Ormonde as lord lieutenant made a great fight for his fellow countrymen, and finally by the English Act of Settlement the Cromwellian party consented to surrender one-third of the lands in dispute, but 5,000 claims were left unheard. Roughly, the old proprietors now held one-third of Ireland; in population the Catholics were about 800,000 to 150,000, but in the corporations, parliament and government they scarcely counted at this time. Much, however, was done to restore Catholics to the corporations, and their numbers and influence grew steadily. The popish plot of 1678 brought on a terrorism to which Archbishop Oliver Plunket fell a victim, but on the return of reason toleration was resumed and the Irish later looked back on Charles's reign as a golden age.

In James II Ireland found a king who could be trusted to restore the faith and might be induced to repeal the detested Act of Settlement. For more than a year the earl of Clarendon acted as viceroy, but his royal brother-in-law balanced him by Richard Talbot, whom he created earl of Tyrconnell, an Irishman and Catholic who first as lieutenant general and then as sole lord deputy increased and remodelled the Irish army, officered it with Catholics, secured the garrisons and admitted his coreligionists into the council, the corporations, the shrievalty and highest legal offices. Ireland for a time was truly a Catholic kingdom, and Tyrconnell planned an independent parliament to repeal at once the penal laws and the Act of Settlement. From the military point of view his mistake was in not securing Ulster, and so, when James's cause collapsed at the end of 1688, though a great Irish army was in the field, Derry, Enniskillen and other places became cities of refuge for a Protestant population ready to fight for William.

In March 1689 James himself landed from France, with officers, money and arms from Louis XIV, but no men. Catholic Ireland could provide these in plenty, but only on terms. When James, in May 1689, summoned what was practically a Catholic parliament to Dublin, he announced liberty of conscience for all and some relief for sufferers by the Act of Settlement, but parliament totally repealed the hated act and restored the heirs of those dispossessed since 1641. An act of attainder was passed which included about 2,400 persons supposed to be supporters of the prince of Orange. As for religion, Catholics and Protestants were to pay their tithes to their own clergy.

Settlement Under William III and Anne.—The successful stand and relief of Derry was a prelude to the wider operations in which first Marshal F. H. Schomberg and then William himself landed at the head of professional armies. On the other hand, a French force arrived to help the Irish. The battle of the Boyne was won and lost on July 1, 1690, and James returned to France, leaving the Irish to ruin themselves in his cause. At least the gallantry of Patrick Sarsfield and the heroic stand of Limerick illuminated the last fight of Catholic Ireland as a nation in arms. At Aughrim in July 1691 the issue long hung in the balance until the French commander, the marquis de Saint-Ruth, fell, and the Dutch general Godart van Ginkel, who was in command of the English forces, carried the hill. Tyrconnell died, and Sarsfield finally capitulated on terms at Limerick on Oct. 13. By the Articles of Limerick the Irish Catholics were guaranteed the religious liberty they had enjoyed under Charles II, and all officers in arms and those under their protection in the five western counties covered by the terms were to retain their estates and professions under a simple oath of allegiance "and no other." William was to have the terms ratified by parliament and do his best to get those who had been attainted restored to their estates; this latter clause was omitted in the signed articles but restored by William. Officers and men who would not take the allegiance oath might depart for France; 7.000 did so, and among the flower of the Irish aristocracy that sailed away was Sarsfield. William was a tolerant man and, after all, the Irish had but served the king de *jure;* but he now had to divide his prerogative with parliament, and, while he strove to keep the spirit of the treaty, the parliaments of both islands ratified it in less than the letter. Irish opinion has always called it "the violated treaty." The English Whigs meant to keep the Irish Protestants in the saddle, and a Test act of 1691 was extended to Ireland and excluded Catholics from the Dublin parliament. In 1697 this body ratified what remained of the treaty, but William had to drop the omitted clause and abandon the stand he had made for justice. Finally, in 1699, the English houses confirmed the settlement by which about 750,000 ac. passed to new owners. Thus the third conquest of Ireland within a century was achieved. The most illustrious names of the Irish nation disappeared from their country by attainder, death or voluntary exile. Those that remained owned only about a seventh of the soil. The middle classes suffered exclusion from the corporations, trades and professions, and the penal laws began with acts of the Dublin parliament in 1695 and 1698 which debarred conscientious Catholics from wearing arms, teaching publicly and practising the law.

English arms and statutes had given the Protestant ascendancy the title deeds of Ireland but at the cost of its own political and economic subjection. Under Charles II English acts had debarred Ireland from the colonial trade and prohibited the import of Irish cattle into England. Now an act of 1699 ruined the export trade in Irish woollens; Ireland retained the provision trade with Europe and America, and William encouraged the linen industry.

The Penal Laws.—The new ascendancy, full of memories of 1641 and 1689, was bent on treating the Jacobites like a beaten enemy. The land settlement as made under Charles II and William was final, and Catholic landowners had to keep what little they had and no more. The penal code, by which the majority was rendered powerless to rise again, was passed mainly in 1702–15. The acts that concerned the landowners forbade them to acquire freehold other than by inheritance or to take leases of more than 31 years at a crushing rent. By the Gavelling act if the eldest son conformed he succeeded to the whole estate; otherwise it was equally divided. This, more than anything else, served to extinguish this class, whose members either conformed or were impoverished by subdivision. The Catholics in general were barred from trades and professions, education, office (great or small), juries, the electoral vote, the right to arms and a horse.

Feeling against the Presbyterians of the north was hardly less strong in the Episcopalian ascendancy. A Test act was passed against them in 1703, but after the accession of George I the "Regium Donum" was restored to their ministers and a Toleration act allowed them to worship freely and hold petty offices. Though these Protestants were debarred from parliament and from the government of the country, their lot could not be compared in severity with that of the Catholics, with whom, however, they shared the grievance of riches paid to a church they both detested.

The Hanoverian **Succession.**—With the Hanoverian succession the last hopes of the Jacobites faded away. For the old Irish nation the next half-century was a time of oppression, despair and decay; the great exodus of the gentry and the more adventurous spirits to join the continental armies was balanced by emigration of the poorer Protestants ruined by heavy rents and the commercial acts. The penal laws steadily crushed the upper classes, and by 1780 about 4.000 of them had conformed. The old landlords had been the protectors of the Gaelic poets and scholars, and as they decayed or joined the ascendancy the old native culture declined, but a new group of poets took the place of the old aristocratic literati, using popular language and sharing the lives of the peasantry. Such histories as W. E. H. Lecky's, however excellent on Anglo-Ireland, fail to discern the strong current that ran, half underground, among the Gaelic-speaking people of poetic memories and hopes for a future in which now the Stuarts, now the French, would come over to restore "the Dark Rosaleen." Such feelings were not merely poetic; they were kept alive by unjust laws and what was perhaps the worst land system anywhere in Europe.

The Protestant ascendancy of Ireland now began to resent its political and economic subjection to English interests. The constitutional and legal benefits of the Glorious Revolution had not been extended to Ireland; while in England the sovereignty of parliament had been established, the Irish parliament was shackled by Poynings' law. Ministers were responsible only to England, and in 1719 by the Declaratory act the imperial parliament affirmed its right to legislate for the sister island. The Dublin legislature

became a mere dependency, hardly representative of even the Anglican minority.

How to keep Ireland at once dependent and secure was a question the imperial government solved for 50 years by putting power successively into the hands of such men as Archbishops Hugh Boulter and George Stone, both Englishmen, who managed the country in the English interest. The regime had its merits; government was cheaply run, the national debt kept low, and the surplus revenue was used to beautify Dublin and develop the country. Economic progress made itself visible, an influential class of rich Catholic merchants appeared, and the wane of Protestant bigotry on the one hand and the ultramontane spirit on the other made toleration possible.

The Patriot Movement.—A political party now appeared among the Protestants, inspired by John Locke, William Molyneux, Jonathan Swift and George Berkeley, which found its leaders in Henry Flood and Henry Grattan. On the other hand, the British government was ready to make concessions. The viceroy, Viscount Townshend (1767–72), was instructed to offer an octennial bill limiting the duration of parliament, and Lord Harcourt continued the policy with the purpose of procuring troops from Ireland for the war with America. After the defeat of the British at Saratoga (1777), the "restrictive acts" had to go; at the same time the imperial government encouraged the Irish Protestants to relax the penal code, and in 1778 Catholics were allowed on a simple form of oath drawn up by the Catholic association to inherit land and take leases like Protestants, while the Gavelling act was repealed. Events of the American Revolution put Ireland for the first time into Irish hands, those of the Protestant ascendancy, and 80.000 volunteers raised under Lord Charlemont boasted themselves "the armed property of the nation." Free trade with the colonies was won by Flood, and Grattan moved the famous declaration; "No power on earth but the king, lords and commons of Ireland is competent to bind Ireland." The volunteer convention at Dungannon emphasized these demands, and the view was general that without legislative autonomy there was no security for Irish rights. The imperial government gave way and an act of the Irish parliament was confirmed, amending Poynings' law and providing that bills duly enacted and sent to England should be returned without alteration under the great seal and receive the viceroy's assent. At the same time the Test act for Protestant dissenters was repealed, and by Luke Gardiner's Relief bill of 1782 Catholics were allowed to purchase lands freely and have their own schools.

The Irish Constitution, 1782–1800.—The constitution of 1782 was completed by the Renunciation act of the next year, by which England admitted the claim of the people of Ireland to be bound only by their own laws and courts. But Irish ministers were still appointed by and were responsible to the imperial authority; they could not be turned out by vote of the majority, and though John Fitzgibbon (later Lord Clare) and the rest were Irishmen, Grattan, Flood and their party remained a mere opposition, and legislative autonomy without responsible government and electoral reform proved vain.

Popular support was needed for the new constitution and Flood and Charlemont sought it in a more representative parliament still confined to Protestants, while Grattan aimed at an extension of the franchise to Catholics and the admission of their gentry to parliament. But both were thwarted by the narrow clique which under Fitzgibbon controlled the government and resisted pressure alike from Ireland and England. William Pitt's failure to carry a commercial treaty and the Regency dispute emphasized the difficulties created by the constitution, but it might have survived long (for Ireland as a result of commercial freedom, bounties and John Foster's corn law was progressing rapidly in wealth. manufactures and agriculture) had not the war with France brought on a situation which grew ever tenser. French principles spread among the Presbyterians, the Catholic association passed into the hands of bold politicians, and agrarian discontent vented itself in the Defenders, a Catholic society formed in opposition to the Peep-of-Day Boys (*q.v.*). Clare held that either the Protestant ascendancy must remain intact or give way to a union, for general enfranchisement would fill parliament with disloyal dissenters and Catholics and imperil the imperial connection. The British government preferred Catholic relief to reform, but finally, faced with the question of how to hold Ireland against the French menace, Pitt chose to buttress up the unreformed Irish house which Clare and John Beresford could "manage," and after 1798 decided on a union. The approaching crisis was accentuated in 1795 when, after British pressure had compelled the Irish government in 1793 to admit Catholics to the electoral franchise, the viceroy, Lord Fitzwilliam, failed to carry final emancipation and to break the Clare-Beresford junta. The Society of United Irishmen, formed originally by Theobald Wolfe Tone on constitutional lines, now became revolutionary and entered into negotiations with France for an Irish republic, while the founding of the Orange society intensified the religious feud. Insurrection acts and the suspension of *habeas corpus* bridled a country which was becoming an armed camp, and the peril of a French invasion had to be faced. The Brest expedition of 1796–97 had failed to land troops at Bantry bay, but Tone still hoped for foreign aid, and a determined French invasion would undoubtedly have set Ireland ablaze. The Ulster Presbyterians were more feared by the authorities than was the Catholic south, and when in 1797 Gen. Gerard Lake "disarmed the north" by the most savage methods the back of a national rising was broken. The military forces were small, but 30,000 yeomanry led by the gentry sufficed to break the rebellion when it came. It was but a partial one, for the government had seized the leaders, and though June 1798 witnessed a Presbyterian rising in Down and Antrim and a far more dangerous one of the Catholic peasantry in Wexford, both failed, and Tone, who was on board the "Hoche," surrendered with it and ended his life by his own hand in prison. (*See* TONE, THEOBALD WOLFE.)

After this the union was inevitable. Many of the ascendancy became convinced that only such a measure could maintain them in power over the Catholic majority; the Presbyterians were disillusioned by the events of the rebellion, and the Catholic population had been cowed into submission. Pitt and his Irish agents, Clare, Viscount Castlereagh and Lord Cornwallis, had effective arguments for all—the Catholics could only be sure of emancipation from the imperial assembly, only union could save the Protestant establishment, and free trade would compensate the commercial classes. Several Catholic bishops declared for union in the inspired belief that emancipation would follow it, but it is very doubtful how far they spoke for their whole people. There was little to fear from the Irish parliament, where the majority was corrupt and unrepresentative, where the ministry could survive defeat after defeat and where patronage and bribery were at the government's disposal. Grattan and the poor remnant of the patriots made a brave fight, but the union became law by acts of both parliaments in May 1800.

Thus ended the patriot parliament. The ascendancy, for which it spoke exclusively, had been created by the revolutions of the 17th century. It had ruthlessly exploited the helpless Catholic population in the interests of a small Protestant minority. Yet in the later stages at least it produced men of ability and generosity who identified themselves with the country of their adoption and strove to temper the harsh lot of its people. Dublin's Georgian buildings, beautiful even in decay, are a monument to the 18th-century ascendancy. (E. Cu.; U. G. F.)

THE UNION (1800-1921)

Resistance to Pitt's campaign for a legislative union had been so strong in the Irish parliament that the measure was carried only by the undisguised purchase of votes, either by cash or by the bestowal of honours. But opposition to it among the landowners and the lawyers did not last long, and after a few years the agitation for a repeal of the union was being generally opposed, even by those who had protested vehemently against the extinction of the Irish parliament. On the other hand, the support for the union which Pitt and Castlereagh had gained from most of the leading Catholics was quickly lost. Bishop Francis Moylan and others had used their great influence on behalf of the union, in expectation that Pitt would redeem his promise to introduce

Catholic emancipation at once by an act of the joint legislature in London. The Catholics had already gained important concessions since the establishment in 1795 of the Royal Catholic college at Maynooth as a national seminary for training Irish priests. They could no longer be educated in France and the Low Countries, since the Irish colleges there, which had kept the Catholic Church supplied with priests for generations, had been suppressed under the penal laws by the Revolution. The bishops had been appalled by the antireligious campaign in France. and they had also seen the Irish regiments of the French army disbanded, their officers enlisting in other armies to fight against revolutionary France. Pitt had not only endowed Maynooth but had given active help to the French clergy who escaped from imminent danger of death. He had promised to admit the Irish Catholics to full civic rights, which the ascendancy in Dublin had persistently denied to them; and they had little sentimental regard for the Irish parliament, which was determined to uphold Protestant domination.

But Pitt's failure to carry out his promises produced a sense of betrayal and humiliation, and the Catholic Church had no further sympathy with the new experiment. Wolfe Tone's attempts to bring a French expeditionary force to assist a national uprising had been actively opposed by the Catholic bishops, who dreaded revolutionary ideas. But Robert Emmet's abortive rising in Dublin in 1803, though it had much less chance of success and was little more than a local riot, had a stronger sentimental appeal. The promised emancipation of the Catholics had been withheld because the king considered that their admission to parliament would be a violation of his coronation oath. Pitt had resigned the premiership as a gesture of loyalty to his promises, but he soon returned to office and refused to raise the Catholic question again.

Economic Effects of Union. — While the hopes of the Irish Catholics had thus been defeated, the economic and social consequences of the union for Ireland were soon found to be disastrous. Dublin ceased to be the metropolis in which the landowners had their town houses and their lavish social life. Many activities that had been connected with the Irish parliament either ceased or languished when London became the political and social centre. The most gifted and most public-spirited members of the community who were still elected to parliament now had to spend most of their time in London, while those who were no longer legislators soon tended to become absentee landlords. Trade and industry declined rapidly, especially in Dublin, and the sudden increase of absenteeism had an unexpected effect upon Irish agriculture when prices rose abnormally during the Napoleonic wars.

Ireland's population in 1800 was 4,500,000. Of these, fewer than 500,000 were Protestants and about 900,000 were dissenters, who were chiefly in the eastern half of Ulster. Almost all the landowning class was Protestant, and Catholics had not been allowed even to buy land until the recent relaxation of the penal laws. The great majority of the 3,150,000 Catholics were either labourers or tenant farmers who held their land on short leases without any security of tenure or protection against increase of rents if they improved their holdings. When the landlords became absentees, they left their estates in the hands of agents who had no social responsibility and were concerned only with extorting the utmost profit from the land. A swift rise of prices during the Napoleonic wars made it more profitable to multiply the smallholdings. by dividing the estates, and so increase the rent rolls.

With no alternative occupation the competition for smallholdings was extremely keen, and the landlords were not required to provide farm buildings or even cottages. Any young labourer who could build a miserable hut for himself could therefore attain at once all that could be expected by any tenant farmer. While high prices continued, the subdivision of farms increased everywhere, with rents steadily rising and no outlay of capital on improvements. There was no inducement to delay marriage until later in life, and the population rose very rapidly with young marriages and large families. The standard of living was miserably low. On smallholdings of less than ten acres it was scarcely possible to grow an3 crops other than potatoes, which provided the only food for a whole family throughout the year. Even milk and butter were luxuries seldom seen. Any small crops of grain had to be sold to pay rent and tithes which were exacted regularly; and the few cattle or pigs which could be kept on the little holdings were the chief source from which such payments had to be met.

Catholic Emancipation. — The Catholic peasantry and labourers, who formed the bulk of the population, suffered acutely when prices fell after the Napoleonic wars. Dublin declined rapidly after the extinction of the Irish parliament, and many industries in all parts of the country decayed. But a new Catholic middle class was slowly emerging, since the mitigation of the penal laws. Education was no longer forbidden, and churches could be built without breach of the law. There were no Catholic secondary schools, however, and the merchants and others who had formerly sent their sons to school in France now sent them to the few Catholic colleges which had been opened in England, since they found refuge there from the Revolution. Catholics were already admitted to Trinity college, Dublin, and they could now become lawyers and doctors. The young barristers who had benefited from these new advantages became the most active leaders of the demand for full civic rights.

Among them was Daniel O'Connell, who had been at school in Douai until the French Revolution and had completed his legal training in London. One of his uncles, Gen. Count Daniel O'Connell, had been the last colonel of the now disbanded Irish brigade in France, and Daniel had been brought up in County Kerry by another uncle who had for years conducted a flourishing contraband trade with the continent but had now become a loyal supporter of government since the Revolution. Among the young Catholic barristers who infused new life into the Catholic committee, Daniel O'Connell soon displayed outstanding gifts of popular leadership and great courage in asserting the Catholic claims. He had imbibed the new doctrines of democracy and equality and also the nationalism which had spread since the French Revolution. His attempts to revive and broaden the agitation for Catholic rights brought him into collision with Dublin castle, but he showed great skill in confining his agitation to strictly constitutional demands. By exploiting his legal rights as a defending counsel, he converted the law courts into a platform for political agitation.

Grattan had continued at Westminster to press for Catholic emancipation, but he and other Protestant reformers were prepared to make concessions which O'Connell as a fervent Catholic would not accept. Sympathy with the Catholic grievances was widespread in England, and by 1815, when O'Connell had created a really formidable popular agitation in Ireland, emancipation probably would have been carried in the house of commons if the Catholics had agreed to a government veto upon the appointment of Catholic bishops. But O'Connell objected so vehemently to any government interference with religious matters that he preferred to allow his agitation to collapse. His nationalism also was so intense that he regarded repeal of the union as being more important than Catholic emancipation, which he knew that an Irish parliament must concede. His defiant methods and his democratic claims aroused alarm among the Protestant landowners who had formerly resisted the union but now feared that an Irish parliament would be overwhelmed by a Catholic majority.

O'Connell's personal magnetism and his unrivalled success as an advocate had brought new energy to the popular movement. In 1823 he revived the Catholic agitation, with the help of some brilliant younger leaders, by forming a Catholic association which was financed by subscriptions of a penny a month. A concerted revolt against payment of tithes to the established Church of Ireland was developing widely, and the demand for emancipation assumed a wider aspect, with O'Connell as the national leader asserting the people's rights against an oppressive system. Although sympathy with the Catholic claims was now widespread in England, King George IV refused to allow the question to be raised. In 1826 the peasantry in Waterford showed its independence by voting against the powerful Beresford family on its own domain. In 1828 O'Connell himself stood for Clare, as a Catholic who would not take his seat until the anti-Catholic oath was

abolished. His triumphant election compelled the duke of Wellington and Sir Robert Peel to carry the Emancipation act of 1829, which admitted Catholics to parliament and to most public offices.

Demand for Repeal of the Union. — When the Whigs had obtained power soon afterward, O'Connell attempted to agitate by similar methods of mass meetings and popular organization for repeal of the union. His efforts were defeated by vigorous repression, and for about ten years he gave the Whigs a chance to fulfil their promises of enlightened reforms. But the house of commons had neither the time nor the knowledge to attend to Irish problems, which required drastic remedies, and the ascendancy still controlled Dublin castle and kept Catholics out of almost every office. Property, as well as land, was still mainly in Protestant hands, and the Catholic population was more impoverished than ever, while its numbers continued to expand. By 1841 there were about 8,200,000 people in Ireland, and the increase had been chiefly in all the overcrowded and infertile counties of the west. Destitution had become so prevalent that landowners were already doing their utmost to encourage emigration and to reduce the number of holdings.

After a decade of disappointment O'Connell derided to revive the repeal agitation in 1840. It came to life swiftly when the Young Ireland leaders, Gavan Duffy and Thomas Osborne Davis, founded the weekly newspaper the Nation and threw their energies into organizing monster meetings in all parts of Ireland. Action in parliament was disregarded, while the popular demonstrations assumed a more definite character. A climax was reached in Oct. 1843 when Feel mobilized troops and artillery to suppress the monster meeting arranged at Clontarf, outside Dublin. O'Connell and the principal leaders were tried for seditious conspiracy and imprisoned, but were soon released after an appeal to the house of lords. O'Connell's method of popular agitation within the law had proved unavailing, and his strength was now broken by age and the disease which caused his death in 1847.

The Great Famine. — The younger leaders demanded a bolder policy of revolt, and open friction between O'Connell and the Young Ireland movement had developed before the country was suddenly confronted by national famine in 1846. The potato crop, which was as indispensable to the people as rice in India, failed everywhere as a result of the blight, which was still an unknown disease. In 1846 and 1847 the blight was more general and devastating, and, with typhus following upon famine, vast numbers died. Emigration became the sole hope of escape, and there was a catastrophic decline of population. Every little farm had to support a family, but without potatoes the people could not survive. Out of less than 700,000 holdings, about 300,000 were smaller than 3 ac. and another 250,000 were between 3 and 15 ac. Attempts to relieve the universal distress were ineffective. Large supplies of maize were imported by the government and by charitable agencies, and many temporary schemes of relief work were organized to provide employment. Subscriptions poured in from the United States and other countries. But emigration was the chief escape from death by starvation and pestilence, and the population, which had risen to about 8,500,000 by 1845, had fallen by 1851 to 6,550,000.

O'Connell's cautious policy after his release in 1844 had made the Young Ireland leaders restless, while the popular agitation died down. The great famine intensified their conviction that unless the union was repealed there could be no constructive improvement. There was now a much wider difference between the economic conditions and needs of the two countries, and Irish needs were overridden or ignored, even when famine was depopulating the country. Young Ireland demanded that the export of grain and cattle should be forbidden while the people starved, and that the state should finance new industries and railaays to give employment. But these demands conflicted with the sacred principles of free trade and private enterprise, and the house of commons generally ascribed Irish misery to the results of political agitation. In desperation the Young Ireland leaders began preparations for an armed rising to achieve national government. They were encouraged by the bloodless revolution in Paris which overthrew Louis Fhilippe early in 1848. But the government forced a premature outbreak in June, and the leaders were either deported as convicts to Tasmania or escaped to the United States.

Rise of **Fenianism.**—For about 20 years after the great famine, political agitation was subdued, while emigration continued to reduce the population every year. The landowners had also suffered severely from inability to collect rents, and there was a wholesale transfer of estates to new owners. Their first concern was to reduce the number of smallholdings and to substitute grazing for tillage on larger, consolidated farms. Evictions were widespread, and cottages were burned down at once by the landlords to prevent other impoverished tenants from occupying them. The flow of emigrants to the United States was now encouraged by invitations from relatives and friends who were already there. And in England, also, the new industrial cities and shipping centres attracted large settlements of hopeless and embittered exiles from Ireland. Among them, both in the United States and in England, the Fenian movement spread widely as a secret revolutionary society which aimed at securing Ireland's political freedom by exploiting every opportunity to injure English interests. Fenianism became a serious menace when it was reinforced by many Irish-Americans who had served on both sides in the American Civil War. W. E. Gladstone at last recognized the necessity for drastic Irish reforms, and in 1869 he disestablished the Protestant Church in Ireland. The next year he introduced the first Irish Land act which conceded the principles of secure tenure and compensation for improvements. In 1870 the Home Rule association was founded by Isaac Butt, a prominent Unionist lawyer who had been converted by the famine experience to the necessity for Irish self-government.

A return of bad harvests in 1879, however, brought new fears of famine, and the Land league was founded by Michael Davitt. The son of an evicted tenant, he had become a Fenian as a young labourer in England and had spent years in prison there. His Land league soon gathered wide support for its program of fixity of tenure, fair rents and free sale. **A** formidable agrarian agitation developed when Davitt was joined by Charles Stewart Parnell, a young landowner and member of parliament in the Home Rule party, which soon elected him as its leader in place of Butt. Parnell and Joseph Bigger had adopted a new policy of persistent obstruction at Westminster to compel attention to Irish needs. Their skilful and determined tactics brought parliamentary business to a standstill and galvanized the new popular agitation in Ireland. Gladstone was forced to introduce his Land act of 1881, which made large concessions; and its new rent tribunals soon insisted upon wholesale reductions of rent.

The Fenian revolutionary movement in the United States and in England agreed to support Parnell's dynamic leadership of the Home Rule party, which now aimed at forcing either Liberals or Tories to concede national government. In 1886 Gladstone introduced a home rule bill, but it was defeated and the Liberal party was split. Parnell, however, had created such a formidable movement, with widespread support from the United States and in England, that he seemed likely to succeed, until he was suddenly involved in divorce proceedings brought by his colleague Captain William O'Shea. Gladstone then announced that his nonconformist followers would not co-operate further if Parnell retained the leadership, and in Ireland the Catholic Church also insisted on his retirement. But Parnell refused to resign, and his party was bitterly divided when he died in Oct. 1891, fighting vehemently as leader of the minority.

The Nationalist Revival. — Gladstone introduced his second home rule bill in 1893; the house of commons passed it by 301 to 267, but the lords rejected it by 419 to 41. It became evident that the lords would always resist home rule, and nationalist hopes were further discouraged by the party split. Ireland's population had declined to 6,700,000 by 1891, and emigration continued to reduce it. But a new phase of nationalist revival now began, with a cultural and economic program. There was a revival of the Irish language, led by Douglas Hyde, and the co-operative movement in agriculture, fostered by Sir Horace Plunkett, coincided with a movement for Irish industrial develop-

ment and with a general policy of creating an Irish Ireland. Anti-English feeling and a concentration upon internal progress, without regard to Westminster, were fostered by the centenary of the 1798 rebellion and by the pro-Boer demonstrations during the South African War. A new party called Sinn Fein (Ourselves Alone) was founded in 1900 by Arthur Griffith, who ridiculed dependence upon the British parliament and demanded that the Irish members cease to attend it and form a national council in Ireland.

Conservative Reforms.—Around the close of the century Arthur Balfour had initiated a new Tory policy, designed to "kill home rule by kindness," by introducing constructive reforms in Ireland. The Congested Districts board carried out a general improvement of the uneconomic smallholdings in the west. A new department of agriculture and technical instruction gave much practical aid under Plunkett's direction. The Local Government act of 1898 abolished the grand juries and entrusted local affairs to elected councils. In 1903 George Wyndham, as Irish secretary, was enabled to carry the Land Purchase act. It offered generous inducements to the landlords to sell their estates to the Land commission, which was to collect terminable land annuities instead of rent. The response was immediate and overwhelming, and the Irish land question was settled at last by transferring ownership of the land to the occupying tenants on easy terms.

The Third Home Rule Bill.—In 1900 the two rival wings of the Nationalist party were at last reunited by consent, when John Dillon as leader of the larger section agreed to serve under the Parnellite John Redmond. But hopes of carrying home rule were still distant while the lords' veto remained, though the party continued to press for an Irish parliament, with increasing support in England and the dominions. The Liberals' triumph in 1906 revived hope, but it was soon disappointed by the meagre offer of an Irish councils bill, which was at once rejected. Other reforms, however, including the National University act of 1907, were obtained; and in 1909 Redmond seized his chance of demanding a home rule bill when Lloyd George's radical budget provoked a collision with the house of lords. H. H. Asquith promised home rule if the Nationalists would support his campaign against the lords, and iti 1910 the Parliament act appeared to leave the way open for the restoration of an Irish parliament. Popular enthusiasm had revived after years of despondency; a new generation, free from the inhibitions of old grievances and already accustomed to the responsibilities of local government, looked forward to a new era of opportunity in public service and in scope for employment at home. Nearly all the most important positions in the civil service and industry and commerce were still largely reserved for Englishmen or for members of the old Protestant ascendancy. Even in the professions advancement had usually been the reward of service to the Unionist party and to Dublin castle.

Redmond, however, had unexpectedly achieved the balance of power between the rival parties at Westminster which had been Parnell's ambition. The two elections of 1910 had each returned a Liberal ministry dependent upon Irish Nationalist support. But they had abolished the lords' veto, and home rule had become part of the Liberal and Labour programs in England. Under the Parliament act, the Home Rule bill of 1912 was apparently ensured of enactment after two years' delay if it passed the commons a second time during the same parliament.

Opposition in Ulster.—The Unionist party adopted unexpected methods to defeat its progress. Bonar Law replaced Balfour as its leader in 1911, and he gave full support to the threats of defying parliament by armed resistance in Ulster. Sir Edward Carson, as leader of the Ulster Unionists, announced that a provisional government would be formed there to defeat home rule. Both Carson and J. H. Campbell represented Dublin university at Westminster, but every other Irish constituency outside Ulster had returned a Nationalist, almost without an exception, for many years. Even in Ulster, 16 of the 33 members were Nationalists, and a by-election for Derry city in 1912 was won by a home ruler, so that the province had a majority against the union. The Ulster Unionists for some time proclaimed their intention of defeating home rule for all Ireland by defying its operation; but they gradually fell back on a demand for exclusion of all Ulster from its scope. Redmond's claim that there was "no Ulster question" implied that even among the Ulster members there was now a majority for home rule. But his claim hardened the Protestant and Unionist resistance in the heavily populated counties around Belfast. Down, Antrim, Armagh and Derry all contained large Unionist majorities and were predominantly Protestant or Presbyterian. Donegal, Cavan and Monaghan had strong home rule majorities, and Tyrone and Fermanagh each had a small total majority for home rule.

No serious consideration had been given to separate treatment for Ulster, but the Unionists now claimed exclusion for the whole province. They organized the Ulster volunteer force, for which the veteran Field Marshal Lord Roberts chose Gen. George Richardson as commander in chief. Arms for the Ulster volunteers were soon imported in defiance of the law, while Bonar Law and most of the leading English Unionists gave full encouragement to Carson's whirlwind campaign inciting to disorder. At Westminster Redmond had apparently won the political game by the accepted rules, but the Unionists were openly organizing defiance of parliament in Ulster. They were boasting of active sympathy among most of the serving officers in the army. Their boasts became formidable when all officers in the cavalry brigade at the Curragh, led by Gen. Sir Hubert Gough, suddenly announced in March 1914 that they would resign if called upon to move into Ulster. Mobilization orders had not even been issued, but there had been raids on war office depots in Ulster and reinforcements were needed, before Carson achieved a spectacular success in landing a large cargo of arms from Germany at Larne on April 24, 1914. The Curragh mutiny was followed by the resignation of Col. J. E. B. Seely as war minister, and Asquith personally assumed control.

The Irish Volunteers.—Before these sensational incidents, the Ulster volunteer movement had provoked inevitable countermeasures among the Nationalists. Faith in the efficacy of parliament had been rudely shaken by Carson's successful defiance. The younger Nationalists, especially in Ulster, considered Carson's aggressive realism more effective than Redmond's patient negotiations. In Nov. 1913 the Irish volunteers were launched in Dublin, to counteract the Ulster volunteers. They spread swiftly, especially in Ulster, and still more after the Curragh episode in March. Redmond was convinced that the Home Rule bill would become law that autumn and that only a European war could delay its operation. But the threats of civil war in Ulster were now reinforced by large cargoes of imported rifles, and the British army's readiness to enforce order in Ulster was seriously in doubt. The Irish volunteers were gaining such support among the younger Nationalists that Redmond found it necessary to assume control of an unconstitutional movement which he instinctively distrusted. In May 1914 the Irish volunteers agreed to expand their former provisional committee, which consisted mostly of unknown men, into a larger directorate composed chiefly of Redmond's supporters.

By the early summer Ireland was thus confronted with the prospect of civil war, while the rival volunteer forces collected arms wherever they could. The outlook was so menacing that in July the king convened a conference of leaders on both sides at Buckingham palace to find an agreed solution. Carson's earlier efforts to prevent an Irish parliament were now reduced to demanding exclusion of Ulster, and the issue had been narrowed to a definition of the area for exclusion. Redmond had agreed reluctantly to a strictly temporary exclusion of those counties which had Unionist majorities. He would not concede Tyrone or Fermanagh or Derry city, and he insisted on exclusion only for a short period. After several days the conference reached a deadlock and reported its failure to agree.

Meanwhile a small cargo of arms for the Irish volunteers had been bought in Belgium and was brought secretly into Dublin bay at Howth on July 26. A parade of Irish volunteers unloaded the cargo but was challenged by military and police on returning to Dublin. An armed collision on the Dublin quays resulted in many civilian casualties. The Ulster volunteers had run their cargo at Larne with impunity, and this discrimination against the National-

ists aroused fierce popular resentment. Redmond obtained the adjournment of the house of commons in protest, but events swiftly eclipsed the crisis in Ireland when the Germans invaded Belgium on Aug. 3.

World War I.—When Sir Edward Grey announced the declaration of war, Redmond intervened to promise full Irish sympathy. He made an immediate offer that the Irish volunteers of both forces (renamed the national volunteers) would defend the coasts of Ireland and that all troops could be withdrawn. Soon afterward he undertook an open campaign to encourage recruiting for the Irish regiments in the British army.

Great numbers of young Irishmen enlisted rapidly, and three new Irish divisions were recruited, one of them in Ulster. But Redmond's assurances that the Irish recruits would serve together soon led to bitter disappointment. Lord Kitchener, who had become war minister, had a deep distrust for Irish regiments, and he refused even a distinctive flag to the southern Irish divisions, though the Ulster division was allowed even to elect its own officers. Redmond's protests were unavailing, and the first enthusiasm for war service was soon deadened by official discouragement. But the flow of recruits continued steadily until it was computed that more than 200,000 had gone from Ireland without any measure of conscription.

Kitchener's attitude had also stimulated the more extreme Nationalist wing of the Irish volunteers, who had protested against Redmond's recruiting campaign, and they seceded as a separate force. Military repression, by censorship and by prosecutions for alleged seditious behaviour, soon increased disaffection. The original organizers of the Irish volunteers had consisted largely of recent recruits to the old Fenian Irish Republican brotherhood (I.R.B.), which had been lately revived in the United States. The Irish Republican brotherhood had discerned new prospects of anti-English intervention in case of war in Europe, and Carson's successful defiance of parliament had stimulated anti-English feeling in the United States. The supreme council of the Irish Republican brotherhood had decided, immediately after war broke out, that the long-delayed opportunity for an armed rising in Ireland must now be seized. Steps were taken to solicit help from Germany, and arrangements were made for regular secret instructions to Ireland from the United States. Membership of the secret Irish Republican brotherhood was very restricted, and its influence was not recognized until long afterward. Before the end of 1914 full plans had already been made for the revolutionary outbreak which took the country by surprise on Easter Monday, 1916.

Redmond's national volunteers were then almost moribund, because the more active members had either gone to war service or seceded. The republican Irish volunteers, more active though less numerous, had been drilling intensively with a view to serious action. They were ostensibly led by Eoin (John) MacNeill, though the I.R.B., which had planned an insurrection, kept him in ignorance. The I.R.B. had been in touch with Sir Roger Casement during his futile mission to Germany and knew that he had obtained only a small cargo of obsolete arms. When Casement was arrested in County Kerry after landing from a German submarine on April 21, 1916, and the German arms ship was sunk at sea, they had planned to rise on Easter Sunday, April 23. But MacNeill forestalled them by cancelling all mobilization orders, and only about 2,000 out of the small total force available were actually engaged on Easter Monday, when the general post office and other parts of Dublin were suddenly seized. For a week Dublin was paralyzed by street fighting until bombardment or fires compelled Padraic Pearse and his colleagues to surrender.

Asquith went at once to Ireland for a short visit, and announced openly that the former system of government there had completely broken down and a new departure was necessary. Lloyd George was appointed to attempt a final settlement by negotiating with both Irish parties. Each interpreted his offer differently and agreed to temporary concessions which were repudiated when the truth became clear. Redmond had persuaded the Ulster Nationalists to accept exclusion for six counties for six years only, while Carson had surrendered his claim to the three western counties of Ulster on condition that the rest got permanent exclusion. Bitter feeling had been aroused by the prolonged succession of executions and the deportation of a great number of political suspects. Redmond had vainly insisted that only a few exemplary sentences should be imposed, for what he described as an un-Irish conspiracy, inspired and financed by Germany. Lloyd George's part in the negotiations only strengthened the growing sense of betrayal, while the Home Rule act was still in abeyance. Sinn Fein candidates were now put forward at by-elections and received overwhelming support. Popular sympathy with Sinn Fein was immensely increased by Lloyd George's decision to apply conscription to Ireland early in 1918. A general surge of protest was supported by a resolution from the Irish bishops at Maynooth, who denounced conscription in Ireland as being morally unjust. When this protest prevailed, Sinn Fein gathered momentum everywhere. At the elections in Dec. 1918 it captured almost every seat which had formerly been held by Redmond's party.

The Growth of Republicanism.—Irish influence in the United States had grown steadily since the great famine, and bitter memories still inspired anti-English sentiment even during the war. The Nationalist revival in Ireland was being harshly repressed, and, though the Home Rule bill had been enacted late in 1914, a suspensory act delayed its operatian till the war ended. In a fast-changing world, Asquith's act seemed utterly inadequate. Sinn Fein was demanding an independent republic, claiming the right of national self-determination which Pres. Woodrow Wilson asserted to be the Allied war aim. Increasing pressure from the United States compelled Lloyd George to make new efforts; but the Irish convention which he appointed in 1917 to frame an Irish constitution by consent contained no representation of Sinn Fein. Many of the new members elected at the end of 1918 were then in prison for political agitation, and the Irish-Americans soon organized support for Ireland's representation at the peace conference at Versailles.

Agitation in Ireland intensified, and the Irish volunteers began to conduct guerrilla war against the military and armed police. As the Irish Republican army (I.R.A.) they soon engaged in widespread ambushes and attacks on barracks and convoys, and the government retaliated with ruthless reprisals. A large proportion of the Irish police resigned, and they were replaced by recruits from England, who became known as the Black and Tans, from their temporary uniforms. A new force of auxiliary police, recruited wholly from demobilized officers who lacked other employment, was organized under Gen. Hugh Tudor. They undertook a systematic campaign of reprisals, which culminated in setting fire to a large part of Cork city, after similar outbursts in Balbriggan and other towns.

This open competition in violence soon brought deep discredit upon British rule, and a wave of protest arose in England, as well as in the United States and the dominions. The Times of London joined vigorously in denouncing the excesses of the crown forces and put forward a constructive solution in proposing dominion status for a new Irish parliament. Lloyd George made yet another attempt by carrying the Government of Ireland act of 1920, which was to establish two Irish parliaments, with equal though very limited powers, one for southern Ireland and one for the six counties of northern Ireland. There was to be a joint council representing both Irish governments, which was to propose future extensions of independent authority when opportunity arose. But Sinn Fein refused to bring the southern parliament into operation, though it contested the elections and won 73 of the 102 Irish constituencies, including every seat outside Ulster except the four allotted to Dublin university. The Northern Ireland parliament was brought into being, though the Ulster Unionists protested that they preferred to remain within the union. King George V went to Belfast and formally opened the new parliament on June 22, 1921. He had been deeply concerned over the chaos in Ireland, and his speech contained a deliberate appeal for reconciliation. Gen. Jan C. Smuts and other dominion statesmen had been urging a settlement on the lines of offering dominion status and had gained the king's support. Within a week Lloyd George offered a truce to Eamon de Valera as the Sinn Fein leader and invited negotiations which were soon opened and resulted in the Anglo-Irish

treaty of Dec. 1921. For the subsequent history of Ireland see IRELAND, NORTHERN and IRELAND, REPUBLIC OF. (D. G.)

BIBLIOGRAPHY.—*General works:* R. Dunlop, *Ireland From the Earliest Times* (London, 1922); E. Hull, *A History of Ireland and Her People* (London, 1926); M. Hayden and G. A. hloonan, *A Short History of the Irish People,* 2nd ed. (London, 1927); E. Curtis, *A History of Ireland,* 2nd ed (London, 1936); J. T. Gilbert, "Irish Bibliography," *Proc. Roy. Ir. Acad.* (Dublin, 1904); C. Maxwell, *A Short Bibliography of Irish History* (London, 1921). (U. G. F.)

Early history: E. MacNeill, *Phases of Irish History* (Dublin, 1920), *Early Irish Laws and Institutions* (Dublin, 1935) and *St. Patrick, Apostle of Ireland* (London, 1934); T. F. O'Rahilly, *Early Irish History and Mythology* (Dublin, 1946); A. S. Green, *Hzstory of the Irish State to 1014* (London, 1925); L. Gougaud, *Christianity in Celtic Lands,* tr. by M. Joynt (London, 1932); J. Ryan, *Irish Monasticisnz* (London, 1931); J. F. Kenney, *The Sources for the Early History of Ireland* (1929); A. Holder, *Alt-Celtischer Sprachschatz,* 3 vol. (Leipzig, 1891–1913). (JA. HN.)

Middle ages: Contemporary accounts of this period are contained in the Irish and Anglo-Norman annals. Students should also consult the calendars of state papers and the papal registers. The following is a list of modern works: M. V. Clarke, *Medieval Representation and Consent* (London, 1936); H. G. Richardson and G. O. Sayles, *The Irish Parliament in the Middle Ages* (1952); G. H. Orpen, *Ireland Under the Normans, 1169–1335,* 4 vol. (Oxford, 1911–24); W. A. Phillips (ed.), *History of the Church of Ireland,* vol. ii (London, 1934); A. Gwynn, *The Medieval Province of Armagh, 1470–1545* (Dundalk, 1946); E. B. Fitzmaurice and A. G. Little, *Materials for the History of the Franciscan Province of Ireland, 1230–1450* (Manchester, 1920); M. H. MacInerny, *A History of the Irish Dominicans* (Dublin, 1916); J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865); F. E. Ball, *The Judges in Ireland, 1221–1921,* 2 vol. (London, 1926); E. Curtis, *A History of Mediaeval Ireland From 1110 to 1513,* 2nd ed. (London, 1938); *Richard II in Ireland, 1394–1395* (Oxford, 1927).

English domination (1485–1800): Contemporary accounts of this period are to be found in the annals mentioned above, and in the calendars of state papers and official letters. *See* also L. O'Clery, *Life of Hugh Roe O'Donnell,* ed. and trans. by D. Murphy (Dublin, 1893); T. O'Cianain, *The Flight of the Earls,* ed. and trans. by P. Walsh (Maynooth, 1916); Edmund Spenser, *View of the State of Ireland;* Sir John Davies, *A Discovery of the State of Ireland and Historical Tracts,* ed. by A. Grosart (London, 1869–76); W. Knowler (ed.), *Letters and Dispatches of the Earl of Strafford,* 2 vol. (London, 1739); Edmund Burke, *Letters, Speeches and Tracts on Irish Affairs,* ed. by M. Arnold (London, 1881); T. Wolie Tone, *Autobiography,* ed. by R. B. O'Brien (London, 1893); R. R. Madden, *Literary Remains of the United Irishmen* (Dublin, 1887); A. Young, *A Tour in Ireland, 1776–1779* (London, 1780).

Modern works: R. Bagwell, *Ireland Under the Tudors,* 3 vol. (London, 1885–90), and *Ireland Under the Stuarts,* 3 vol. (London, 1909–16); R. D. Edwards, *Church and State in Tudor Ireland* (London, 1935); C. Maxwell (ed.), *Irish History From Contemporary Sources, 1509–1610* (London, 1923); D. Bryan, *The Great Earl of Kildare* (Dublin, 1933); S. O'Faolain, *The Great O'Neill* (London, 1942); M. V. Ronan, *The Reformation in Dublin, 1536–1558* (London, 1926) and *The Reformation in Ireland Under Elizabeth, 1558–1580* (London, 1930); P. Wilson, *Beginnings of Modern Ireland* (Dublin and London, 1912); W. F. T. Butler, *Confiscation in Irish History* (Dublin, 1917) and *Gleanings From Irish History* (London, 1925); T. W. Moody, *The Londonderry Plantation, 1609–1641* (Belfast, 1939); J. P. Mahaffy, *An Epoch in Irish History* (London, 1903); R. Dunlop (ed.), *Ireland Under the Comnzonwealth,* 2 vol. (Manchester, 1913); D. Murphy, *Cromwell in Ireland* (Dublin, 1883); R. B. O'Brien (ed.), *Two Centuries of Irish History, 1691–1870* (London, 1907); W. E. H. Lecky, *Leaders of Public Opinion in Ireland,* 2 vol., 2nd ed. (London, 1912), and *History of Ireland in the 18th Century* (London, 1892); H. Grattan, *Memoirs of the Life and Times of the Rt. Hon. Henry Grattan,* 5 vol. (London, 1839–46); Sir T. Wyse, *Historical Sketch of the Late Catholic Association of Ireland,* 2 vol. (London, 1829). (U. G. F.)

The union (1800–1921): P. S. O'Hegarty, *A History of Ireland Under the Union, 1801 to 1922* (London, 1952); Sir James O'Connor, *History of Ireland, 1798–1924,* 2 vol. (London, 1925); D. Gwynn, *Daniel O'Connell,* 2nd ed. (Cork, 1947), *Young Ireland and 1848* (Cork, 1949), *Life of John Redmond* (London, 1932) and *The History of Partition, 1912–25* (Dublin, 1950); N. Mansergh, *Ireland in the Age oj Rejorm and Revolution, 1840–1921* (London, 1940); J. Mitchel, *Jail Journal,* rev. ed. (Dublin, 1918); Sir C. G. Duffy, *Young Ireland,* rev. ed. (London, 1896), *Four Years of Irish History* (London, 1882) and *League of the North and the South . . . 1850–54* (London, 1886); R. B. O'Brien, *Dublin Castle and the Irish People,* 2nd ed. (London, 1912), and *The Life of Charles Stewart Parnell,* 2 vol., 2nd ed. (London, 1899); J. Devoy, *Recollections of an Irish Rebel* (1929); M. Davitt, *Fall of Feudalism in Ireland* (London, 1906); F. S. L. Lyons, *The Irish Parliantentary Party, 1890–1910* (London, 1951); R. MacNeill, *Ulster's Stand for Union* (London, 1922); T. M. Healy, *Letters and Leaders of My Day,* 2 vol. (London, 1928); L. Paul-Dubois, *Contemporary Ireland* (1908); W. A. Phillips, *The Revolution in Ireland, 1906–23,* 2nd ed. (London, 1926); P. Beaslai, *Michael Collins, Soldier and Statesman* (Dublin and Cork, 1937); D. Breen, *My Fight for Irish Freedom* (Dublin, 1924); D. Ryan, *The Man Called Pearse* (Dublin and London, 1919), *James Connolly* (London, 1924) and *The Rising* (Dublin, 1949); J. Carty, *Bibliography of Irish History, 1870–1911* (Dublin, 1940) and *Bibliography of Irish History, 1912–21* (Dublin, 1936). (D. G.)

POPULATION

The population statistics for Ireland show some interesting and unusual features. Its population decreased by no less than half in the 100 years after the middle of the 19th century, in spite of a very high birth rate (about 20 per 1,000). Emigration became apparently a permanent and accepted characteristic of Irish life. It is normal for some of the young persons of both sexes to leave home permanently. Even in the most remote districts some members of nearly every family are settled in an overseas country. For many years most of them found homes in the United States and the British dominions overseas. When these lands limited immigration the numbers leaving Ireland quickly fell, and the main stream was directed toward Britain. During World Wars I and II and after World War II, the Republic of Ireland especially formed something of a reservoir of labour to be drawn upon by Britain when faced with a shortage of labour. The emigrants are drawn from every social grade. A curious feature is that, though most of them come naturally from rural environments, they become mainly town dwellers, largely employed on unskilled or semiskilled work in factory occupations. There is also of course the usual drain from the country toward the larger cities, notably to Dublin and Belfast, where many become, at least for a time, slum dwellers.

The distribution of the people over the land also shows some unusual features, perhaps more akin to those found in France than in other western countries. It is most dense where farming conditions are hardest; that is, along the Atlantic coasts. The general picture is of a widespread scattering of people on isolated farms with market centres (often quite small but all dignified with the name of town) at fairly regular intervals. The distance between these towns is probably determined by the length of the journey which can be undertaken by driven cattle and the time taken to return after their sale. Wide spaces without any population at all are found in the mountain areas, and there are numerous smaller unpopulated patches on the bog country of the lowlands.

The traveller in the coastal districts of the west is likely to be surprised by the unending series of small farmhouses along the roads. The associated farms reach back but a little way, however, to the mountain or bog which forms the limit to the occupied land. Many of them are of less than ten acres, and since each is occupied by a household of perhaps five persons on the average, the density on the useful land is evidently very high. These were the districts whose improvement was entrusted to the Congested Districts board in 1891. The density of rural population was as high as 400 per square mile in some of these areas. It is generally more than 100 in the country north of a line from Dundalk to Galway bay and in the southwest, and less than 100 in the south and east. In the big-farm country it falls to less than 30.

The census definition of a village in the republic is "a cluster of 20 houses or more." but in Northern Ireland the limit is raised to 50 houses. Yet even such small groups are few in number. Farmhouses and labourers' cottages are not usually grouped around a church, a few shops, an inn or two and a post office as in Great Britain. They generally occur in any sort of order along the highway or with each farm at the end of its own lane. Towns on the other hand may have as few as 200 people. Only ten have populations exceeding 20,000. No less than one-third the total population of Northern Ireland lives in Belfast, one-sixth that of the Republic of Ireland in Dublin. Nevertheless the tiny country towns play an essential part in the life of the country. They carry on the commercial life of the areas surrounding them. Most of them have monthly fairs; a few have weekly markets. There the farmer sells his young stock, eggs and poultry and some of his crops, or buys stock for fattening. There too he banks his savings and consults his solicitor or doctor. Their shops cater for the needs of both home and farm, and the inn provides for travellers.

Most of them have motor services for both goods and passengers, and the larger places have rail services too. The populations of such places are remarkably stable, nicely adjusted to the business of the areas they serve. Where some industry has been established they may rise to between 5.000 and 10,000, but there are still only about a score of this size in the whole country.

The church plays such an important part in the social and educational life of the country that religious adherence is recorded in the census returns. These show that the Republic of Ireland is predominantly Roman Catholic (2,786,033 as against 169,074 of other denominations in 1946), almost exclusively so over a quarter of its area. In Northern Ireland the Catholic element is in a minority (471,460 as against 899.461 in 1951), but the two groups are mixed throughout, with no regions exclusively of either kind.

ECONOMICS

Agriculture. — Ireland's main resource is its land. Two-fifths of its people look to farming for a livelihood, as against one-third depending on trade and manufactures. Good agricultural prices, primarily good prices in English markets, mean prosperity for the Irish people. Throughout its history Ireland has been a land of peasants, of people working the land mainly for their own sustenance and that of their near neighbours. The land hunger, typical of peasant communities everywhere, has been a constant factor in its social and political life. The tendency to invest surplus capital in land purchase is still strong. From mid-19th century, government action brought about the breakup of the old semifeudal estates so that the land became to an increasing degree the property of those who work it. Many of the old farm holdings, much too small to maintain the households living upon them and often consisting of scattered plots hopelessly uneconomic as working units, were combined to form more compact and larger farms. The governments of both the Republic of Ireland and Northern Ireland still maintain a lively interest in the welfare of their rural populations.

It is customary in Ireland to speak of holdings of less than 30 ac. as small farms, of 30–100 ac. as medium and of more than 100 ac. as large farms. These very descriptions in themselves suggest the small scale on which Irish farming is carried on. About 60% of all the farms fall into the first group, and together these cover nearly a quarter of the improved land. The large holdings occupy one-third the farmed acreage. Unimproved lands, in part used as rough pastures, include the mountains of the northwest, west and southwest, of Mourne and Wicklow, much of the bog country and the barren limestone plateaus of Clare. Bogs occur on all the uplands and over much of the central lowlands, more especially in the west. According to T. W. Freeman they cover probably not less than one-fifth of the country and form an important element in the rural economy. For centuries they have been the main source of fuel, providing in later years about 4,000,000 tons of peat annually. For the farmer they provide rough grazing for both sheep and cattle and bedding for stock under shelter. Sometimes the peat-cleared bog lands provide additional cultivable land, but often it is wet, infertile clay.

The small farm units are found in all parts of the country but are dominant in the north and west, particularly in east Connaught and in Armagh, Monaghan and Down. Those of the northern group are intensively worked, with half the land under crops. Flax growing and its first preparation for the mill is an important element in the farming economy and, combined with milk and egg production, provides a fair standard of living for the occupying household. The western farms support a much lower standard. Some of them, particularly those near the coast, provide only a precarious existence. Oats and potatoes, meadow and pasture, divide the acreage. Livestock include one or two cows and sheep, a few pigs and a fair number of poultry. It is usually necessary for some member or members of the household to become seasonal migrants, many going harvesting on the Scottish potato lands. On the edge of the lowlands conditions are a little better. Young cattle and butter are the main farm products, but home industry for the women and seasonal migration by the younger men are still necessary.

The medium-sized farm is more characteristic of the central lowlands of the south, though it frequently has as neighbour at least one farm of the higher category. A farm of this middle class is usually a family farm; that is, worked by members of one household. Besides fattening beef cattle, it supplies milk to the local creamery and grows a variety of crops — wheat for sale or barley for the local brewery where conditions permit, and such crops as oats, potatoes and turnips for feeding the stock. If it is within reach of one of the four sugar refineries, sugar beets may be included. In Northern Ireland flax will probably also appear. The variety of produce enables the owner to switch the emphasis from one product to another as the state of the markets suggests. Other variations are dictated by local facilities, as in the case of sugar beets or of fresh milk production near the larger town centres. The large farms are more specialized in their production. Notable types are those producing fat cattle for slaughter or export to Britain, dairy farms, horse breeding and training establishments and sheep farms on the borders of the uplands. The first of these is particularly important in Meath, Westmeath and Kildare, where there is a great concentration of the bigger farms, obviously related to the export trade of Dublin.

The great famine of 1846 shook the faith of the Irish fanner in arable farming, and thereafter pastoral farming was the principal type followed. During World War II a change took place, probably only temporary however. Much grassland was plowed up, partly in an attempt to compensste for the forced reduction of imported foodstuffs. The difficulty of procuring foreign feeding grain (mainly maize) and concentrates for stock fattening or dairying gave an additional impetus in the same direction by causing a reduction in the number of animals raised. Wheat production was increased, but the number of pigs fell to half the prewar figure. The trend was later reversed but without the 1939 position being quite recovered. Both climate and soil suit grass production and this, with the long period during which outdoor feeding is possible, obviously encourages dependence on grass feeding. Advice to increase the production of winter fodder in order to lengthen the period of butter manufacture seems to be oftener given than taken. More than three-quarters of the farm land remains untilled. Market gardening and fruit growing, for both of which conditions appear to be favourable, are certainly neglected.

The beef cattle trade has a characteristic organization. The small farms produce a surplus of calves which are sold in the western fairs. These are reared for a time on the medium-sized farms, sometimes on two or three in succession, before being passed on to the specialized big farms for finishing. At each sale the beasts move toward the ports — Dublin, Belfast or Londonderry. Dairying is chiefly developed in two areas, a northern belt through Leitrim and Fermanagh and a southern one from the Barrow valley to the Shannon estuary and Bantry. Its main product is butter, the creameries producing a standardized product on the Danish model. In the Republic of Ireland alone there were 4,504,026 cattle in 1954. The number of pigs in that year (958,321) was nearly double that in 1951. They are raised on all the small farms, mainly for home consumption, and in the creamery districts, where the waste milk is fed to them, to supply the bacon factories. In 1954, 3,112,842 sheep were raised, chiefly on the eastern uplands and the dry limestone areas of eastern Connaught.

Industry and Trade. — The character of Irish industry has been largely determined by two factors: (1) the strong tradition of self-sufficiency natural to the remote farm; (2) the absence of resources other than those derived from farming. In the 1950s they still affected both the nature and the distribution of manufactures in Ireland. The agricultural basis is evident in the great number of establishments producing butter and bacon, the breweries and distilleries, the newer meat packing and dried milk factories, the tanneries, the mills handling grain, flax and wool. The farm and its occupants still form the main market for the produce. Thus workshops and factories of small size are found in all the country towns. Lack of capital and narrow markets limit the size of these undertakings and check specialization. The industrial town or large village dependent on a single product, so common in

England, is virtually unknown in Ireland. The abundance of labour throughout the land and the lack of coal fields also remove some of the usual incentives to localize particular industries. It appears only in such simple forms as the preponderance of creameries and bacon factories in the dairying areas and of brewing and distilling near the barley-growing districts. Government action, too, encouraged both the scattering of industry and variety in its forms, though for different reasons in Northern Ireland and in the republic. The object in Northern Ireland is to reduce the dependence on linen and shipbuilding by creating a more diversified economy. In the Republic of Ireland the primary aims are to check the drift of population from the rural areas, whether overseas or to Dublin, and to raise living standards. Its strongly protectionist policy is also influenced by the ideal of creating a self-sufficient community.

Since the more modern industries depend very largely on imported raw materials they naturally tend to gather in the ports. The need for imported fuel has long had the same effect. Thus, in the Republic of Ireland, Dublin is the only place with any sort of claim to be regarded as an industrial city. It has great breweries and distilleries, fertilizer works treating imported phosphates, factories manufacturing biscuits, tobacco, soap, shoes and chocolate, and light engineering and assembly works. It remains, however, essentially a port and a capital city. Industry is far more important in Northern Ireland than in the republic. Belfast, though originally a market town, later a port and still later a centre of government, is essentially industrial in character. The making of linens was its first large industry and remains the most important. To it was soon added the making of cottons, and the manufacture of garments naturally followed. The improvement of its harbour and the reclamation of marsh land that accompanied it made possible the development of shipbuilding. It was this which finally changed the character of the city and quickened its growth. It works in well with the textile industry, employing almost entirely male labour whereas in the linen factories two-thirds of the workers are women. Subsidiary industries such as engineering and ropemaking followed in the wake of shipbuilding, and the later growth of aeroplane construction was yet another offshoot. Tobacco manufacture is of earlier establishment, but with the newer synthetic fibre factories adds to the demand for female labour. Other towns of east Ulster share in the linen trade but without creating any such industrial agglomerations as those of south Lancashire or the West Riding of Yorkshire.

BIBLIOGRAPHY.—T. W. Freeman, *Ireland* (1950); G. A. J. Cole and T. Hallissey, *Handbook of the Geology of Ireland* (London, 1924); W. B. Wright, *The Quarternary Ice Age*, 2nd ed. (London, 1937); E. G. Bilham, *The Climates of the British Isles* (London, 1938); R. L. Praeger, *The Botanist in Ireland* (Dublin, 1934) and *Natural History of Ireland* (London, 1950); R. J. Ussher and R. Warren, *The Birds of Ireland* (London, 1900); G. R. Humphreys, *List of Irish Birds, Showing the Species Contained in the National Collection*, 5th ed. (Dublin, 1937); G. A. J. Cole, *Ireland, Industrial and Agricultural* (Dublin, 1902); J. O'Donovan, *The Economic History of Livestock in Ireland* (Dublin and Cork, 1940); C. M. Arensberg and S. T. Kimball, *Family and Community in Ireland* (1940); J. M. Mogey, *Rural Life in Northern Ireland* (Oxford, 1947); T. S. Wheeler, *Industrial Resources of Ireland* (Dublin, 1944); *Irish Industrial Yearbook*, pub. annually (Dublin, 1934–). (T. HER.)

IRELAND, CHURCH OF. The beginnings of Christianity in Ireland are difficult to trace, but there is no doubt that the first Christian missionary whose labours were crowned with any considerable success was Patrick (fl. c. 450), the patron saint of the country. Ireland was never conquered by the Romans and, chiefly for that reason, occupied a peculiar position in western Christendom for about six centuries. The church was mainly monastic, without parochial or diocesan divisions. Government was from the monasteries, and the powers of the bishops were limited to their purely spiritual functions. During this time missionaries went from Ireland to Britain and much of the continent of Europe; Irish scholarship was widely famous; and much evidence exists today of the devoted skill and craftsmanship of the Irish monks. (See IRELAND: History.)

The Norse invasions, beginning at the close of the 8th century, precipitated a decay in culture and learning. The weakness of an unco-ordinated ecclesiastical organization became evident, and the influence of Rome, through Canterbury, began to be felt for the first time. English bishops, chief among them Gilbert of Limerick, possessed themselves of the most important sees. About the year 1110 Gilbert held a synod at Rathbreasail which divided Ireland into 25 sees subject to the primacy of Armagh. Subsequently the pope sent legates to assist at the bringing of the Irish church into conformity with the rest of western Christendom, and the synod of Kells (1152) created four provinces with Armagh, Dublin, Cashel and Tuam as archbishoprics. The final step in the process of reform was taken at the synod of Cashel (1171), when obedience to Rome was accepted. There also regulations were made for marriage and baptism, tithes and papal tribute. The native liturgies were abandoned and the usage of the Church of England was adopted. With this began a period of subservience which was to last for 700 years.

The mediaeval history of the church in Ireland follows that of the country as a whole. Ireland was never completely conquered, but strategically important centres were developed and strengthened, and from these England exercised a measure of control. Most of the country was only at intervals made conscious of this overlordship, and the tribal kings continued to wield authority. In the church, Englishmen were appointed to the more important positions, the native orders were gradually replaced from abroad, but the mass of the secular clergy were Irish and retained something of the old Celtic spirit. It is possible that had this remnant of independence been considered and fostered at the Reformation the Church of Ireland might have become the church of the majority. In the event, a quite different course was followed. The native Irish were antagonized and came to look on the attempt at reformation as a political expedient and a weapon of conquest.

The Reformation period began with the passing of the Irish Supremacy act in 1537. This asserted the English king's supremacy in the Irish as in the English church. No attempt was made to win the mass of the Irish people to Reformation principles, and they were ignorant of and unaffected by the religious controversies which had been raging in Europe and Great Britain for many years. Nor were the differences of religious outlook of succeeding English sovereigns brought home to them as they were to the people of England. At Mary's accession five bishops either abandoned or were deprived of their sees; but the Anglo-Irish who remained faithful to the Reformation were not subjected to persecution such as would have been their fate on the other side of the channel. Again, under Elizabeth, while two bishops were deprived far open resistance to the new order of things, and while stern measures were taken to suppress treasonable plotting against the constitution, the uniform policy of the government in ecclesiastical matters was one of toleration. James I caused the Supremacy act to be rigorously enforced, but on political rather than on religious grounds. The episcopal succession was unbroken at the Reformation, and the Church of Ireland claims to be the direct and legitimate successor of the church of the 14th and 15th centuries. The continuity of that church with the church of pre-Norman times is not easily demonstrated, however.

On the accession of Charles II, the church was strengthened by the translation of John Bramhall (the most learned and zealous of the prelates) from Derry to the primatial see of Armagh and by the consecration of 12 other bishops, among whom was Jeremy Taylor. But though the church had now been reformed for more than a century, it had made little progress; and the tyrannical provisions of the penal code introduced by the English government during 1702–15 made it more unpopular than ever. The clergy, finding their ministrations unacceptable to the great mass of the population, were tempted to indolence and nonresidence; and, although bright exceptions could be named, there was much that called for reform. To William King (1650–1729), bishop of Derry and subsequently archbishop of Dublin, was mainly attributable the reorganization of the work of the church, and the impulse which he gave it was felt all through the 18th century. In 1800 the Act of Union was passed by the legislature, and thenceforward, until disestablishment, there was but one "United Church of England and Ireland." The dissatisfaction felt by the majority of Irishmen because of the continued existence of the established

church in a privileged position became increasingly plain as the years passed. Discontent was increased by the fact that the church drew its tithes largely from Roman Catholic tenant farmers. In the 1830s the agitation against this privilege became strong enough to be known as the tithe war. The census of 1861 showed that out of a total population of 5,798,967, only 693,357 belonged to the established church, 4,505,265 being Roman Catholics; once this had been made clear, the passing of the Act of Disestablishment was only a question of time. Introduced by W. E. Gladstone, and passed in 1869, it became law on Jan. 1, 1871.

The church was thus suddenly thrown on its own resources and called on to reorganize its ecclesiastical system as well as to make provision for its future clergy. This challenge met with a magnificent response from both clergy and laity. The spirit of the church of that time is shown by the fact that in 1865, with disestablishment imminent, the foundation stone was laid in Cork of an elaborate cathedral for that diocese. Many other cathedrals and parish churches were restored and adorned during the 20 years following the passing of the act.

A convention of the bishops, clergy and laity was summoned in 1870, and its first act was to declare the adherence of the Church of Ireland to the ancient standards and its determination to uphold the doctrine and discipline of the Catholic and Apostolic Church, while reaffirming its witness, as Protestant and Reformed, against the innovations of Rome. Under the constitution then agreed on, the supreme governing body of the church is the general synod, consisting of the bishops and of 208 clerical and 416 lay representatives of the several dioceses, whose local affairs are managed by diocesan synods. There are two primatial sees, Armagh and Dublin, the archbishops being chosen by the bishops from their own number. The number of dioceses was reduced by amalgamations to 14. Bishops are elected by a two-thirds majority of each order of the diocesan synod. Failing such majority, appointment passes to the house of bishops. Private patronage of benefices is almost nonexistent, and appointments are made by boards of nomination composed of diocesan and parochial nominators meeting under the chairmanship of the bishop. Most of the clergy receive their training for the ministry in the divinity school of Trinity college, Dublin.

The Book of Common Prayer was twice revised after 1662—in 1878 and in 1924. Changes were slight, but criticism was directed against the "Constitutions and Canons Ecclesiastical" by which are forbidden the placing of the cross on the altar, the making of the sign of the cross by clergy or laity, except where ordered in the baptismal office, and bowing to the altar. There is a high degree of uniformity in ceremonial throughout the church.

The finances are controlled by the Representative Church Body, to which a sum sufficient to provide life annuities for the existing clergy (2,043 in number) was handed over by the Church Temporalities commissioners in 1870, together with £500,000 in compensation for private endowments. The annuities provided were subsequently commuted for a capital sum. So skilfully was this fund administered, and so generous were the contributions of clergy and laity, that the total assets of the Representative Church Body amounted by the latter 1950s to more than £13,000,000. Church of Ireland membership was approximately 500,000.

BIBLIOGRAPHY.—A. T. Lee, *The Irish Episcopal Succession* (London, 1867); G. T. Stokes, *Ireland and the Celtic Church,* 7th ed. by H. J. Lawlor (London, 1928), *Ireland and the Anglo-Norman Church* (London, 1889) and *Some Worthies of the Irish Church* (London, 1900); J. T. Olden, *The Church of Ireland* (London, 1892); J. T. Ball, *The Reformed Church of Ireland, 1537–1886,* 2nd ed. (London, Dublin, 1890); H. C. Groves, *The Titular Archbishops of Ireland* (Dublin, 1897); H. J. Lawlor, *The Reformation and the Irish Episcopate* (London, 1906); W. A. Phillips (ed.), *History of the Church of Ireland,* 3 vol. (London, 1933–34); R. P. McDermott and D. A. Webb, *Irish Protestantism— Today and Tomorrow* (Dublin and Belfast, 1945); Church of Ireland, *Reports of the Proceedings of the Representative Church Body* (Dublin, 1872 ff.; index, 1943). (F. A. G. W.)

IRELAND, NATIONAL UNIVERSITY OF. The National University of Ireland had its beginning in the Queen's university, incorporated in 1850. In 1880 the Queen's university was superseded by the Royal University of Ireland. It in turn was dissolved on Oct. 31, 1907, giving place to the National university. Of the rhree Queen's colleges, founded in 1845 at Belfast, Cork and Galway, which had formed the constituent colleges of its two predecessors. Belfast became a separate university, Cork and Galway were taken over as constituent colleges, while a new college was projected in Dublin and Maynooth was added as a recognized college. The headquarters of the university are in Dublin.

University representation in *dail eireann* was discontinued on June 14, 1937; the *Seanad* Electoral (University Members) act, 1937, entitled the university to three representatives in *seanad eireann.* Faculties include arts, philosophy and sociology, Celtic studies, science, medicine (including dentistry), engineering and architecture, law, commerce, general agriculture, dairy science and veterinary science. In 1951–52 there were 5,274 students, including 1,242 women. *(See* also UNIVERSITIES.)

See *Calendar of the National University of Ireland* (annual).

IRELAND, NORTHERN, a part of the United Kingdom of Great Britain and Xorthern Ireland, with a certain measure of local self-government. It comprises the counties of Antrim, Armagh, Down, Fermanagh, Londonderry and Tyrone and the county boroughs of Belfast and Londonderry. The area is 5,459 sq mi. It is bounded by the sea on the north and east, where there is a seaboard of 245 mi., and on the south and west by the Republic of Ireland, with which it has a common frontier zoo mi. long. The geology, physical geography and archaeology of Northern Ireland are described in the article IRELAND. The modern Northern Ireland is roughly similar in extent to the ancient province of Ulster and is often called Ulster. It is almost identical with the distribution area of the Ulster megalithic culture of the horned cairn, and it contains six of the nine counties defined as constituting Ulster at the beginning of James I's reign. Four of the counties of Northern Ireland were included in the colonization scheme known as the Plantation of Ulster in the early 17th century. Even larger bodies of British colonists settled in Antrim and Down, which were omitted from that scheme.

HISTORY

The first parliament of Northern Ireland was opened by King George V on June 22, 1921, the first prime minister being Sir James Craig, who took office at the head of a Unionist government. The new government had to deal with a disturbed country, troubied by bombings, shootings and incendiarism. From the close of 1921 there was civil war in the Irish Free State, and this overflowed into Northern Ireland, making the years 1922 and 1923 very disturbed. During 1922, in the course of these disturbances, 232 persons were killed in Northern Ireland, including two Unionist members of parliament, and nearly 1,000 were wounded. Enormous damage was done to property.

In accordance with the agreement which the United Kingdom government had made with the Free State, a boundary commission was established to investigate possible frontier changes between the Free State and Northern Ireland. The commission failed to agree and presented no report; negotiations were then opened between the governments concerned. A tripartite agreement was signed in 1925 between the governments of the United Kingdom, the Free State and Northern Ireland, agreeing to maintain and respect the existing frontier.

A new phase in political affairs opened in 1932 with the advent of Eamon de Valera to power in the Free State. Tension arose in Northern Ireland with his policy of growing dissociation from the United Kingdom and the commonwealth and his substantial repudiation of the binding character of the 192j agreement. His policy of tariffs also made the frontier between Northern Ireland and the Free State into a formidable economic barrier and rendered any possibility of being merged in the Free State extremely alarming to many interests and classes of people in Northern Ireland whose prosperity depended upon a flourishing export trade. The government of Eire, as the Free State then came to be called, made emphatic irredentist claims upon Northern Ireland.

During the same period Northern Ireland suffered from serious industrial depression and recession of export trade. Unemployment remained in the neighbourhood of 70,000 over long periods.

The Unionist party, standing for the maintenance of the union with Great Britain, gained a strong majority at every general election in Northern Ireland, whether for the parliament of Northern Ireland or for the province's representation at Westminster. Though united on this issue, the Unionist party allowed and experienced differing opinions in its ranks on a good many other issues. Sir James Craig (later Viscount Craigavon) held office as prime minister until his death on Nov. 24, 1940, when he was succeeded by John Miller Andrews, formerly minister of finance. In May 1943 Andrews was succeeded by Sir Basil Brooke (who was created Viscount Brookeborough in 1952).

The strategic importance of Northern Ireland, covering Britain's main shipping route, providing a landing place for the U.S. forces and filling the gap created by Eire's neutrality, was very great and was emphasized by Winston Churchill, Gen. Dwight D. Eisenhower and other war leaders. In addition the agricultural and industrial resources of the province were very valuable. Belfast constructed 600,000 tons of merchant shipping, a tenth of the output of the whole United Kingdom, as well as doing extensive admiralty work, including the building of six aircraft carriers, three cruisers and several other large ships, making a total of 140 warships of all sizes and 123 merchant ships. Among other wartime products of the province were 1,500 heavy bombers. 2,000,000 parachutes, 200,000,000 yd. of cloth for service use, 90% of the service shirts for British forces and one-third of the ropes required by the war department, as well as considerable quantities of tanks, guns and ammunition. Because of its industrial importance Belfast was the target of several destructive air raids.

In the period following the war, Northern Ireland adopted schemes of social insurance, free health services and other aspects of the welfare state as they were introduced in Great Britain. Though a policy of nationalization was denied, steps were taken to unify a number of public services under newly created public authorities. Road transport had already been treated in this way in 1933, and the principle was extended to rail transport and electricity. As new types of public service came into being it became necessary to amend the Government of Ireland act, 1920, in the United Kingdom parliament. New legislation was necessary to empower the government of Northern Ireland to proceed with its scheme of social insurance and state health services. But the essential principles of the 1920 act remained, and this amendment was only a natural development of the original principle that the government of Northern Ireland should control its own local affairs and welfare services.

In 1949 Eire, as the Republic of Ireland, withdrew from the commonwealth. To meet various legal problems arising from this, the United Kingdom parliament passed the Ireland act, 1949. This act contained the following provision: "It is hereby declared that Northern Ireland remains part of His Majesty's Dominions and of the United Kingdom and it is hereby affirmed that in no event will Northern Ireland or any part thereof cease to be part of His Majesty's Dominions and of the United Kingdom without the consent of the Parliament of Northern Ireland." Northern Ireland thus acquired something in the nature of federal status within the United Kingdom. Incidents connected with nationalist activities occurred sporadically, and in 1954 army barracks in Armagh and Tyrone were raided by members of the illegal Irish Republican army.

Limited self-government as a distinct entity within the United Kingdom intensified an Ulster regional self-consciousness. Attention was drawn to the province's high output of talent in many fields—particularly in the military, where it was represented by such figures as Viscount Alanbrooke, Earl Alexander of Tunis, Sir John Dill and Sir Gerald Templer. Efforts were made to create in Northern Ireland those cultural and other institutions which governments, when bestowing them on Ireland in the past, had always located in Dublin. A regional radio station also heightened this self-consciousness. The province was meanwhile represented in literature by Forrest Reid, St. John Ervine, Robert Lynd, C. S. Lewis, Louis MacNeice, H. Montgomery Hyde and Stephen Gilbert and in art by Sir John Lavery, Paul Henry, Frank McKelvey, Rosamond Praeger, J. Humbert Craig, William Conor, Maurice Wilks, John Luke and Colin Middleton. Music and drama received attention as never before.

POPULATION

More than two-thirds of the modern population of Northern Ireland is located in the eastern part of the province, in the city of Belfast and the adjacent counties of Antrim and Down. Belfast has a very restricted county borough boundary, and a "greater Belfast" extends considerably into Antrim and Down. More than half the population lives in cities or towns. Belfast is by far the largest city, Londonderry being the only other with populations of more than 10,000 at the 1961 census: Newtownabbey (37,440), Bangor (23,865), Portadown (18,605), Lurgan (17,873), Lisburn (17,691), Larne (16,341), Ballymena (14,740), Newtownards (13,090), Newry (12,450), Coleraine (11,912) and Carrickfergus (10,211).

Distribution of Area and Population of Northern Ireland, 1961 Census

Counties and county boroughs	Area (sq.mi.)	Urban	Per cent of total	Total	Density per sq.mi.
Antrim	1,176	113,353	41.4	273,923	232.9
Armagh	512	49,379	42.0	117,580	229.6
Belfast county borough	26	416,094	100.0	416,094	16,003.6
Down	952	82,600	30.9	267,013	280.5
Fermanagh	715	7,438	14.4	11,613	722
Londonderry (excluding county borough)	814	20,186	18.1	111,565	137.1
Londonderry county borough	3	53,744	100.0	53,744	17,914.6
Tyrone	1,261	27,353	20.4	133.930	106.2
Total	5,459	770,147	54.0	1,425,462	261.1

Religion. — The religious professions of the population at the 1951 census were as follows: Roman Catholic 471,460, Presbyterian 410,215, Church of Ireland 353,245, Methodist 66,639, other 69,362. Thus, roughly two-thirds of the population was Protestant and one-third Roman Catholic.

Education. — The county and county borough councils, through their respective education committees, act as education authorities in their areas. They carry on primary, grammar, secondary intermediate and technical schools. But a majority of the primary schools, a third of the secondary intermediate schools and most of the grammar schools are under voluntary management, by denominational bodies, boards of governors or other organizations. Primary schools provide for children under 11; after 11 the majority attend intermediate schools, but those who show that they can benefit by a more academic education go into grammar schools. Education in the early 1950s was free and compulsory up to the age of 15, and this was to be raised to 16. There are many scholarships in higher education. Extensive technical education facilities are also available. There are two training colleges for teachers. Queen's university, Belfast, is a self-governing university. It receives parliamentary grants and also grants from local government authorities. It has about 3,000 students. Magee university college, Londonderry, is a teaching body which prepares students for the arts examinations of Dublin university.

GOVERNMENT AND ADMINISTRATION

British antecedents, Protestant religion and economic interest caused a large proportion of the population of Ulster to resist all schemes for Irish self-governmerit in the later 19th and early 20th centuries. The Government of Ireland act, 1920, was an attempt to give a measure of self-government to Ireland but at the same time to give the Ulster community guarantees against being placed under the rule of the predominantly Roman Catholic and nationalist majority. The act set up two legislatures, one in Dublin for the 26 counties of southern Ireland and one in Belfast for the 6 counties of Northern Ireland. These two subordinate governments were to deal with purely local affairs, and all Ireland was to remain within the United Kingdom and was to continue to send representatives to the United Kingdom parliament at Westminster. A common council of representatives from both north and south was to provide a link between Northern and southern Ireland and a means of discussing matters of common interest and extending co-operation.

This scheme was accepted as a compromise in Northern Ireland but was rejected in southern Ireland, which ultimately received dominion status as the Irish Free State in 1922. With modifications appropriate to these changed circumstances, the Government of Ireland act, 1920, continued to be the basis of the constitution of Northern Ireland.

Constitution. — The essential feature of the constitution of Northern Ireland is that the province forms an integral part of the United Kingdom of Great Britain and Northern Ireland. Northern Ireland elects 12 members to the United Kingdom parliament; but within the province a large range of legislative and administrative functions is delegated to the government of Northern Ireland. The head of that government and the representative of the sovereign within the limits of the Northern Ireland constitution is the governor. The governor summons, prorogues and dissolves the parliament of Northern Ireland, gives the final assent to its legislation and fulfils other functions which are fulfilled by the sovereign within the larger field of the United Kingdom constitution.

The parliament of Northern Ireland consists of two houses. There is a house of commons of 52 members elected by universal adult franchise from single-member constituencies, with the exception of the university constituency, which is not single-member; and there is a senate or upper house of 26 members, of whom 24 are elected by the house of commons on the principle of proportional representation. Each elected senator holds office for eight years, and half the seats in the senate are vacated every four years. The two other senators are the lord mayor of Belfast and the mayor of Londonderry, who become senators ex officio. The house of commons has a maximum life of five years. Members of parliament receive salaries. Each house elects its own speaker. Legislation going through the Northern Ireland parliament takes a course similar to that in the United Kingdom parliament, with the usual readings and committee stage in each house; but a finance bill can be passed by the commons alone. In the event of a deadlock between the houses they can meet together in joint session, but this has never occurred.

There is a prime minister of Northern Ireland and a small cabinet of ministers. A minister is permitted to introduce business, answer questions or make a statement in either house, but he can vote only in the house in which he has a seat. Ministers represent the following departments: finance, home affairs, labour and national insurance, education, agriculture, commerce and health and local government. The functions of these departments indicate the range of functions delegated to the parliament of Northern Ireland. A wide range of other subjects is entirely reserved for control and legislation by the United Kingdom parliament, including problems affecting the crown and succession, decisions about peace, war or neutrality and the armed services, relations with foreign powers or with other parts of the commonwealth and empire, titles of honour, treason, extradition, naturalization, aliens, foreign trade, navigation by sea or air, post office, submarine cables, radio, lighthouses, coinage, weights and measures, trade-marks, copyright and patents. In these and some other matters, unless the exclusion of Northern Ireland is specially provided for, the province is legislated for in the United Kingdom parliament like any other part of the United Kingdom. Northern Ireland, for example, came under all food rationing regulations which applied to the rest of Great Britain during and after World War II.

Public Finance. — The taxation of Northern Ireland is the same as that of the rest of the United Kingdom, and the taxation revenue of the province goes into the United Kingdom exchequer. A deduction is then made for the full cost of all services carried on in Northern Ireland under direct control of the United Kingdom government, such as the post office and the inland revenue and customs and excise services. A further sum is deducted to meet Northern Ireland's share of certain liabilities remaining from before 1921. Out of the revenue that remains after these deductions, a sum is handed over to the government of Northern Ireland to meet the cost of services directly administered by it.

The size of the annual allocation of funds to the government of Northern Ireland for the purpose of carrying on the public services delegated to it is decided by the Joint Exchequer board, consisting of a chairman appointed by the crown and a representative each from the United Kingdom treasury and from the ministry of finance, Sorthern Ireland, on the principle that Northern Ireland shall have equality with other parts of the United Kingdom in social services and, so far as possible. equality in other services also. In the early 1950s this sum annually amounted to about £35,000,000. In addition to this sum, the Northern Ireland government is in direct control of a small range of local taxes, including death duties, stamp duties and motor vehicle duties, which usually amount to about 10% of its total revenue.

The amount of Northern Ireland taxation revenue still remaining in the United Kingdom exchequer after all these deductions and payments represents Northern Ireland's contribution to the general services of the United Kingdom as a whole, including the armed services, the national debt and other general Cnited Kingdom liabilities. This is called the "imperial contribution." It has varied considerably in size according to conditions and taxation levels. The highest sum in any one year was 536.300 ooo in 1944–45. The size of the imperial contribution also depends on the decision of the Joint Exchequer board. The purpose of this board is to ensure that Northern Ireland does not pay too much or too little in relation to its own needs and taxable capacity. This is brought about automatically in the case of other parts of the United Kingdom by the complete pooling of taxation, but it requires administrative action in the case of Northern Ireland, nhose finances form a special segregated transaction within the larger system of the United Kingdom's public finances.

Local Government. — There are five main types of local government authority in Northern Ireland. There are the two corporations of the county boroughs of Belfast and Londonderry; nine borough councils in Ballymena, Bangor, Carrickfergus, Coleraine, Enniskillen, Larne, Lurgan. Newtownards and Portadown; 24 urban district councils for various smaller towns; six county councils; and 32 rural district councils. These bodies are elected by householders and owners of property in the areas which they serve. With the exception of rural district councils, they have power to levy rates. They work under the supervision of the ministry of health and local government.

Other Administrative Bodies and Public Services. — In addition to the local government bodies, there is a variety of boards and authorities established to do special administrative work or to organize public utility services. Most of these work under the supervision of one of the ministries. Thus the attention of the ministry of commerce is given to several administrative bodies, including the Ulster Transport authority, which is responsible for carrying on the whole road and rail transport system of the province, with the exception of municipal passenger transport, the work of private carrying firms in Belfast and Londonderry and certain railways which cross the frontier; the Northern Ireland Electricity board, which provides electricity supplies over the greater part of the province; and the Tourist board, which supervises tourist and hotel accommodation.

Other administrative bodies are associated with the work of the ministry of health and local government. Three are concerned with health services: the General Health Services board, the Hospitals authority and the Tuberculosis authority. The Northern Ireland Housing trust builds workers' houses throughout the province and co-operates with local authorities or acts as agent for them in the building of houses. It is financed by advances of capital from the ministry of finance. Other public administrative bodies include the Belfast Harbour commissioners and the Belfast City and District Water commissioners. Several public bodies established under the United Kingdom government also operate in Sorthern Ireland, including the British Broadcasting corporation and British European Airways. A number of steamship routes from Northern Ireland to Great Britain are operated by British railways.

Justice and **Police.**—The superior courts in Northern Ireland, including the supreme court and the court of criminal appeal, are under the jurisdiction of the United Kingdom parliament. The

supreme court has two main divisions, the high court of justice and the court of appeal, the former having in turn the three divisions of queen's bench, chancery and assize courts. From the court of appeal there is possibility of further appeal to the house of lords in certain matters, including, by leave of the court, certain cases regarding the validity of acts passed by the parliament of Northern Ireland.

The inferior courts, dealing with minor civil and criminal matters, are under the jurisdiction of the parliament of Northern Ireland and are the concern of the ministry of home affairs. There are five county court judges, two of whom act as recorders of Belfast and Londonderry. Quarter sessions courts are held in 29 towns. Petty sessions courts are normally composed of a single resident magistrate, except in a few cases where two must adjudicate. In 1935 the judicial functions of honorary justices of the peace were abolished and those functions altogether transferred to a full-time professional magistrature.

The police force, the royal Ulster constabulary, is under the ministry of home affairs. It is not permitted by law to exceed 3.000 and has a normal strength somewhat below that number. There is a special constabulary with a small full-time establishment and its ranks filled by citizens doing part-time service. Its total strength is usually about 10,000.

Social Services.—Health.—The general medical and dental services are administered by the General Health Services board. It makes available to every resident in the province general practitioner and specialist services and attendance, a dental service and pharmaceutical services. These services are available without charge, except in certain cases where charges are also made in Great Britain. A hospital service is also available, administered by the Northern Ireland Hospitals authority.

Health authority services, including maternity services, immunization, aftercare and health education, are operated by county and county borough health authorities, who work in co-operation with the Hospitals authority and General Health Services board. The Tuberculosis authority specializes in prevention, discovery, care, aftercare and education with respect to tuberculosis.

Welfare.—The eight county and county borough councils also act as welfare authorities in their respective areas. They provide residential accommodation for old people and others and are responsible for care of children, the blind and other handicapped persons. They co-operate with voluntary organizations and with the National Assistance board. The Assistance board gives grants and supplements pensions and unemployment benefit to prevent destitution and administers a number of welfare schemes.

Social Insurance.—A comprehensive scheme of social insurance operates in Northern Ireland. Although separately financed, the scheme is the same as that operating in Great Britain in nearly every particular. The scheme provides industrial insurance, unemployment benefit, sickness benefit, maternity benefits, retirement pensions and other allowances and grants. The rates of payment are the same as in Great Britain. The scheme is administered by the ministry of labour and national insurance. Family allowances and noncontributory old-age pensions are also provided.

ECONOMICS

Northern Ireland is not rich in natural resources. There is almost no coal, and the extensive deposits of iron and bauxite are not sufficiently rich or accessible to compete economically with ores brought from elsewhere. There is, however, much good agricultural land; there are many streams and rivers useful in connection with the textile industries; there is a considerable quarrying industry; and there are substantial deposits of diatomic earth. Although there are many hills and much of the land is above the 500-ft. contour, the streams are not well suited to provide hydroelectric resources capable of economical development on a big scale. The province has thus to conduct some of its industries by meeting a high import of raw materials with a high production of goods and also a slightly diminished profit margin in some industries. The province's natural beauty and the opportunities it offers for sports and pleasures of many kinds have given it a considerable and thriving tourist industry.

Agriculture and Fisheries—The land is divided into small family farms, and there are nearly 90,000 agricultural holdings. There is a tendency for holdings gradually to become fewer and larger. Mixed farming is the general custom. A large proportion of the crops grown are used to feed livestock and poultry, and the greater part of the income of farmers comes from sale of livestock and livestock products, including dairy produce. Oats are the chief cereal crop. There is a big production of potatoes, particularly of high-quality seed potatoes, and seed hay is a popular crop. Flax is grown by about 25% of the farmers. In suitable districts, particularly in County Armagh, fruit is grown.

From 1924 onward a series of schemes was introduced and enforced by law for the inspection, grading, packing and marketing of agricultural produce, and Northern Ireland farm produce has gained a high reputation for quality and reliability. Most of it is sent to Britain. The chief agricultural exports are fat and store cattle, eggs, potatoes, poultry, bacon, milk products, grass seed, seed potatoes and apples. A proportion of the produce of the land goes through the province's many food-processing and canning factories.

Great progress has been made in agricultural education and in improved methods, mechanization and electrification, and this was speeded by wartime and postwar need for increased production. Under the ministry of agriculture financial and technical assistance is given for improvement of land and equipment. The ministry has also undertaken extensive reafforestation schemes and gives grants to encourage planting of trees by private owners.

Salmon fishing is carried on in the tidal portions of the Foyle, Bann and Bush and at several stations along the seacoast. Trout and pollan are caught in Lough Neagh, and there are eel fisheries on the Bann. Herring fleets operate from Ardglass, Portavogie, Kilkeel and Annalong.

Industry.—Textiles.—The linen industry gives employment to nearly one-fifth the gainfully occupied population in Northern Ireland. The mills of the province contain about 800,000 spindles, and the weaving factories contain about 25,000 looms. The industry is carried on in all parts of the province but chiefly within a 30-mi. radius of Belfast. Clothing and cotton goods are also extensively manufactured and there is a flourishing shirt industry in Londonderry. Various types of synthetic fabrics are also produced. Textiles, textile goods and clothing account for nearly a third of Northern Ireland's exports.

Shipbuilding and Other Industries.—The Belfast shipyards have long been the largest single establishment of their kind in the world, and their annual tonnage output of new ships has often run far into six figures. There is also a big volume of repair work. Though Belfast has a great tradition in the building of passenger liners, the main output is cargo vessels, particularly tankers. A considerable number of passenger liners has also been launched, and much work has been carried out for the admiralty, including the building of aircraft carriers of the largest size.

In 1937 a large industry for the manufacture of aircraft was established at Belfast. Many engineering industries also operate in Belfast and district, some specializing in textile machinery or machinery for other local industries. There is a tea-processing plant and ventilating machinery is produced. Belfast is also the site of a large ropemaking industry and possesses the largest ropeworks in the world.

Tobacco, whisky and mineral waters are long-established industries in the province.

In 1955 a Northern Ireland Development council was set up to attract new industries in order to help solve the unemployment problem. The inducements include the leasing of government-built factories, advances of capital, relief from rates and special co-operation from the Housing trust and other bodies.

Trade.—The total volume of trade in visible exports and imports is usually more than £500,000,000. Total exports in 1955 were £267,475,000 and total imports were £295,327,000.

BIBLIOGRAPHY.—*The Ulster Year Book* (H.M.S.O., Belfast, triennially, 1926–38 and 1947 ff.); Northern Ireland parliamentary papers (H.M.S.O., Beliast, 1922–); Public General Statutes (H.M.S.O., Belfast); Sir A. S Quekett, *The Constitution of Northern Ireland,* 3 vol. (Beliast, 1928–46); F. Gerber, *Die Verfassung von Nordirland*

(Dresden, 1934); N. Mansergh, *The Government of Northern Ireland* (London, 1936); H. Shearman, *Northern Ireland,* rev. ed. (H.M.S.O., Belfast, 1955), *How Northern Ireland Is Governed* (H.M.S.O., Belfast, 1951), *Anglo-Irish Relations* (London, 1948) and *Ulster* (London, 1950); C. B. Falls, *The Birth of Ulster* (London, 1936); D. A. Chart, *A History of Northern Ireland* (Belfast, 1928); M. Glasgow, *The Scotch-Irish in Northern Ireland and in the American Colonies* (1936); R. Hayward, *In Praise of Ulster,* 5th ed. (Belfast, 1946), and *Ulster and the City of Belfast,* vol. ii of *This Is Ireland* (London, 1950); J. M. Mogey, *Rural Life in Northern Ireland* (London, 1947); E. E. Evans, *Northern Ireland* (London, 1951); S. H. Bell (ed.), *The Arts in Ulster* (London, 1951); D. O'D. Hanna, *The Face of Ulster* (London, 1952); the B.B.C. publication, *Ulster since 1800* (London, 1954). (HU. S.)

IRELAND, REPUBLIC OF. The republic occupies four-fifths of the island of Ireland and is bounded on the northeast by Northern Ireland. Its total area is 27,136 sq.mi. For details of its topography and for the country's history up to 1921 *see* IRELAND.

The Republic of Ireland, as an independent state divorced from its former association with the British crown, came into operation under the Republic of Ireland act as from April 18, 1949. The interparty government, headed by John A. Costello, thereby repealed the External Relations act of 1937, which had already diminished the connection with the commonwealth. *Dail eireann* approved the decision without a single dissentient, and the British government acknowledged the right of Eire as a dominion to secede. This secession without active opposition from the British government was the climax of a rapid process of political separation within the previous years.

HISTORY

Establishment of the Irish Free State. — The intensive conflict which took place during and after World War I and is known in Ireland as the Anglo-Irish war resulted in the Irish peace agreement, which was signed in London by British and Irish plenipotentiaries on Dec. 6, 1921. The agreement provided that Ireland should thenceforward have the "same constitutional status in the Community of Nations known as the British Empire" as had the dominions of Canada, Australia, New Zealand and South Africa; "with a Parliament having powers to make laws for the peace, order and good government of Ireland and an Executive responsible to that Parliament." The new dominion was to be known as the Irish Free State. This peace agreement was ratified by the British parliament on Dec. 16, 1921, and became operative when it had also been passed on Jan. 15, 1922, by a meeting of the parliament of southern Ireland convened by Arthur Griffith. The new state included only 26 of the 32 Irish counties, as the northeastern area, known as Northern Ireland, was to decide whether or not it would accept inclusion in the dominion.

The peace agreement had been concluded between the British government and the representatives of an Irish government which it had previously refused to recognize. The Irish representatives held their authority from *dail eireann* (the assembly of Ireland), which had come into existence in Jan. 1919. The general elections held at the end of 1918 had resulted in an overwhelming majority for Sinn Fein as the party which declared for an Irish republic. All members elected for any Irish constituency were invited to attend an assembly in Dublin on Jan. 21, 1919, but in fact only the Sinn Fein members attended. Acting as a constituent assembly for all Ireland, they then proclaimed the Irish republic in existence, and they elected a president and ministers. Eamon de Valera was then in prison in Lincoln jail, but was regarded as president designate. He was to be both national president and chief executive, as in the United States. But the immediate concern of *dail eireann* in Jan. 1919 was to present Ireland's claim to national independence at the international peace conference which was then assembling at Versailles.

In the period of acute Anglo-Irish conflict which ensued, *dail eireann* regarded itself as the constitutional legislature of Ireland. The British government did not accept that claim until it signed the treaty of Dec. 6, 1921, and agreed to the establishment of the Irish Free State. The negotiations had been begun in July between De Valera and David Lloyd George, but were soon entrusted to plenipotentiaries, who were appointed by De Valera but required to consult closely with him while the negotiations proceeded. The final agreement was reached in Downing street only after Lloyd George had delivered an ultimatum threatening "immediate and terrible war" if the terms were not accepted at once. Griffith, Michael Collins and E. Duggan then agreed to sign, and Robert Barton and Gavan Duffy added their signatures under protest. Their chief objections were to the prescribed oath of allegiance to the British crown and to the provisions which allowed Northern Ireland to remain outside the new state.

During the interval between the assembling of the first *dail eireann* in Jan. 1919 and the conclusion of the treaty in Dec. 1921, the British parliament had in 1920 passed an act to establish two Irish legislatures, one for the 6 counties of Northern Ireland and the other for the remaining 26 counties. Both parliaments and their executives were to possess identical powers, much more restricted than had been conceded under the prewar Home Rule bill, which had been enacted in Sept. 1914, though its operation was indefinitely suspended. But under this Government of Ireland act of 1920, general elections were held in Ireland so that the two Irish parliaments should be brought to life. In the 26 counties every constituency except Dublin university returned a Republican candidate; and even in Northern Ireland some seats were also won by Republicans. All except the four members for Dublin university refused to bring the southern Ireland parliament into operation, and it consequently never functioned. But the same Republican members who had been elected in 1920 assembled for the first time on Aug. 16, 1921, in the Dublin Mansion house, after the truce had brought an end to military hostilities. They then constituted themselves the second *dail eireann,* and all members took the oath of allegiance to the Irish republic while negotiations were proceeding between De Valera and Lloyd George. Soon afterward plenipotentiaries, led by Griffith and Collins, were appointed by De Valera to conclude the peace agreement, which eventually fell short of the full Republican demands.

The Provisional Government. — Although the British parliament ratified the peace agreement on Dec. 16, De Valera immediately repudiated it, on the ground that the plenipotentiaries had departed from their instructions. In *dail eireann* a long and bitter debate developed, and on Jan. 8, 1922, ratification was passed by a majority of only 64 to 57. De Valera at once resigned the presidency, and Griffith was elected to replace him, but by a majority of only two votes. A provisional government was then appointed under article 17 of the treaty, by a meeting to which all members elected in 1920 for the southern Ireland constituencies were summoned. Those who had opposed the treaty refused to come, and the provisional government was composed largely of men who were little known in public life. Griffith as president remained outside the government, as did Gen. Richard Mulcahy, who now became minister for defense. Collins, who had attained an almost legendary reputation and great popularity by his daring and energy during the Anglo-Irish war, was appointed head of the provisional government. The only minister whose name was well known was Eoin (John) MacNeill, who had long been prominent in the Gaelic league and as founder of the Irish volunteers. The others were still young men. In opposition to the government were De Valera and most of the active leaders of Sinn Fein. The armed forces were still nominally the army of the republic, and their allegiance was divided. The old police force was disbanded, and a new force, the civic guard, was formed at once; but it was to be unarmed.

Griffith and Collins desired an immediate general election to obtain a verdict for the treaty. But De Valera anticipated them by convening a full convention of Sinn Fein delegates, and in the interests of maintaining national unity Collins then agreed to delay the election. There was still a dim hope of inducing Northern Ireland to come into the new dominion, and an attempt was made by the provisional government to negotiate with Sir James Craig (later Lord Craigavon), the Northern Ireland prime minister. But in Belfast fierce sectarian riots were raging, and these approaches had no success. In the meantime defiance of the provisional government began to spread, and De Valera proclaimed openly that only the Republican *dail* had legitimate authority. Many of his followers were calling for renewed military action

against the British government. Incidents of open defiance and violence became frequent, but Collins was always determined to avoid taking punitive action, though Griffith was believed to consider it necessary. Collins reached an agreement with De Valera, which was announced on May zo, that elections should be held on a basis of putting forward candidates representing both sides in the same proportion as in the existing *dail.* A coalition government would then be formed after the elections, in which De Valera would have four seats and the protreaty party five. All parties were urged to refrain from proposing candidates other than those selected from this joint panel. Moreover, the election was not to be regarded as a verdict for or against the treaty. But this arrangement was out of touch with general feeling in the country. The Irish Labour party gave a lead in putting forward its own candidates. Many others also came forward, and at the elections on June 16, 34 members were elected who were not on the joint list, all of them being in favour of accepting the treaty. Of the panel candidates who were elected, 58 were protreaty and 36 Republican.

Although faced with this decisive defeat, the Republicans maintained that the republic was still in existence and refused to recognize any other authority than the Republican minority of the second *dail.* The Irish Republican army (I.R.A.) soon took the law into its own hands, and large areas in the south and west were more or less under its control. Acts of violence and arson became more frequent, and the British government was soon accused in England of having let loose conditions of anarchy without protecting its friends. A crisis arose when Field Marshal Sir Henry Wilson was shot dead on June 22, on his own doorstep in London, by two Irishmen who had served in the British army during World War I. Drastic action to restore order in Ireland was demanded from London, and an open conflict became inevitable on June 28. The Republicans in Dublin seized the assistant chief of staff of the Irish army as a hostage and imprisoned him in the Four Courts, which they had occupied. The provisional government demanded his immediate release and besieged the courts. Serious fighting in Dublin ensued for a week, until Rory O'Connor, who had occupied the courts, blew them up before surrendering. British military equipment and munitions had been supplied to assist the government, and the conflict was assuming a new phase. Meanwhile De Valera, who had escaped to the southwest, was openly supporting the insurgents. Griffith and Collins decided that there could be no further compromise, and Collins assumed charge of the army as commander in chief. The strain had told so heavily upon Griffiththat he died suddenly on Aug. 12. Then Collins rashly left Dublin to inspect the military operations in the south. On Aug. 22 he ran into an ambush in west Cork and was shot dead.

The provisional government had thus lost its two most prominent leaders within a fortnight, while De Valera was openly heading the insurgents in the west. The surviving ministers could not even appear openly without armed protection and were obliged to live at the central government offices which had been established in the college of science. Under the treaty the newly elected *dail* was required to frame its constitution before Dec. 6, 1922, and the new constitution had then to be ratified also by the British government. The new *dail* was therefore summoned to meet on Sept. 9, in the building of the Royal Dublin society, Leinster house, which later became the seat of both the *dail* and senate. The building was for some time kept closely guarded.

Its first business was to elect a new president in place of Griffith. None of the acting ministers had yet attained a national reputation, but W. T. Cosgrave was older than most of the others, with active experience as a member of the Dublin corporation, and he had shown great competence and energy as minister for local government during the Anglo-Irish war. He was now chosen as president, and the *dail* also elected a team of 11 ministers whom he proposed. It then had to pass the clauses of the constitution defining relations between the Irish Free State and the crown, and questions of imperial defense, which Griffith had already settled with the British government. In the absence of the Republican deputies, who refused to recognize the new *dail,* the work proceeded swiftly, and the constitution was ratified both in Dublin and in London by Dec. 6.

Open conflict between the armed forces of the Republicans and of the Free State had ceased by the autumn, but public order and security were still being widely violated in many districts. Courts had not yet been formally constituted, and the new police, or civic guard, had to be organized and trained under great difficulties. Kevin O'Higgins, as minister for justice, insisted that the police must be unarmed, in contrast with the old royal Irish constabulary. They were consequently at a grave disadvantage in restoring public order while irregular Republican forces were still active. The government had to rely on military forces, which were hurriedly recruited until they exceeded 50,000 men. Under such conditions, trial by jury could not be expected to obtain convictions. The *dail* authorized trial by court-martial, with drastic punishments. But the prisons were already filled with men awaiting trial for reasons which usually had some political pretext. Attacks upon life and property were still widespread, and agrarian outrages were reoccurring. The government decided that the unauthorized possession of firearms must be resolutely punished, and in November it was solemnly announced that four men had been tried, convicted and executed on the sole charge of having revolvers without licence. Other similar trials soon followed, and Robert Erskine Childers (*q.v.*) was likewise executed after he had been found to have a revolver. These executions were fiercely resented by the Republicans and embittered Irish politics for years afterward.

The Cosgrave Ministries. — By Dec. 6 the new Irish constitution had been ratified, both by the *dail* and at Westminster. The new ministry had to test its own powers while labouring to restore confidence and good order. A crisis arose on Dec. 8, when the *dail* met to choose a senate under the new constitution. One member of the *dail* was shot dead and another wounded on their way to the meeting. The government decided upon immediate reprisals against the Republican leaders, and on the following day four of the principal insurgents, one from each province, were shot in prison without trial. They included Rory O'Connor, who had seized the Four Courts in June. Republican opposition to the government became more bitter than ever, but there was soon a lessening of organized resistance. More than 10,000 prisoners had been placed under restraint, and there had been about 50 executions. In May 1923 De Valera openly appealed to the Republicans to cease fighting and to conceal their arms. Soon afterward it was found generally possible to hold public meetings.

Confronted with the problems of civil war and with responsibility for reorganizing the country's normal life, the young ministers under Cosgrave's leadership displayed remarkable ability and energy. They were untrained either by office or by public experience, and they were regarded by their former Republican comrades as having betrayed their oath to the republic. But they received more encouragement than had been expected both from the conservative elements in Ireland and from the British government. At the outset they had applied to London, with success, for the appointment of an Irish nationalist as the first governor general of the Free State. They suggested T. M. Healy, a veteran of Charles Stewart Parnell's agitation who in later years had shown his active sympathy with Sinn Fein. In approving his nomination, the British government went far toward creating a sense of co-operation and mutual confidence. It also showed its willingness to admit the wider implication of dominion independence, which the Irish ministers soon found other opportunities to press forward. But the first necessity was to restore public order and to bring the new constitution into operation.

The first senate was duly created, and Cosgrave gave generous representation to the former Unionists when he had to nominate half its membership. It elected as its first chairman Lord Glenavy, who as Sir James Campbell had been Sir Edward Carson's principal colleague in the campaign to resist home rule before World War I. But the Northern Ireland government was now headed by Sir James Craig, since Carson's retirement, and it had formally notified the British government that it would not join in the Irish Free State. By April 1923 the Free State had consequently been obliged to establish a customs system along the border of Northern

Ireland and also in the Irish ports. Cosgrave was still finance minister, as well as head of the government, and the British financial system was still being operated, though preparations were being made for protective tariffs.

At the end of August, when order was generally restored and De Valera had instructed his followers to abandon armed resistance, the fourth *dail* was elected, on a basis of adult suffrage for men and women. De Valera retained his personal following, and his party won 44 seats out of 128. Cosgrave's party did not secure half the total of seats; but as the Republicans refused to sit in the new *dail,* Cosgrave had a majority among those who did attend, and on many issues he had general support from Labour and the others. The absence of any effective opposition party greatly strengthened the power of the new government to carry measures quickly, and it displayed great energy in the following years. In September the government sent its official representatives to attend the council of the League of Nations, and soon afterward the Irish ministers, headed by Cosgrave, took part in the Imperial conference in London. These contacts soon led to co-operation with several other dominions in pressing for a more definite recognition of sovereign rights. Partly under pressure of criticism from the Republicans outside the *dail,* and partly in the direct tradition of Irish nationalist aspirations, the government concentrated steadily upon the expansion of dominion status.

An executive council of seven ministers with four other "extern" ministers was established after the elections of Aug. 1923. Ernest Blythe now became finance minister, and in December he succeeded in floating the first national loan of £10,000,000 at 5%, repayable in 20 years, which was quickly oversubscribed. Conditions had improved immensely during the year, but there had been a bad harvest and unemployment was inevitably increased when the government decided to reduce the army, which was costing £14,000,000 a year. Blythe courageously faced the unpopular task of collecting arrears of taxes and land annuities which had been withheld during the years of unrest. He reduced old-age pensions and made other unwelcome cuts in expenditure, and by introducing a protective tariff he caused new dislocation of trade which could not be expected to produce immediate benefits in increased employment. But the government had a great advantage in being free from effective opposition in the *dail,* so long as De Valera's followers refrained from attending it.

Reconstruction and Progress.—Patrick Hogan, as minister for agriculture, had already completed land purchase by the tenant farmers. He introduced a licensing system for the export of butter and eggs which soon resulted in higher prices when it was found that a high standard was enforced and that regular deliveries could be ensured. He also provided long-term credits to farmers. His energy and knowledge of Irish agriculture, combined with great gifts of popular appeal, produced remarkable results, which were hastened by the skilful assistance of John Dulanty as trade commissioner in London. Other economic developments were inspired by bolder conceptions than had ever been attempted under British rule. Plans for providing hydroelectric power for the Dublin area were already in preparation when the government was offered assistance by the Siemens company in Germany for introducing electric power on a national scale by harnessing the river Shannon. P. McGilligan as minister for industry and commerce accepted early in 1925 the German company's offer to undertake a full survey at its own expense on condition that Siemens would get the contract if the work proved economically desirable. Its report, after approval by an independent committee of international experts, was then adopted. The Shannon scheme provided for utilizing three lakes in stages, as reservoirs to meet future requirements. All three were brought into operation much sooner than had been foreseen, and the Shannon power was later supplemented by other similar sources. Another new enterprise was the introduction of beet sugar factories, under a scheme which provided a government subsidy of more than £1,000,000 to a Belgian firm which undertook to organize the industry. Various other important industries were also encouraged, and before long many factories mere being organized in Ireland by British and other enterprises which undertook to produce goods in Ireland for the Irish market. The new system of protective tariffs became a powerful inducement, and the government soon insisted that the Irish companies so constituted should be under the control of a majority of Irish shareholders.

Reconstruction proceeded vigorously in other directions also. Political control of the elected corporations in Dublin and Cork, and of some county councils, led to such conflicts with the government that it boldly suppressed the corporations, in disregard of their long association with the nationalist agitation. City managers were appointed, and they soon removed old abuses and reduced the prevalent corruption while introducing useful reforms. District councils were abolished and their powers transferred to the county councils; and the central government exerted its authority with increasing disregard for local objections. Many good results followed, though it was clear that the government was often exercising its power to override political opposition.

O'Higgins, the young minister for justice, was particularly high-handed in carrying out his reforms, and he enforced drastic and unpopular restrictions on the drink trade. He had created an efficient, though unarmed, civic guard, which replaced the old royal Irish constabulary with a much smaller and less expensive force. The unpaid justices of the peace were abolished and district justices for each area were appointed instead. The high court judges ceased to go on circuit, and circuit judges were appointed. Many of these judges were young men of outstanding ability who brought integrity and enthusiasm to their work. In former days judges had been appointed largely for their political services while they were barristers. Most of the senior judges had retired on the generous pensions offered to them under the treaty settlement, but among the appointments to replace them the government had included a large proportion of former Unionists.

The Ulster Boundary Crisis.—One overriding problem had clouded the whole prospect since the new state began to function. The Republicans, who still held more than 40 seats in the *dail,* had repudiated the treaty mainly because it allowed Northern Ireland to remain separate. Collins had been convinced in his negotiations with Lloyd George that the treaty supplied a solution, by providing under article 12 that if Northern Ireland did not come into the Free State there must be a boundary commission to decide what areas were to remain excluded. Two of the six excluded counties, Tyrone and Fermanagh, contained clear, though small, majorities in favour of union with Ireland; and on the southern side of both Down and Armagh were substantial areas which had for years returned nationalist members. Collins, like most Irish nationalists, had assumed that when a boundary commission was set up these areas would all be withdrawn from Northern Ireland and that the remaining territory would be too small to continue as the basis of an independent legislature and government.

On these assumptions Cosgrave's ministry was soon criticized for delay in demanding the appointment of a boundary commission. In 1924 Ramsay MacDonald's Labour government had taken office, and soon Cosgrave demanded that the commission be set up to "determine in accordance with the wishes of the inhabitants, so far as may be compatible with economic and geographical considerations, the boundaries between Northern Ireland and the rest of Ireland." The Northern Unionists quickly organized preparations to resist any interference, and Craig was soon threatening to revive the Ulster volunteers. Attempts to obtain a settlement by consent failed, and when Eoin MacNeill was appointed to represent the Free State on the boundary commission the Northern government refused to appoint a representative. The dispute was referred to the judicial committee of the privy council, which decided that legislation was necessary if a representative of Northern Ireland were to be appointed by the imperial government. An act for that purpose was accordingly passed, and MacDonald appointed a well-known Ulster barrister, T. R. Fisher, to represent Northern Ireland. As chairman, Judge Richard Feetham was brought from the Union of South Africa. During 1925 the commission conducted its inquiry in secret, but in November a London newspaper published a detailed anticipation of its report which suggested that the alterations would be small and even adverse to

the Free State in important areas. MacNeill resigned at once from the commission and also from the government, protesting his disagreement with the newspaper report. But Irish disappointment was so great that Cosgrave's ministry was in real danger of defeat.

MacDonald then called a conference in London, which Craig attended, and a new agreement was made which left the existing boundaries intact in consideration of large financial concessions. Under article 5 of the treaty, Ireland had accepted liability for part of the United Kingdom's public debt in 1921, to be determined "in such proportion as may be fair and equitable, having regard to any just claims on the part of Ireland by way of set off, or counterclaims." This article, as well as article 12, was now cancelled, while Ireland agreed to pay a revised claim in compensation for war damages, estimated at less than £5,000,000.

Removal of this uncertain but great financial liability was an immense help to the Irish government, but the agreement involved surrender of all hopes of compelling Ulster to come in. The agreement was vehemently opposed by the Labour party, as the *dail* had not been consulted before it was made. The Republicans renewed their accusations that Ireland's national integrity had been surrendered, and even the supporters of the treaty were shaken in their confidence. But the danger of collision with the Northern Ireland government was removed, and it at once disbanded two of the three branches of the Ulster special police force. Meanwhile the Irish ministry had found that the British government was disposed to be actively helpful in overcoming difficulties, and the approach of another Imperial conference gave opportunities to press for fuller independence. Ireland was already actively participating in the League of Nations, and both at Geneva and in the Imperial conference collaboration with other dominions was pursued, to develop greater freedom from imperial control. Passports for Irish citizens were now issued from Ireland; the authority of the governor general in regard to diplomatic and other appointments was subjected to increasing restrictions; and the right of appeal from Irish courts to the judicial committee of the privy council was strongly contested. These and other matters affecting the implications of dominion status were considered, with growing support from Canada and South Africa.

Republicans in the **Dail.**—By the spring of 1927, five years of intensive work had produced striking progress. Blythe's new budget reduced the estimate of normal army expenditure by £500,000, and income tax was now lowered below the English rate to 3*s.* in the pound. The fourth *dail* alone had passed nearly 200 acts, and a sense of security had been achieved. But there was a natural desire for change, and when general elections were held in June the smaller parties increased their strength. Cosgrave's party was reduced from 57 seats to 46 and could no longer command a majority, even while the Republicans remained outside the *dail.* But Cosgrave agreed to form a new ministry to continue its own course with support from other groups until it was outvoted. Among the other ministers, Hogan, McGilligan and Blythe had shown great abilities, but O'Higgins had made the strongest mark, especially at the Imperial conference and in Geneva. He was now vice-president of the executive council, the ablest debater and most decisive character in the government. But his sardonic wit and provocative speeches had incurred intense resentment during the civil war. The old feuds were suddenly revived when he was murdered by gunmen outside his house on Sunday, July 10, 1927.

The Republicans at once disclaimed all sympathy with his murder, but Cosgrave denounced it as a deliberate attack on the state. He took drastic powers by carrying the Public Safety act, which proclaimed all revolutionary societies as treasonable and gave power to arrest or deport suspected persons. The Republicans still refused to enter the *dail* and continued their efforts to discredit the government from outside. Cosgrave decided to force them to come in by introducing a bill which prescribed an oath of willingness to enter the *dail,* and also an oath of allegiance to the constitution, for every candidate at future elections. De Valera did his utmost to defeat the bill but found it impossible to hold out. He decided that he and his party would subscribe to the oath, but only after proclaiming that they regarded it as an "empty formula" which would have no binding force. He then led his followers into the *dail,* and an agreement was reached with T. Johnson's Labour party, and with Capt. W. A. Redmond's National league, that they would outvote the government on a motion of no confidence. Johnson was to assume office with the support of the Republicans. The motion was debated on Aug. 16, but one member absented himself and Cosgrave's ministry was saved by the speaker's casting vote. Two by-elections in Dublin soon afterward gave Cosgrave large majorities, and he at once dissolved the fifth *dail.* The two main parties gained heavily from their previous allies, and Cosgrave won 61 seats as against 57 won by the Republicans.

The sixth *dail* assembled in Oct. 1927, and Cosgrave again formed a ministry, with support from the Farmers' party and independents. De Valera was now leading the opposition in the *dail,* supported generally by the Labour party and the National league, and an alternative to the Cosgrave ministry could easily be formed. The government had exercised almost unchallenged authority and had introduced a great number of drastic changes, many of them unpopular. The young ministers had tended to disregard criticism while they pursued their program of reconstruction, and they increased resentment by their undisguised satisfaction at their success. But economic conditions favoured them during the sixth *dail,* until the general trade depression of 1930 began to affect Ireland also. Cosgrave's ministry, while introducing protective tariffs and encouraging the foundation of new industries behind the customs barrier, had relied chiefly upon trade with England. Agriculture had benefited from that policy and from taking advantage of imperial preferences in which the Free State shared. But the economic crisis in England brought down prices for Irish produce, and unemployment was spreading. Discontent gave new life to the activities of the Irish Republican army, and Cosgrave introduced yet another amendment to the constitution to establish a military tribunal for political crime. De Valera opposed it, with increasing support, and in Feb. 1932 the general elections produced the seventh *dail,* in which De Valera had gained enough seats to form a ministry, with the Labour party's support.

De Valera in **Office.**—After ten years in office, Cosgrave had been prime minister longer than almost any other statesman in Europe. But De Valera had been the Republican leader since 1916, as the senior survivor of those who escaped execution after the rising. He had a definite program which appealed especially to the poorer classes, who felt that Cosgrave had chiefly encouraged the large farmers and the middle classes. With trade depression increasing, De Valera promised relief by wider social services, by reducing the high salaries of public officials and especially by his promise to withhold the land purchase annuities which were being paid to the British government. This promise was especially effective in the western counties, where the land annuities were the principal outgoings of the small farmers. At the same time he renewed his appeal to national sentiment by demanding the removal of the oath of allegiance and the abolition of the governor general as representative of the king. His personal prestige was strengthened by the accident that, soon after he assumed office, the international Eucharistic congress was held in Dublin. A million people, including great numbers of Irish pilgrims from overseas, attended the impressive ceremonies.

De Valera's refusal to continue payment of the land purchase annuities produced an economic conflict with Britain which enabled him to press at the same time for abolition of the oath of allegiance. The annuities had been cancelled by the Government of Ireland act of 1920, which never became operative, but Cosgrave's government had subsequently accepted liability for paying them as part of the financial agreement of 1926, which abolished all Irish liability for the imperial public debt in compensation for throwing over the promised adjustment of the Northern Ireland boundaries. De Valera claimed that this agreement was invalid because it was never submitted to the *dail.* The British government insisted that the moneys were due, and J. H. Thomas, as secretary of state for the colonies, retaliated by securing the imposition of tariffs on imported Irish cattle and farm produce. De Valera then imposed a similar punitive levy on Eng-

lish coal and other imports. The annuities were still collected, but for the Irish exchequer. An economic war developed with crippling results for the more prosperous Irish farmers, though the small farmers were less directly affected. Denmark and the dominions had new opportunities of capturing the English market from their Irish trade rivals; and at the Ottawa conference later in 1932, Ireland gained no benefit, whereas Cosgrave had always obtained sympathetic support at such conferences. Nevertheless the economic war had created favourable conditions for De Valera to pursue his deliberate policy of achieving full political and economic independence. A conflict with the governor general, James MacNeill, after the Eucharistic congress in June enabled him to demand MacNeill's retirement, and he then insisted successfully in asserting the right to nominate MacNeill's successor. The Viceregal lodge ceased to be the official residence, and D. Buckley, a veteran of the Gaelic revival who had taken part in the rising of 1916, became governor general, living in a modest house in south Dublin. By simple legislation De Valera abolished the oath of allegiance as prescribed by the treaty. While the economic war continued, protective tariffs were used with increased vigour to promote a general policy of achieving economic self-sufficiency. Austerity as the price which must be paid while full independence was being achieved became the subject of constant exhortation. Salaries of ministers were reduced, while the greatly reduced expenditure on the governor general's establishment was cited as an example that more modest standards must be adopted. An offer by the British government to invoke arbitration on the disputed land annuities, by a commission which would include no members of the commonwealth, was rejected by De Valera, and the conflict became more intense. In Jan. 1933 he appealed directly to the country, and in the eighth *dail* he had 77 seats instead of 70. He had now a bare majority of one, and the Labour party continued to support him.

Internal troubles increased with the growth of unemployment and the depressing effects of the economic war. Evidences of Communist influence began to appear, especially among the I.R.A. The Army Comrades association formed a new organization of national guards, led by Gen. Eoin O'Duffy, whom De Valera had dismissed from command of the civil guard. Demands from the I.R.A. for his dismissal had made De Valera's action appear as a weakening of his authority, and O'Duffy soon became prominent as leader of the Blue Shirts, which came into collision with the government as an apparently Fascist movement. De Valera had attempted on first taking office to repeal the Public Safety act which had been passed by Cosgrave's government after the murder of O'Higgins, but had failed to secure a majority in the *dail.* He now invoked the act against O'Duffy's Blue Shirts and declared the national guard an illegal organization. O'Duffy lacked the sagacity necessary for leading the opposition in such conditions, and his movement soon lost much of its earlier support. The Civil War which broke out in Spain in 1936 had encouraged his Fascist sympathies, and he enrolled an Irish brigade to serve under Gen. Francisco Franco, which, however, found little scope in Spain and received small sympathy in Ireland. Recruitment of Irish volunteers for Spain was made illegal by the *dail.* While the economic war continued, De Valera exploited his oppartunities for reducing any formal dependence upon the British connection. Cosgrave's government had already achieved notable advances toward full autonomy by gaining the support of other dominions at the Imperial conferences. Ireland had been actively represented in the League of Nations since 1923, and in Sept. 1932, shortly after assuming office, De Valera had been elected president of the League's council and had made a notable presidential address at Geneva. During the Spanish Civil War he had supported the British attitude of nonintervention. But he had abolished the oath of allegiance and forbidden appeals to the judicial committee of the privy council. He had reduced the governor general's status to a minimum, and he announced his intention of framing a new constitution. The senate, which still represented chiefly the conservative elements, with a large proportion of former Unionists, was to be replaced by a more widely representative body. With continued support from the Labour party, De Valera had been pursuing his policy of self-sufficiency and extending the social services. Tension in the economic mar was partly relaxed in 1935 when a coal-cattle agreement was negotiated, after much skilful diplomacy, by Dulanty as high commissioner in London. Within stipulated limits, it was agreed that Irish cattle should be allowed into England in return for similar exports of English coal to Ireland. These agreements were renewed in 1936 and again in 1937.

Constitution of 1937.—De Valera proceeded to introduce his proposals for the new Irish constitution, "as if there were no relationship with the states of the British Commonwealth." His proposals were introduced when the British government was unexpectedly confronted with the constitutional crisis that resulted in the abdication of King Edward VIII. Under the Statute of Westminster each dominion was expected to ask the imperial parliament to enact a statute of abdication; but De Valera declined to make any such request. The *dail,* however, passed an act accepting the abdication, and it authorized King George VI to act as a symbol of Ireland's co-operation in the commonwealth on such matters as the Irish executive council might refer to him for advice. De Valera had thus gained a direct opportunity for establishing his own conception of Ireland's special position as a state in "external association" with the British Commonwealth.

The new constitution gave effect to this general idea. It did not proclaim a separate and independent republic, but it abolished the title of the Irish Free State and substituted the word "Eire" (Ireland). The British government accepted these proposals, in spite of protests from the Northern Ireland government. De Valera held another election to secure approval of his proposals, and the new constitution was formally ratified by a plebiscite which was held concurrently with the elections. It became operative on Dec. 29, 1937. One symbolic change was that the former governor general was now replaced by a president, elected by the whole people, who was to be the nominal head of the state. The leader of the largest party in the *dail* was to be prime minister. The first president, elected by the consent of all parties, was Douglas Hyde, a famous Celtic scholar who had been the chief organizer of the Irish language revival and president of the Gaelic league. As a Protestant, the son of a clergyman and a graduate of Trinity college, Dublin, his unanimous choice was regarded as evidence of good will toward the Anglo-Irish minority. That point was especially important, because even the new constitution was only a further stage toward attaining the national independence of a united Ireland, which could not be completed without the inclusion of the six counties of Northern Ireland. Full achievement of what the first *dail eireann* had proclaimed was not yet within reach, and the continued conflict with the British government had hardened the opposition of the Ulster Unionists.

The Naval Bases.—Events in Europe were creating a new situation, which concerned De Valera directly in his dual capacity as prime minister and minister for external affairs. As president of the League of Nations council at Geneva in 1932 he had spoken gravely of the risks of war. During the Civil War in Spain, as already noted, he had supported the British policy, and during the invasion of Ethiopia he had given full support from Ireland for sanctions against Italy. The growing fears of a European war, however, had a direct concern for Ireland, because the Anglo-Irish treaty had left certain naval bases in Ireland under British occupation. Cork harbour and Berehaven in the southwest, besides Lough Swilly in the north, were still occupied by the British fleet. In the event of war in Europe, this would involve Ireland inevitably as a participant. The Republican program, to which De Valera was irrevocably committed, demanded absolute independence and sovereignty for the whole island, which implied an unfettered freedom of decision. De Valera had insisted repeatedly, in all negotiations with London, that in the event of war Ireland would never give active support to England while partition continued. Now that war was apparently imminent, Neville Chamberlain had to face the probability of renewed difficulties in Ireland if the British naval bases there became isolated. The new Irish constitution, evolved after several years of economic conflict, showed-that De Valera was uncompromising in his claims to sov-

ereignty but anxious to restore friendly relations. Chamberlain's government accepted the new situation in Dec. 1937 by announcing that the British and dominion governments "are prepared to treat the new constitution as not effecting a fundamental alteration in the position of the Irish Free State."

Anglo-Irish Agreement of 1938.—Chamberlain then invited De Valera to hold new discussions in London covering the whole position. Conversations were accordingly opened in Jan. 1938 and resulted in three agreements on April 25. The preamble announced that they had been made with the object of promoting friendly relations between the two countries, of facilitating trade between them and of reaching a final settlement of all financial claims. The agreements went far beyond the immediate dispute concerning the land annuities and the resulting economic war. They made a dramatic change by relinquishing British occupation of the Irish naval bases outside Northern Ireland. The treaty of 1921 had provided that until arrangements were made between the two governments for the Irish Free State to defend its own coasts, "the defence by sea of Great Britain and Ireland should be undertaken by the imperial forces." In view of later developments, Eire was now entitled to declare itself neutral in case of war, but the naval bases at Cork harbour, Berehaven and Lough Swilly were still under British occupation. De Valera now claimed that Eire was prepared to undertake its own coastal defense, while Chamberlain recognized the obvious difficulties in maintaining isolated naval bases in case of war. Chamberlain decided to rely upon Irish good will in withdrawing the British naval forces. It was agreed that before Dec. 31, 1938, the United Kingdom would transfer to Eire the property and rights of the admiralty at Berehaven and also the harbour defenses there and at Cork harbour and Lough Swilly. This part of the new agreement was vehemently opposed by Winston Churchill, who was not then in office, on the ground that British naval defense would be greatly hampered by the surrender of the Irish bases.

Besides terminating the British naval occupation, the agreements provided for a settlement of the land annuities dispute and a cessation of the trade war. The original treaty had contained vague provisions for adjustment of financial claims on both sides, but these had been generally settled by the agreement of 1925 which abolished the Ulster boundary commission and cancelled almost every outstanding financial liability except the land annuities. It was now agreed that, apart from a separate payment for damages to British property which had been agreed upon in 1925, Eire should pay £10,000,000 to the British government before Dec. 1938. This was to be a final settlement of all outstanding claims between the two governments. At the same time the British government was to abolish the special duties which had been imposed to collect the amount claimed for the land annuities. Almost all exports of Irish animals and agricultural produce had been subject to these duties, ranging from 20% to 40%. Quota restrictions on Irish imports had also been imposed, and imperial preference had been withdrawn from Irish produce. There had been some concessions under the coal-cattle pacts of 1935, 1936 and 1937, but many severe tariff restrictions had been introduced on both sides. De Valera had utilized the abnormal situation to develop new Irish industries behind protective tariffs, and the money collected for land annuities had been spent on subsidizing exports. The new agreements brought an end to such penal tariffs on both sides; but Irish trade was already beginning to follow a new pattern, and exports to Britain had been prejudiced by the loss of preferential treatment.

Irish Neutrality.— The new Anglo-Irish agreements, much wider in scope than had been expected, enabled De Valera to appeal for a new verdict of popular approval. The *dail* approved the new pact on April 29 with only one dissentient, and the general election on June 17 returned De Valera to power with a clear majority, having 77 votes against 45 for Cosgrave's Fine Gael, 9 Labour and 7 independents. On July 11 the last British troops were withdrawn from Cork harbour. Events in Europe were shaping rapidly, but Chamberlain had been fully aware that the Irish government might proclaim its neutrality in case of war. He had told the house of commons plainly, in explaining the agreements on May 5, that De Valera had attached primary importance to the question of partition, which the British government had considered itself unable to discuss. In a statement published on Oct. 18, shortly after Chamberlain's return from his visit to Hitler in Munich, De Valera declared that "quite obviously the existing partition would be a grave danger to England in the event of that country becoming involved in a European war." He asserted that "we have definitely committed ourselves to the proposition that this island shall not be used as a base for enemy attacks on Great Britain," and that quite possibly "a united free Ireland" would be willing to co-operate with Britain to resist a common attack. But until there was a "united, free, independent Ireland," Irish support could not be expected. In the same interview De Valera expounded his own views on the possible settlement of partition. He agreed, though reluctantly, that Northern Ireland might keep its "local Parliament with its local powers," but that "the powers at present reserved to the English parliament shall be transferred to the all Ireland Parliament."

A series of bomb outrages committed by the I.R.A. in Belfast and in English cities during the folloning winter and spring aroused anger in England and compelled the Irish government to tighten its control by new legislation against subversive activities. But on April 16, 1939, De Valera announced that in the event of war he would try to maintain and preserve Irish neutrality. The extension of conscription in England raised the question of compulsory military service in Northern Ireland, and on May 2, 1939, De Valera protested against its application there. Two days later Chamberlain announced that Northern Ireland would continue to be exempted from conscription. When war came, De Valera at once announced that Ireland would continue its policy of neutrality. On Sept. 27 Sir John Maffey was appointed to the new position of United Kingdom representative in Eire.

World War II.—During the first phase of relative quiet, the Irish government was concerned chiefly with economic measures to meet the war situation and with the suppression of seditious activities by the I.R.A. In Jan. 1940 power was taken to intern persons suspected of activities against the state. But by May the need for serious national defense became apparent, and weekly conferences were arranged between the government and leaders of Fine Gael and Labour. All parties united in a recruiting rally in Dublin on June 16, and on June 29 Lord Craigavon, in response to urgent messages from Churchill and Franklin D. Roosevelt, promised co-operation with Eire for national defense. But the basis of co-operation was disputed, and De Valera announced on July 5 that Ireland must be both united and neutral. Craigavon then reported to the Northern Ireland parliament that De Valera had refused his offerof joint defense. On Nov. 7 De Valera again asserted that there could be no question of handing over ports in Eire as bases for Britain. His chief preoccupation, since the German occupation of France, had been the possibility of a German air-borne landing in Ireland, and Irish neutrality was jealously preserved to prevent any pretext for such attack. But in Jan. 1941 German bombs and magnetic mines were dropped near Dublin, and De Valera had to protest formally to Berlin. That same month it was made known that nine Irish ships had been sunk since the war began.

On April 13, in a broadcast, De Valera asserted that Eire would defend its neutrality by armed force. But in May the intention to apply conscription in Northern Ireland made him protest again, and on May 27 Churchill announced that it would not be applied. Four days later German bombers did serious damage in Dublin, but regrets and a promise of compensation were forthcoming from Berlin. A new situation arose after the United States entered the war in Dec. 1941; and while De Valera no longer feared invasion by either German or British forces, there was nem pressure from the United States against his neutral policy. On Jan. 27, 1942, he protested strongly against the landing of U.S. troops in Korthern Ireland. declaring that the Irish government had not been consulted; President Roosevelt replied by expressing amazement at the protest. On Feb. 3 De Valera appealed for the enrolment of an Irish army of 250,000 men "to maintain Eire's liberty." But the U.S. forces in Northern Ireland had been rapidly increasing,

and on July 1 it was revealed that the United States had built a powerful naval base, costing several million pounds, at Derry.

Lord Craigavon had died in Nov. 1940 and been succeeded as prime minister of Northern Ireland by J. M. Andrews. Andrews resigned in May 1943, and Sir Basil Brooke replaced him. In June De Valera decided to appeal for a new mandate, and in the general election he lost his former clear majority, returning with only 67 seats. Cosgrave's Fine Gael also lost seats, and Labour came back with 17, while the Farmers and independents together had 22. But De Valera was re-elected prime minister in July, and in November he was still insisting that Eire should remain neutral. In fan. 1944 Cosgrave retired from leadership of the chief opposition party and was replaced by Gen. Richard Mulcahy.

Pressure from the United States increased while preparations for the landings in Normandy were progressing. In March 1944, De Valera rejected a formal request by the United States for the removal of axis consular and diplomatic representatives from Eire "because their presence constituted danger to the lives of American soldiers and the success of Allied military operations." The British government then immediately suspended, for military reasons of paramount importance, all travel between Britain and Eire or Northern Ireland. But De Valera's neutral policy and his firmness in resisting pressures still commanded general support in Eire. A defeat in the *dail* on the Transport bill gave him a pretext for holding another election, and he was returned with 76 seats and a majority of 14 over all other parties. On June 9 he was re-elected prime minister by 81 votes to 37.

His government was thus securely in office during the closing phase of the war. On May 13, 1945, Churchill in his victory broadcast made reference to the difficulties which had resulted from surrender of the Irish ports, and asserted that if necessity had arisen they would have been seized by the British navy. De Valera replied on May 16 with remarkable restraint, declaring that Churchill had, by resisting that temptation, advanced the cause of international morality. With the restoration of peace, Eire quickly attracted an immense number of visitors from England, and relations were entirely friendly. A new president was needed when Douglas Hyde's term expired in June, and Sean T. O'Kelly, one of De Valera's principal ministers, was elected by 565,000 votes to 453,000 for the Fine Gael candidate. In July De Valera declared in the dail that Eire had been in effect a republic since the new constitution became operative in Dec. 1937.

Postwar Prosperity. — In supplying food and other exports to Britain during the war years, Eire had accumulated large sterling assets. The postwar influx of English visitors, who came eager to enjoy the abundant supplies of food, clothing and other rationed goods, added to these favourable balances, and they were further increased by the large number of English people who bought houses and settled for a time in Eire. The country's new prosperity was reflected in the budget of May 1946, which reduced income tax by 1*s*. in the pound. There was a wave of inflation with prices rising fast, while trade required abnormally large purchases to replace stocks and to buy goods which had been unobtainable for years. Tourist development soon became one of the principal sources of income to meet the cost of such necessary imports. In 1947 tourism was estimated to have earned nearly £30,000,000, and forecasts by the travel organizations predicted that Ireland would soon rank next after France and England in tourist earnings. But this sudden influx of visitors, combined with heavy expenditure on capital and consumption goods, was producing serious problems. In Sept. 1947 De Valera went to London for talks on trade and finance with C. R. Attlee and Sir Stafford Cripps. A restless spirit was growing in Ireland, after De Valera had been continuously in office for 1 j years. A new party, Clann na Poblachta, formed by Sean MacBride, appealed specially to the new generation and to those who were tired of the old party rivalries. At two by-elections at the end of 1947 it presented its first candidates and won both seats. De Valera had threatened to appeal to the country if he were defeated, and in Feb. 1948 a new general election resulted in his resignation. His party was still by far the largest in the *dail,* but the other groups combined unexpectedly under a new leader.

Interparty Government. — In the 13th *dail* the number of members had been increased, by a redistribution of seats, from 138 to 147. De Valera refused to enter into any coalition with other parties, though his Fianna Fail had won 68 seats and Mulcahy's Fine Gael had only 31. Labour's forces were split, with 14 seats held for the Labour party led by W. Norton and 5 for National Labour. There were now 13 independents, among whom the ablest figure was James Dillon, who had been the only active advocate of Ireland's participation in the war. MacBride's new party, Clann na Poblachta, had put forward many candidates but won only nine seats. The Farmers' party held seven more. It was obvious that De Valera could easily form a coalition with a few of the smaller groups, but he refused all such approaches. Since Cosgrave's retirement, there had been no Fine Gael leader who commanded general support, and Mulcahy soon agreed to make way for any new leader who did not arouse hostile memories.

Urgent consultations with the independents and with MacBride's party resulted in agreement to combine under a new leader, John A. Costello. He had been attorney general and had close experience of imperial and international conferences, but with a large legal practice he had taken little part in political controversy. The desire for a change of government was especially strong among younger persons, who felt themselves excluded from all opportunity so long as De Valera kept his older colleagues in office. It was agreed quickly that an interparty government should be formed under Costello, without any formal coalition and with each party free to press for its own program. On that basis Costello secured 75 votes, after De Valera's nomination as prime minister had been outvoted, and the interparty ministry took office, with promises of reducing extravagant expenditure.

During the general election there had been little difference between the rival programs except that Costello's Fine Gael had openly declared its support for close relations with the British Commonwealth. MacBride's new party was regarded as the most adventurous, with its demand for a separate Irish currency and for an active policy to end partition. But its conditions for supporting Costello had been simply that MacBride himself should become minister for external affairs and his young colleague Noel Browne should be minister for public health. McGilligan, the ablest survivor of Cosgrave's former team, became finance minister. Dillon, as the most important independent, took charge of agriculture. Norton, the Labour leader, became deputy prime minister. But Costello's inexperience of leadership, which he had never desired, was soon reflected in nervousness about De Valera's intentions for the future. After 1 j years in office he undertook a world tour, and his speeches in the United States, India and Australia suggested that he would revive the fuller demand for national independence and for ending partition. His prestige outside Ireland was so evident that Costello found it advisable to undertake a similar mission overseas, and he accepted an invitation to visit Cahada in August. Until his departure there had been no rumour of any impending constitutional change. But in Montreal on Sept. 1 Costello made his first declaration of his new policy. After reviewing the constitutional developments in Ireland since the treaty of 1921 and the progressive stages of national independence, he claimed that Ireland's sovereignty was no longer in doubt but that the question now arose whether the existing constitution was in a form "compatible with our national sentiment and historical tradition." It was plain that the new government proposed to forestall any intention by De Valera of demanding full independence as a republic.

On Nov. 17 Costello introduced in the dail the Republic of Ireland bill, which proclaimed secession of the 26 Irish counties from the commonwealth and empowered the Irish president to exercise all functions concerning external affairs previously exercised by the British crown. The state was to be the Republic of Ireland, but the name "Eire" or "Ireland" would continue to be used. While the bill was in preparation urgent talks were held on Nov. 15 between Irish ministers and British and commonwealth leaders. MacBride then announced that as from Jan. 1949 there would be in Britain three categories of citizens: British, commnnwealth and Irish. Attlee conferred with Sir Basil Brooke, the Ulster premier,

and insisted that no change affecting the constitutional position of Northern Ireland be made without the consent of its people. Costello in introducing the bill proclaimed that it was "conceived in no spirit of hostility to the British people or the institution of the British Crown." He believed it would produce greater friendship between Great Britain and Ireland. The bill was not opposed at any stage and became law on Dec. 21. De Valera expressed his cordial support, regretting only that effective jurisdiction for the republic over the whole of Ireland could not yet be claimed.

The British government had shown its desire to assist in overcoming difficulties by declaring that Irish nationals would not be regarded as foreigners. But consequential legislation was necessary, and the Northern Ireland ministers pressed for new assurances in London. Brooke held a general election in Northern Ireland on Feb. 10, 1949, which produced an emphatic verdict for retaining the British connection. Labour lost 3 seats, and the Unionists now held 37 out of 52. But MacBride on Feb. 26 asserted again that Eire would not consider joining the North Atlantic treaty unless partition were first abolished. On April 17 the Irish republic was formally proclaimed in the Irish cities, and messages of good will were sent from King George VI and from Pres. Harry S. Truman. But in May Prime Minister Clement Attlee introduced the Ireland bill to provide for consequential changes. It expressly "recognised and declared that the part of Ireland heretofore known as Eire ceased to be part of His Majesty's Dominions" as from April 18, but clause (b) declared "that Northern Ireland remains part of His Majesty's Dominions and of the United Kingdom" and affirmed that "in no event will Northern Ireland or any part thereof cease to be part of His Majesty's Dominions and of the United Kingdom without the consent of the Parliament of Northern Ireland." This clause provoked great indignation in Ireland, as being a claim that the six counties should be permanently excluded from jurisdiction of the Irish parliament; whereas the Government of Ireland act of 1920, as well as the treaty of 1921, had contained provisions for united control. Large public meetings of protest were held in Ireland, and on May 10 the *dail* unanimously voted a resolution by Costello protesting against the Ireland act.

Within its first year Costello's government had thus unexpectedly severed relations with the commonwealth and apparently left less ground than ever for difference among the principal Irish parties. Partition was now the chief outstanding problem, but the cleavage with the Ulster parliament had been deeaened by secession. With no clearly defined program, the interparty government was soon weakened bv the competing claims of its component groups. Public expenditure rose rapidly to meet such demands, and heavy purchases to replace exhausted stocks were depleting the large sterling assets that had been accumulated during World War II. Ireland had obtained inclusion in the benefits of the European Recovery program to assist agricultural production. Dillon's ambitious scheme for land reclamation with U.S. aid promised big results over a long period; but his first success in increasing Irish exports of eggs and butter to England was not maintained when export prices fell, and the cost of imported fertilizers and maize was increased by the sudden devaluation of sterling. Internal discords in the ministry reached a crisis over Noel Browne's plan for free public health services under state control, which was strongly opposed by the Catholic bishops. Costello then repudiated Browne's proposals, and his narrow majority in the *dail* was at once shaken.

The Elections of 1951 and of 1954.—In May 1951 a general election was held, to clear the air. The new *dail* that resulted scarcely differed in composition from the previous one, the interparty groups retaining 78 seats and Fianna Fail gaining one. which brought its total to 69. MacBride's new party, however. had been split by a bitter feud with Browne, and some of the independents withdrew their support from Costello. De Valera then. though still refusing to enter any grouping. won promises of support outside his own party and was elected prime minister by 74 votes against 69. Taking office in June, he declared that the republic would continue to stand aloof from the British Commonwealth and pursue a policy of neutrality. His ministry consisted almost entirely of his former colleagues, with hardly any attempt to enrol younger members; and in April 1954, by which time his party had been defeated in four out of five by-elections since 1952, he decided to dissolve the *dail*. In the ensuing general election (May 1954), only 65 seats went to Fianna Fail. On June 2, therefore, though Fine Gael now had only 50 seats, Costello was elected prime minister by the interparty grouping, which gave him 79 votes against 66.

Raids by the I.R.X. on British military barracks at Armagh and Omagh—in the following year, 1jj. a raid was even made on a barracks in England itself and arms and ammunition were stolen from it—made it necessary for Costello to reaffirm that the final authority of the Irish nation resided in the *dail*.

The new minister of health. while postponing the coming into operation of certain measures of the much-debated Health act passed by the previous government, was able to state that the mortality rate from tuberculosis in 1953 had fallen to 40 per 100.000 of the population, the lowest yet recorded in Ireland and half the 1950 rate.

BIBLIOGRAPHY.—D. MacArdle, *The Zvish Republic,* 4th ed. (Dublin, 1951); W. O'Brien, *The Irish Revolution and How It Came About* (London, 1923): D. Gwynn, *Thr Irish Free State, 1922–1927* (London, New York, 1928); F. Pakenham, *Peace by Ordeal* (London, New York, 1935); T. de Vere White, *Kevin O'Higgins* (London, 1948); H. Harrison. *The Neutrality of Ireland* (London, 1942); E. De Valera, *Ireland's Stand* (selected speeches) (Dublin, 1946); Arland Ussher, *The Face and Mind* of *Ireland* (London, 1949; New York, 1950).

(D. G.)

POPULATION

In 1961 the population of the Republic of Ireland was 2,814,-703, slightly less than the figure for 1946, which was 2,955,-107. In the intercensal period 1946–51 the number of marriages registered was 79,231, or about j.5 per 1,000 of the population; the number of births was 322,33j, or about 22.2 per 1,000; and the number of deaths was 197,281, or about 13.6 per 1,000. The natural increase in the population was 12 5,054. Net emigration was 119,568, leaving an increase in population of 5,486, the first increase recorded between two census dates since 1841. Between 1900 and 1946 the population had declined by about 8%. A high proportion of the migrants were women; the number of females per 1,000 males of the population was 965 in 1951—one of the lowest ratios in the world.

Until 1930 Irish emigration was directed mainly toward the United States. After that time the flow was mainly to Great Britain. Of those emigrating to Great Britain a considerable number returned home for permanent residence after an absence of a few years. In 1950, 73,000 emigrated to Great Britain, but about 36,000 persons returned home.

The official languages of the republic are Irish (see IRISH LANGUAGE) and English. About one-fifth of the population speaks Irish. the revival of which official policy encourages. The teaching of Irish is an important feature of the educational system. and a knowledge of the language has gradually been made compulsory for most examinations. Despite the efforts made to foster it, however. enthusiasm for the Irish language abated after the achievement of independence from Great Britain.

Religion.—Under article 44 of the constitution. the special position of the Roman Catholic Church was recognized "as the guardian of the Faith professed by the great majority of the citizens"; recognition was also given to the Church of Ireland, the Presbyterian Church, the Methodist Church, the Religious Society of Friends, the Jewish congregations and "the other religious denominations existing in Ireland at the date of coming into operation of the Constitution." "Freedom of conscience and the free profession and practice of religion are, subject to public order and morality, guaranteed to every citizen." The state guaranteed not to endow any religion and not to impose any disabilities or make any discrimination on the ground of religious profession, belief or status. According to the 1946 census the number of persons of each religion in the republic was: Roman Catholics. 2,786,-033; Protestant Episcopalians, 124.829; Presbyterians, 23,870; Methodists, 8,355; Jews. 3,907; Baptists. 462; others. 7,651.

Education. — Elementary education, which is given in national schools, is free. Since 1922 the Irish language has been an essential feature of the curriculum in state-aided schools, and there is insistence on the desirability of teaching classes, so far as is practicable, through the medium of Irish. Attendance at some school is compulsory for children between the ages of 6 and 14 years, and more than 40% of children between 14 and 16 years attend voluntarily. either in elementary or in other schools. The total number of national schools in 1955 was 4,874, as compared with 5,648 in 1925–26. The average number of pupils on the rolls fell from 518,000 in 1925–26 to 490,157 in 1955. The total number of teachers — two-thirds women — varied only slightly after 1925. State expenditure on primary education increased from £3,500,000 in 1925–26 to £8,262,490 in 1954–55.

Secondary education is given in private schools which, in many cases, are conducted by Catholic religious orders. Where state grants are paid, as is the general rule, the schools are open to inspection. In contrast with falling numbers of pupils in elementary schools, the number of pupils attending recognized secondary schools rose from 25,500 in 1925–26 to 56,411 in 1955. There were 458 recognized secondary schools in 1955, in about half of which instruction was either entirely or partly in Irish. State expenditure on secondary education was £1,689,870 in 1954–55.

Vocational schools in cities, towns and some rural areas provide continuation and technical education. They are maintained partly from the rates and partly from state grants. The total expenditure from public funds was £1,016,230 in 1954–55. There were 90,000 students, nearly three-quarters of whom were over 16. Agricultural and veterinary education is provided in institutions managed either by the department of agriculture or by religious orders. Short courses in agricultural instruction are also organized locally by statutory county committees which receive grants from public funds. Higher agricultural education is given by the universities.

The oldest university in Ireland, the University of Dublin (Trinity college), was founded in 1591. The National University of Ireland, founded in 1909, has constituent colleges in Dublin, Cork and Galway and treats St. Patrick's college, Maynooth, as a recognized college. University education is financed partly from state grants.

CONSTITUTION AND GOVERNMENT

Constitution. — The constitution shows three main influences: Irish nationalism; English and Free State parliamentary traditions; and Catholic philosophy.

The preamble of the constitution invokes the Holy Trinity and, acknowledging the dependence of the people of Eire, declares that the purpose of the constitution is the promotion of "the common good, with due observance of prudence, justice and charity, so that the dignity and freedom of the individual may be assured, true social order attained, the unity of our country restored, and concord established with other nations."

The constitution declares Eire to be a democratic state, sovereign and independent. The head of the state is the president (*Uachtaran na hEireann*), who is elected for seven years by the direct vote of all citizens. Nominations are made by members of the *oireachtas* (parliament) or of the county councils. The president appoints the prime minister on the nomination of the *dail,* and on the nomination of the prime minister and with the previous approval of the *dail* he appoints the other members of the government. He signs and promulgates laws. He can refer certain bills to the supreme court to test their constitutionality. He also has power to refer certain bills to a popular referendum upon petition of a prescribed percentage of the *dail* membership. He is supreme commander of the armed forces. The president is advised by a council of state consisting of former presidents, former and incumbent prime ministers and chief justices, as well as of others, some of whom he may name.

The *oireachtas* consists of the president and two houses. The house of representatives *(dail eireann)* consists of 147 members elected by adult suffrage under a system of proportional representation. The government, which consists of from 7 to 15 members, is responsible to the *dail.* The maximum term of the *dail* is seven years. The *dail* alone can initiate money bills, and the *seanad eireann* may only make recommendations on them. *Seanad eireann,* an unsuccessful attempt to create a vocational chamber, is composed of 11 members nominated by the prime minister and 49 members who are elected by the *dail* and the county councils from panels representative of the universities, culture and education, agriculture, labour, industry and public administration and social services. The system of proportional representation is used in the election of a *seanad,* which has to take place within 90 days after a dissolution of the *dail.* The *seanad* cannot veto legislative proposals and has but 90 days for the consideration or amendment of bills passed by the *dail.*

The constitution recognizes the family as the unit of society with rights superior to all positive law. Divorce is practically forbidden. Private property is recognized as a natural right of man, but this and other personal rights may be limited by law out of consideration for the common good. No religious endowment is permitted.

An interesting feature of the constitution is the enumeration of directive principles of social policy. The courts may not take cognizance of them in determining the application of laws. The principles, intended for the guidance of the *oireachtas,* include the right of every citizen to a decent livelihood, the establishment of families in economic security on the land, and the regulation of credit and of the distribution of property in the interests of the common good.

For the first three years after its establishment the constitution was amendable by ordinary legislation. Thereafter a popular referendum was necessary.

External Relations. — An important change affecting the relations of the Free State with the Commonwealth of Nations occurred when Edward VIII abdicated on Dec. 11, 1936. An act was passed to remove from the constitution all reference to the king and to abolish the office of governor general. The Executive Authority (External Relations) act of Dec. 11, 1936, accepted the abdication of Edward VIII. It also provided that executive authority. which it vested in the Free State executive council, could, in certain circumstances, be exercised for the appointment of diplomatic representatives and conclusion of international agreements by the king. The king had ceased to be head of the state, but, by virtue of his recognition as the hereditary symbol of commonwealth co-operation, he might, on the advice of the Free State executive council, exercise certain powers concerning external relations. The new constitution enacted in 1937 did not alter the operation of these provisions. Diplomatic representatives continued to be appointed by the king when advised by the Irish government, and the credentials of foreign diplomatists accredited to Ireland were addressed to the king.

The Executive Authority (External Relations) act, 1936, was repealed by the Costello government in 1948 when the Republic of Ireland act was passed. Under this act the exercise of executive powers concerning external relations was transferred to the president acting on the advice of the government. The description of the state was declared to be the Republic of Ireland, but in accordance with the constitution, which was not affected by the act, the name of the state remained Ireland. The aim of the act was to clarify the constitutional position and to terminate association with the commonwealth. This aim was accepted by the commonwealth countries. The Ireland act, 1949, which was enacted by the British parliament, declared that from April 18, 1949, the state had ceased to be a British dominion; it did not, however, become a foreign country so far as British statutes were concerned, and its citizens did not become aliens in Great Britain. Australia: New Zealand, South Africa, Canada and Southern Rhodesia adopted legislation declaring Irish citizens to have the same rights and obligations as their own citizens.

Judiciary. — Judges are appointed by the president on the advice of the government; they retire on pension at the age of 70. They are independent of the executive in the exercise of their judicial functions and are subject only to the constitution and the law.

There are four courts: the district court has civil jurisdiction

up to £25 and minor criminal jurisdiction; the circuit court has civil jurisdiction up to £300 and extended criminal jurisdiction, and acts as a court of appeal for the district court; the high court has unlimited juriidiction in civil and criminal cases and acts as a court of appeal for the circuit court; the supreme court acts as a court of appeal for the high court.

Defense. — The supreme command of the defense forces is vested in the president. The minister of defense is assisted by a council of defense consisting of the minister, his parliamentary secretary, the chief of staff, the adjutant general, the quartermaster general and the permanent secretary of the department of defense. The establishment provides for a permanent force of just under 13,000 officers and men, including the air corps and naval services. The number in the reserve (first and second line) in 1955 was 23,714. The first-line reserve is composed of officers and men who have already been trained during service in the permanent force. There is no compulsory military service. Minimum service is two years' permanent enlistment and six years in the reserve. Expenditure on defense was estimated at £7,114,230 for 1955–56.

Social Services. — The comprehensive organization of social services began with the Irish Poor Relief act of *1838,* which divided the country into poor law unions and created the workhouse system of relief. In 1923 home assistance was substituted for workhouse relief. In *1851* free medical attendance became available for the sick poor in their homes or in dispensaries. Health services are organized and directed by county medical officers. Public hospitals provide treatment free or at a charge graduated according to means. and proposals were introduced in 1952 for the improvement and extension of state-sponsored health services generally. For tuberculosis and some other diseases examination and treatment are free, and cash allowances are paid, in certain circumstances, to patients who are prevented by their illness from providing for their own maintenance and that of their dependents.

Income-maintenance social services, administered by a department of social welfare, include unemployment insurance and assistance, national health insurance, contributory and noncontributory pensions for widows and orphans, children's allowances and noncontributory old-age and blind pensions. Unemployment and national health insurance is compulsory for specified insurable occupational groups, and contributions are payable by workers, employers and the state. Manual workers in the building trade may be insured against loss of employment resulting from bad weather.

Grants are paid by the state to local authorities. public utilities and private persons for building and reconstructing houses. In 1954, 10,490 houses were built and reconstructed under state-aided schemes, and for 1955–56 the estimate for state grants was £2,250,-*000.*

ECONOMICS

Agriculture. — The total acreage under crops in 1954 was 3,686,456; this included *1,872,266* ac. under hay, 1,187,296 ac. under cereal crops and *607.169* ac. under root and green crops. The acreage under fruit was *11,*698.

The total acreage of plowed land rose from 1,492,000 in 1939 to 2,567,000 in 1944, during a period nhen wartime regulations for compulsory tillage were in force. From 1944 to 1954 there was a decline of more than 30% in the area of plowed land, but it still remained somewhat greater than it had been in 1939. The wartime increase in tillage was the result mainly of a temporary expansion of the acreage under wheat and oats.

After 1932, when the acreage of wheat was only 21,000 government policy encouraged the growing of wheat. Acreage began to expand after 1933 when legislation was enacted to permit the payment of bounties on home-grown wheat and the imposition of restrictions on imported wheat and on certain feeding stuffs. By 1939 the acreage had increased to 255,000; it reached a peak of 662,000 in 1945 but fell to 358,006 in 1955.

Tillage has in general played a comparatively unimportant part in the Irish agricultural economy. As a result mainly of increasing foreign competition in grain in the last decades of the 19th century, the farming system gradually changed to stock raising. Between *1861* and 1955 the number of cattle increased from *2,802,715* to 4,455,600. The Irish system of animal husbandry is based on grass; the decline in cereal and other tilled areas was accompanied therefore by an increase in hay and pasture areas. In 1953 almost 58% of the total land area was used for pasture and hay; crops, flax and fruit accounted for more than 10% of the total area.

There were 379,317 agricultural holdings in the republic in 1953. Of those, 64,041 were less than 1 ac.; *171,444* were more than *1* ac. and less than 30 ac.; *136,669* were more than *30* ac. and less than *200* ac. Holdings varied greatly in size, but the average nas about 30 ac. Holdings of betneen 15 ac. and 100 ac. constituted the mainstay of the country, and (leaving out of account those of less than 5 ac.) 207,850 holdings or nearly 55% of the total were under 50 ac. in 1953. There were *52.036* holdings between 50 ac. and 100 ac., and only *7,163* over 200 ac. of which not more than about *1,*500 were over 500 ac.

The principal crops grown in the republic are oats, wheat, potatoes, turnips and barley. Sugar beet was the only new crop introduced after the establishment of the state in 1922 and the Beet Sugar (Subsidy) act, 1925, marked the beginning of an important state-sponsored industry. The first sugar factory was opened in Carlow in *1926;* three additional factories were erected in 1934 at Mallow, Thurles and Tuam. The Irish Sugar company operating these factories became outstandingly successful, producing sugar at less than world prices and fostering agriculture by extending credit to farmers for seeds, fertilizers and machinery.

Following recommendations of the agricultural commission of 1923, legislation was enacted for the improvement of livestock breeding, the establishment of high standards in the production and marketing of creamery butter and for the testing, grading and marketing of eggs. As part of a general rationalizatiori of the dairy industry the majority of privately owned creameries were purchased by the state and transferred to co-operative societies. In 1930, when as a result of the world agricultural depression the prices of dairy produce fell sharply, a duty of fourpence per pound was imposed on imported butter. Previously, it had been the custom to export the surplus of Irish dairy produce of the summer months and to import butter to meet home requirements in late winter and spring. After 1930 the export of Irish butter declined; by 1950 home-produced butter was held in cold storage to meet winter requirements; in 1954 a surplus of butter was available for export.

The compulsory licensing of bulls, and other government schemes for providing premium bulls and boars and for subsidizing the purchase of pedigree rams, substantially raised the quality of the country's livestock. The cattle-export trade consists of fat cattle and of store cattle exported on sale and fattened abroad.

The government established an agricultural credit corporation to provide long-term loans for farmers and to co-ordinate the activities of local co-operative credit societies. Despite the existence of these credit facilities, agricultural capitalization in the republic remained extremely low, with considerable scope for further agricultural investment. In 1937, out of approximately *202,000* agricultural holdings in Denmark (a country often contrasted with the Republic of Ireland), only about 7,400 holdings were free from debt; on the average, a debt of more than £25 *10s.* had been incurred per each cultivated Danish acre. Debt per cultivated Irish acre in 1937 was slightly more than £3 *10s.,* indicating the low level of agricultural capitalization in the republic rather than freedom from the necessity to borrow.

In 1949 a land rehabilitation project was introduced which had as its aim the investment of £40,000,000 in agriculture over a period of ten years. This was the most ambitious scheme yet undertaken for the improvement of agriculture, and there was a reasonable hope that it might make a permanent contribution to the reconstruction of an industry which for more than a century had not made the progress which the natural resources of the country would seem to warrant. In the 19th century the capital of the country was drained away and utilized elsewhere, while the Irish farmer was offered little incentive to improve his holding.

After 1850 efforts were made to improve the arterial drainage of Ireland, but financial, legislative and social restrictions prevented the work from being effectively done until the enactment in

1945 of the Arterial Drainage act, which enabled operations to be undertaken on a broad basis. This measure made possible a great advance toward using the full productive capacity of the land.

Land Purchase.—Between 1870 and 1919 a series of ameliorative land acts was adopted by the British parliament as part of a program of agrarian reform for Ireland. The acts of 1870 and 1881, while mainly concerned with remedying defects in the relation between landlord and tenant, were also designed to achieve an alternative solution to the land problem by enabling occupiers to acquire by agreement the superior interests in their holdings with the aid of funds lent by the state. Subsequent acts extended these facilities of purchase. The Wyndham act of 1903 was of particular importance because it was aimed at the purchase of estates rather than of individual holdings, and it greatly cheapened and facilitated legal procedure. The total amount of the purchase money for which advances were made under the land purchase acts of 1870–1919 in respect of lands in the republic was just £100,000,000; 316,395 holdings amounting to a total area of 11,304,668 ac. were affected by these transactions.

The comprehensive Land act of 1923, one of the first important economic measures adopted by the native legislature on the attainment of self-government, aimed at completing land purchase and relieving congestion. It provided that holdings in any part of the state in which a dual interest of landlord and tenant still existed should be transferred to the Irish Land commission and then become the property of the tenants, subject to the payment of specified annuities toward the compensation of the former landlords. A system of standard prices was prescribed; in addition, the state provided the vendor of the land with a contribution equal to 10% of the standard price as well as an amount in respect of legal costs. The price, including the state contribution, was payable in 43% land bonds guaranteed by the state and by the British government. Advances made to purchasers were to be repaid by an annuity at the rate of 4¾% of the amount advanced. The price to be paid was equal to about 15 years' purchase of the value of the holding. Wide powers were given the Land commission to acquire untenanted land for the creation of holdings in relief of congestion, and to consolidate and exchange holdings for the same purpose. The purchase price for untenanted land was payable as in the case of tenanted land in guaranteed 4½% land bonds, but no state contribution was given. Untenanted land, unlike tenanted land, is, for the most part, land on which only one interest subsists, that of its landlord or proprietor.

Later land acts were directed mainly at increasing the powers of the Land commission for the acquisition of land, for the relief of congestion and for the division of that land among unemployed agricultural workers, former evicted tenants and other suitable persons. The act of 1933 reduced, by at least half, the amount of the land purchase annuities payable by farmers. It also gave substantial concessions in regard to arrears of annuities.

The annuities arising under the land acts before 1923 formed an important element in the financial relations between the republic and Great Britain. Until 1931 the Irish government made payment in respect of these land annuities to the British government. The principal item consisted of annuities amounting to about £3,000,000 a year, payable by Irish tenant purchasers in respect of advances made by the British government under the land acts of 1891–1919. Until 1932 the Irish government had accepted responsibility for the collection of these annuities from the tenant purchasers and for their transmission to the British government. In 1932 Eamon de Valera's government disclaimed liability for all but a small part of these payments; thenceforward they became payable as revenue to the Irish exchequer; they were later halved under the act of 1933. Other payments which had previously been made to the British government were also discontinued in 1932; the total of all the intergovernmental payments terminated at that time amounted to about £5,000,000 a year. The withholding of the payments marked the beginning of an economic dispute between the two countries which continued for six years. In an effort to recoup the amounts involved, the British government imposed tariffs on agricultural products imported from Ireland and also restricted by means of quotas imports of Irish cattle. The dispute, which caused widespread economic and social distress in Ireland, was ended in 1938 when the two governments negotiated a comprehensive trade agreement, all outstanding Irish financial liabilities being settled by a capital payment of £10,000,000. The question of long-term prices for Irish agricultural exports as well as other matters relating to postwar trade between the two countries was dealt with in the Anglo-Irish trade agreement of July 1948.

In the 1950s the division and resettlement work of the Land commission was still continuing, but the growing need for mechanization of farm operations as a means of increasing output seemed to set definite limits to further extensive division of land. There is no doubt, however, that the program of agrarian reform introduced in 1870 had brought very great benefits to Ireland.

Occupiers of the land had become full owners of their holdings on the payment of terminable annuities representing much less than the rents which their forbears were willing to pay when the principle of a fair rent was first recognized in the second half of the 19th century. Between 1923 and 1953 the Irish government advanced about £40,000,000 for land purchase and for the division of untenanted land.

***TABLE** I.—Land **Use**, 1930 and 1955*

(In acres)

Item	1930	1955
Crops		
Wheat	26,740	357,300
Oats	643,910	548,700
Barley	116,195	210,200
Rye, beans and peas	3,559	5,000
Potatoes	346,770	287,700
Turnips	178,721	129,100
Mangolds	80,436	62,800
Sugar beet	14,388	55,100
Cabbage, etc.	24,186	46,700
Hay	2,295,726	1,893,700
Livestock		
Cattle	4,038,344	4,455,600
Sheep	3,515,147	3,224,300
Pigs	1,052,217	804,800
Poultry	22,899,596	15,914,100

Industry.—The lack of satisfactory deposits of coal or other minerals precluded the growth of heavy manufacturing industries in the Republic of Ireland, but an extensive system of light industries assumed considerable importance. The separation of the six partitioned northern counties from the republic further accentuated the predominance of agriculture in the south of what had always been an overwhelmingly agricultural country. Nevertheless, certain long-established and world-renowned manufacturing industries existed in 1922. These consisted mainly of brewing, distilling, biscuit making, poplin weaving and bacon curing; all had roots deep in the economy, and most of them commanded a valuable export trade.

The widespread poverty of the country in the 19th century prevented Ireland from availing itself of the great technical advances which had taken place in Great Britain. Moreover, the Act of Union of 1801 denied Irish industries the benefits of protection after 1825, and many enterprises foundered as a result of foreign competition. The revival of native manufacturing industries became a foremost part of the policies of the Irish nationalist movement, and successive native governments after 1922 sponsored policies for the extension of industrialization with a view to effecting a better economic balance between agricultural and manufacturing enterprise. The doctrine that protection was necessary to encourage the revival and expansion of industry was widely propounded and fairly generally accepted. It was, however, more critically applied by W. T. Cosgrave's government than by subsequent governments. In the budget of 1924 protective duties were imposed experimentally on five classes of goods, and in 1925 three additional categories of duties were introduced. The government indicated that it had adopted no doctrinaire attitude on the merits of either free trade or protection; the matter was regarded as one of expediency which might be variously decided in different circumstances. The Tariff Commission act of 1926 inaugurated a cautious regime of "selective protection." Each proposal for a protective tariff was examined solely on its economic merits. Of 15 applications considered between 1926 and 1933, recommenda-

tions in favour of protective duties were made in 12 cases. In 1934 the Tariff Commission act was repealed De Valera's government, which had been elected to office in 1932, was pledged to a policy of protection for relieving unemployment and developing the resources of the country. A more extensive form of protection was therefore adopted; any interests prepared to establish a new industry or to extend an existing one could apply for the imposition of the duties necessary to afford protection. As a result foreign competition was in many cases either eliminated or modified. Legislation was introduced in 1934 to permit the quantitative regulation of imports by means of quotas, and a substantial range of imported industrial goods was affected. The importation of wheat, uheaten flour, maize, maize products and a wide range of other feeding stuffs was prohibited.

There had been two phases, therefore, in industrial policy up to 1939. Until 1932 policy had been determined mainly by the consideration that industrial protection even when desirable tended to increase the costs and so to impair the profitableness of the country's principal industry — agriculture. After 1932 the advancement of industrialization for social as well as purely economic reasons became the most significant determinant of policy. Each phase, however. made notable contributions to the development of the country. Despite the world depression of the 1930s and the six-year economic dispute uith Great Britain, industrial development continued at an increasing pace until the outbreak of World War II.

From 1922 until 1939 most progress was made in industries producing consumer goods, which previously had had to be imported. boots, shoes, paper, hosiery, linen and cotton goods and clothing. The important primary industries for beet sugar and cement production were also established.

Industrial progress was sharply arrested by the mar, particularly in enterprises nhich relied on imports for raw materials and fuel. Recovery was effected with remarkable rapidity, however, when the war ended. Between 1946 and 1950 the volume of industrial production increased by well over half, and the number of persons employed in all industries (except agriculture) increased from 167,000 to 220.000. These developments were marked by increasing awareness of the need for greater industrial efficiency and by groning interest in the use of opportunities for securing higher standards of industrial management. It was becoming recognized that the growth of industrial activity depended on the development of a substantial export trade to competitive markets and that there were limits to the toleration by domestic consumers of the protective measures which had fostered industries during their infancy. This new attitude toward the future of mdnufacturing industry found expression in the founding in Dec. 1952 of a management institute supported by industrialists generally and by the universities and encouraged by the minister for industry and commerce.

Specialist institutions were set up by the state to assist the promotion of manufacturing industry by private enterprise. The capital for this purpose is, as a rule, provided by private and institutional investors, but powerful assistance to industrial development has been given by the Industrial Credit Company. Ltd., created by the government in 1933 as a channel for directing domestic saving into Irish industrial enterprise. The company. acting as a general industrial finance house, was emponered to sponsor public issues, including governmental and corporation issues. A certain amount of the capital required for industry has come from foreign sources, but the Control of Manufactures acts precluded the external investment in a new project for a manufacturing industry of more than 49% of the share capital or of more than one-third of the amount involved in any class of share which directly or contingently carried voting rights. Certain kinds of enterprise exempt from this control were covered by separate legislation.

An institute of industrial research and standards makes scientific information available, and an industrial development authority advises the minister for industry and commerce on the establishment of industries of a kind not already in existence. Another state-sponsored body, Coras Trachtala Teoranta, fosters the development of industrial exports, mainly to hard-currency areas. undertakes market research abroad and investigates industrial export potential generally.

TABLE II.—*Industrial Employment and Production*
(1938=100)

Year	Average number of persons employed	Index of industrial production
1938	166,000	100
1948	198,000	128.6
1954	228,000	18j.j

Of the working population of the republic slightly more than 20% is engaged in industries other than agriculture. Despite the fact that agriculture is the predominant industry, this percentage is low; the republic in the 1950s was not even moderdtely industrialized by contemporary European standards. There nas. nevertheless, a very much greater diversity of economic activity than there was in 1922.

The trend of industrial employment and production in all industries (except agriculture) and services is indicated in Table II.

Trade and the Balance **of** Payments. — International trade has always been of great importance to the republic because of its size and 'geographical position and because of the nature of its economy. In 1950, for example, exports and imports totalled £232,000,000, or about £77 per head of population. as compared with about £80 for Great Britain, one of the greatest trading nations in the world. Traditionally the republic's imports of goods exceed its exports, the deficit being financed by substantial earnings on invisible account, mainly tourist income. emigrants' remittances and income from foreign investment. After 1947 these deficits

TABLE 111.—Foreign Trade and Balance d *Payments*
(In millions of pounds sterling)

Item	1938	1941	1946	1947	1951	1954	1955
Imports. .	41.4	29.j	72.0	131.3	204.4	179.9	204.3
Exports* . .	24.2	31.8	3 9	39.5	81.5	115.1	110.3
Surplus† . .	2.0	14.3	19.7	...	...	...	...
Deficitt . .	...	...	...	20.8	61.6	5.5	35.5

*Including re-exports
†After reckoning "invisible" payments and earnings.

were also financed by capital imports. the proceeds of aid under the European Recovery program and drawings on external assets accumulated mainly during World Wars I and II nhen the volume of imports was reduced and the volume of exports maintained.

Power and Fuel. — A notable stimulus to industrial advance was provided by a scheme of hydroelectric development begun in 1925 with the harnessing of the river Shannon. Later the Liffey and the Erne rivers were also harnessed. Two peat-burning generators, one at Portarlington and one at Allenwood, were built, and there are two stations in Dublin. one coal-burning and the other oil-burning. The total installed capacity of generating plant by 1952 was 308,000 kw., and additional generators then under construction were expected to raise this total capacity to 609 500 k ~ $ In 1952 the capacities of hydro and steam plant were about equal. but it nas expected that when the construction program was completed the capacity of hydro plant would represent only 35% of the total.

Under the Electricity Supply act of 1927 a public corporation, the Electricity Supply board, was established and by 1953 it controlled practically the complete generation, transmission. distribution and sale of electricity in the republic. The capital requirements of the corporation are provided by the state. Existing legislation in 1952 provided for a total investment of about £73,000,000. These advances are repaid to the state over a period of 50 years; interest is also paid on advances and normal provision is made for depreciation. in 1926–27 electrical output was about 50,000,000 units (kw.hr.); in 1951–52 output had risen to 1,033,000,000 units (kw.hr.), a twentyfold increase in a quarter of a century. In 1951–52 production per head of population nas 34j units (kw hr.). nhich was low compared with other small agricultural countries in Europe; the corresponding figures for Denmark and the Netherlands, respectively, were 590 units and 735 units.

Industrial consumption accounted for about one-third of total Irish output.

In 1934 a state company was set up to develop the country's peat bogs by modern mechanical methods. Peat which is cut and harvested mechanically is a clean and efficient fuel. It is produced either in the form of "sods," containing about 30% moisture, or in the form of briquettes, which consist of milled peat taken off the surface of the bog at 55% moisture and artificially dried before being briquetted with 12% moisture. As already indicated peat is also used for generating electricity in stations built on the bogs. Every county in the republic has its bogs, but the principal areas extend across the middle of the country from the borders of Dublin westward to the Atlantic. In addition to mechanically produced peat, a great quantity of the fuel is harvested by hand, mainly by farmers on their own turbaries for their own use; in 1950 about 2,400,000 tons were produced.

Communications. — Under the Railways act of 1924, 26 separate and distinct railway companies were amalgamated, and in Jan. 1925 the Great Southern Railway company came into being. The peak of Irish railway prosperity had been reached during World War I. After 1918 the beginning of competition from road transport introduced the railway system to financial and economic problems which rapidly grew in magnitude. In 1927 the Railways (Road Motor Services) act authorized the railways to operate road services either directly or through their agents. The position of the Great Southern Railway company continued to deteriorate, however, and further financial reconstructions led eventually to nationalization. In 1944 legislation was enacted to secure the amalgamation of the company's services with those of the Dublin United Transport company, which had been successfully operating the city's omnibus and tramway services. Despite this move the financial problems of the public transport system persisted, and on June 1, 1950, the undertakings which had been created under the act of 1944 were merged with those of the former Grand Canal company in a newly constituted board of Coras Iompair Eireann. Extensive modernization of the railways followed, but continued and growing competition from private road vehicles left the public transport service generally in a precarious condition, and the future structure of the system remained uncertain. In 1953 there were 108.805 private motorcars and 33,196 commercial goods vehicles licensed in the republic; the corresponding figures for 1930 had been 32,632 and 7,695, respectively.

To help to maintain essential supplies during World War II a statutory company, Irish Shipping, Ltd., was set up on the initiative of the government, and its ships sail under the Irish flag to Baltic, North American and other ports.

In 1936 the state sponsored the formation of a commercial air transport service by the establishment of Aer Lingus Teoranta. That company developed air transport extensively and maintained high standards of safety, efficiency and reliability. It operates direct air services to London, Paris, Amsterdam, Jersey, Glasgow, Manchester, Liverpool, Lourdes, Biarritz and Barcelona from Dublin airport. The airport at Rineanna, County Clare—Shannon airport—is regarded as one of the safest in the world; it provides excellent facilities for the Atlantic air routes and those to Great Britain and the continent and achieved a foremost position in international air navigation. There is a daily service to and from Dublin. Seven private aerodromes are also licensed.

National Income. — The estimated national income was £147,000,000 in 1926, £151,900,000 in 1938, £302,100,000 in 1947, £347,000,000 in 1950 and £448,000,000 in 1954. These figures, representing current prices, take no account of changes in the value of money, but if related to the price index for personal expenditure on goods and services, they indicate the following approximate variations in real national income: (1) an increase of about 14% between 1926 and 1938; and (2) an increase of about 25% between 1938 and 1954, most of which took place between 1945 and 1954. In 1938 agriculture contributed 23½% of the national income; in 1954 its contribution was 30.6%.

The nonagricultural sector of the economy contributed 69% of national income in 1938 and 63% in 1954; a considerable part of the increase in this sector was the result of state capital expenditure, particularly on housing construction.

Banking and Finance. — The republic has its own paper and metallic currency. The currency unit is the Irish pound, with the same value as the pound sterling. The principal circulating medium is the legal tender note convertible into British legal tender at the Bank of England. The total monetary circulation in March 1955 was £77,990,797; in March 1939 it had been 617,605,098 and in March 1952, £62,789,224.

Under the Central Bank act, 1942, eight associated commercial banks operate in the republic. The total of their current and deposit accounts in March 1951 was £260,200,000 and £298,200,000 in March 1955. The net surplus of the foreign assets of the associated banks over their foreign liabilities was £120,500,000 in March 1955.

The total revenue received into the exchequer increased from £39,782,000 in 1942–43 to £83,905,310 in 1951–52. In 1954–55 current revenue amounted to £106,700,000 and net borrowings, etc., to £32,700,000. Total current expenditure out of the exchequer in 1954–55 amounted to £105,400,000 in respect to supply services, but £14,700,000 of this amount represented expenditure on capital services.

Net exchequer borrowings were £21,800,000 in 1950–51, £38,800,000 in 1951–52 and £32,100,000 in 1954–5j. These borrowings were derived partly from current savings of the public, partly from the sale of foreign securities held by state funds and, particularly in 1950 and 1951, from the Irish currency counterpart of European Recovery program funds. The national debt of the republic increased steadily after World War II; most of it is held internally, and the main external liability is a loan of $128,200,000, obtained under the European Recovery program. Between March 1948 and March 1952 total state debt increased from £100,000,000 to £192,000,000. The budget of 1952 raised the standard rate of income tax by 1*s.* to 7*s.*6*d.* in the pound, subsidies on butter, tea and sugar were withdrawn, the flour subsidy was reduced and additional indirect taxation was imposed on tobacco, beer, spirits and oils. These measures were designed to achieve a balance between revenue and current outgoings and to provide for some additional expenditure on current social, health, educational and defense services.

The principal aim of the budget of 1952 was to "restore order in the public finances." It had been hoped to achieve a balance in the exchequer accounts, but the actual out-turn showed a deficit of more than £2,000,000. The budget was more successful economically than financially: domestic consumption was reduced; the demand for imports was abated; and the deficit in the balance of payments fell from £61,000,000 in 1951 to £9,000,000 in 1953. Current revenue amounted to £95,900,000 (an increase of £12,000,000 over that of the previous year). Current expenditure amounted to £98,000,000 (an increase of £7,400,000). Capital issues, financed from borrowing, amounted to £32,900,000; the ultimate sources of these borrowings were: national loan, £20,000,000; small savings and investment income of departmental funds, £5,900,000; sales of foreign investments, £4,500,000; and bank advances £2,500,000 (net).

The 1955 budget provided for certain tax reliefs and increased social services but the standard rate of income tax remained at 7*s.*6*d.* in the pound. The budget provided for capital outlay estimated at £34,000,000 to be financed from borrowing. Housing expenditure constituted more than a quarter of the total; £4,670,000 was provided for agricultural development, £4,000,000 for electrical projects and £3,120,000 for transport.

In March 1955 the gross liabilities of the state amounted to £331,000,000. Assets held against these liabilities amounted to £181,000,000. The charge for debt service (interest and sinking fund) was £15,000,000.

BIBLIOGRAPHY.—N. Mansergh, *Survey of British Commonwealth Affairs* (Oxiord, 1952); G. O'Brien, *The Economic History of Ireland From the Union to the Famine* (London, 1921); J. E. Pomiret, *The Struggle for Land in Ireland, 1800–1923* (Princeton, N.J., 1930); E. J. Riordan, *Modern Irish Trade and Industry* (London, 1920); *Irish Review and Annual*, supplement to the *Irish Times* (Dublin, annual); J. Toner, *Rural Ireland* (Dublin, 1955).

Official publications (all published at Dublin unless otherwise stated):

Constitution of Ireland (1937); *Official Reports of the Dail and Seanad Debates* (1922–); *Reports* of the Departments of Education, Health and Social Welfare; *Report of the Commission of Agriculture* (1924); *Reports* of the Land Commission; *Report of the Committee of Inquiry on Post-Emergency Agricultural Policy* (1946); Central Statistics Office, *Census of Population, 1946 and 1951, Trade Statistics of Ireland* (monthly), *Irish Statistical Survey, 1950–54, Irish Trade Journal and Statistical Bulletin* (quarterly), *Statistical Abstract of Ireland, 1954, Tables of National Income and Expenditure 1938 and 1944–50, Balance of International Payments, 1951* etc.; Irish Stationery Office, *Annual Estimates for Public Services, Annual Appropriation Accounts, Annual Estimates of Receipts and Expenditure;* Department of Finance, *Annual Accounts;* Central Bank of Ireland, *Annual Reports; Report of the Commission on Banking, Currency and Credit* (1938); *Journal of the Statistical and Social Inquiry Society of Ireland* (annually, 1855–); Trade Union Congress, *Trade Union Information* (monthly, 1949–). (P. K. L.)

IRENAEUS (b. *c.* 130), bishop of Lyons at the end of the 2nd century, was one of the most distinguished theologians of the ante-Nicene Church. Very little is known of his early history. His childhood was spent in Asia Minor, probably at or near Smyrna; for he says (*Adv. haer.* iii. 3, 4, and Euseb. *Hist. Eccl.* v. 20) that as a child he heard the preaching of Polycarp, the aged bishop of Smyrna (d. 156). He can hardly have been born very long after 130, for later on he frequently mentions having met certain Christian presbyters who had actually seen John, the disciple of our Lord. At the time of the persecution of the Gallic Church under Marcus Aurelius (177) he was a presbyter of the church at Lyons. In 177 or 178 he went to Rome on a mission from this church, to make representations to Bishop Eleutherius in favour of a more lenient treatment of the Montanists. (*See* MONTANISM; Eus. v. 4. 2.)

On his return to Lyons Irenaeus was called upon to replace Bishop Pothinus, who had perished in the persecution (Eus. v. 5. 8). As bishop he carried on a great and fruitful work. Though the statement of Gregory of Tours (*Hist. Franc.* i. 29), that within a short time he succeeded in converting all Lyons to Christianity, is probably exaggerated, from him at any rate dates the wide spread of Christianity in Lyons and its neighbourhood. He sought to reconcile the numerous sects which menaced the existence of the church. In the dispute on the question of Easter, he endeavoured to effect a compromise, and in particular to exercise a moderating influence on Victor, the bishop of Rome, and his unyielding attitude towards the dissentient churches of Africa, thus justifying his name of "peace-maker" (Eirenaios) (Eus. H.E. v. 24. 28). The date of his death is unknown. His martyrdom under Septimius Severus is related by Gregory of Tours, but by no earlier writer.

The chief work of Irenaeus, written about 180, is his "Refutation and Overthrow of Gnosis, falsely so called" (usually indicated by the name *Against the Heresies).* Of the Greek original of this work only fragments survive; it only exists in full in an old Latin translation. The treatise is divided into five books: of these the first two contain a description and criticism of the tenets of various heretical sects, especially the Valentinians; the other three set forth the true doctrines of Christianity. His work is the first systematic exposition of Catholic belief. The foundation upon which Irenaeus bases his system consists in the episcopate, the canon of the Old and New Testaments, and the rule of faith. With their assistance he sets forth and upholds, in opposition to the gnostic dualism, *i.e.,* the severing of the natural and the supernatural, the Catholic monism, *i.e.,* the unity of the life of faith as willed by God. The "grace of truth" (the *charisma),* which the apostles had called down upon their first disciples by prayer and laying-on of hands, and which was to be imparted anew by way of succession (διαδοχή, *successio*) to the bishops from generation to generation without a break, makes those who receive it living witnesses of the salvation offered to the faithful by written and spoken tradition. The Scriptures of the Old and New Testaments, rightly expounded by the church alone, give us an insight into God's plan of salvation for mankind, and explain to us the covenant which He made on various occasions (Moses and Christ; or Noah, Abraham, Moses and Christ). Finally, the "rule of faith" (*regula fidei*), received at baptism, contains in itself all the riches of Christian truth.

This exposition by Irenaeus of the divine economy and the incarnation was taken as a criterion by later theologians, especially in the Greek Church. (*Cf.* Athanasius, Gregory of Nyssa, Cyril of Alexandria, John of Damascus.) He himself was especially influenced by St. John and St. Paul. Before him the Fourth Gospel did not seem to exist for the Church; Irenaeus made it a living force. His conception of the Logos is not that of the philosophers and apologists; he looks upon the Logos not as the "reason" of God, but as the "voice" with which the Father speaks in the revelation to mankind, as did the writer of the Fourth Gospel. And the Pauline epistles are adopted almost bodily by Irenaeus, according to the ideas contained in them; his expositions often present the appearance of a patchwork of St. Paul's ideas. Certainly, it is only one side of Paul's thought that he displays to us. The great conceptions of justification and atonement are hardly ever touched by Irenaeus.

Till recent times whatever other writings and letters of Irenaeus are mentioned by Eusebius appeared to be lost, with the exception of a fragment here or there. Two Armenian scholars, Karapet Ter-Mĕkĕrttschian and Erwand Ter-Minassianz, published from an Armenian translation a German edition (Leipzig, 1907; minor edition 1908) of the work "in proof of the apostolic teaching" mentioned by Eusebius (*H.E.* v. 26). This work, which is in the form of a dialogue with one Marcianus, otherwise unknown to us, contains a statement of the fundamental truths of Christianity. It is the oldest catechism extant, and an excellent example of how Bishop Irenaeus was able not only to defend Christianity as a theologian and expound it theoretically, but also to preach it to laymen.

BIBLIOGRAPHY.—The edition of the Benedictine R. Massuet (Paris, 1710 and 1734, reprinted in Migne, *Cursus patrologiae,* Series Graeca, vol. v., Paris, 1857) long continued to be the standard one, till it was superseded by the editions of Adolph Stieren (2 vols., Leipzig, 1848–53) and of W. Wigan Harvey (2 vols, Cambridge, 1857), the latter being the only edition which contains the Syriac fragments. For an English translation *see* the *Ante-Nicene Library.* Of modern monographs consult H. Ziegler, *Irenaeus, der Bischof von Lyon* (1871); Friedrich Loofs, *Irenäus-Handschriften* (Leipzig, 1888); Johannes Werner, *Der Paulinismus des Irenaeus* (Leipzig, 1889); Johannes Kunze, *Die Gotteslehre des Irenaeus* (Leipzig, 1891); Ernst Klebba, *Die Anthropologie des heiligen Irenaeus* (Münster, 1894); Albert Dufourcq, *Saint Irénée* (Paris, 1904); Franz Stoll, *Die Lehre des heil. Irenaeus von der Erlösung und Heiligung* (Mainz, 1905); also the histories of dogma, especially Harnack, and Bethune-Baker, *An Introduction to the Early History of Christian Doctrine* (1903); Bonwetsch, *Die Theologie des Irenaeus* (1925).

IRENE, the name of several Byzantine empresses.

1. IRENE (752–803), the wife of Leo IV., East Roman emperor. Originally a poor but beautiful Athenian orphan, she speedily gained the love and confidence of her feeble husband, and at his death in 780 was left by him sole guardian of the empire and of their ten-year-old son Constantine VI. Seizing the supreme power in the name of the latter, Irene ruled the empire at her own discretion for ten years, displaying great firmness and sagacity in her government. Her most notable act was the restoration of the orthodox image-worship, a policy which she always had secretly favoured, though compelled to abjure it in her husband's lifetime. Having elected Tarasius, one of her partisans, to the patriarchate (784), she summoned two church councils. The first, held in 786 at Constantinople, was frustrated by the opposition of the soldiers. The second, convened at Kicaea in 787, revived the adoration of images and reunited the Eastern church with that of Rome.

As Constantine approached maturity he began to grow restive under her autocratic sway. An attempt to free himself by force was met and crushed by the empress, who demanded that the oath of fidelity should thenceforward be taken in her name alone. The discontent which this occasioned swelled in 790 into open resistance, and the soldiers, headed by the Armenian guard, formally proclaimed Constantine VI. as the sole ruler. A hollow semblance of friendship was maintained between Constantine and Irene, whose title of empress was confirmed in 792; but the rival factions remained, and Irene, by skilful intrigues with the bishops and courtiers, organized a powerful conspiracy on her own behalf. Constantine could only flee for aid to the provinces, but even there he was surrounded by participants in the plot. Seized by his

attendants on the Asiatic shore of the Bosporus, the emperor was carried back to the palace at Constantinople; and there, by the orders of his mother, his eyes were stabbed out.

Irene reigned in prosperity and splendour for five years. She is said to have endeavoured to negotiate a marriage between herself and Charlemagne; but according to Theophanes, who alone mentions it, the scheme was frustrated by Aetius, one of her favourites. A projected alliance between Constantine and Charlemagne's daughter, Rothrude, was in turn broken off by Irene. In 802 the patricians, upon whom she had lavished every honour and favour, conspired against her, and placed on the throne Nicephorus, the minister of finance. The haughty and unscrupulous princess, "who never lost sight of political power in the height of her religious zeal," was exiled to Lesbos and forced to support herself by spinning. She died the following year. Her zeal in restoring images and monasteries has given her a place among the saints of the Greek church.

See E. Gibbon, *The Decline and Fall of the Roman Empire (ed.* J. Bury, London, 1896), vol. v.; G. Finlay, *History of Greece* (ed. 1877, Oxford), vol. ii.; F. C. Schlosser, *Geschichte der bilderstürmenden Kaiser des ostromischen Reiches* (Frankfort, 1812); J. D. Phoropoulos, *Εἰρήνη ἡ αὐτοκράτειρα Ῥωμαίων* (Leipzig, 1887); J. B. Bury, *The Later Roman Empire* (London, 1889), ii. 480–498; C. Diehl, *Figures byzantines* (Paris, 1906), pp. 77–109, and in *Cambridge Mediaeval History,* vol. iv., pp. 19–25. (M. C.)

2. IRENE [DUCAS] (c. 1066–*c.* 1120), the wife of Alexius I. The best-known fact of her life is the unsuccessful intrigue by which she endeavoured to divert the succession from her son John to Nicephorus Bryennius, the husband of her daughter Anna. Having failed to persuade Alexius, or, upon his death, to carry out a *coup d'état* with the help of the palace guards, she retired to a nunnery and ended her life in obscurity.

3. IRENE (d. 1161), the first wife of Manuel Comnenus. She was the daughter of the count of Sulzbach, and sister-in-law of the Roman emperor Conrad III., who arranged her betrothal. The marriage was celebrated at Constantinople in 1146. The new empress, who had exchanged her earlier name of Bertha for one more familiar to the Greeks, became a devoted wife, and by the simplicity of her manner contrasted favourably with most Byzantine queens of the age.

H. v. Kap-Herr, *Die abendlandische Politik des Kaisers Manuel* (Strasbourg, 1881).

IRETON, HENRY (1611–1651), English parliamentary general, eldest son of German Ireton of Attenborough, Nottinghamshire, was baptized on Nov. 3, 1611, became a gentleman commoner of Trinity college. Oxford, in 1626. graduated and entered the Middle Temple in 1629. On the outbreak of the Civil War he joined the parliamentary army, fought at Edgehill (1642) and at Gainsborough (1643), was made by Oliver Cromwell deputy governor of the Isle of Ely, and next year served under the earl of Manchester, afterward supporting Cromwell in his accusations of incompetency against the general. On the night before the battle of Naseby, in June 1645, he surprised the royalist army and captured many prisoners, and next day was made commissary general and appointed to the command of the left wing, Cromwell himself commanding the right. The wing under Ireton was partly broken by the charge of Rupert, and Ireton was wounded and taken prisoner, but after Cromwell's rout of the enemy he escaped.

Ireton took an active part in the campaign of 1645–46 which resulted in the overthrow of the royal cause. On Oct. 30. 1645, Ireton entered parliament as member for Appleby, and while occupied with the siege of Oxford he was, on June 15, 1646, married to Bridget, Cromwell's daughter. He was opposed to the destructive schemes of the extreme party. disliked especially the abstract and unpractical theories of the Republicans and the Levellers, and desired. while modifying their mutual powers, to retain the constitution of king, lords and commons. He urged these views in the negotiations of the army with the parliament, and in the conferences with the king, being chiefly entrusted with the drawing up of the army proposals. He endeavoured to prevent the breach between the army and the parliament. but nhen the division became inevitable he took the army side. He aroused great suspicion by supporting the negotiations with the king. But becoming at length convinced of the hopelessness of dealing with Charles, after the king's flight to the Isle of Wight he urged the parliament to establish an administration without him.

Ireton served under Sir Thomas Fairfax in the Second Civil War in the campaigns in Kent and Essex, and was responsible for the executions of Sir Charles Lucas and Sir George Lisle at Colchester. After the rejection by the king of the last offers of the army, he showed special zeal in bringing about his trial, was one of the chief promoters of "Pride's Purge," attended the court regularly, and signed the death warrant.

Ireton accompanied Cromwell in his Irish campaign as second in command; on the recall of his chief to take the command in Scotland, he remained as lord deputy to complete Cromwell's work of reduction and replantation. He was rapidly bringing his task to a close, when he died of fever on Nov. 26, 1651, after the capture of Limerick. His loss "struck a great sadness into Cromwell," for as well as possessing high abilities as a soldier, and great political insight, he resembled in stern unflinchingness of purpose the protector himself. Ireton left one son and three daughters.

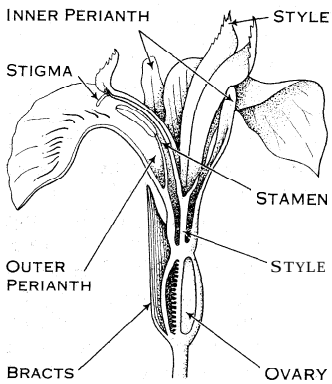
See R. W. Ramsey, *Henry Ireton* (London, 1949; New York, 1950).

IRIARTE (or YRIARTE), **TOMÁS** DE (1750–1791), Spanish poet, was born in the island of Teneriffe. His *Fábulas literarias* (1781), composed in a great variety of metres, show considerable ingenuity in their humorous attacks on literary men and methods; but their merits have been greatly exaggerated.

During his later years, partly in consequence of the *Fábulas,* Iriarte aas absorbed in personal controversies with Forner and others.

See E. Cotarelo y Mori, *Iriarte y su época* (1897).

IRIDACEAE (the iris family), a family of flowering plants belonging to the order Liliiflorae of the class Monocotyledons, containing about 900 species in 60 genera, and widely distributed in temperate and tropical regions. The members of this family are generally perennial herbs growing from a corm as crocus and gladiolus, or a rhizome as iris; more rarely. as the Spanish iris, from a bulb. A few South African representatives have a shrubby habit. The floners are hermaphrodite and regular as in iris and crocus, or with a symmetry in the median plane as in gladiolus. The arrangement of the flower parts resembles that in the nearly allied order Amaryllidaceae (narcissus, snowdrop), but differs in the absence of the inner whorl of stamens.



IRIS (IRIS PSEUDACORUS). LONGITUDINAL SECTION THROUGH FLOWER
FROM GROOM, "ELEMENTARY BOTANY" (G. BELL)

The most important genera are *Crocus* (*q.v.*), with about 75 species, *Iris* (*q.v.*), with about 200 and *Gladiolus* (*q.v.*), with 200. *Ixia, Freesia* (*q.v.*) and *Tritonia* (including *Montbretiu),* all natives of South Africa, are well known in cultivation. *Sisyrinchium,* blue-eyed grass, is a new world genus of 75 species extending from arctic America to Patagonia and the Falkland Islands. One species, S. *angustifolium,* an arctic and temperate North American species. is also native in Galway and Rerry in Ireland. Other British representatives of the familv are: *Iris pseudacorus* (yellow iris), common by river banks and ditches. *I. foetidissima* (stinking iris); *Gladiolus illyricus,* a rare plant found in the New Forest and the Isle of Wight; and *Romulea columnae,* a small plant with narrow recurved leaves a few inches long and a short scape bearing one or more small regular funnel-shaped flowers, which occurs at Dawlish in Devonshire.

In the eastern United States there are 10 species of *Iris* and 13 species of *Sisyrinchium,* but in the Rocky mountain region these genera are represented by only 2 or 3 species. Many new species of *Iris* have been described from the southern United States.

IRIDIUM, a chemical element, is a precious heavy white metal, one of the six platinum metals (*q.v.*). Its specific gravity, 22.56 is equaled by osmium; these metals are the densest terrestrial substances. With a melting point of 2,4j0° C., iridium is difficult to fuse. Its boiling point is estimated at above 4,800° C. The metal is hard and brittle; however, it becomes ductile and can be worked at a white heat, from 1.200° C. to 1,500° C. The chemical symbol of iridium is Ir; atomic number is 77 and atomic weight is 192.2.

In the massive state the metal is practically insoluble in acids and is not even attacked by aqua regia, which dissolves gold and platinum. Iridium is oxidized by a mixture of fused potassium hydroxide and potassium nitrate. Iridium crucibles are superior to those of platinum because of their resistance to carbon and phosphorus at high temperatures. However, their gradual loss in weight by air oxidation above 1,000° C. is greater than that of platinum.

Because of difficulties in preparation and fabrication the pure metal has no important applications. The element's principal use is in the preparation of platinum alloys. Pure platinum is a soft metal and unsatisfactory for many uses. Alloyed with from 5% to 10% iridium, it forms a readily norked metal, much harder and stiffer and more resistant to chemical attack.

For ordinary purposes these iridium-platinum alloys are always used unless pure platinum is needed for special reasons. They are used for jewelry and surgical pins and pivots. With their superior resistance to the action of the high-temperature electric spark they are widely used for electrical contacts and sparking points.

The international prototype standard metre of length and kilogram of mass have been constructed from the alloy containing 90 parts platinum and 10 parts iridium.

Iridium has also been used as a major component of precious metal tips on gold fountain pens.

Iridium is generally obtained from the native alloy. osmiridium, but is always found in small amounts in platinum-bearing ores. Its discovery in the acid-insoluble residues of platinum ores was announced by Smithson Tennant in England in 1804. It was named by him in consequence of the various colours of its compounds. In metal preparation, osmiridium is heated with zinc to give an acid-soluble alloy. After separation of osmium as OsO_4 the platinum is removed by repeated fractional precipitations of the compound $(NH_4)_2PtCl_6$. The ammonium hexachloroiridate (IV), $(NH_4)_2IrCl_6$, then crystallized, is decomposed to give sponge metal.

Iridium forms the oxides Ir_2O_3 and IrO_2 and important series of compounds with oxidation states $+3$ and $+4$. In many of these compounds it exists in complexes in which chloride, ammonia, water and other groups are bonded covalently to a central iridium atom. These complexes are of the inert type, in that the groups are replaced slowly.

Iridium compounds decompose readily upon ignition. and the element in analysis is determined gravimetrically as metal. Strong oxidizing agents or electrolysis will give oxidation states higher than $+4$ of transient stability in water. (D. S. Mx.)

IRIS, in Greek mythology. daughter of Thaumas and the ocean nymph Electra (according to Hesiod), the personification of the rainbow and messenger of the gods; as a messenger of the gods. she is mentioned frequently in the *Iliad,* but never in the *Odyssey,* where Hermes takes her place.

In Homer. she is the messenger of both Zeus and Hera, but later the servant of Kera. By command of Zeus she carries in a ewer water from the Styx, with which she puts to sleep all gods who perjure themselves. Her attributes are the *caduceus* (herald's staff) and a vase.

IRIS, a large genus of popular herbs of the family Iridaceae much grown for ornament. They have a petaloid six-parted perianth. an inferior ovary and only three stamens (the outer series). being thus distinguished from the Amaryllidaceae, which have six stamens. They are handsome showy-flowered plants, the Greek name *Iris* ("rainbow") having been applied on account of the hues of the flowers. The genus contains over 1j0 species widely distributed throughout the north temperate zone.

In North America there are about 30 native species, found chiefly in the eastern United States; among the best known are the blue flag (*I. versicolor*), which grows in wet places from Newfoundland to Manitoba and southward to Florida and Arkansas. and the western blue flag (*I. missouriensis*), native to met soils from Korth Dakota and New Mexico westward to California and British Columbia.

The Eurasian **I,** *pseudacorus,* the yellow flag or iris, is common in Britain on riverbanks and in marshes and ditches. It was called the "water-flag" or "bastard floure-de-luce" by John Gerard in his *Herball* (1 597); its flowers appear in June and July, and are of a bright golden yellow colour. *I. foetidissima,* the fetid iris, stinking gladwin or roast-beef plant. is a native of England south of Durham and also of Ireland, southern Europe and Korth Africa. Its foliage, when bruised, has an offensive odour.

J. HORACE MCFARLAND

BLUE FLAG IRIS (IRIS VERSICOLOR)

Iris florentina, with white or pale blue flowers. a native of the south of Europe, is the chief source of the violet-scented orris-root used in perfumery. *Iris pallida* and its relatives appear to be the origin of the large common blue iris of gardens, the bearded iris or *fleur-de-lis* and probably the Illyrian iris of the ancients. *I. pallida* and *I. variegntn* have also been assumed to be the parents of the so-called German iris, better knonn as tall bearded iris: but these plants. long known as *Iris gernznnica,* are of very doubtful origin, never having been found as native plants

The garden plants knonn as Spanish iris and English iris are both of Spanish origin and have very shony flowers. Along with some other species such as *I reticulata* and *I. persica,* both of nhich are fragrant. they are great favourites nith florists. All these just mentioned differ from those formerly named in the nature of the underground stem. which forms a bulb and not a strict creeping rhizome as in *I. pseudacorus, pallida, florentina,* etc.

For many centuries. probably long antedating the culture of any of the above species. Japanese horticulturists mere hybridizing what are today knonn as Japanese iris Hundreds of named forms of these. in a variety of colours. are perhaps the showiest of all garden irises. They appear to be derived from *I kaempferi* or its allies, a plant with a creeping rootstock, long leaves and, in the cultivated forms. very large flowers (six inches across in some varieties). The original species nhich is wild in eastern Asia, was in ancient times developed by Japanese families or guilds, some of nhom produced identical varieties but applied their onn names to them. The hundreds of named forms are hence in much confusion but the folloning appear to be reasonably accurate: Gold Bound and Morning Mists (white); Blue Belle and Blue Bird (blue), Pink Progress (pink) and Mahogany and Purple and Gold (reddish purple). Most Japanese vernacular names are hopelessly confused.

The iris floner is of interest because of the flower shape, which appears to prevent self-pollination and ensure cross-pollination by insect visitors. The floner parts are so ingeniously arranged that an insect bearing pollen from one floner will, in entering a second, deposit the pollen on the stigma: the pollen which it bears in emerging will not be rubbed off on the stigma of the same flower.

The rootstocks of irises may be planted shallonly in spring (in colder climates) or autumn in an open, sunny exposure and well-drained garden soil. Propagation is commonly by division of rootstocks just after the flonering period. Irises do not breed true from seed; honever, seeds may be planted upon ripening and may germinate the folloning spring Although irises thrive under a variety of conditions, mulching is desirable in cold climates.

There are large collections of iris at Washington, D.C., and at Cornell university, Ithaca, N.Y. The American Iris society has published a catalogue comprising thousands of varietal names, and the Royal Horticultural society has issued a schematic key for the whole genus as well as a key for the tall bearded sorts. The keys are tables by which the plants can be identified on the basis of their relationships.

(N. Tr.; X.)

IRISH LANGUAGE. Irish is the only representative of the Goidelic or Gaelic branch of the Celtic languages (*q.v.*). Its history may be divided into four periods: (1) that of the Ogham inscriptions, probably A.D. 300–500; (2) Old Irish, 600–900; (3) Middle Irish, 900–1200; (4) Modern Irish, 1200 to the present day. This division is, of course, arbitrary, and archaizing tendencies confuse the situation, especially during the period 1100–1600, after which the literary language ceases to dominate and the modern dialects, among which may be reckoned Scottish Gaelic and Manx, appear.

Although there are more than 300 Ogham inscriptions, none is of more than a few words and the great majority are names in the genitive case, so that their evidence is almost entirely phonological. Original final syllables are generally preserved and the language is remarkably like that of the Gaulish and British inscriptions; the *q*, which corresponds to Brythonic *p*, is distinguished from *c*. There is no sign of intervocalic consonant weakening; when this happened is not known, but it is firmly established in Old Irish, where it has affected word clusters as well as individual words, so that words originally ending in a vowel weaken a following consonant as though it were in intervocalic position, although nearly all original final syllables have been lost by the Old Irish period. This mutation continues to be very important functionally in all dialects; *e.g., a bó,* "her cow," but *a bhó,* "his cow," where *b* is weakened to a spirant *v* (written *bh*). Nasalization, arising from a lost final nasal, continues in all the dialects of Ireland but has been given up in Scottish Gaelic and Manx, except for a few fossilized forms; *e.g.,* Ir. *a mbó,* "their cow," where *mb=m;* Sc. G. *am bò.*

Old Irish had developed a very strong stress accent on the first syllable of the word, with resulting loss of weak syllables. The vowels of lost weak and final syllables often have a reflection, however, in consonant quality. Every consonant can have three qualities: palatal (Ir. *caol,* "slender") if originally followed by *i* or *e;* neutral (Ir. *leathan,* "broad") before *a* and *o;* and *u*-coloured before *u*. The last category fell, together with the second, in the Old Irish period, but the other two have continued to exist in all the dialects, though the distinction is almost obliterated in the last stages of Manx. As the final syllables were lost, these distinctions of quality became of great morphological significance; *e.g., cat,* "cat," *cait,* "cats"; the *i* is purely graphic and the difference of pronunciation is nearly that between Russian *brat* and *brat'*. The stress on the first syllable continues to be typical of all dialects, often, as in Scottish and northern Irish, with reduction of unstressed syllables, but southern Irish in the early modern period transferred the stress to syllables containing a long vowel; Manx shows both tendencies and the lines of distribution have not yet been fully worked out. Old Irish was recognizably an Indo-European language, while possessing a very individual treatment of such features as compound verbs and infixed pronouns. The verbal system, however, shows a rapid development from the beginning of the Middle Irish period, especially characterized by the spread of the periphrastic construction with the verb "to be" and the verbal noun—a development common to all the languages of the British Isles. In Scottish Gaelic and Manx, as in spoken Welsh, this continuous present has almost superseded the old present forms, which have taken on a future meaning, with the consequent loss of the old future tense. Meanwhile the loss of the infixed pronoun brought about the rise of the independent pronoun, first as object and then as subject, when it takes the third singular form of the verb. This tendency, which can be traced to the beginning of the Modern Irish period, has again developed farthest in Scottish Gaelic and Manx, where, as in modern Danish, there is only one verbal form for each tense; southern Irish is considerably more conservative.

In vocabulary, again, while the archaic texts show many words with Indo-European etymologies, the rapid dilution of these in later texts points to a very large substratum (which, it has been suggested, may contain Brythonic elements). Later contributions are Latin, in two strata, one very early, the other later and showing signs of a British pronunciation; Scandinavian (especially in Scottish Gaelic and Manx); Norman French; and, finally, English, which plays a very large part in the modern dialects.

There are no examples of writing in Irish before the 8th century; the system evolved then was based on the British pronunciation of Latin and has never been satisfactory, still less so since many of the weakened consonants disappeared altogether in the early modern period while continuing to be written. Scottish Gaelic as such first appears in the 18th century. At first greatly influenced by Irish spelling, it has gradually evolved into a less clumsy system and has abandoned the traditional variety of the western half-uncial alphabet which is still used to a large extent in Ireland. Manx had the misfortune to be first written down in the 17th century in an orthography based on that of English, which often makes it hard to say what sounds were intended, especially since hardly any genuine speakers survive. In Ireland and Scotland, where there are still considerable Gaelic-speaking areas, dialect surveys are being undertaken, with a view to the construction of linguistic atlases.

Bibliography.—R. I. Best, *Bibliography of Irish Philology and of Printed Irish Literature,* 2 vol. (Dublin, 1913 and 1942); H. Pedersen, *Vergleichende Grammatik der keltischen Sprachen,* 2 vol. (Göttingen, 1908 and 1913).

The Ogham inscriptions: R. A. S. Macalister, *Corpus Inscriptionum Insularum Celticarum,* 2 vol. (Dublin, 1945 and 1949); J. Vendryes, "L'Ecriture ogamique et ses origines," *Etudes celtiques,* vol. iv (Paris).

Old and Middle Irish: R. Thurneysen, *A Grammar of Old Irish,* rev. ed., trans. by D. A. Binchy and O. Bergin, 2 vol. (Dublin, 1946–49); W. Stokes and J. Strachan (eds.), *Thesaurus Palaeohibernicus,* 3 vol. (Cambridge, 1901–10); T. Ó Máille, *Language of the Annals of Ulster* (Manchester, 1910); C. Sarauw, *Irske Studier* (Copenhagen, 1900); J. Strachan, "Verbal System of Saltair na Rann," *Phil. Soc. Trans.* (London, 1895); T. F. O'Rahilly, "The Goidels and Their Predecessors," *Brit. Acad. Proc.,* vol. xxi (London, 1936); M. L. Sjoestedt-Jonval, "Etudes sur le temps et l'aspect en vieil-irlandais," *Etudes celtiques,* vol. iii (Paris). The Royal Irish Academy's *Dictionary of the Irish Language* and *Contributions to a Dictionary of the Irish Language* (Dublin, 1939–) will eventually deal with the whole corpus of Old and Middle Irish.

Early Modern Irish: O. J. Bergin, *Irish Grammatical Tracts,* supplement to *Ériu,* viii–x, xiv (Dublin), and *Tri Biorghaoithe an Bhais* (Dublin, 1931); T. F. O'Rahilly (ed.), *Desiderius* (Dublin, 1941); L. McKenna (ed.), *Bardic Syntactical Tracts* (Dublin, 1944). There is no dictionary of the classical language, but P. Dinneen, *Foclóir Gaedhilge agus Béarla* (Dublin, 1927), which deals mainly with the modern language, may be consulted.

Modern Irish: T. F. O'Rahilly, *Irish Dialects Past and Present* (Dublin, 1932); B. Ó Cuiv, *Irish Dialects and Irish-Speaking Districts* (Dublin, 1951); E. C. Quiggin, *A Dialect of Donegal* (Cambridge, 1906); T. de Bhaldraithe, *The Irish of Cois Fhairrge, Co. Galway* (Dublin, 1945); M. L. Sjoestedt-Jonval, *Phonétique d'un parler irlandais de Kerry* (Paris, 1931) and *Description d'un parler irlandais de Kerry* (Paris, 1938); G. O'Nolan, *The New Era Grammar of Modern Irish* (Dublin and Cork, 1934); C. Ó Cadhlaigh, *Gnás na Gaedhilge* (Dublin, 1940).

Scottish Gaelic: G. Calder, *Gaelic Grammar* (Glasgow, 1923); N. Holmer, *Studies on Argyllshire Gaelic* (Uppsala, 1938); C. H. Borgstrom, "The Dialect of Barra," *Norsk tidsskrift for sprogvidenskap,* vol. viii (Oslo, 1928), *A Linguistic Survey of the Gaelic Dialects of Scotland,* vol. i–ii (Oslo, 1940–41); E. Dwelly, *The Illustrated Gaelic Dictionary* (Glasgow, 1930).

Manx: J. Rhys, *Outlines of the Phonology of Manx Gaelic* (London, 1895); J. Kneen, *Grammar of the Manx Language* (Oxford, 1931); C. J. S. Marstrander, "Det norske landnam pa Man," *Norsk tidsskrift for sprogvidenskap,* vol. vi; A. Cregeen, *Dictionary of the Manks Language* (Douglas, I. of M., 1833); K. H. Jackson, *A Handbook of the Manx Language* (, 1953).

Periodicals: Zeitschrift für keltische Philologie (Halle); *Revue celtique* (later *Etudes celtiques*) (Paris); *Ériu, Éigse, Celtica* (Dublin); *Scottish Gaelic Studies* (Aberdeen). (D. Ge.)

IRISH LITERATURE. Ireland is unusual in that it has two literatures, one in the native language and another in the language of the English conquerors. This division excludes numerous writings in Latin, mostly theological and antiquarian, from Johannes Scotus Erigena to Sir James Ware, as well as some works in French, from the early poems of the Norman conquerors to the

Mémoires du comte de *Gramont* of Anthony Hamilton (1713). This article deals first with Gaelic literature and then with Irish writing in English, commonly called Anglo-Irish literature.

(X.)

GAELIC LITERATURE

The Celtic language spoken in Ireland from the earliest historic period, often described as Gaelic (or Goidelic, from Old Irish *Goidel,* a Brythonic loan word of which the modern equivalent is Welsh Gwyddel, "Irishman"), has no close connections on the continent of Europe, where evidence shows instead a connection with Celtic, of which the surviving Brythonic languages are representatives (see GAELIC LANGUAGE). Nor is it certain when Goidelic was brought to Ireland, but research suggests a date not long before the beginning of the Christian era.

The earliest evidence consists of sepulchral inscriptions in the Ogham alphabet. These are found mainly in the southwest of Ireland, but there are examples from the rest of the country and from Wales, where small Goidelic colonies existed. These inscriptions, usually ascribed to the 4th and 5th centuries, show an archaic state of the language, phonologically very close to the early Brythonic of British and Gaulish inscriptions; its relation to the Irish found in the earliest literary sources may be compared with that between Latin and Old French. The alphabet in which these sources were written was the Roman one, introduced by the Christian missionaries in the 5th century. The precise date at which it began to be used for writing Irish is uncertain, for we have no examples before the 8th century, and even then only incidentally, in scribal notes and glosses. The language of the 8th- and 9th-century manuscripts, conventionally called Old Irish, provides an indispensable criterion for dating other material, and it is the discovery in later manuscripts of linguistic forms considerably more archaic than those of the classical Old Irish period that allows us to ascribe the compositions in which they occur to the 7th century or perhaps even the 6th. None of these later manuscripts, on which we depend for our knowledge of early Irish literature, is earlier than the 12th century, when the vernacular was already nearer to Modern Irish than to Old Irish. We owe the preservation of the older literature to the piety and conservatism of monastic scribes. All attempts to divide a literature chronologically are of necessity unsatisfactory; but the existence for more than 1,000 years of a literary class in Ireland allows certain landmarks to be established. Four periods may be recognized: (1) the early period, when the literature was composed by the order called filid and by churchmen and was preserved in the monasteries; this stretched from the earliest times to the 12th century and linguistically covered the whole field from archaic Old Irish to late Middle Irish; (2) the middle period, when the custody of the tradition passed to the lay and hereditary bardic order; this dated from the middle of the 12th century to the middle of the 17th and is linguistically late Middle Irish and classical Modern Irish; (3) the late period, when both literati and patrons had disappeared and the literature became purely popular and peasant; this continued from the middle of the 17th century until the end of the 19th, and during it the language, at first close to classical Irish, evolved finally into the dialects as they are known today; (4) the revival period, from the end of the 19th century to the present day.

EARLY PERIOD

Irish literature was from the earliest times an aristocratic one, kept in the hands of a professional class, the *filid* (singular *fili,* etymologically "seer"); it has been suggested, with considerable probability, that *fili,* bard (originally apparently a lower grade of poet than the fili), *brithem* (judge), senchaid (historian) and drui (druid) all belonged originally to the same privileged caste. The drui was ousted by the Christian clergy, though he is still a prominent figure in the sagas; the other professional orders are ranked by the early laws together with the landowning aristocracy. The status and rewards of the jlid are also set out—no doubt a necessary provision, for the extravagance of their demands is a recurrent theme and caused them to be severely censured as early as the assembly of Druim Ceta in 575. Their duties were to know the sagas and genealogies and to compose encomiastic poems; that is, to serve the past and present glory of the ruling class. This function did not, however, prevent a considerable pride, even arrogance, in their calling, and they could enforce their demands by the threat of the lampoon (der), which could not only take away a man's reputation but also damage him physically and even kill him. The laws set out penalties for the abuse of the der, and the belief in its powers continued up to modern times.

Verse.—The earliest verse has not been well preserved, no doubt because of its considerable obscurity. For the official work of the *filid* it is necessary to rely on the fragments in the annals and genealogies and, above all, in the later treatises on metrics, where they often appear in very corrupt form. There are, however, two fairly long pieces in what must be regarded as a poetical style. The first and perhaps the older is the Fdeth Fiada (Cry of the Deer), a rhythmical incantation traditionally ascribed to St. Patrick; whether of the saint's composition or not, it is undoubtedly very archaic in language. There is less doubt about the *Amra* (Eulogy) on St. Columba (521–597); this, couched in rhetorical style, in short sentences linked by alliteration, is ascribed to Dallan Forgaill, who was chief poet (rigollam) of Ireland. This device of alliterative rhythmical prose is used again in the sagas, and the technical term for it is a Latin loan word, retoric. Probably the oldest metre in the strict sense of the word is that in which two half-lines are linked by alliteration—a system strikingly reminiscent of early Germanic verse. Another pattern which can be discerned is that of a heptasyllabic line with trisyllabic ending; this is found both in legal tracts and in the sagas. Rhyme is found from the 7th century onward. Although it is often a full rhyme, the requirement is only that there should be identity of vowel and syllabic length and that the consonants should belong to the same phonetic class—a system found also in early Welsh. At the same time the quatrain, with seven or eight syllables to the line and rhyme between the second and fourth lines, was derived from Latin hymn metres. Still later are found the first examples of a metre later to become the most popular of all—debide (literally "cut in two"), where the quatrains consist of two couplets, and the rhyme between the two lines of each couplet is usually that of a stressed syllable with an unstressed one.

The official poetry consists, as must be expected, mainly of panegyric, elegy and similar products of the *fili's* relation to his patron. The incident in Tromddm Guaire (*Guaire's* Oppressive Guests), a late satire, where a king is made to say, after hearing a poem, "that is a good poem, for him who could understand it," may contain more than a grain of truth, for the poets often affected a deliberately obscure style, like the Provençal trobar *clus.* Naturally enough, it is their official rather than occasional work which tends to be preserved, but some fragments showing a genuine lyric note have survived to be collected and published in Irish and German by K. Meyer in *Bruchstücke der älteren* Lyrik *Irlands* (Berlin, 1919).

It must be assumed that the remarkable freedom from dialect variations found in Irish right up to the modern period was a result of the influence of the filid, and later the baird, but there is no evidence that their language was handed down otherwise than orally until the time when the filid are found in the monasteries. The whole written tradition is monastic, and the name of the Christian learning, *légend* (Lat. legendum), suggests a contrast in techniques. But from the beginning the church in Ireland not only tolerated but cultivated the vernacular in religious writing, and after the first few centuries it had completely superseded Latin in every field except the purely liturgical.

Religious Verse.—The official verse of the church is hardly more lively than that of the *filid;* for example, the *Félire* or Calendar of Oengus, composed about 800 and containing a quatrain for each day of the year. More interesting is the 10th-century *Saltair* na Rann (Psalter), a biblical history in 150 debzde poems, which contains a great deal of strange learning. But it is not these ponderous works which constitute the real glory of Irish religious verse, but rather the personal note heard in the voice of the monk who asks forgiveness for his lapses in meditation, or the nun who asks God

to grant her the nursing of the infant Jesus. The anonymous poets who composed such poems as these, as well as the famous address to Pangur, the white cat. were not filid, and they avoided the more complicated metres but had the immense advantage of using a language which had been cultivated for many centuries, to which they brought a freshness of insight denied to the filid.

Nature Poetry.—The happiest wedding of the literary tradition and religious feeling was in the nature poetry, hardly to be paralleled elsewhere in Europe. The native poetry had already shown, both in the lyrics in the sagas and in the seasonal songs, a remarkable sensitivity to natural beauty; perhaps because some of these were ascribed to Find Fili, later confused with the hero, this type of verse became associated with the Fenian tradition. That the filid could adapt their technique to new circumstances is shown by an 11th-century poem on the sea, where the preface, choice of theme and free use of kennings all suggest Scandinavian influence. The monastic movement in the Irish church provided a far stronger impetus to nature poetry. Exile from men, whether beyond the seas or to lonely places in Ireland itself, was held to be, a bloodless but meritorious martyrdom, and the bare cells of the hermits brought them very close to earth and sky and their creatures. This almost Franciscan poetry mould naturally have an especial appeal to monastic scribes, so that a considerable amount of it has been preserved.

Historical Verse.—Remembrance of the past was an important part of the work of the *fili;* indeed, some of the earliest poems are more metrical genealogy than anything else. As time went on and many texts became obscure and different traditions conflicted, the necessity for compendiums of information grew, and these were often couched in metrical form. They are especially numerous toward the end of the early period. In a long poem, Fianna bdtar i *nEmain (The Warriors Who Were* in *Emain),* Cinied ua Artaciin (d. 975) summed up the saga material, while Fland Mainistrech (d. 1056) collected the work of the generations of filid who had laboured to synchronize the traditional history of Ireland with that of the outside world as it was then known. Equally important is the great collection, existing both in prose and verse forms, called the *Dindshenchus,* which, as R. Flower has well said, formed "a kind of Dictionary of National Topography, which fitted the famous sites of Ireland each with its appropriate legend." And, indeed, the development of a loose debide form, making rhyming easy, produced mnemonic verse on all sorts of subjects—hagiology. grammar, lexicography, metrics and law.

Prose.—The Saga.—The early Irish epic is a prose narrative, which usually. though not always, contains non-narrative passages in a heightened style, whether retoric or verse; these passages often take a dialogue form. E. Windisch first pointed out the resemblance between this and the type of epic found in early Sanskrit sources and suggested that the tradition went back to early Indo-European times. It seems at least to be common Celtic; whatever the date and origin of the poems which 'make up the Welsh Gododdin, they do not constitute an epic, and Sir Ifor Williams has seen in the scattered *englynion* of the early manuscripts the lyrics from an early saga cycle the prose of which has been lost. There are parallels for this in Irish; in the love tale Liadain and Cuirithir the prose consists of a few scattered and cryptic sentences and the famous poem of the Old *Woman* of *Beare,* the Irish *Vieille Heaulmiere* may also be a fragment of an old story. This does not imply a common Celtic literature, but that the traditions of early storytelling in both languages were similar to what is found best preserved in early Irish. In saying this, the difficulties of interpretation arising from the conditions already mentioned must be remembered. The oldest stories found in Ireland show linguistic forms which suggest that they had reached settled patterns in the Old Irish period; we possess no manuscript evidence earlier than the time when late Middle Irish was passing into Modern Irish. The historical background to this is obvious; the Scandinavian invasions of the 9th and 10th centuries disrupted the entire Irish polity and seriously affected literary studies, as they did everything else. Not until the 11th century did life become sufficiently settled for the works of the past to be collected in the monasteries, and this antiquarian revival was both eclectic and uneven. The great codex Lebor *na* Huidre (The Book of ***the Dun*** Cow), written early in the 12th century, shows, both in the main text and in the later interpolations, older treatments of the saga material than those found in the Book of *Leinster,* written a few score years later. Only the shortest stories are preserved in forms approximating to the original; the rest abound in doublets, repetitions and conflations due to uncritical editorial handling of earlier material. The rhythmic prose used in the heightened passages of the older stories rapidly became unintelligible and was replaced in later recensions by longer poems in the syllabic metres.

It was the duty of the fili to know these stories (*scél*), both primary and secondary. Although in this function he may be described as a *scélaige,* he was really fulfilling the same office as the *senchaid;* that is, the preservation of the glories of the past. Occasionally the authenticity of the *scél* is guaranteed by bringing one of the old heroes into contact with later generations, whether it be the supernatural appearance of Cu Chulainn to St. Patrick, Senchin's evocation of Fergus mac Róig, or Oisín's miraculous survival. Although these stories tend to group themselves in cycles, they range over a period from the earliest fables to the 11th century, and in the catalogues—containing the titles of many stories now lost—they are arranged by type rather than by period, so that the headings are stormings, cattle raids, courtships, battles, voyages and so on. There are nearly 100 *scél* in the primary class and half as many in the secondary.

Whatever the attitude of the storytellers and their hearers to these stories may have been, they must be regarded as almost completely unhistorical, so far as personages are concerned; even those which relate to the 7th century usually fail to agree with the more reliable evidence of the annals. It is possible, however, that some of them may contain traditional material capable of historical interpretation. The oldest of them preserve for us a picture of a primitive and pre-Christian state of society—fighting from war chariots, the taking of heads as trophies, the privileged position of the druids, the force of taboo (*geis*) as a supernatural sanction—for which there is little or no evidence from historical sources. They are best paralleled by the classical descriptions of the continental Celts, and the preservation of a memory of them is a result of that conservatism of the Irish literary classes which made a 16th-century bard ignore the bow and the gun alike and send his patron into battle armed only with sword and spear. It is hard to arrive at any convenient division of these stories. The mythological cycle, so called because of the frequent references in some of the stories to immortal beings, cannot easily be separated from the cycle of the kings; all were of equal historicity from the storytellers' point of view and all are equally unhistorical from ours. The most important cycle is that of the Ulaid, the people who gave their name to the modern province of Ulster. As so often happens, their days of power and influence were long over when the sagas took the form in which they are known today, and the problem of why their tradition especially should have been so much cultivated by the *filid,* and why it should have been so much neglected when the period of the filid came to an end, is still unsolved. But certainly the figures of Conchobar, king of the Ulaid; Cu Chulainn, the boy warrior; Medb, queen of Connaught; and Noisi and Déirdre (*q.v.*), the doomed lovers, are outstanding both in early Irish literature and, even more, in that of the Anglo-Irish revival, and it is on elements from the sagas of the Ulaid that the nearest approach to an Irish epic was built—Tdzn *Bó Cúailgne* (*The* Cattle *Raid* of Cooley).

It is probable that even when first put together, in the 7th or 8th century, the Tdzn was not a very coherent work of art; it must be remembered that the oldest type of *scél* does not exceed a few thousand words and is striking chiefly for the laconic vividness of its narrative and the wit of its dialogue. There is little attempt at construction; the longer stories are no more than a chain of loosely connected incidents. *Táin* Bd *Cúailgne,* which would appear to be a conscious attempt to provide Ireland with an epic comparable to the Aeneid, shows this tendency carried ad *absurdum.* There are dramatic episodes, such as Medb's dialogue with the soothsayer and Cú Chulainn's dealings with the Connaught scouts, but the long series of single combats becomes wearisome and the story

tails off badly. Undoubtedly the finest section is that where Fergus, an exile from Ulster, recalls for Medb and Ailill the deeds of Cú Chulainn's youth. This story of the boyhood of a hero abounds in convincing touches and is obviously the work of an accomplished artist, and it has been transmitted to us, by some fortunate chance, in a reasonably correct form. But the Tdin generally is of less literary interest; its value for the literary historian lies in the fact that, as it was being continually worked over, it provides a kind of stratified record of the degeneration of Irish style. Just as the bare prose of the early period is replaced by bombastic alliterative passages, and the retoric, emotive in its obscurity, by longer and longer poems in clumsy debide, so the ruthless humour with which Cu Chulainn's early killings are described is replaced by the sentimentality of the fight between him and his boyhood friend Fer Diad.

The Tdin collected around itself a number of ancillary stories, not the least important of which is that of its revelation to the *filid* in the 7th century by the ghost of Fergus. This may point to the date at which a number of tales of the Ulaid were first combined into an epic. Better known is the tragedy of Noísi and Déirdre, linked through their enemy Conchobar to the Ulster stories. In a modern form it became known as one of the Three Sorrows of Storytelling, being linked incongruously with a "mythological" story about the children of Tuireann and a late romance called Oidheadh *Cloinne* Lir (The Children of Lir). It is, of course, known to the world through the work of the Anglo-Irish school, notably J. M. Synge and W. B. Yeats. Equally full of drama, but not so easily adapted to modern taste, is *Scél Mucce* Mic Da Thd (The Story of Mac Da Thd's Pig), which includes such primitive elements as the award of the best portion of meat to the leading champion, the boasting competition which ensues, and the resolution of the contest by the production of a head just taken in single combat.

Although the early sagas exaggerate to the point of grotesqueness, there is little trace in them of the supernatural. This can hardly be explained by the monastic origin of the manuscripts; the few attempts to introduce Christian elements are easily detected interpolations, and it is more probable that pagan deities, as such, played comparatively little part in the stories, even in their oldest form. Immortals are found, certainly, especially in the stories ascribed to a period deep in antiquity; the Dagda, Lug, Manannán, Midir and Oengus are all beings of more than human stature, and some of them may, in name at least, be linked with Gaulish and Welsh gods and heroes. But they interfere little in mortal affairs and cannot be said to constitute any kind of pantheon; they live in dwellings (sid), which may be mounds or islands but in either case hide them from mortal eyes. In general, mortals may visit the sid only at the wish of its occupants, usually because a woman of the sid has fallen in love with a mortal man. Life there is eternal, but no mortal can return to the world without taking on the burden of the pears he spent in the *síd*. If the pre-Christian Irish had a belief in the immortality of the soul, no intimation of it reaches us from the sagas.

One of the most delightful of these stories is *Imram* Brain (The Voyage of Bran), edited by K. Meyer and A. Nutt (London, 1895), which describes a voyage to Tir inna mBan (the Land of Women). The same plan is followed in other *imrama* (which were to have their ecclesiastical counterpart in the Navigatio *Brendani*), but the later tales tend to stress the marvellous rather than the supernatural. A recently edited story of the *síd* is Tochmarc Étaine (*The* Courtship of *Étain*), which describes how Étaín, once a royal immortal, was reincarnated as a woman and married to Eochaid Airem. Her original husband, Midir, finds her again, wins her from her earthly husband at the gaming board and carries her back to the sid, where he holds her in spite of all attempts to rescue her. Nowhere are the unchanging delights of the other world better described than in the songs in which Midir reminds his lost wife of her former home.

Other Early *Stories*.—In this period stories with an origin outside the recognized tradition began to appear. An obviously exotic element is represented by Togazl Troi (The Taking of Troy) and The Story of Alexander, which appear in the oldest saga lists, but the classical learning had comparatively small effect until the next period. The same is true of the stories of Finn; although Meyer demonstrated in Fianaigecht (Dublin, 1910) that the traditions go back to an early period, their real development was at the time when the *filid* were no longer in control. Later research would indicate that the "wild man of the woods" cycle associated with the name of Suibne Geilt had its origins in Strathclyde, where Irish and Brythonic literature must have been in contact at an early date; this mixture of hagiographical, saga and nature material is one of the most attractive stories of the later period. For a discus. sion of the Suibne story, cf. J. G. O'Keeffe, *Buile* Shuibhne (London, 1913); J. Carney, Eigse, vi, 83 ff. (Dublin, 1950).

Religious Prose.—Although Irish was used for didactic purposes from the earliest period (one of the most archaic pieces of prose is the fragment known as the *Cambrai* Homily), the material is mostly derived from Latin, and that belonging to the earliest period consists mainly of monastic rules, *exempla* to illustrate a moral and anecdotes about saints. The two latter types often show a style and humour worthy of the professional *scélaige*. At a later stage a number of homilies such as In Tengae *Bithnue* (The *Evernew* Tongue) appear; they are interesting, both linguistically and because their sources are often obscure, but of small literary value. The lives of the saints have little interest, either from the literary or the biographical point of view. Intended, no doubt, to be edifying, they are works of fantasy, incorporating with the passage of time more and more elements from folklore on one side and from the saga material on the other. The emphasis is always on the miraculous; it is the fact that they incidentally contain a great deal of information about everyday life in early Ireland that makes them so valuable today as social documents. Naturally enough, Latin and Irish traditions are mingled in this field, in which the standard works are those of C. Plummer, Vitae Sanctorum Hiberniae (Oxford, 1910), and Bethada *naem nÉrenn* (Oxford, 1922). Another important type of religious work is the vision, the best known example of which is Fis *Adamnáin* (The Vision of Adamndn), whose soul is represented as leaving his body for a time to visit heaven and hell under the guidance of an angel. To what extent this type of Irish religious work, found also in Latin, may have influenced Dante is still a subject for speculation. Both the saints' lives and the visions tended to degenerate into extravagance and buffoonery—so much so that parodies on both were composed. The outstanding example is *Aislinge* Meic Con Glinne (The Vision of Mac *Con* Glinne), which describes how a king possessed by a demon of gluttony is cured by the recital of the vision of a land of Cockaigne.

Speculative and Technical Writing.—Theory has always been at least as important as practice in Irish cultural life, and the filid built up for themselves a considerable body of academic speculation. Very little has survived, but we have obscure fragments on the nature of inspiration and the origin of language, combined with more practical instructions on matters of metrics and style. At an early stage this learning became interpenetrated with that of Latin, as the collection of texts gathered together under the title of *Auraicept na nÉces* (The Scholars' Primer) shows; and a full technical vocabulary was built up to deal with Latin, as well as Irish, grammar. In several very ancient texts the discussion of the art of the poet is mixed with questions relating to his legal status. As early as the 10th century the changes in the language had necessitated glossing and interpretation of the older texts; Cormac mac Cuilennáin, the bishop-king of Cashel (d. 903), compiled a glossary of archaic words with illustrations, etymologies (of the school of Isidore) and illustrative passages.

Just as important to the *fili* as the study of the language and literature was that of history and genealogy. J. MacNeill was the first to point to the immense amount of work that was done in adapting the Latin historical synchronisms to the legends and genealogies of Ireland. A synthetic history of the pre-Christian period was thus built up, and the genealogy of the leading families carried back to Adam. The sequence of events depicted in a compilation such as the Leablzar *Gabhála* (Book of Conquests), with its Milesians, Fomorians, Tuatha DC Danann and whatnot, has been a fruitful source of speculation to modern archaeologists

and historians. Far more reliable are the annals kept in the monasteries from early times; these are generally agreed to be reliable from the 6th century onward.

Law and medicine were both important professions in ancient Ireland. By a curious chance, we owe most of our early knowledge of medicine to legal men, for the only surviving material, apart from a few charms, is from legal tracts of the Old Irish period, which deal with the status and responsibility of doctors. No doubt medical knowledge was conveyed orally from master to pupil. The same may have been true of legal studies themselves at first, but there exist texts the language of which clearly shows that they were composed in the earliest period known to us. Remarkably archaic in content as well as in language, they no doubt represent several traditions. but chief place was held by the *Senchas Már (Great Old Law Book)*. a codification given its authority by ascription to a commission sitting under St. Patrick. This must be regarded as an appeal to history of the same type as was used in the literature, and the real date of systematization must be placed several centuries later. Nevertheless, the oldest strata of the laws are now recognized as providing the best evidence not only of archaic Old Irish but also of social life in early Christian Ireland. The system, however, is merely a description of the legal relationships of a small landowning aristocracy. As life became more complicated, it appears to have broken down altogether, and the judges seem to have given their decisions as simple arbitrators, supporting their judgments with imperfectly understood tags.

MIDDLE PERIOD

The 12th century is a period of contradictions. On the one hand, the oldest surviving codices were being written in the monasteries, preserving the literature of many centuries earlier with remarkable fidelity; on the other hand was the gradual rise of a new literary order which, while elaborating the verse forms to a far greater extent than before, at the same time recognized the changes in language which had taken place and codified for poetic use a language which must have been very near the vernacular of the day. After the 12th century the hereditary bardic families became the custodians of Irish literature and continued in that function until the collapse of the Gaelic polity. R. Flower suggested that the bardic movement may have received its impetus during the reign of the centralizing Brian Bóroimhe (Boru) (926–1014), and this may well be true. The conditions mere favourable, for the upholders of the older tradition had become almost completely identified with a church which was now doubly threatened by the Norman invasion and by the introduction of new orders of monks from abroad. Also, the language had evolved so far during the unsettled period of the viking raids that the older tradition must have become almost unintelligible; the Book of Leinster *Táin,* for example, swarms with fantastic and, one is tempted to say, unreal linguistic forms. The new bardic families were at first completely divorced from ecclesiastical influence, though we soon find them sending their sons into the recently introduced orders, above all the Franciscans, who mere to become by the end of this period the greatest custodians of the tradition.

Bardic Verse.—The bardic reform of verse was sweeping. The language was brought into conformity with the speech of the time, the large number of metres used by the *filid* was greatly reduced and, in compensation, a greater strictness in rhyme and lavishness in ornament—internal rhyme and alliteration—was insisted on. The scope of the verse became considerably less; the vast bulk which has come down is praise poetry, addressed either to the poet's temporary or permanent patron or to God. This arose naturally from the status of the new order of poets; being no longer associated with monastic foundations, they were dependent entirely upon patronage for the high standard of living which they claimed as their own right, for the bards were no less arrogant than the *filid* whom they replaced. After a course of training which lasted six or seven years, these journeymen poets were free to seek a temporary or permanent patron. It is no accident that they praise generosity as highly as bravery in their poems, which many of the chiefs had copied into family verse books (*duanaire*). There is a considerable monotony in these poems, for, though a chief must be described as victorious, it was considered prudent to avoid mentioning the details, lest the poet should wish to sell a poem to the defeated enemy at some future time. Nevertheless, there is often real poetic feeling in the earlier poems; but by the end of the period many poets were content to string together the clichés evolved through the centuries, with little regard for meaning so long as the metre was correct.

Modern taste finds little of interest in even the best of the official bardic poetry; it is the handful of occasional verse which survives that shows real worth. One of the earliest poets of the great bardic family of Ó Dálaigh, Muireadhach Albanach (c. 1214–40), has left, as well as a stirring defense of his action in killing a tax collector, an elegy on the death of his wife which is unsurpassed in Irish literature. Such gems are rare.

A new note was brought into Irish literature by the Gaelicized Norman invaders, that of the *amour courtois,* and the combination of this exotic element with the wit and felicity of the bardic style has left a number of enchanting poems. No doubt there were once many, many more than those collected by T. F. O'Rahilly in *Ddnta Grddha* (Cork, 1926), but it was only by a fortunate chance that precious vellum was devoted to the preservation of such frivolities. A different kind of departure from praise poetry is the *crosánacht,* a poem in which the verse is frequently interspersed with humorous or satirical prose passages.

The Fenian Cycle.—The vast bulk of native prose of this period is concerned with the hero Finn and his war band (*fian;* hence "Fenian"). In spite of their comparative neglect in the 12th-century manuscripts, the stories about Finn, Oisin, Caoilte and the rest must have existed among the people for many centuries. MacNeill may be right in seeing in them the traditions of a subject race, for the proportion of folklore elements in them is far higher than in the aristocratic Ulster cycle. The outstanding work is *Agallamh na Seanórach (The Interrogation of the Old Men),* in which Oisin and Caoilte are represented as surviving the battle of Gabhra and living on until the time of Patrick, whom Caoilte accompanies through Ireland, explaining to him the origin of the names of the places which they visit—a technique no doubt borrowed from the older *Dindshenchus,* as is also the form of prose with verse passages. But whereas in the Ulster cycle the introduction of the hero of former times is merely a way of authenticating the story, in the Fenian stories it is used to introduce a note of nostalgia for past glory, so that in modern speech "Oisin after the Fianna" is the type of the survivor of a heroic period. No doubt this contrast reflects that between an old hierarchical society and one facing a rapidly changing and hostile world. The Fenian stories never received such careful literary treatment as did those of the older tradition, and the old form was soon abandoned for prose tales and ballads—the latter something of an innovation in Irish literature, though there are examples of metrical versions of prose sagas even in the Ulster cycle. The prose tends to degenerate into a bombastic and alliterative style, seen at its worst in *Cath Fionntrágha (The Battle of Ventry).* There are echoes of this style in the "runs" of the modern folk tale, where the Fenian tradition is supreme. The ballads are easier reading and may be regarded as the beginnings of popular, as opposed to professional, literature in Irish. The metres represent such a drastic simplification of the bardic technique that versification became even easier than in the English ballad, and a distinct change in theme can be seen as this literature passed into the hands of the people. St. Patrick still makes his appearance, but he is now a malevolent and hostile figure, starving and bullying the aged heroes who represent the pagan and warlike tradition. These ballads had an immense popularity among the common people; the collection made by James Macgregor, dean of Lismore, early in the 16th century, shows that the tradition of ballads about Oisin and Finn, on which James Macpherson was later to base his forgeries about Ossian and Fingal, was already flourishing.

Other Prose.—Retelling of the stories popular with the *filid* of course continue to be found, but these steadily dropped out of favour. Sometimes they were combined with folk-tale elements, as was the case with the very old saga of Fergus mac Léti, which was rewritten, perhaps in the 14th century, to include a story of

a people of tiny stature — the leprechauns of folklore. It has been suggested that Jonathan Swift may have heard some version of this and incorporated it in his *Gulliver's Travels*. A curious example of a saga technique being applied to a great historical personage is the *Cogadh Gaedheal re Gallaibh (The War of the Irish With the Foreigners)*, which deals with the wars of Brian Bóroimhe; the style is bombastic and inflated, and it was to find many imitators, of which probably the worst is Lughaidh Ó Cléirigh's *Life of Aodh Ruadh Ó Ddmhnaill*. Most important of all, a flood of translations from both Latin and English began. The stories of Marco Polo, Sir John Mandeville, Prester John and Guy of Warwick, as well as classical and Arthurian stories in their mediaeval adaptations, become well known in Ireland. The new religious orders were responsible for the translation of many spiritual and devotional works. There was also a considerable amount of technical writing. On the native side, the most important was the grammatical and metrical teaching which was set out in many elaborate tracts, giving examples of correct and incorrect usage. Legal science appears to have been moribund. From abroad came translations of medical tracts in large numbers. Continental teaching seems completely to have superseded the native tradition during this period. The churchmen made the experiment, remarkable for the time, of handling philosophical material in the vernacular; unfortunately very few of these tracts are extant and almost nothing has been published.

By the 15th century the printing press was beginning to make literature available to larger numbers in most European countries. In Ireland, however, in spite of the fact that Irish was the language of most of the country and that the literature was flourishing at that period, there was one fatal obstacle; the Irish did not control the towns, and so had no access to printing. Irish literature perforce remained an aristocratic one, the preserve of those who could afford to maintain the literati and supply them with the costly vellum, which was not replaced by paper until the end of this period. It is easy to understand that this literature had little effect on the masses of the people.

LATE PERIOD

It was during the reign of Elizabeth I that English policy first succeeded in breaking the power of the Irish and Anglo-Irish nobility, and the process was completed by the middle of the 17th century. The emigration or dispossession of this nobility entailed also the disappearance of the bards who were at once its dependents and propagandists — a fact well known to the English power, which persecuted the "rhymers" bitterly. Their eyes fixed on the past, they had shown no sign of interest in the renaissance of learning going on elsewhere; with their elimination the old tradition itself was doomed, and there were no learned men to found a new one. Indeed, from this time onward the Irish language itself began to slip from its position as the common speech of the country.

Verse. — The poets did not give up without a struggle. In the early part of the 17th century they were engaged in a long and heated poetic debate on early Irish history, and the tradition was to survive in Scotland, together with the native aristocracy, until after the 1745 rebellion. But bardic language and diction, unchanged for more than 400 years, were too difficult for poets who had not undergone the strict discipline of the schools. Without patrons the schools soon died, and hardly any correct bardic verse was written in Ireland after 1650. But just as the bards had taken over from the *filid* 500 years before, so a new school of poets took over from the bards. And just as the bardic measures had been in preparation for centuries before they established themselves as canonical, so the song metres which replaced them had existed for centuries among the people, though rigorously excluded from the vellums. The new poets abandoned the syllable counting by lines with a fixed number of stresses; the stressed vowels rhymed in patterns which might be very simple or, later, bewilderingly intricate, but simple vocalic assonance took the place of the earlier rhyme. The language of poetry moved consistently toward the language of the people, and this, combined with the freedom of the new metres, allowed the poets to speak with a new vigour. While they had little patronage, there was at least an increasing supply of paper, so that their works, still barred from the printing press, were able to be circulated freely among the literate. Naturally enough, the tone of verse throughout the 17th century was one of passionate defiance of the new regime. In it is found the first coherent expression of patriotism conceived as devotion to an abstract ideal rather than as loyalty to an individual — a concept of considerable importance in the later history of the country. But it must be admitted that much of the verse of this period represents a mere nostalgia for the past, the vain regrets of men who had been forced to exchange the pen for the spade.

By far the greatest of the poets of the song metres was Dáibhidh Ó Bruadair, who died at the end of the 17th century (works edited with translation by J. MacErlean, London, 1910–17). Ó Bruadair and Ó Raithile, of slightly later date, still had some patrons. After them the poetic tradition, while remaining, in Munster at least, extraordinarily subtle in craftmanship, was preserved only among the common people and ceased to have any contact with reality, as the *aisling* (vision) poetry, singing a Jacobite restoration, sufficiently demonstrates. But it had real vigour in such themes as satire and *pastourelle*, and these peasant poets maintained the literary tradition until the end of the 18th century. The last magnificent flowering of the Munster tradition was *Cúirt an Mheánoíche (The Midnight Court)*, written by Brian Merriman, a Clare schoolmaster (translated by Frank O'Connor, London and Dublin, 1945). Perhaps the best-sustained poem in Irish, it is an exercise on traditional themes, such as that of the *mal mariée*, in a metre which is an ingenious and successful adaptation of the heroic couplet to the Irish style. After it, Irish poetry became a matter of folk songs, and even these were produced less and less after the crushing blow to the language inflicted by the great famine (1846–47).

Prose. — During the 17th century the tradition continued to produce a good deal of prose, mainly antiquarian and of inestimable value today, for the writers were able to draw on many sources now lost. By far the most important is *Annála Rioghachta Eireann (The Annals of the Four Masters)*, a compilation of all the available material on the history of Ireland to 1616, made under the direction of the Franciscan lay brother Micheál Ó Cléirigh (Michael O'Clery; *q.v.*). Less readable, but also of great historical importance, are the genealogies compiled by Dubháltach Mac Fir Bhisigh. Geoffrey Keating (c. 1570–1646), who wrote a dignified yet simple prose based on the bardic language, produced the first historical (as opposed to annalistic) work in Irish in his *Foras Feasa ar Eirinn* (edited with translation by D. Comyn and P. Dinneen, London, 1901–08), as well as some fine verse in both the old and the new metres, and two spiritual treatises. A number of religious works, printed by the Irish Franciscans in Louvain, were smuggled into the country; it is significant that manuscript transcripts are more numerous today than printed copies. The earliest book to be printed was the Protestant translation of the New Testament (in 1603), but for obvious reasons this has exerted little influence.

An interesting development in prose style was the satire called *Páirliment Chloinne Tomáis (Parliament of Clan Thomas)*, in two parts, probably of different authorship, one written before, one after, the Cromwellian wars. It appears to have been written by a representative of the bardic order, for it attacks with equal savagery the new ruling class and the native peasantry, using a style very close to that of the earlier *crosánacht*, but with the prose now predominating over the verse. It found several imitators, but the old tradition was by this time too attenuated for so aristocratic an attitude to be maintained.

The imaginative prose of the paper manuscripts was in general of a much more popular kind; it consisted mainly of developrnents of the Fenian themes or of romances in which themes drawn from Irish and foreign mediaeval literature were freely mingled with folklore and *fabliau* elements. As in the case of the song metres, there is reason for believing that these romances had a considerable tradition behind them before they appeared in writing. They were the form in which the people assimilated the literature circulating among the aristocracy. The circumstances of their trans-

mission have caused a considerable divergence in the forms in which they are found; it may be for this reason that comparatively few of them have been published, let alone studied. With a public growing steadily more apathetic and less able to read Irish, there could be little hope for prose production. During the 18th and early 19th centuries the only books printed in Irish were a few catechisms and devotional tracts. The manuscript tradition was carried on by a few devoted scribes into the first half of the 19th century, when it all but died out. By the middle of the century there was no literary activity in Ireland and all but a handful of the speakers of the language were illiterate in it.

REVIVAL PERIOD

An antiquarian interest in the Irish language and its literature had begun early in the 19th century, and the publications of J. Hardiman, J. O'Donovan and E. O'Curry, especially the last-named's *Lectures* on the Manners *and Customs* of the Ancient *Irish* (London, 1873), had caught the imagination of many of the educated classes, whose language of culture had for centuries been English. The Young Irelander Thomas Osborne Davis was probably the first to see how the restoration of the Irish language could be made a political force in a national movement, but the increasing interest remained for a time academic and did not turn to discussion of measures for the preservation or extension of the speaking of Irish until the establishment of the Gaelic league in 1893. This movement had its counterparts in every European country from Catalonia to Finland, but there were difficulties in Ireland unparalleled elsewhere. The speakers of Irish had sunk to the status of a minority and, worse still, since the language of Irish nationalism had been English for more than 200 years, neither they themselves nor their English-speaking fellow countrymen looked on Irish as a prerequisite of separate nationhood. The curious result was that the revival in Irish, came from the enthusiasm of antiquarians and nationalists, few of them Irish-speaking in origin, rather than from the Irish-speaking peasants themselves—a situation which still exists to some extent. The culmination of the revival movement was the situation in the Republic of Ireland, where Irish and English enjoy equality before the law and all schoolchildren must reach a given standard in both languages. We need concern ourselves only with the results for Irish literature.

The revivalists were faced with a grave difficulty when they came to face the problem of writing a language which had lost its old standard and had split up into dialects. The classical bardic language was too archaic to be restored, and no Ivar Aasen or V. S. Karajich came forward to form a new language on the base of the dialects. The inevitable result was that native speakers and learners alike wrote the language of their native or adopted parish, a situation which continued, although by the middle of the 20th century a standard evolved by government departments was being increasingly accepted. This might have happened naturally had there been more speakers in the province of Munster, where the literary tradition was best preserved. It was a Munster priest, Father Peter O'Leary, who gave impetus to the revival with a stream of novels, essays and translations of all sorts, and it was a Munster fisherman, Tomás O Criomhthain, who produced the finest book of the revival in his An *tOileánach* (The *Islandman*) (translated by R. Flower, Dublin, 1934). In the Ulster dialect there was some good writing by Séamus Ó Grianna ("Máire") and his brother Seosamh Mac Grianna. Connaught produced three good short-story writers in Padraic Ó Conaire, Máirtín O Cadhain and Liam O'Flaherty (who also wrote in Englishj. In general the short story is the most successful as well as the most popular form. The novels demonstrate the national inability to handle *l'œuvre* de *longue haleine*. The drama, still lacking theatres, consists mostly of translations, and no poet of force has yet appeared. While a 20th-century literature is thus being built up in Irish, the older tradition has not been forgotten, and the Irish Folklore commission collected vast numbers of folk tales and songs and undertook the classification and publication of the material.

BIBLIOGRAPHY.—*General* works: The older period is covered by R. I. Best, *Bibliography* of Irish Philology and *of* Irish Printed *Literature*. vol. i (Dublin, 1913), vol. ii (Dublin, 1942); the literature of the revival period is dealt with by R. de Hae and B. Ni Dhonnchadha, *Clár Litridheacht na Nua-Ghaedhilge, 1850–1936,* 3 vol. (Dublin, 1938–40). There is no adequate history, A. S. de Blácam's Gaelic Literature *Surveyed* (Dublin and Cork, 1929) being merely a popular account. For the first two periods R. Flower, The *Irish* Tradition (Oxford, 1947), and M. Dillon, *Early Irish* Literature (1948), are authoritative studies. The most important periodicals are Zeitschrift *für* celtische Philologie (later *keltische*) (Halle, 1896–); Revue celtique (Paris, 1870–1934), continued as *Etudes celtiques* (Paris, 1936–); School of Irish Learning, Eriu (Dublin, 1904–); National University of Ireland, *Éigse* (Dublin, 1939–); *Celtica* (Dublin, 1950–); Folklore of Ireland Society, *Béaloideas* (Dublin, 1927–).

Early period: J. Vendryes, "L'Ecriture opamique et ses origines," Etudes *celtiques,* vol. iv (Paris); K. Meyer, Selections From Ancient Irish Poetry (London, 1913), Learning in Ireland in the Fifth Century (Dublin, 1913); R. Thurneyson, Die *irische Helden- und Königsage* (Halle, 1921); M. Dillon, Cycles of the Kings (London, New York, 1946); *Early Irish Society* (Dublin, 1954); K. jackson, *Studies in Early Celtic Nature* Poetry (Cambridge, 1933); T. F. O'Rahilly, Early Irish History and *Mythology* (Dublin, 1946); D. A. Binchy, "The Linguistic and Historical Value of the Irish Law Tracts," Proc. Brit. *Acad.,* vol. xxix (London, 1943), Studies *in Early Irish Law* (Dublin, 1936); G. Murphy, *Saga* and Myth in Ancient Ireland (Dublin, 1955).

Middle period: E. Knott, *Tadhg Dall O Huiginn* (Dublin, 1922–26), is the best study of bardic system and technique. See also E. C. Quiggin, "Prolegomena to the Study of the Later Irish Bards," Proc. *Brit.* Acad., vol. v (London, 1913); P. Walsh, Irish Men of Learning (Dublin, 1947).

Late period: D. Corkery, *The Hidden Ireland,* 2nd ed. (Dublin, 1925); G. Murphy, "Notes on Aisling Poetry," *Éigse,* vol. i (Dublin, 1939); J. H. Delargy, "The Irish Storyteller," Proc. Brit. Acad., vol. xxxi (London).

Revival period: The best appreciation is M. L. Sjoestedt-Jonval, "La Littérature qui se fait en Irlande," *Etudes celtiques,* vol. ii (Paris).

(D. GE.)

ANGLO-IRISH LITERATURE

It is impossible to dogmatize, as some have tried, about the limits of Anglo-Irish literature. It is enough to exclude on the one hand writers of Irish descent who have no direct connection with the country, such as the Bronte sisters, Edward FitzGerald, Edgar Allan Poe, Eugene O'Neill and T. E. Lawrence; and on the other, English writers domiciled in the country for a considerable time and showing decided traces of this in their work, such as Edmund Spenser and Anthony Trollope. We cannot draw hard and fast boundaries between a distinctive Irish literature in English and the contribution of Irish writers to English literature. The difference may be a real one, but it is too vague and uncertain to be taken into account here. The one type of writing merges into the other. All must count as Anglo-Irish literature, in whatever country and for whatever public it was originally produced. As to what constitutes an Irishman, one can only fall back on birth, early training and habitual residence.

The Beginnings.—Irish people take readily to writing in any language, perhaps more readily than they do to reading. Ireland's total output of literature must be enormous. It is therefore perhaps surprising that the first products of Anglo-Irish literature were so inconsiderable. It must, however, be remembered that until the 17th century the language of Ireland was Irish. The so-called Anglo-Irish were a small colony, a garrison holding a perilous outpost, constantly yielding linguistic as well as physical ground to the resurgent Gael; and even among the colonists English had to struggle for supremacy with Latin and French. A few manuscripts have survived, showing the existence of a vernacular poetry of no great originality or distinctiveness. The most striking example is the 13th-century satire *The* Lund of Cockaigne; but it is hard to say if any work lacking local allusions was originally composed in the country.

The first notable Irish writer in English was Richard Stanyhurst (1547–1618j, who contributed sections dealing with Ireland to Holinshed's Chronicle's, and attempted to write English quantitative verse on Latin models, with extraordinary results. From this time on, as the colony grew in numbers and importance and the conquest of the whole country was seriously attempted, the stream of Anglo-Irish writing began to swell, and gradually Gaelic as well as English names began to appear. In the next century may be found Sir John Denham (1615–69), author of the much admired Cooper's **Hill** and one of the pioneers of a smoother and

more regular versification, Lord Roscommon (c. 1630–85), Nahum Tate (1652–1715) and Nicholas Brady (1659–1726) among minor poets; Lord Orrery (1621–79) among minor dramatists; and Sir John Temple (1600–77), father of the more famous Sir William, may be mentioned among minor historians. But there was as yet no major name.

The 18th Century. — Writers of the first rank did not appear until the establishment of English as the predominant language, after the overthrow of the Gaelic culture and the arrival of hordes of new immigrants who were not so easily absorbed as their predecessors had been. But from then on, Irish writers of English were among the great. The first of these was Jonathan Swift (1667–1745). Irish-born of English parents and educated wholly in Ireland, he became a dominant literary figure in England. He returned to Ireland unwillingly as dean of St. Patrick's cathedral, Dublin, to become the idol of Ireland for his championship of a people he hated and loved, as he hated and loved all humanity, and to end as one of the great names in the literature of the world. Swift to the world at large means Gulliver's Travels. Ireland has rather remembered his tracts on its own wrongs, such as the *Drapier* Letters, among the first of a long series of such writings by Irishmen, which raised pamphleteering to the status of literature.

Nor does the dean stand alone at the beginning of the century. If Swift made politics literature, his friend George Berkeley (1685–1753) (*q.v.*), bishop of Cloyne, wrote philosophy which, apart from its importance in the history of human thought, is almost as admirable from the purely literary point of view as that of Plato. And it must not be overlooked that Bishop Berkeley was a convinced and admitted Irishman and a lover of his country, about whose welfare he expressed strong views in his *Querist*.

The Theatre. — Perhaps the greatest contribution of Ireland to the literature of the English language has been neither in philosophy nor in politics but in drama, especially comedy. Where would the English theatre be without William Congreve, George Farquhar, Oliver Goldsmith, Richard Brinsley Sheridan, Oscar Wilde, George Bernard Shaw? The first permanent theatre in Dublin was established in 1662. The swarms of Irish dramatic authors, both of native and of English stock, as well as of actors and managers, from the Restoration to the 20th century defies enumeration. Here we are concerned only with the authors. William Congreve (1670–1729) (*q.v.*), probably English-born but entirely Irish in rearing and education, is the greatest name in English Restoration comedy. George Farquhar (1678–1707) (*q.v.*), coming from the north though of Gaelic origin, has a gaiety and humanity all his own. Passing over Sir Richard Steele (1672–1729), a sentimental dramatist but primarily an essayist, and Thomas Southerne (1660–1746), a tragedian, we come to Oliver Goldsmith (1728–74), who touched nothing which he did not adorn, or was, if one prefers it, jack of all literary trades and perhaps entirely master of none, and who was the author of one supreme comedy, She Stoops to Conquer, said to be based on his own early experiences in County Longford.

Richard Brinsley Sheridan (1751–1816) was born in Dublin of a decidedly literary family of native origin. He was exiled at a very early age through the misfortunes of his father and never returned to Ireland; but he maintained the witty tradition of Anglo-Irish comedy, raising it to unprecedented heights in his immortal comedies The Rivals and The School for Scandal. There were many successful minor Irish dramatists, including Arthur Murphy (1727–1805) and Hugh Kelly (1739–77), but the plays were the common repertory of the English-speaking theatre of the time. The few plays written especially for Irish consumption were of no particular merit.

Poetry and Prose. — Turning to poetry mention must be made again of Swift and Goldsmith, and Thomas Parnell (1679–1718) (*q.v.*), a melancholy though not unpleasing poet, chiefly remembered for his *Nightpiece* on Death, must not be forgotten. There were some minor poets, but on the whole Anglo-Irish poetry did not flourish till the romantic movement late in the century. As for prose, the novel was only just coming into existence. Once again Goldsmith produced a major work, The Vicar of *Wakefield*. Laurence Sterne (1713–68) was born in Ireland, though he did not live or work there. Political eloquence in those days grew into literature. Edmund Burke (1729–97) (*q.v.*) was a political philosopher and an orator whose speeches read better than they sounded. Sheridan was as great a parliamentary speaker as he was a dramatist. No less notable was the eloquence of John Philpot Curran (1750–1817), and some of the speeches on Irish themes by Henry Grattan (1746–1820) are among the greatest of their kind.

The 19th Century. — With the 19th century came a change. The old, conquered Ireland, prostrate for so long, was beginning to rise to its feet. The Anglo-Irish colony, too, was gaining self-confidence and feeling itself a distinct entity. Nationalism, liberalism and revolution were in the political air, while romanticism was beginning to affect the arts. Moreover, antiquarianism had begun to uncover the Gaelic past. This had never been wholly forgotten; even Dean Swift had translated a poem from the Irish. But Charlotte Brooke (1740–93), the daughter of Henry Brooke, a dramatist and novelist himself, was the first to make verse translations on a more extensive scale, and soon there were others. Native and settler alike began to feel a new interest in their country. Irish nationality, as it is known today, was born. Until this time we have had for the most part merely to consider books by Irish authors; thenceforth books about Ireland predominated. Of such books an enormous number was produced. The romantic movement and the discovery of Ireland's ancient tradition provided an incentive. Irish literature in English became more plentiful and more distinctive than ever before.

Poetry. — For the first time poetry came to the forefront. Anglo-Irish verse was definitely established by Thomas Moore (1779–1852). Moore was a most versatile poet and a singer of his own songs. In his Irish *Melodies* he attempted to solve the problem of setting English words to Irish airs, which was not so easy as it sounds. The result may not please the purist in folk song, but it was very singable as well as good poetry; as the matter of the songs was Irish, often vehemently so, the wrongs of Ireland were warbled in English drawing rooms, with great ultimate advantage to the Irish cause. Nor did Moore's own people fail to appreciate him; he was a national hero as no other Irish poet has been. Quite apart from his songs, his oriental epic Lalla Rookh brought him wealth and fame. At one time there was a tendency to deprecate Moore, both as poet and as Irishman. Fortunately, this attitude seems to have largely passed away.

Moore wrote in English. In order to be Irish, he did not think it necessary to write in dialect or to attempt the style of folk poetry, as did some of his contemporaries, such as J. J. Callanan (1795–1829), who wrote very free adaptations from the Irish. Another contemporary, however, George Darley (1795–1846), wrote in a most exquisite and scholarly style, and his work was mistaken for that of an Elizabethan or 17th-century poet. It is a pity that most of his work is now inaccessible. A slightly earlier writer was the Spenserian poet Mary Tighe (1772–1810), much admired in her own day, and with good reason, for her Psyche.

In 1842 the patriotic organization known as Young Ireland, led by Thomas Osborne Davis (1814–45), an eloquent and sincere writer in prose and verse, founded a new paper, the *Nation*. A large number of poets and prose writers attached themselves to it. Besides Davis himself, who died young and regretted in 1845, poets of merit were Thomas D'Arcy McGee (1825–68), Richard Dalton Williams (1822–62) and Lady Wilde (1826–96). Another notable journal of the time was the Dublin University Magazine, which lasted for about 40 years and was probably the finest magazine ever produced in Ireland. Its politics were the direct opposite of those of the Nation, but it was mainly literary, and most of the best Irish writers contributed to it. Of its poetical contributors the most notable was James Clarence Mangan (1803–49) (*q.v.*), an enormously prolific and most uneven writer of every kind of verse, including numerous translations from languages which he probably did not know of poems which did not exist. At his best, when inspired by his love of Ireland or by his own miseries, due largely to alcohol, he was one of the very greatest poets of Ireland. He was much influenced by the German romantics and in turn

influenced Edgar Allan Poe. Another notable poet was Sir Samuel Ferguson (1810–86), who wrote on Irish themes in a strikingly original way, inspired to some extent by Gaelic examples. Among other poets of a very poetical time were Denis Florence MacCarthy (1817–82) and Aubrey de Vere (1814–1902), who were more typical of their period. William Allingham (1824–89) wrote poems in ballad style and a long and interesting narrative in verse, *Laurence Bloomfield in Ireland.* He later settled in England and became an associate of Dante Gabriel Rossetti. He adopted the Pre-Raphaelite manner, which links him with W. B. Yeats and the next period of Irish writing.

Prose.—Among the novelists are found Charles Maturin (1782–1824), whose *Melmoth the Wanderer* had a wide influence in Europe. Even better known was Maria Edgeworth (1767–1849) (*q.v.*). In the course of a long and busy life she produced many novels, always with some edifying tendency but none the worse for that. She knew the Ireland of her day well and depicted it with insight and humour in *Castle Rackrent* and *The Absentee.* A landlord's daughter, she believed firmly that the solution of Ireland's troubles lay in the improvement of the outlook of its landlords. Novelists who wrote of country life mainly from the point of view of the tenant were William Carleton (1794–1869), a powerful storyteller though a poor stylist, whose masterpiece is *Fardorougha the Miser;* and the immensely popular Charles Joseph Kickham (1826–82), poet, Fenian and political convict, whose *Knocknagow* was for long Ireland's favourite reading. Other novelists of rural life were Gerald Griffin (1803–40) and the brothers Banim. Lady Morgan (1783–1859) wrote *The Wild Irish Girl* and other novels.

William Hamilton Maxwell (1792–1850) wrote lively stories dealing largely with sport. He inspired the better-known Charles Lever (1806–72). Lever, at one time editor of the *Dublin University Magazine,* wrote a long series of novels, lively and interesting, though often careless. He knew Ireland well and could write seriously enough of Irish matters; but as some of his best-known work is broadly humorous, he has been unjustly accused of ridiculing the nation. Another humorous writer, often mentioned with Lever though not his equal, was the versatile Samuel Lover (1797–1868).

Joseph Sheridan Le Fanu (1814–73) was a successful writer of a different kind. Owner and editor of the *Dublin University Magazine* in the 1860s, he wrote many novels and short stories, chiefly dealing with mystery, crime and the supernatural. He was perhaps the greatest Irish master of the ghost story. *In a Glass Darkly* contains the best of his work of this kind. *Uncle Silas* is his finest novel. He was also a poet, and there is a poetic quality about all his work which raises it far above the commercial thriller.

John Mitchel (1818–75), author of the *Jail Journal,* W. E. H. Lecky, the historian (1838–1903), and Edward Dowden, the critic (1843–1913), were all outstanding 19th-century writers in their several ways. Only the drama produced no outstanding name.

The Literary Renaissance.—Toward the end of the 19th century a new movement in Irish literature became apparent. In fact, such changes came over literature everywhere. In the 1890s two great Irish dramatists appeared, the first for a century: Oscar Wilde (1854–1900), son of Sir William Wilde, a fine writer on Irish antiquities, and Lady Wilde of the *Nation;* and George Bernard Shaw (1856–1950). Neither wrote of or for Ireland, but they were outstanding Irish dramatists in the old Anglo-Irish tradition. Perhaps they were the last of their kind; for a definitely Irish theatre was now arising, as part of a new, consciously Irish literary movement, known as the Irish literary renaissance.

The movement, which was closely allied with a new and strong political nationalism and with a revival of the Irish language, centred from the first around the greatest Irish poet, William Butler Yeats (1865–1939) (*q.v.*), Pre-Raphaelite, theosophist, modernist, but always a thorough Irishman. Though he contributed to the foundation of the first Irish theatre, the Abbey, his dramas were few. He wrote some beautiful plays, but they were not easily produced. His chief colleague at the Abbey was Lady Gregory (1852–1932), who not only took a leading place in the management but also contributed many plays, mostly peasant comedies. The greatest dramatic name of the movement was that of John Millington Synge (1871–1909). He wrote in a peasant dialect, largely of his own invention, and his plays have great beauty and power. His early death was an irreparable loss to Irish drama. Later, the theatre, founded for poetry and noble speech, became absorbed in realism, mostly rural realism. Lennox Robinson (1886–1958) and T. C. Murray (1873–1959) are the most important of the realists, and Sean O'Casey (1884–) replied to peasant realism with his brilliant and moving dramas of the Dublin slums. Subsequently he left Ireland and attempted a kind of symbolical drama with less obvious success. Later dramatists continued to supply plays to the Abbey and its younger rival, the Dublin Gate theatre, and most modern Irish writers occasionally attempted drama. St. John Ervine (1883–) wrote successfully for both the Irish and English theatres.

In poetry, besides Yeats, was George Russell, known as Æ (1867–1935), mystic, patriot and agricultural reformer, who left a large quantity of beautiful if rather vague verse. Also notable were Padraic Colum (1881–), Austin Clarke (1896–), Seumas O'Sullivan (1879–1958), F. R. Higgins (1896–1941) and Oliver St John Gogarty (1878–1957). The Republican movement which led to Irish independence had its poets, P. H. Pearse (1879–1916), Thomas Mac Donagh (1878–1916) and Joseph Mary Plunkett (1887–1916), all executed after the rising of 1916; and a strong sympathizer in Francis Ledwidge (1891–1917), a rural lyricist, though he was killed fighting for England in World War I. More recent poets are numerous, but too many are either a pale reflection of the earlier writers of the literary renaissance, or a still paler reflection of English literary fashions. A very individual writer who went his own delightful way was Lord Dunsany (1878–). He was not only a poet but a prolific and successful writer of novels, plays and short stories.

In the realm of the novel were the historical tales of Emily Lawless (1845–1913) and Standish James O'Grady (1846–1928), while Canon P. A. Sheehan (1852–1913) presented aspects of Irish life through the eyes of an Irish priest. By way of contrast there was George Moore (1852–1933), an imitator of French naturalism, who suddenly attached himself for a time to the Irish cultural movement; his delightfully impudent account of its leading figures in *Hail and Farewell* is on the whole more readable than his over-carefully written novels.

So we come to the amazing productions of James Joyce (*q.v.;* 1882–1941), who made himself and Dublin famous throughout the world. Whatever else may be said of his work, it was redolent of Dublin from end to end. James Stephens (*q.v.;* 1882–1950) wrote fanciful stories as well as verse of some charm. The excellent novels of E. Œ. Somerville (1861–1941) and Martin Ross (1865–1915), some humorous, some tragic, must also be mentioned.

The Moderns.—Of later writers, Liam O'Flaherty (1897–) produced a new and more violent type of fiction, stripping away many of the illusions which enveloped Irish writing, but probably creating a few of his own. When he was not writing sensationally for sensation's sake, his novels and stories were full of power. Brinsley MacNamara (1890–), also a dramatist, wrote tales of the quiet midlands which were original and interesting. Frank O'Connor (1903–) began as a poet, earned distinction as a novelist, but later wrote mainly short stories and articles. Sean O'Faolain (1900–) was equally versatile. His biographical works are outstanding. Elizabeth Bowen (1899–) and Kate O'Brien (1898–) were popular women novelists. Stephen Gwynn (1864–1950) excelled in biography, history and many kinds of writing. His son Denis Gwynn (1893–) followed worthily in his footsteps. (*See* also ENGLISH LITERATURE; POETRY.)

BIBLIOGRAPHY.—S. Gwynn, *Irish Literature and Drama in the English Language* (London, 1936); A. P. Graves, "Anglo-Irish Literature," ch. ix of *Canzbridge History o j English Literature* (Cambridge, 1916); A. de Blacam, *A First Book of Irish Literature* (Dublin and Cork, 1934); St. John D. Seymour, *Anglo-Irish Literature, 1200–1583* (Cambridge, 1929); E. A. Boyd, *Ireland's Literary Renaissance* (1922); U. Ellis Fermor, *The Irish Dramatic Movement* (London, 1939); P. Kavanagh, *The Irish Theatre* (Tralee, 1946); M. Mac Liammoir, *Theatre in Ireland* (Dublin, 1950); L. Robinson, *Ireland's Abbey Theatre* (London, 1951); B. MacNamara, *Abbey Plays, 1899–1948*

(Dublin, 1949); S. J. Brown, *Ireland in Fiction* (Dublin, 1919); *B.* Kiely, *Modern Irish Fiction* (Dublin, 1950); J. Eglinton, *Irish Literary Portraits* (London, 1935); A. Clarke, *Poetry in Modern Ireland* (Dublin, 1951). (LD.)

IRISH MOSS or CARRAGEEN (Irish *carraigeen,* "moss of the rock") a seaweed (*Chondrus crispus*) which grows abundantly along the rocky parts of the Atlantic coast of Europe and North America. In its fresh condition the plant is soft and cartilaginous, varying in colour from a greenish yellow to a dark purple or purplish brown; but when sun-dried and bleached it has a yellowish, translucent, hornlike aspect and consistency. The principal constituent of Irish moss is a gelatinous substance carrageenin. Carrageenin for commercial use is extracted by boiling Irish moss that has been dried to a hornlike aspect and consistency, In Europe, Irish moss used for the extraction of carrageenin is obtained from plants cast ashore. In the United States it is collected from shallow water and dredged with special rakes. Commercial uses of carrageenin include its use as a thickener in calico printing. for clarifying beer and as a suspension medium. One use as a suspension medium is in the preparation of chocolate milk by dairies. (G. M. S.)

IRKUTSK, a city in the East Siberia region, administrative centre of an *oblast* of the same name. in the Russian Soviet Federated Socialist Republic, in latitude 52° 36' N., longitude 104° 10′ E., altitude 1,490 ft. It is situated on the right bank of the Angara river, a tributary of the Yenisei river, 45 mi. below its outflow from Lake Baikal; its suburb Glazkovskoe lies on the left bank, and a pontoon bridge spans the river, which is 630 yd. wide. The railway and station are on the left bank. The Irkut river, from which the town of Irkutsk takes its name. enters the Angara river on its left bank, but is not navigable, and the small Ushakovka river flows through the town and enters the Angara on the right bank. The town grew out of the winter quarters established by Ivan Pokhabov in 1652 for the collection of the fur tax from the Buriats. Its position for trade with China, the Amur region, the Lena gold fields and the fur regions of Siberia made it an important city; its estimated population in 1948 was 300,000. A post road runs north to the Lena and Yakutsk and southeast to Listvenichnoe on Lake Baikal, and other roads link it with the east. The Angara is navigable for steamers to Lake Baikal, though the current is against them. The river is frozen from January to April. The average January temperature is —5.4° F., July 65.1° F.; the average rainfall per annum is 14.5 in. The town is well built with wide streets and has a drainage system and an electric power station. In 1879 fire destroyed many of the public buildings, including the library and museum of the Russian Geographical society which has there the headquarters of its Siberian section, with valuable books, maps and exhibits. The town has long been a cultural centre for the district. It contains schools, a training college for teachers and a Workers' Scientific institute. St. Innocent's monastery, five miles outside the town, influenced much of eastern Siberia. Its industries include brewing. timber milling. flour milling, leather works, the making of fur and sheepskin coats and various small articles especially for the posting routes. It was a storm centre from 1918 to 1921, and much damage was then done to the town and railway. The state gold treasure, which had been removed from Leningrad under the charge of employees of the tsarist regime. was handed over by them to the Bolshevists in Irkutsk in 1920; and Admiral Kolchak was executed there in the same year. The town was in tsarist times the centre of the Irkutsk province, an area occupying 287,061 sq.mi., but is now only the centre of one of the 20 counties of the Siberian area (*q.v.*).

IRMIN or IRMINUS, in Teutonic mythology, a deified eponymic hero of the Herminones. The chief seat of his worship was Irminsal, or Ermensul. in Westphalia. Wooden pillars raised to his honour were regarded as sacred by the Saxons.

IRON ranks second in abundance among the metals and fourth in abundance among the elements. The earth's core is largely metallic iron. but in the crust the element has had an opportunity to react with other substances and the free metal is rarely found except in meteorites or disseminated as minute speculae in basaltic rocks. Iron is a constituent of hundreds of mineral species; small amounts are found also in water, plants and blood.

Meteors are composed chiefly of iron, and tools and weapons were made from this by primitive man. The Aztecs had implements made of meteoric iron before the coming of the white man, and prized this metal above gold. In general use, however, bronze tools and weapons came long before iron ones, the smelting of copper being an easier process than that of iron. The metallurgy of iron is believed to have been developed in western Asia in the 2nd millennium B.C., spreading in waves that reached other regions at intervals centuries apart.

The Assyrians and Egyptians made considerable use of iron. In Gen. iv. 22, Tubal-cain is mentioned as an instructor of workers in iron and copper; and iron was utilized to make tools and weapons in the time of David. The Dorian invaders. who were the forerunners of the classic Greeks, were equipped with iron tools and weapons, Homer speaks of a ball of iron as the prize awarded to Achilles for athletic prowess. The Greeks obtained ores from the south coast of the Black sea, and the Romans from Spain and Elba; evidently there were earlier sources in India.

Igneous rocks contain an average of 5.01% of iron. The important ores are the oxides and carbonates from which the metal is obtained by smelting with carbon.

This is done commercially by blowing heated air through a mixture of ore, coke and limestone in a blast furnace under conditions where a maximum temperature of about 1,300° C. is reached. The crude metal obtained is called cast iron or pig iron and contains various impurities; carbon, silicon. sulfur, manganese and phosphorus are most important. Steel and wrought iron are made by oxidizing the impurities in pig iron with air or ferric oxide at high temperatures and collecting them in a suitable flux to obtain the required degree of purification. Commercial production and industrial uses of these materials are treated under IRON AND STEEL, this article being limited to a general description of the properties of the element and its important compounds.

Iron, as commonly available, nearly always contains small amounts of carbon, which modify its properties. It may be prepared by passing hydrogen over purified iron compounds (the oxides for example) at high temperature or by electrodeposition from solutions of iron salts.

PHYSICAL PROPERTIES

Iron is tetramorphous. The delta form exists above 1,400° C., at which temperature there is a transition to gamma iron. The latter has a face-centred cubic lattice, is weakly paramagnetic and forms solid solutions with iron carbide (Fe_3C); this property is of importance in the preparation of steel. At 89j° C. there is a transition to beta iron. This form is body-centred cubic, weakly paramagnetic and stable down to 766° C., where alpha iron is obtained. The body-centred cubic lattice is retained in this transition but alpha iron is strongly paramagnetic, indicating a definite change in electronic structure in going from beta iron to alpha iron. In the alpha form, iron is a soft, ductile. gray-white metal of high tensile strength.

Values for some of the physical properties of the pure metal are given in the accompanying table.

Physical Properties of Iron

Coef. expansion; cubic 0° to 100° C. ..... 0.04355/° C.	Tensile strength annealed wire ..... 50–60 × 10^3 lb./sq. in.
Electrode potential $Fe=Fe^{++}+2e$ 25° C. .... +0.440 v.	Boiling point ..... 2,73j° C.
Ionization potential of gas atom ..... 7.83 v.	Density 20° C. ..... 7.86 g./ml.
Resistivity 20° C. ..... 0.04100 ohm-cm.	Melting point ..... 1,530° C.
	Radius of Fe^{++} ..... 0.7j A
	Specific heat (average 0° to 100° C.) .. 0.11 cal./° C.

CHEMICAL PROPERTIES

Iron, the metallic chemical element of atomic number 26, symbol Fe, has an atomic weight of 55.85, which represents a mixture of the isotopes 56, 54, 57 and 58 in that order of abundance. Radioactive isotopes with mass numbers j3, 55 and 59 have been prepared.

Iron is a member of the first transition series, in which the electrons in the third level increase from 8 to 18, and has the following outer electron arrangement: $3d^6$, $4s^2$.

The properties of iron are similar to those of the other transition elements, particularly cobalt and nickel. Iron is also related to ruthenium and osmium, the corresponding elements in the second and third transition series. In common with the other transition elements in this series?it readily loses its 4s electrons to form the +2 oxidation state shown in ferrous iron. The properties of ferrous ion are similar to those of the other +2 ions in the series and it resembles manganous ion, particularly, in the solubilities of its compounds. Ferric iron, the +3 oxidation state, is readily obtained and the ion resembles the chromic ion in the solubilities of many of its salts. The +4 state is realized in perferrite, FeO_3^{--}, and the +6 state in ferrate, FeO_4^{--}, both being obtained by the action of strong oxidizing agents in alkaline media. Only a limited number of ferrites and ferrates are known and the most important oxidation states of iron are the +2 and +3.

The Metal.--In accordance with the potential given in the table, metallic iron acts as a strong reducing agent. Solutions containing the ions of gold, platinum, silver, mercury, bismuth and copper are reduced by iron to yield the metal in each case. In contact with nonoxidizing acids, iron dissolves by reducing hydrogen ion to hydrogen gas, forming ferrous ion. Since the metal reduces ferric to ferrous ion, moderately strong oxidizing agents produce ferrous ion if the metal is in excess and ferric if the oxidizing agent is in excess. Iron combines directly with most of the nonmetals at moderate temperatures and may be made to "burn" in many of these cases because of the large amounts of heat evolved in the reactions. Upon immersion in concentrated nitric acid, which does not dissolve it, iron is made "passive" and will not dissolve in dilute acids nor in the metal ion solutions listed above. This phenomenon is shown by other transition metals such as chromium, molybdenum, cobalt and nickel in this series and by many other metals. In general, passivity is produced by the action of strong oxidizing agents, including anodic polarization, and may be destroyed by the action of reducing agents, by scratching the surface. or by specific agents in particular cases. It is apparently caused by the formation of surface oxide films and is useful in controlling corrosion.

Under the usual atmospheric conditions iron rusts to form hydrated ferric oxides. This process occurs in two steps: first, iron dissolves in the acid solution provided by the moisture and the carbon dioxide of the air to form ferrous ion and liberate hydrogen; second, oxygen from the air oxidizes the ferrous ion to form hydrated ferric oxides. The first step is slow with pure iron but is catalyzed by many impurities which facilitate the liberation of hydrogen from the metal surface. (See CORROSION AND OXIDATION OF METALS.) Iron reacts with steam to produce hydrogen and ferroferric oxide, or ferrous oxide if the temperature is above about 570° C. Ammonia acts on iron at high temperatures to form hydrogen and the nitride Fe_2N. Carbon dioxide is reduced by the metal at elevated temperatures to carbon monoxide with the formation of ferrous oxide.

Properties of Ferrous and Ferric Ions.—Ferrous ion is pale green in solution and in most of its hydrated salts. Solutions of ferrous ion are only slightly hydrolyzed since ferrous hydroxide is a fairly strong base. The electrode potential of the ferrous, ferric couple is −0.77 v. at 25° C., and solutions of ferrous ion are unstable with respect to air oxidation. Common reagents used to oxidize it to ferric are permanganate, dichromate, peroxide. bromine and nitric acid. Ferrous ion may be precipitated from approximately neutral solution as the sulfide, hydroxide, phosphate, arsenate, carbonate and oxalate; the ferricyanide may be precipitated from acid solution. In strongly acid solution ferric ion is yellow; as the acidity is decreased, hydrolysis occurs to an increasing degree, forming basic ions and colloidally dispersed hydrated ferric oxide, which colour the solution brownish yellow. There is little tendency to form acid ions even in strongly basic media although many compounds contain the +3 state as ferrite, FeO_2^-. Ferric ion is commonly reduced to ferrous by sulfide, sulfite, stannous chloride, zinc amalgam, hydroxylamine and iodide. It may be precipitated from weakly acid solution as the hydroxide, ferrocyanide, phosphate, arsenate, and by the formation of salts with many organic compounds.

In addition to forming simple salts, where the valence and the oxidation number are equal, ferrous and ferric iron form many complex compounds and ions in which the co-ordination number is six; that is, where there are six atoms or groups attached to the metal ion. Simple examples of such complex formation are ferrocyanide $Fe(CN)_6^{-4}$ and ferricyanide $Fe(CN)_6^{-3}$ ions.

The formation of complexes is common to almost all of the ions that have more than eight electrons in their outer shell and is associated with the existence of partially occupied orbitals of closely related energies that can be used to accept electron pairs from various atoms or groups. In the case of ferric and ferrous iron six pairs of electrons can be so shared by using the vacant 3d (two), 4s (one) and 4p (three) orbitals, giving the co-ordination number of six, independent of the oxidation state of the iron. Complexes are formed with iron in which the type of binding of the complexing groups is ionic as well as covalent. Ferric iron forms complex ions with such inorganic groups as water. ammonia, cyanide, fluoride, chloride and thiocyanate and with such organic ions as oxalate, citrate, tartrate, tannate and gallate, to mention only a few. In addition there are an extremely large number of chelate compounds formed with organic molecules in which each of the organic molecules is bound to the iron through two of its atoms, making use of both valence and co-ordination bonds. Most of these compounds are very stable and are soluble in organic solvents but not soluble in water. Many of the organic reagents such as cupferron, orthophenathroline, 8-hydroxyquinoline and dipyridil, used in analysis for iron, form such chelate compounds; ferric and ferrous hemoglobin, so important in blood, are of this type.

See CO-ORDINATION COMPOUNDS.

COMPOUNDS OF IRON

Oxides, Hydroxides and Acids.—Iron forms three oxides: ferrous oxide, FeO; ferric oxide, Fe_2O_3; and ferroferric oxide, Fe_3O_4. It also forms ferrites, perferrites and ferrates which may be regarded as salts of the potential acids, ferrous, $HFeO_2$; perferrous, H_2FeO_3; and ferric, H_2FeO_4.

Ferrous oxide is a black pyrophoric powder readily soluble in acids. It may be obtained by reducing ferric oxide in hydrogen or by the action of steam, carbon dioxide or oxygen on iron at high temperatures.

Ferrous hydroxide is precipitated from neutral or basic, air-free solutions as a white flocculent material that is rapidly oxidized by air to become green and finally reddish brown as ferric oxide is formed. It readily absorbs carbon dioxide to form ferrous carbonate and is easily dissolved in acids.

Ferric oxide or iron sesquioxide exists in several anhydrous and hydrated forms including the important ores hematite and specular iron; the minerals limonite and goethite; and iron rust. It is obtained as a steel-gray powder by igniting almost any ferric compound in air; when finely powdered, the ignited material appears brownish red. After ignition it dissolves extremely slowly in acids, hydrochloric acid in combination with a reducing agent being the best solvent. The finely divided oxide is used as an abrasive called "iron rouge" and as pigment, venetian red.

Ferric hydroxide is not simply characterized since hydrated ferric oxides of various structures and compositions are included by the name. It precipitates as a red-brown gelatinous material that is difficult to filter and tends to form stable colloidal dispersions that are usually positively charged. Among structures that have been characterized by X-ray patterns are alpha Fe_2O_3 hydrate, precipitated as a brown gel by the addition of alkalies to ferric solutions; beta Fe_2O_3 hydrate, formed by the hydrolysis of ferric chloride solutions; and gamma Fe_2O_3 hydrate, obtained under certain conditions when ferrous is oxidized to form ferric hydroxide. The freshly precipitated forms are readily soluble in acids but become more difficult to dissolve if they are partially dehydrated There is only a slight solubility in strong bases with the formation of ferrite ion, FeO_2^-. Purified colloidal ferric hydroxide is used in medicine as "dialyzed iron."

Ferrites may be prepared by fusing ferric oxide with basic oxides to form such compounds as sodium ferrite, $NaFeO_2$. Magnesium ferrite occurs as the mineral magnoferrite, and zinc ferrite occurs as franklinite; iron commonly occurs as ferrite in many complex minerals. The important mineral magnetite is ferrous ferrite. $Fe(FeO_2)_2$.

Ferroferric oxide, mentioned above as ferrous ferrite and magnetite, is always attracted by a magnet and is frequently magnetic; specimens in the latter case are loadstones. The compound is most simply obtained by passing steam over red-hot iron and is commonly observed as mill scale in the fabrication of iron and steel. It dissolves in acids forming ferric and ferrous ions in the ratio of 2 to 1 and a brown hydrated form may be precipitated from such a solution by the addition of alkali.

Perferrites of barium ($BaFeO_3$) and strontium ($SrFeO_3$) have been prepared by heating a mixture of barium hydroxide or strontium hydroxide and ferric oxide in a stream of oxygen. Water decomposes these compounds with the liberation of oxygen.

Ferrates are formed by strong oxidizing agents acting on iron ions in fused alkali or in concentrated alkaline solutions. Thus chlorine acts on a suspension of ferric hydroxide in concentrated potassium hydroxide to form an amethyst or purple-red solution of potassium ferrate. The addition of barium ion to this solution precipitates barium ferrate. $BaFeO_4.H_2O$, as a dark red powder. Barium ferrate is fairly stable. It dissolves in acetic acid to form a red solution, is not attacked by cold sulfuric acid but evolves chlorine and oxygen from cold hydrochloric acid.

Arsenides, **Arsenites, etc.**—Several iron arsenides occur as minerals; mispickel or arsenical pyrites, Fe_2AsS_2, is an important commercial source of arsenic. A basic ferric arsenite, $4Fe_2O_3.As_2O_3.5H_2O$, is obtained as a flocculent brown precipitate by adding an arsenite to ferric acetate or by shaking freshly prepared ferric hydrate with a solution of arsenious oxide. The last reaction is the basis of the application of ferric hydrate as an antidote in arsenical poisoning. Korma! ferric arsenate, $FeAsO_4.2H_2O$, constitutes the mineral scorodite.

Carbides, Carbonates, Carbonyls, Cyanides.—The importance of the carbide Fe_3C, cementite, in the manufacture of steel is treated under IRON AND STEEL. (See also CARBIDES.)

Ferrous carbonate, $FeCO_3$ occurs as the mineral siderite or spathic iron ore. It is precipitated from ferrous solutions, by the addition of a soluble carbonate, as a white flocculent material that rapidly oxidizes in air to become green and finally brown as ferric salts form. It is readily soluble in acids. Ferric carbonate cannot be precipitated from solution because of hydrolysis which leads to the formation of ferric hydroxide and basic carbonates.

Carbonyls of iron form an interesting group of compounds. Finely divided iron slowly reacts with carbon monoxide to form ferropentacarbonyl, $Fe(CO)_5$, which distills off at 120° C. It is a pale yellow liquid which freezes at −21° C., boils at 102° C., decomposes above 200° C. and is decomposed by air and moisture. When ferropentacarbonyl is dissolved in a base, the carbonate and the ion $Fe(CO)_4^{--}$ form, the latter being the anion of the acid carbonyl hydride, $Fe(CO)_4H_2$. Carbonyl hydride is formed when the solution is acidified in the cold. Upon oxidation with hydrogen peroxide, carbonyl hydride yields $Fe_3(CO)_{12}$. In sunlight the pentacarbonyl loses carbon monoxide to form the nonacarbonyl, $Fe_2(CO)_9$, and upon heating the tetracarbonyl, $Fe_3(CO)_{12}$, is obtained. The nitrosocarbonyl, $Fe(CO)_2(NO)_2$, is also known.

For the relation of these compounds to the other carbonyls see CARBONYLS, METAL.

Cyanides.—The very stable complexes ferrocyanide, $Fe(CN)_6^{-4}$, and ferricyanide. $Fe(CN)_6^{-3}$, are formed in excess cyanide and are not decomposed even in strong acid solutions. The ferrocyanide, ferricyanide potential is about −0.4 v., so that the oxidation and reduction of these ions is easily accomplished by many of the common oxidizing and reducing agents. Sodium and potassium ferrocyanides are obtained as by-products in the distillation of coal, after absorbing the evolved hydrogen cyanide in iron oxide "purifiers" Potassium ferrocyanide is commonly called yellow prussiate of potash and the ferricyanide, red prussiate of potash.

Addition of ferric ion to a solution of ferrocyanide first yields soluble prussian blue, $KFeFe(CN)_6$, and then $Fe_4[Fe(CN)_6]_3$, which is the insoluble pigment prussian blue. Many metal ions such as zinc, uranyl and copper form insoluble ferrocyanides of analytical use. Ferrous ion forms a white precipitate ferrous ferrocyanide. With ferricyanide, ferric ion forms a brown soluble ion and ferrous ion forms Turnbull's blue, $Fe_3[Fe(CN)_6]_2$, which is insoluble. In both ferrocyanide and ferricyanide, one of the cyanide groups can be replaced by other groups such as nitrite oxide, carbon monoxide. sulfite, nitrite or ammonia to form complex pentacyanides. The compound $Na_2FeNO(CN)_5$, sodium ferrinitrosopentacyanide (often called sodium nitroprusside), is used as a test for sulfide in basic solution where an intense blue colour is produced.

Blueprint paper is made by treating paper with ammonium ferricyanide and ferric citrate. Upon exposure to light the ferric ion is reduced by citrate to ferrous which then reacts with the ferricyanide to form insoluble prussian blue. The paper may then be developed by washing out the unchanged ferricyanide and ferric salts with water. (See also PRUSSIC ACID.)

Halides of ferrous ion have the general formulas FeX_2, where X represents any of the halogens. They can be prepared by passing the halogen acid, HX, over metallic iron or by reaction of excess metal with the halogen. X_2, under controlled conditions. The anhydrous salts are very hygroscopic, form a series of hydrates and, with the exception of the fluoride, $FeF_2.8H_2O$, are very soluble in water. The hydrated salts may be prepared by dissolving the metal in aqueous halogen acid solution from which the salts can then be crystallized. The anhydrous salts absorb ammonia to form ammoniates corresponding to their absorption of water to form hydrates.

Ferric iodide does not exist. The other ferric halides, FeX_3, can be made by the action of the halogens on the metal, and the hydrated salts can be crystallized from solutions made by dissolving freshly precipitated ferric hydroxide in aqueous halogen acids. The anhydrous salts are hygroscopic and are quite soluble in water. Ferric ion forms complex ions with the halides and many of the corresponding complex salts are known such as K_3FeF_6, $(NH_4)_3FeCl_6$, etc.

Pharmacopoeia1 forms of the halides include *syrupus ferri* iodide, a dilute solution of ferrous iodide, and liquor ferri chloridi, a strong solution of ferric chloride.

Hydrides of iron do not form as definite compounds but the metal does dissolve hydrogen and some of the other gases to form solutions. The solubility of hydrogen in iron increases from roughly 0.03 vol. of hydrogen per volume of iron at 400° C. to one volume per volume at the melting point. Iron is permeable to hydrogen at high temperatures. Electrolytic iron contains dissolved hydrogen which can be removed in a vacuum. See also HYDRIDES.

Nitrides, Nitrates, **etc.**—Several nitrides are known. A. N. Guntz obtained ferrous nitride, Fe_3N_2, and ferric nitride, FeN, as black powders by heating lithium nitride with ferrous potassium chloride and ferric potassium chloride, respectively. G. J. Fowler obtained a nitride, Fe_2N, by treatment of anhydrous ferrous chloride or bromide with ammonia at 460° C.; reaction of ammonia with finely divided reduced iron; or by the reaction of iron amalgam with ammonia at 420° C.; and also, in a compact form, by the action of ammonia on red-hot iron wire. It oxidizes on heating in air and ignites in chlorine; on solution in mineral acids it yields ferrous and ammonium salts, hydrogen being liberated. (See NITRIDES.) Ferrous nitrate, $Fe(NO_3)_2.6H_2O$, is a very unstable salt and is obtained by mixing solutions of ferrous sulfate and barium nitrate, filtering and crystallizing in a vacuum over sulfuric acid. Ferric nitrate, $Fe(NO_3)_3$, is obtained by dissolving iron in nitric acid (the cold dilute acid leads to the formation of ferrous and ammonium nitrates) and crystallizing, when cubes of $Fe(NO_3)_3.6H_2O$ or monoclinic $Fe(NO_3)_3.9H_2O$ crystals are obtained. It is used as a mordant.

Ferrous solutions absorb nitric oxide, forming dark green to black solutions which contain the ferronitroso ion, $FeNO^{++}$. The reaction is utilized in the brown ring test for nitrates. Red-

dish-brown amorphous powders of the formulas $2FeCl_3.NO$ and $4FeCl_3.NO$ are obtained by passing the gas over anhydrous ferric chloride. By passing the gas into an ethereal solution of the salt, nitrosyl chloride is produced, and on evaporating over sulfuric acid, black needles of $FeCl_2.NO.2H_2O$ are obtained, which at 60° C. form the yellow $FeCl_2.NO$. Complicated compounds discovered by O. Pavel are obtained by the interaction of ferrous sulfate and alkaline nitrates and sulfides. Two classes may be distinguished: (1) the ferrodinitroso salts, *e.g.*, $K[Fe(NO)_2S]$, potassium ferrodinitrososulfide; and (2) the ferroheptanitroso salts, *e.g.*, $K[Fe_4(NO)_7S_3]$, potassium ferroheptanitrososulfide. These salts yield the corresponding acids with sulfuric acid.

Phosphides, Phosphates. — H. le Chatelier and S. Wologdine obtained Fe_3P, Fe_2P, FeP and Fe_2P_3, but failed to prepare five other phosphides previously described. Fe_3P occurs as crystals in the product of fusing iron with phosphorus; it dissolves in strong hydrochloric acid. Fe_2P forms crystalline needles insoluble in acids except aqua regia; it is obtained by fusing copper phosphide with iron. FeP is obtained by passing phosphorus vapour over Fe_2P at a red heat. Fe_2P_3 is prepared by the action of phosphorus iodide vapour on reduced iron. Ferrous phosphate occurs in nature as the mineral vivianite, $Fe_3(PO_4)_2.8H_2O$. It may be obtained artificially as a white precipitate, which rapidly turns blue or green on exposure, by mixing solutions of ferrous sulfate and sodium phosphate. It is employed in medicine. Normal ferric phosphate, $FePO_4.2H_2O$, occurs as the mineral strengite, and is obtained as a yellow-white precipitate by mixing solutions of ferric chloride and sodium phosphate. It is insoluble in dilute acetic acid but dissolves in mineral acids. The acid salts $Fe(H_2PO_4)_3$ and $2FeH_3(PO_4)_2.5H_2O$ have been described. Basic salts have been prepared and several occur in the mineral kingdom; dufrenite is $Fe_2(OH)_3PH_4$. See PHOSPHORIC ACIDS AND PHOSPHATES.

Sulfur Compounds. — Ferrous sulfide, FeS, results from the direct union of its elements. It is best prepared by stirring molten sulfur with a white-hot iron rod; the sulfide drops to the bottom of the crucible. It then forms a yellowish crystalline mass, which readily dissolves in acids with the liberation of hydrogen sulfide "gas." Heated in air it at first partially oxidizes to ferrous sulfate, and at higher temperatures it yields sulfur dioxide and ferric oxide. It is unaltered by ignition in hydrogen. A black finely divided form results when ferrous salts are precipitated by ammonium sulfide.

Ferric sulfide, Fe_2S_3, is obtained by gently heating a mixture of its constituent elements. or by the action of hydrogen sulfide gas on ferric oxide at temperatures below 100° C. It is also prepared by precipitating a ferric salt with ammonium sulfide; unless the alkali be in excess a mixture of ferrous sulfide and sulfur is obtained. Magnetic pyrites or pyrrhotite has a composition varying between $5FeS.Fe_2S_3$ and $6FeS.Fe_2S_3$. It has a somewhat brassy colour, and occurs massive or as hexagonal plates; it is attracted by a magnet and is sometimes itself magnetic. The mineral is abundant in Canada, where the presence of about 5% of nickel makes it a valuable ore of this metal. Iron disulfide, FeS_2, is found as the mineral pyrite, which is important as a source of sulfuric acid, and also as the mineral marcasite (*q.v.*); the formula of copper pyrites is $(Cu,Fe)S_2$ Pyrite may be prepared artificially by gently heating ferrous sulfide with sulfur, or as brassy octahedra and cubes by slowly heating an intimate mixture of ferric oxide, sulfur and salammoniac. It is insoluble in dilute acids, but dissolves in nitric acid with separation of sulfur.

Ferrous sulfate, green vitriol or copperas, $FeSO_4.7H_2O$, was known to and used by the alchemists; it is mentioned in the writings of Agricola, and its preparation from iron and sulfuric acid occurs in the Tractatus *chymico-philosophicus* ascribed to Basil Valentine. It occurs in nature as the mineral melanterite, either crystalline or fibrous but usually massive; it appears to have been formed by the oxidation of pyrite or marcasite. It is manufactured by piling pyrites in heaps and exposing them to atmospheric oxidation. the ferrous sulfate thus formed being dissolved in water and the solution run into tanks where any sulfuric acid which may be formed is decomposed by adding scrap iron. By evaporation the green vitriol is obtained as large crystals. Ferrous sulfate forms large green crystals belonging to the monoclinic system; rhombic crystals, isomorphous with zinc sulfate, are obtained by inoculating a solution with a crystal of zinc sulfate, and triclinic crystals of the formula $FeSO_4.5H_2O$ by inoculating with copper sulfate. By evaporating a solution containing free sulfuric acid in a vacuum, the heptahydrated salt first separates, then the penta-, and then a tetrahydrate, $FeSO_4.4H_2O$, isomorphous with manganese sulfate. By gently heating in a vacuum to 140° C., the heptahydrate loses six molecules of water and yields a white powder, which on heating in the absence of air gives the anhydrous salt. The monohydrate also results as a uhite precipitate when concentrated sulfuric acid is added to a saturated solution of ferrous sulfate. Ferrous sulfate forms double salts with the alkaline sulfates. The most important is ferrous ammonium sulfate, $FeSO_4.(NH_4)_2SO_4.6H_2O$, obtained by dissolving equivalent amounts of the two salts in water and crystallizing. It is very stable and is used in volumetric analysis. It is often called Mohr's salt.

Ferric sulfate, $Fe_2(SO_4)_3$, is obtained by adding nitric acid to a hot solution of ferrous sulfate containing sulfuric acid, colourless crystals being deposited on evaporating the solution. The anhydrous salt is obtained by heating these or by adding strong sulfuric acid to a solution. It is sparingly soluble in water, and on heating it yields ferric oxide and sulfur dioxide. Many basic ferric sulfates are known, some of which occur as minerals. The iron alums are obtained by crystallizing solutions of equivalent quantities of ferric and an alkaline sulfate Ferric potassium sulfate, common iron alum, $K_2SO_4.Fe_2(SO_4)_3.24H_2O$, forms bright violet octahedra.

Analytical. — The common qualitative tests for iron are: the formation of Turnbull's blue when a soluble ferricyanide is added to ferrous ion; the formation of prussian blue when ferric ion is precipitated by the addition of a soluble ferrocyanide; the formation of an intense red colour when a soluble thiocyanate is added to ferric ion. In the usual systematic scheme of qualitative analysis iron is precipitated as ferrous sulfide as a member of the ammonium sulfide group of elements.

Quantitative methods for the gravimetric determination of iron include precipitation as ferric hydroxide with ammonia and ignition to ferric oxide, precipitation by cupferron and ignition of the cupferride to ferric oxide. These methods require that the iron be previously separated from a larger number of other metals which would also be precipitated under the conditions required. Accurate volumetric methods for iron involve a reduction to the ferrous state by the use of stannous chloride or zinc amalgam and a titration of the ferrous iron using such oxidizing agents as permanganate, dichromate or ceric ion. A titration of ferric ion with standard titanous solution is sometimes made. Small amounts of iron are determined colorimetrically, and a large number of organic reagents are known which yield intensely coloured compounds; orthopenanthroline, which forms a coloured compound with ferrous iron, is commonly used in the colorimetric determination of small amounts of the element.

The thiocyanate reaction is also of use in estimating iron colorimetrically.

Therapeutics. — Although elementary iron comprises only an estimated 0.004% of the average adult body weight, it is an essential element in the body. An intake of 10–20 mg. of iron per day appears to meet the normal metabolic requirements of the average adult. Red meats, egg yolk, carrots, fruits, whole wheat and green vegetables contribute most of the iron in the usual diet. The largest portion (about 55%) of total body iron is found in the red blood cells as an essential constituent of hemoglobin. About 20% of the total is stored in such organs as the liver and spleen, and in bone marrow, to be readily available for conversion to hemoglobin as needed. Except for a small fraction in blood plasma and some iron that is unassociated with hemoglobin in erythrocytes, the remainder is found as muscle hemoglobin, in striated muscle, and as "parenchyma iron" in striated muscle and in almost all other tissue.

Both ferrous and ferric iron form metalloporphyrins in which

the iron atom is bound to the four nitrogen atoms in the centre of the flat porphyrin ring. The particular metalloporphyrin obtained from protoporphyrin and ferrous ion is heme, $C_{34}H_{33}N_4O_4FeOH$. Heme combines with various proteins, presumably by the interaction of the iron atom in the heme with protein nitrogen atoms to establish the maximum co-ordination number of six for the iron. If the protein is globin the resultant molecule is hemoglobin, while other specific proteins give rise to such important enzymes as catalase, cytochrome, peroxidase and Warburg's respiratory enzyme. Hemoglobin, represented as Hb, reacts with oxygen to form oxyhemoglobin, HbO_2, in an amount that is proportional to the pressure of oxygen, until a maximum of about 1.36 c.c. of O_2 gram of Hb has reacted. This is an entirely reversible process and the oxygen taken up to form the equilibrium amount of HbO_2 at some particular Pressure of oxygen will be given up by the HbO_2 if the oxygen pressure is reduced to its original value. It is by the use of this property that hemoglobin functions as an oxygen carrier in the body. The most important therapeutic use of iron is in the treatment of hypochromic anemias, which are commonly the result of an iron deficiency that impairs the formation of hemoglobin and may impair other functions of the red blood cells. Iron is of little value in the treatment of normochromic and hyperchromic anemias which are not caused by iron deficiency. Any of a large number of iron compounds may be used to supply the element in therapy, and inorganic salts are as effective as organic compounds for the purpose. Among the commonly used preparations are: reduced iron, U.S.P.; iron and ammonium citrates, U.S.P.; ferrous sulfate, U.S.P.; ferrous carbonate as Blaud's pills, U.S.P.; or as mass of ferrous carbonate, U.S.P.; ferric pyrophosphate, N.F.; ferrous glutinate and ferrous gluconate.

Soluble ferric salts find a very limited use in the treatment of skin disorders. They are protein precipitants and can produce astringent and irritant effects on the skin and mucous membranes.

BIBLIOGRAPHY.—Louis Goodman and Alfred Gilman, *The Pharmacological Basis of Therapeutics* (1941); Roy K. McAlpine and Byron A. Soule, *Fundamentals of Qualitative Chemical Analysis* (1936); H. J. Emeléus and J. S. Anderson, *Modern Aspects of Inorganic Chemistry* (1938); Wendel M. Latimer and Joel H. Hildebrand, *Reference Book of Inorganic Chemistry* (1940); Fritz Ephraim, *Inorganic Chemistry*, trans. by P. C. L. Thorne and E. R. Roberts (1943).

(E. F. O.)

IRON AGE: *see* ARCHAEOLOGY.

IRON AND STEEL. Iron is the most useful metal of material civilization; it means plants, tools, machinery. It is principally used nhen alloyed with other elements, notably carbon; a moderate amount produces steel, an excess produces cast iron. Many special steels for particular uses have been devised in recent years; these steels contain a proportion of other metals, such as manganese or chromium (resulting in manganese steel, or chromium steel in these two cases, for instance). About 164,000,000 net tons of pig iron and 232,000,000 net tons of steel were made in 1952—a fairly active year.

Outline of Manufacturing Process.—The source of commercial iron and steel is the oxide ores of iron, occurring in great abundance in all continents. Ore is charged into the top of a shaft-like blast furnace together with coke and some limestone. Hot air is blown into this furnace near the bottom, burning the coke and furnishing the gases and heat necessary to reduce the iron oxide to molten iron metal; trickling down over the nhite hot coke it absorbs an excess of carbon; drained from the bottom is the impure high-carbon alloy pig iron, which is merely remelted and cast into moulds to form the familiar iron castings of commerce. Limestone is charged into the furnace to convert earthy minerals mixed with the iron ore (gangue) and the coke ash into a fusible slag; this is also drained periodically from the furnace hearth. The blast furnace therefore operates continuously; solids are charged at the top, liquid iron and slag are drawn from the bottom.

To change pig iron into steel two methods are used extensively, the Bessemer converter and the Siemens-Martin open-hearth furnace. The converter is a brick-lined vessel, with perforations in the bottom through which air is blown. Into this vessel some molten pig iron is charged, and the air blowing through the metal burns out the carbon and some of the other impurities; at these high temperatures there is a pronounced selective action so that relatively little of the iron is burned. Combustion of these impurities furnishes the necessary heat to maintain operations. At the end of the blow, a matter of ten to 15 min., the purified metal is dumped into a ladle, and an alloy of manganese and iron known as spiegel is added to degasify the melt, whereupon the finished steel is poured into ingot moulds. Refining pig iron in an open-hearth furnace is a much more deliberate process, requiring about 10 hours. The furnace is a flat shallow basin with a low roof. At either end are ports through which fuel and hot air enter; the flame sweeps through. out the ports at the other end, and thence into chambers filled with checker brick to absorb some of the waste heat. At intervals the flow of gases is reversed by suitable valves thus returning the recovered heat to the furnace hearth. Scrap and pig iron are placed in the furnace through side doors, and melted down. Iron ore and limestone are also added, and a series of chemical reactions takes place between the iron oxide and the impurities in the metal; the latter either vanish as gases or accumulate in a scum of thin slag. When the reactions are complete the bath is tapped into a ladle from which the slag overflows, and the finished steel is then cast into ingots. Ingots are squat prisms of steel and are given marketable shape in the rolling mills. By successively passing between rolls with steadily diminishing apertures, bulky ingots are converted into long rods, bars, plates, rails or various structural shapes. Rather thicker bars are known as billets and are used in forge shops for hammering out more intricate pieces of nonuniform cross section. Specially shaped rolls and auxiliary machinery also convert bars into sheet steel, plate into pipe, and rods into wire products.

EARLY HISTORY

Antiquity of Iron.—Few implements of iron or steel survive for many years before they rust away, consequently there is little direct evidence to prove the point; nevertheless the antiquity of iron smelting is great. It doubtless has been discovered and rediscovered many times; explorers reaching primitive peoples in many parts of the world find the native blacksmith using methods very similar to those known to other tribes at far distant times and places. An iron blade, probably 5,000 years old, has been found in one of the Egyptian pyramids. Even without this discovery one could plausibly maintain that the ancient Egyptians *must* have had skilled steel workers in order to have built the great pyramids and other monumental architecture, to say nothing of the statuary and hieroglyphics cut into the hardest rocks. Steel working and hardening, an advanced stage in the art which doubtless required centuries to reach, was common 3,000 years ago in Greece, and is mentioned in Homer. It is more probable that iron was first found in the ashes of a big fire built near some red paint rock than that the first tools were made from meteorites. When paint rock and fire came to be associated with iron as cause and effect, the next step was to produce it intentionally in fires built against a bank exposed to prevailing winds, or in pits or rude rock furnaces where the fires were fanned by bellows, one of the earliest mechanical devices.

These are the primitive methods which survive today in the Catalan forge (see FURNACE, METALLURGICAL): a mixture of charcoal and iron ore, selected for its purity, is heated intensely for several hours, with fuel additions made from time to time, and a vigorous blast of air fanning the fire. The iron ore becomes an incandescent sponge of metal; the clay or other minerals mixed with the iron oxide together with the charcoal ash sinter into a slag, permeating the sponge and protecting the reduced iron from further action. After a given time, the furnace is broken into. the glowing ball of iron pulled out, and, while white hot, hammered vigorously to expel as much of the slag as possible and to weld the particles of metal into a coherent mass.

Steel from Indirect Processes.—With various changes in the furnace details, and in methods of producing the air blast, these methods produced all the iron available from the beginning up to the 14th century. It was truly a *wrought* iron, the best product containing no more than 0.1% of total impurities alloyed with the

metal, but shot through with microscopic slag particles, aggregating 3% or more of the total ueight. Steel was made sometimes as an accidental product in the old forges; by design the wrought iron bars would be packed nith charcoal in clay boxes or jars and heated for days, nhereupon the iron absorbed enough carbon to become steel and thus acquired the superior hardness and strength necessary for keener tools.

As the demand for iron grew, the furnaces became bigger, and a stronger blast of air was required to drive the products of combustion from the bottom up through the mixed charge. It resulted that the iron ore nas reduced to spongy metal in the upper part of the furnace, and it then proceeded to absorb more carbon as the charge settled down, thereby converting itself to pig iron, a much more readily fusible alloy. The bigger, taller furnaces introduced in the early 14th century therefore produced liquid pig iron, a complex alloy of iron, carbon and other elements. Subsequent developments have been along three main lines: (1) increasing the size of the furnace and developing mechanical auxiliaries to produce pig iron more economically and in greater amounts; (2) invention of various processes for changing this impure pig iron into the more useful wrought iron; (3) production of steel either by way of wrought iron or from pig iron direct. Sir Henry Bessemer's process, announced in 1856, for making steel from pig iron in a pneumatic converter, began the steel epoch. Cheap and ample supplies of steels in a wealth of sizes, shapes and surface finishes, grades of hardness or types of alloy are now available to meet the special demands of metal workers, machinery builders or tool users.

Modern metallurgical developments have consequently been away from the simple and direct production of wrought iron to the complex indirect manufacture of steel. The change from the small, intermittent operations controlled by a highly skilled artisan to the large continuous furnaces, machine driven, has been associated with enormous expansion in total output and as great a saving in labour, and a notable conservation of raw materials.

Steel from Direct Processes.—Some metallurgists, however, believe that the excessively high temperatures attained in the modern blast furnace cause the pig iron to alloy nith undesirable compounds, notably of nitrogen, which cannot be eliminated later, and which, they say, cause the present day metal to be inferior to that produced by the old direct processes operating at a low temperature. Hence many methods of making iron and steel direct from the ore have been proposed since 1910, and extended experimentation on a semicommercial scale has produced some marketable metal by these processes. Most of them rely upon the fact that iron ore is reduced by gas in the upper cooler part of the blast furnace. That is, the reaction

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

is substantially completed at 800° C., low red heat, too low to break up other minerals in the ore. Consequently hot iron ore is passed through a revolving kiln containing producer gas, and the iron sponge formed therein is either passed direct to an electric melting furnace, or quenched rapidly to prevent reoxidation, separated from unreduced ore and gangue, and the metallic portion briquetted or melted. That these so-called direct steel-making processes are destined to supplant the present indirect system of smelting ore to an impure product, and refining the latter, is very unlikely. In view of the great investment in the present plants for making steel which is reasonably satisfactory to the user, any innovation would have to show a considerable saving in costs, or have material collateral advantages or improved quality, before it could be widely adopted. Such savings and advantages have not been demonstrated.

IRON ORE

Iron is smelted from several oxidized minerals occurring in abundance in the earth's crust. In order of commercial importance these minerals are hematite (Fe_2O_3), magnetite (Fe_3O_4), limonite (hydrated iron oxide) and the carbonate siderite ($FeCO_3$). Great deposits of these minerals in relatively pure state, close enough to the surface to be mined easily, are in many regions. They are so common that an iron and steel industry will be developed whenever and wherever a population of machinery-using humanity accumulates. Iron deposits located in sparsely settled countries are potential ores of the future; for present uses an ore must be so situated and of such a nature that it can be mined, smelted by methods now known and transported to market at a profit. Proximity to cheap fuel will enhance the value of ore—in Great Britain inland furnaces smelt local ores containing as low as 23% iron. The enormous ore deposits near Lake Superior in North America are 1,000 mi. from coking coal and an iron-consuming population, but intensive production and cheap water transport on the Great Lakes enable these deposits to dominate the American market. On the other hand Brazil has huge untouched reserves of iron too far inland to export and with no home demand. The European continent depends upon the minette ores of Lorraine—ores which until the beginning of this century were valueless for steel making because no way was known to eliminate a high percentage of harmful phosphorus.

American Deposits.—The most productive iron ore region in the world is in very old (pre-Cambrian) strata surrounding Lake Superior, on the border between United States and Canada. Several long narrow areas called ranges contain the workable ores, which are hematites. Data on these ranges follow (shipments in long tons of 2,240 lb.):

Name	Location	Opened	Shipments in 1937	Total shipments including 1937	Greatest yearly shipments
Old Ranges					
				Million	
Marquette	Michigan	1854	5,747,812	194	5,747,812
Menominee	Michigan	1872	2,649,062	183	6,569,000
Gogebic	Michigan & Wisconsin	1884	5,661,270	207	8,763,000
Vermilion	Minnesota	1884	1,453,080	65	2,084,000
New Ranges					
hlesabi	Minnesota	1892	45,823,571	1,031	45,823,571
Cuyuna	Minnesota	1911	1,775,445	38	2,479,000

The deposits in the Mesabi range are flat, thick and close to the surface and are, therefore, mined in open cuts by steam shovels. Underground mining is the rule in the others, the veins being fairly steep and worked to 3,000 ft. depth. The wealth of these ranges is such that ores of various analyses and textures are available. One-fourth of the output is Bessemer ore, suitable for acid steel, containing on the average 55% iron and 0.04% phosphorus. The Cuyuna ore contains notable amounts of manganese. Basic or non-Bessemer ores from the ranges are higher in phosphorus and averaged 51.5% iron in 1937, with silica forming the principal impurity.

In view of the tremendous annual production of the Mesabi range, it may be questioned how long it will be before the region is uorked out. The average iron content of all lake ores dropped from 55½% in 1902 to 51¾% in 1910, and has been maintained since then only by mining increasing amounts of high-grade ore and washing, screening or drying one-third of the remainder. Minnesota is estimated by the state geologist to have demonstrated reserves of 1,250,000,000 tons of recoverable ore. Cnless these resenes are increased by new discoveries the Mesabi range will be worked out by 1975 or 2000, depending on whether the predepression or the postdepression rate is figured. But any prediction about the age of a mining district must prophesy also the state of the future art of ore concentration—lean rock today may be workable ore tomorrow. In fact, this region contains an unlimited tonnage of magnetite-bearing ore called taconite, which contains about 25 to 30% iron.

While seven-eighths of American ore comes from the Lake ranges, the balance of about 8.000.000 tons is taken from many ore occurrences in the Clinton formation in the Appalachian mountains, an uplift which parallels the Atlantic coast from north

to south. In the northern region the ores are predominantly magnetites; at the southern end in the State of Alabama, deposits of a low-grade red hematite with an easily fusible gangue are found near extensive coal measures. All these deposits are mined by underground methods; among them are mines which have produced continuously since the earliest iron smelting in America

Lorraine Deposits.--Ore beds second in importance only to those in the Lake Superior region occur in strata of Mesozoic age near the Franco-German border, extending northward into Luxembourg and Belgium. They are of recent commercial development. While only 830,000 tons were produced in 1897, they are now the chief ores for the French, Belgian, German and Luxembourg blast furnaces which together in 1937 produced 30% of the world's pig iron. Mining is done in three principal basins, Longwy near the Belgian border, Briey, and Nancy at the south. Previous to the World War much of this area was German territory, and practically all of the rest was promptly overrun and occupied by the invading army. Possession of this all but essential region was thereafter one of the aims of the contending Powers. Great damage was done during the occupation and the retreat, and not until 1926 did the area approach the productivity of 1913. While the output of the region exclusive of Belgium and Luxembourg was about 40 million tons in 1913, equally divided between France and Germany, the French department of Meurthe-et-Moselle was able to hoist only 5 million tons in 1920. Recovery of the reunited provinces proved to be so rapid. however, that the ore output reached 37 million tons in 1926. The ore beds occur in flat strata 60 to 120 ft. thick, from 300 to 750 ft. below the surface. The iron is contained in tiny nodules of hematite, cemented with a calcareous or a siliceous gangue. It is only necessary to combine these two to procure a self-fluxing, easy smelting mixture, very desirable commercially even though its iron content is quite low. Representative analyses, after driving off 8 to 12% moisture, are as follows:

	siliceous ore	Calcareous ore
	%	%
Iron	35 to 37	38 to 42
Silica	12 to 18	4 to 8
Alumina	3 to 7	3 to 7
Lime	3 to 7	9 to 13

Phosphorus is strikingly uniform, being 1·7 to 1·9% of the iron contained, and the Lorraine pig iron must therefore be used in basic steel making, as later to be explained.

Ores in Great Britain.— Since the rich blackband, clay iron stone and brown hematites of the Carboniferous strata have been almost exhausted, 80% of the iron ore mined in Great Britain is now taken from leaner strata, averaging only 27½%, which are a continuation of the Lorraine beds. Workable deposits extend in a broad strip from the coast of Yorkshire south-west to that of Dorset and are estimated to contain 3,400 million tons of workable ores. The beds are nearly horizontal, and consequently have broad outcrops in gently rolling ground, thus permitting them to be mined by quarrying operations. As a rule the individual deposits are small, and do not warrant the powerful excavating machinery installed in the great Mesabi pits. A maximum working face is 30 ft. Such "marlstones" (or simply "stone") contain the iron in tiny ooliths like the Lorraine ore, but near the surface the iron has been oxidized and hydrated to limonite, and at depth is a carbonate. Gangue materials are either calcareous or siliceous. These deposits have been longest mined at Cleveland, and here a limited area has produced 5½ million tons a year since 1875. All mining is underground in carbonate ores sometimes as deep as 600 ft.; 9 to 12 ft. beds are reckoned excellent. A governmental survey made in 1918 found only 200 million tons of recoverable ore here in reserve. An average analysis follows:

Oxide (FeO)	28%*
Silica (SiO_2)	12%
Alumina (Al_2O_3)	10%
Lime (CaO)	5%
Sulphur	0·26%
Phosphorus	0·47%
Water	6·8%

*(24·6 to 33·3%)

Cleveland ores therefore are suitable for basic steel making, wrought iron manufacture or general iron foundry work. Except for the several post-war years of acute industrial depression, Great Britain's ore demands have been about stationary since the turn of the century. Each year Cleveland hoists 5½ million tons, other regions dig 9 million tons and 6 million tons are imported, principally low-phosphorus ore from Spain and Sweden.

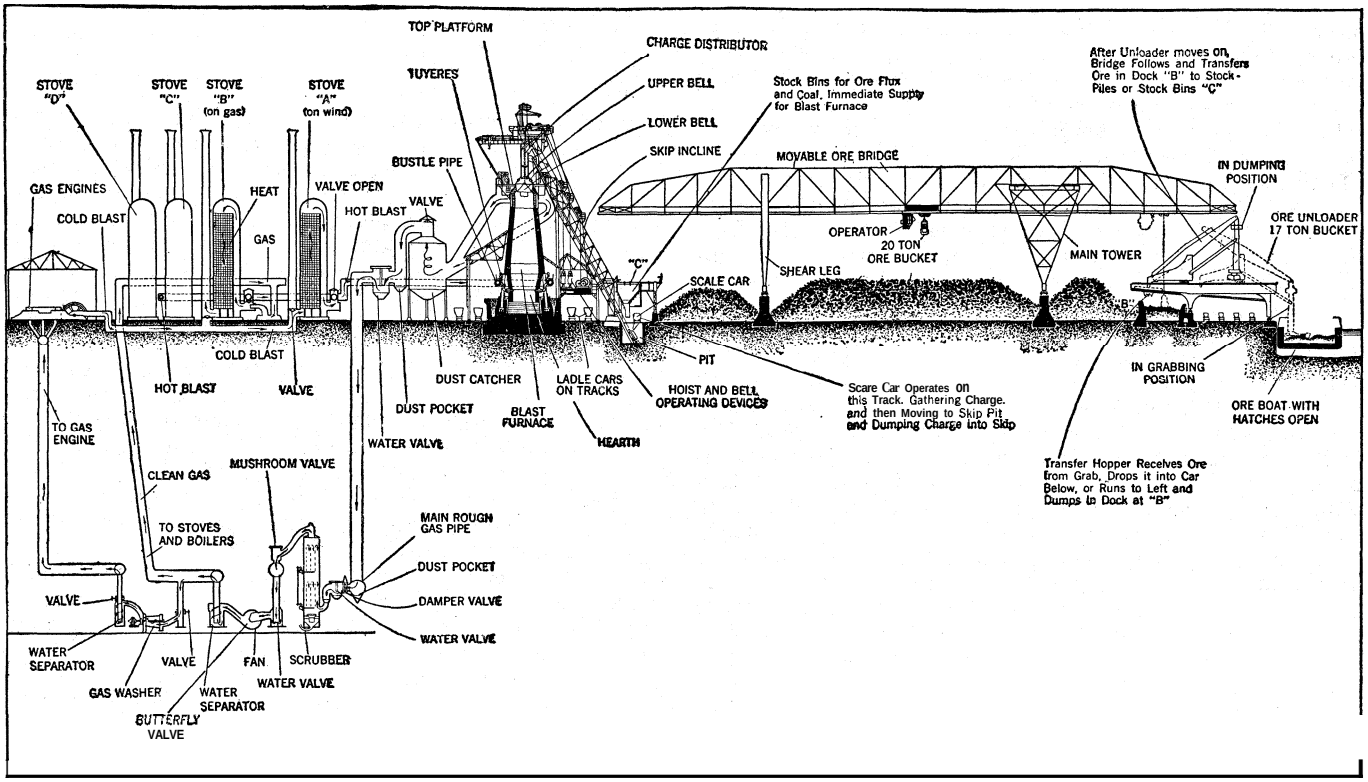
Future Stores of Iron.— Whether there is any likelihood of exhausting the available iron ore is a question which has occupied some minds. From the above remarks, it may appear that certain regions, such as the Mesabi range and the Cleveland beds, may be exhausted in the near future. However there is little to fear but that other deposits, only slightly less favoured, will supply the gap. Conservative estimates by economic geologists indicate that there are now about 30 billion tons of ore in reserve, which at the present annual consumption of 100 to 125 million tons, should last 200 years. Of this huge tonnage, two-thirds is located in the Western hemisphere; Brazil and United States possess most of this, but Newfoundland and Cuba both have notable deposits; France has half the balance, and the rest is scattered about in readily accessible locations. All such computations assume a certain state of metallurgical art in order to define ore. But metallurgical art is constantly advancing. Since so large a proportion of the earth is iron, it is safe to say that in the future, as in the past since before history began, the mind of man will always find means to win from mother earth this most useful metal, in supply ample for his current needs.

PREPARATION OF ORE FOR SMELTING

Transport.— In England and on the Continent much of the iron ore is smelted in furnaces erected nearby—even at the mine mouth. Freight is a minor matter. That which is transported from overseas is handled for the most part in ordinary cargo vessels. In America, however, the long haul down the Lakes from the ranges to the furnaces has caused the development of very specialized handling equipment. At the mines, hopper-bottom railroad cars of 50 to 60 tons capacity are loaded by steam shovels in the pit, or from storage bins at the mine, and hauled to the nearest port. Here long lines of ore bins are built out into the water; whole trainloads of ore are dumped in a few minutes by pneumatic devices. When these bins are full an ore boat docks alongside, opens her hatches, and a load of 10,000 tons of ore is spouted into her in less than a half hour. Ore boats that are used for service on the relatively calm Great Lakes are of special construction and are essentially long, self-propelling barges with a movable deck. Arrived at its destination, the hatches are again opened, and enormous grab-buckets reach through into the hold, scooping out the ore and dropping it inshore, either in railroad cars, or on a stock pile. If the furnace plant is inland, trainloads of ore are hauled to the site, and dumped in bins or placed in stock piles. Hopper-bottomed cars are used almost exclusively for this purpose, although for stockpiling it is generally found better to install a car-dumper, which turns the car upside down, and then to move the ore to the pile by a grab-bucket and overhead bridge. One cannot comprehend the magnitude and power of this unloading machinery, unless it has been seen in operation. Large stock piles, which are almost unknown elsewhere, are the general rule in America, where water transportation is entirely suspended by ice during the winter months. Limestone and coke are also stocked in sufficient quantity to provide against irregular deliveries from a distance.

Dressing.— Up to the beginning of the 20th century iron ore was seldom treated in any way prior to its utilization High grade materials, however, are becoming increasingly scarce, and the future will see a rapid extension of ore dressing methods

Screening is the simplest method Some 17 million tons of Lake ore were improved by this method in 1927. In England as well the miner frequently digs marlstone without removing the



BY COURTESY OF THE WELLM N-SEAVER-MORGAN COMPANY, CLEVELAND, OHIO

FIG. 1.—DIAGRAMMATIC ELEVATION OF BLAST FURNACE WITH AUXILIARIES AND STOCK PILES

loamy overburden; the quarried material is then crushed, and the fine particles screened out and discarded. In this way the average iron content of the ore is increased, and the suitability for smelting improved, for too many fices in the charge slow down blast furnace operations.

Washing is also common in America. This is an application of the water concentration methods so highly developed in ore dressing (*q.v.*) used at copper, lead and zinc mines. Some five million tons of Mesabi ore were treated in log washers in 1927. The washer is an inclined trough; from end to end is a stout shaft or log, with plow blades so set on its circumference that when the shaft revolves the plows clear the trough bottom and move any solid material gradually along. The fine screenings enter at one end, and travel against a copious current of water, which washes out the finer, clay bearing particles, lean in iron.

Calcining is common in England, particularly on the Cleveland carbonate ores. A Gjers kiln is ordinarily used, a short cylindrical steel shell set vertically, and lined with fire urick. A mixture of ore, with about 5% slack coal, is charged through the top as the burned ore is withdrawn at the base. Such a kiln will drive moisture and carbon dioxide from about 1,000 tons of ore in a week; Cleveland ores lose 27 to 30% in weight, but the resulting ore has had its iron percentage increased thereby to about 31%; still a very lean ore, viewed by American standards. Lorraine ores contain much moisture, but cannot be calcined, btcause this preliminary heating causes them to fall to powder.

Sintering is a method of converting fine ores or flue dusts into a porous clinker which can easily be smelted. American and Swedish magnetite ores, low in grade, are frequently concentrated by fine grinding, and drawing the iron bearing minerals out of waste rock with strong magnets. This fine magnetite is then moistened and mixed with fine coal and a little flux or with blast furnace flue dust, and spread over a travelling grate, the coal ignited and burned in a strong down-draft. The resulting clinker smelts so much more easily than the dense magnetic ores that the latter, even of high grade, are frequently sintered at the American plants.

BLAST FURNACES

Having followed thus far the mining, transport and preparation of ore, attention should next be given to the process of smelting it into metal. In the present state of the art, this is done in a blast furnace, and the metallic product is a high carbon alloy of iron called pig iron and containing more or less silicon and manganese. Since an article is devoted to the construction and operation of the blast furnace (*q.v.*) these matters will be summarized only briefly here; more attention however will be given to that entire assemblage of auxiliary, equipment (*see* fig. 1) which together goes to form the blast furnace department of a modern steel making plant. A blast furnace and its top works often rise 200 ft. above the ground level. It is round in cross section, bound with steel plates, and lined with a thick wall of special fire brick. Piercing the very top of the shell are two side openings leading into brick lined pipes—downcomers—for venting the furnace gases. The top is closed by a double bell, which in effect is an air-lock for introducing charges of ore, coke and limestone, while permitting no gas to escape. Charging is continued at such a rate that the furnace shaft is always full. About 8 ft. above the furnace base is a series of 10 or 12 water-cooled nozzles called tuyères, equally spaced around the circumference, through which hot air is blown into the interior. The coke in the mixed charge bums in this air, producing a region of intense heat sufficient to melt the metallic iron descending to that level from above, and superheat it so much that when it trickles to the hearth it collects at the bottom of the shaft in a pool which remains molten for hours. Five or six times a day this iron is drawn off or cast by opening a tap-hole at the very bottom.

Reduction of Iron Ore.—Much study has been given to the chemical reactions which reduce the ore to iron. They can only be presented here in highly simplified form. At the tuyères the heat is so intense that coke burns to carbon monoxide, thus:

$$2C + O_2 = 2CO$$

It is this gas which reduces the ore, and at a fairly low temperature, *i.e.* near the top, by a series of reactions which may be simplified as

$$Fe_2O_3 + 3CO = 2Fe + 3CO_2$$

The secret of rapid furnace driving to produce big tonnages is to use such ore, or prepared sinter, that the gases may permeate it readily and completely. Pure iron is relatively infusible—melting point 1,539° C.; when alloyed uith 4.3% carbon its melting point

is about 1,130° C. The freshly reduced iron in the blast furnace picks up this necessary carbon to convert it into the more fusible pig iron, either by physical contact with the hot carbon, or by the gas reaction

$$2CO = [C]_{Fe} + CO_2,$$

a reaction which is the basis of the case-hardening phenomena. By no means all the CO is oxidized to CO_2 by the furnace reactions. A typical analysis of the gases from the furnace top is

Carbon monoxide (CO)	24·5%	by volume
Carbon dioxide (CO_2)	12·0	
Hydrogen (H_2)	1·25	(from moisture in the air blast)
Methane (CH_4)	0·25	
Nitrogen (N_2)	62·0	

rich enough in the combustible gases CO, H_2 and CH_4 to be valuable as a fuel. Leakage must be carefully avoided, for the monoxide content makes it highly lethal.

Slag Formation. — Impurities in the ore and the coke ash must also be disposed of. They consist of earthy substances like clay. If they contain a preponderance of a single oxide like silica (SiO_2) they cannot even be melted unless sufficient limestone is present to flux them — that is to say, convert them into an easily fusible glass or lava-like substance called slag (*q.v.*) or cinder. The formation temperature of slag depends upon the relative proportion of basic oxides (lime CaO, or magnesia MgO) and acid oxides (silica SiO_2, or alumina Al_2O_3) which are present in the furnace charge. The operator therefore chooses his ores and fluxes with the aim of producing a slag which works well at some temperature, which he does not measure, but which he knows will produce the kind of pig iron which is demanded by his customers. Like the iron, slag melts in the hot region above the tuybres and trickles down, forming a pool floating on the iron. It is tapped or flushed through a cinder notch located between the tuybre line and the furnace bottom; usually just before the iron is tapped.

Ore Handling. — A medium-size furnace making 600 tons of pig iron a day will consume 1,160 tons of ore, 580 tons of coke, 290 tons of limestone, and 2,370 tons of air blast. It produces in addition to the iron, 330 tons of slag, 70 tons of dust and 3,400 tons of gas. It requires 17,000 tons of water to keep the furnace parts cool and to wash the dust from the gas. Therefore equipment must be provided to handle expeditiously no less than 26,000 tons of material each 24 hours. Such auxiliaries are so large and so numerous that the furnace itself is frequently inconspicuous, despite its huge bulk (fig. 1). In America, much space is ordinarily given to stock piles. Ore that comes from such storage, or direct from the mine, is dumped into bins alongside the furnace. Other compartments hold coke and flux. On a track underneath operates a scale car, which stops under appropriate gates and the attendant draws off a specified amount. When the proper quantities have been assembled, the car proceeds to the skip pit, and drops its load into a car which in turn is hoisted up the inclined bridge and dumped into a hopper at the very top of the furnace.

Furnaces a century ago were usually built on sloping ground, and the ore and charcoal wheeled off the hill top and dumped into the furnace. Later, when the value of the gases was discovered, a single bell was used to close the furnace top, and as the tonnage requirements increased, ore, coke and flux were shovelled from stock piles into carts, which were then pushed to the furnace, hoisted on platform elevators, and dumped by hand. Material handling by machinery is essential for furnaces making more than a hundred tons of iron a day.

Disposal of Iron and Slag. — In view of the congested surroundings, the pig iron and slag tapped from a big furnace are led by clay-lined troughs or runners to the edge of the foundation where they flow into ladle-cars standing below, and are hauled away while still liquid. If the furnace is serving a steel-making plant, the iron may be taken direct to a steel-making furnace. More usually it is poured into a mixer that is in effect a storage reservoir, sometimes of 1,500 tons' capacity. A mixer is usually shaped like a huge barrel, made of strong steel plate and lined with fire brick; it may be rolled on its foundation by suitable trunnions so the opening may at one time receive metal from a ladle-car above, or later discharge it into another for transfer to the steel furnace. The bad effect on steel-making processes of sudden variations in composition of the pig iron, so-called off casts, is minimized by dilution in a pool of reserve metal. Furthermore, some of the harmful sulphur may be eliminated from high manganese pig iron in the mixer, if the temperature is properly controlled. Iron which cannot be converted promptly must be cast into pigs. Much of this work is done by machinery. A pig casting machine is an endless chain to which is attached a series of moulds. A ladle-car of iron pours slowly as this conveyor moves underneath. After the iron is chilled, the conveyor passes through a long water tank for more rapid cooling. When the chain moves over the tail pulley the moulds turn upside down and the now solid pig iron drops into a railroad car. Some furnaces specializing on foundry iron, and of rather limited tonnages, run their iron direct from the tap hole into pig moulds formed in the sandy floor of the furnace house (see PIG IRON). Slag may be hauled to a nearby bank, dumped and wasted. In some localities, the slag may be marketed for railway ballast, filling material, or concrete aggregate. It would then be run molten into a water sump, the stream being broken up by a strong jet of water. Granulated in this manner, it can be reclaimed by grab-bucket and crane and shipped. Since the slag is essentially a calcium aluminium silicate, large tonnages are utilized as raw material in the manufacture of Portland cement.

Utility of Blast Furnace Gas. — As noted above, gases from the furnace top are good fuels, but they bear too much dust to be used without cleaning. Even when burned under boilers it is found that dust will fuse to the water tubes, reducing the efficiency of heat transfer and increasing the cost of maintenance to a prohibitive figure. For use in internal combustion engines, the cleaning must be even more complete. Much of the coarser ore and coke particles swept out of the furnace with the gas remains in the dust catchers, one or two cylindrical tanks placed in series just alongside the furnace proper. Essentially they are enlargements of the downcomer pipes; the velocity of the gas and its carrying power are reduced in passing through them. A change in direction of travel also aids in catching solids, which as they accumulate are drawn off from the hopper-like bottom. Usually the reclaimed dust is mixed with fine ore, sintered, and resmelted. Mixed blast furnace and coke oven gas is a good fuel for heating cold steel. Formerly it was usual to send hot gas from the dust catchers direct to the stoves, but lately furnace managers have been convinced that this rough gas contains entirely too much dust for this purpose, and the efficiency of the heat transfer suffers therefrom. Consequently further cleaning, either by scrubbing towers, by electrostatic precipitation, or by filtering through bags is now commonly undertaken. Electrostatic precipitation has the advantage that it handles gas without cooling it and may recover valuable amounts of potash for fertilizer. In this process the slightly humidified gas is passed through vertical pipes; in the centre of each is a wire charged at high voltage. In the electrical field so formed solid particles drift toward the grounded pipe walls, adhering there until dislodged by hammering.

Fig. 1 shows a scrubber, of which two would be required, each about 80 ft. high by 12 ft. diameter. By means of spray nozzles and screens the ascending gas is mixed in these towers with fine particles of water. The dust content, which on entering is about 3.5 grains per cu ft., is washed out except for about 0.2 grain. A powerful fan is necessary to draw the gas through the scrubber and give the necessary delivery pressure; water jets are introduced through the shell at several places so the fan acts as a further cleaner, delivering gas to stoves or boilers with about 0.05 grain of dust per cu.ft. Frequently all the gas is burned in this way, utilizing the steam so generated to drive blowing engines or electric generators. When it is desired to use the heat more efficiently, internal combustion prime movers may be installed (see INTERNAL COMBUSTION ENGINES) whereupon an even cleaner gas is required. Dust may be reduced to less than 0.01 grain per cu ft. by a rotary masher, which is a combination turbo blower and cleaner. Water used for these cleaning purposes may be used again after passing through a cooling tower and settling basin.

BLAST FURNACE PLANT

Blowing Engines.—Fig. 1 indicates the essential steps whereby the energy contained in the furnace gases is utilized to generate hot blast and auxiliary power for pumping, hoisting and lighting. Cleaned gas is used to drive gas engines direct connected with compressor cylinders. Compressed air goes to the furnace by way of a stove. therein acquiring a temperature of some 700° C., and on through a brick lined hot blast main to a bustle pipe circling the furnace. From the bustle pipe gooseneck connections deliver blast to the furnace through the tuyère openings. The required amount of air is fixed by the size of the furnace and the pressure, which varies from 12 to 20 lb. per sq. in. uith operating conditions, and must be delivered without fail. About 50,000 cu. ft. of air per min. is necessary for a furnace making 600 tons of pig iron per day *(see* BLOWING ENGINES).

Dry Blast.—One auxiliary (not shoun in fig. 1) more commonly installed in Great Britain, although proposed by the American James Gayley, reduces the humidity of the blast. Gayley showed that water vapour entering the tuyères, amounting in summer to about 250 gals. per hour, is dissociated into its elements by the white hot coke, this action absorbing heat not usefully regained within the furnace. Variations in moisture content are especially undesirable, for these produce variations in the temperature at the focus, and consequently change the chemical composition of the pig iron. To produce a low and uniform humidity in the air blast, the compressors may suck air through an adequate refrigeration system, (*See* AIR CONDITIONING.) Silica gel has been proposed as a more proper medium to dry the air blast.

Stoves.—Four stoves are usually installed to heat the blast. These are steel cylinders up to 100 ft. high and 22 ft. diameter. Each has a vertical combustion chamber, either at side or centre; the burned gases then return to the bottom through a multitude of narrow flues made of fire brick *(see* COWPER STOVE). In the passage they give much of their heat to the brick work, and flow off through a chimney. In operation (fig. 1), stoves B, C, and D may at any hour be filled with burning gas, thus acquiring heat; the cold blast passes through one of them, stove A; when this one cools off, valves are changed in a certain order, to prevent accumulation of explosive gas-air mixtures; stove **A** mill then be on gas, *i.e.*, heating; stove *B* will be on wind, *i.e.*, giving up its heat to the air passing through it enroute from engines to furnace. Usually valves are changed every hour. In a four-stove installation, therefore, each stove is heating for three hours, and cooling for one. Many designs have been proposed for the method of building the stove interior. A tno-pass stove is simplest, and most favoured in America, where the trend is to use cleaner gas, injected with a regulated amount of air for combustion, through carefully designed burners. Cleaner gas permits much smaller chequer-uork, higher heat capacity, longer life before the openings are plugged with fused dust, frequently enabling satisfactory furnace operation with only three stoves. A three-pass stove, nhere the gas is introduced at the bottom, goes up, down, up again and out a short stack built on top the stove, is favoured by some designers. *(See* HOT BLAST.)

Valves for handling these furnace gases are of special construction. On the cleaning system a water valve is favoured. As shown in the diagram of the blast furnace department, it is nothing much but a large pot with a diaphragm extending from top toward the bottom. To close this valve it is only necessary to fill the pot with water until the bottom of the diaphragm is submerged several inches; draining the pot opens the valve. Valves for handling hot blast are more difficult to construct and to maintain in good condition. Also, since the valve seat is exposed to the corrosive action of hot gases, it requires occasional replacement. This can be done by loosening all the turnbuckle clamps, nedging the flue sections apart, and sliding the old seat out sideways. The valve disc is also a hollow copper casting with spherical bottom; cooling water enters the hollow stem as shown. To open the valve it is only necessary to lift the disc up until it strikes the bricked dome. All blast furnace stoves have four valves. Two are shown on stove A (fig. 1); stove A is on wind, the chimney valve and the gas burner opening being closed. Stove B is on gas; the chimney valve is open, the gas burner in place, and the valves into the cold and hot blast mains are closed.

Blast Furnace Operation.—From the foregoing description it may be surmised that the blast furnace superintendent's task is primarily to harmonize operations of various large mechanical elements. But the furnace itself is his greatest care, even though the principal reactions within it are in mobile equilibrium. Slight variations from normal are self-adjusting—that is to say, if for some reason a surplus of heat is generated, the action within the furnace changes in the direction which will absorb that extra quantity of heat. Nevertheless the skilled operator is quick to observe clues which indicate deviations from the normal, and he immediately makes such adjustments in the operating conditions as experience tells him will avoid any serious irregularity. A hundred years ago his problem was simpler. His furnace plant consisted only of stack and blower; his ore was pure and rich, carefully selected by hand; his fuel was charcoal, ideal in character; the driving rate was slow; under such circumstances his pig iron was relatively free from impurities. Even to-day some of this charcoal pig iron is made in small furnaces with either cold blast or hot blast, and is favoured by foundrymen for castings which require a dense, tough and strong body, or by manufacturers of high grade tool steels. Rich ores and forests were very soon exhausted, however, and the progress of metallurgy has been associated with the ability to recognize the specific effects of each disturbing element and to devise ways and means to utilize the impure ores and coke fuel remaining, for many of the minerals entering the furnace top with the iron ore are broken up and the elements therefrom alloy with the pig iron, often to its detriment.

Control of *Sulphur*.—Sulphur, largely from iron pyrite contained in coke ash, is the worst offender; if left in the iron sulphur causes it to he very brittle at red heat ired short) High sulphur castings often crack in the moulds after cooling, and high sulphur steels may break when being worked in rolls or forging. Since no sulphur is removed in the converter or open-hearth steel making processes, it is essential that this element be eliminated from the pig iron. This is done in the blast furnace by charging limestone so the slag shall be distinctly basic, and thus have a higher solubility for sulphur compounds. Such a slag requires more coke, and German works now smelt uith minimum heat and desulphurize the pig iron with sodium carbonate. Once in the iron, its harmful effects may be mitigated in castings if two or three times as much manganese is present; an innocuous manganese sulphide results. In steel, zirconium has been found to have the same effect. Sulphur may be eliminated in electric furnace steel by refining at a high temperature under a "carbide" slag very high in lime on nhich floats some coke. Pig iron for grey iron castings must therefore have less than 0.10% sulphur; structural steel must contain less than 0 06%; many alloy steels are specified to contain less than 0.04% sulphur.

Effect of *Silicon* on **Pig** Iron.—A blast furnace working very hot tends to reduce silicon and manganese from any minerals containing them present in the charge. Manganese is now considered beneficial in all subsequent processes, but silicon must be sharply limited to pass some specifications. Silicon in pig iron causes much of the carbon present to separate and collect into tiny flakes of graphite, permeating the entire metallic structure; this graphite is responsible for the characteristic grey fracture of castings for machinery; its presence also makes for easy machineability. The carbon nould otherwise exist in the alloy as a compound of iron, a carbide, Fe_3C, called cementite, and form a much harder, stronger alloy. Consequently in such things as car wheels or in nhite iron castings, nhich are later to be converted into malleable iron by annealing, the silicon must be strictly limited. Silicon in pig for steel making must also be under close control, as we shall presently see. T'nerefore for those irons where both sulphur and silicon are limited, the ore and fuel must be specially selected for a low content of sulphur.

Grey and *White* Iron.--Carbon is another element in pig iron which will vary somewhat. It may be from 3.0 to 4 25%, depending upon furnace conditions. Generally if either silicon or phosphorus runs unduly high, the carbon will be low. Manganiferous

irons, on the other hand, are usually high in carbon. The colour of a freshly broken piece of pig iron is due to the way the carbon is held, rather than its total quantity; in white iron, nearly all the carbon is combined with iron in the carbide cementite; in grey iron, seven-eighths of it is in the form of graphite; intermediate proportions are called mottled irons.

Phosphoric Ores and Iron.—Phosphorus, until about the turn of the century, was the most undesirable element entering the blast furnace. Whereas much sulphur can be slagged off. between 90 and 100% of the phosphorus entering with the ore and the fuel ash comes out with the iron, and an excess makes both iron castings and steel brittle. For some types of thin castings requiring fluid iron *e.g.*, stove plates, from about 1.0 to 1.5% of phosphorus may be permitted, but in steel it is kept as low as sulphur, namely from 0.02 to 0.07%; in general, the lower the better the steel. Consequently the phosphoric iron ores of Lorraine were of small value—in fact of no value for steel-making until the Thomas-Gilchrist basic process was suggested (1878). Subsequent developments have converted the phosphorus in the ore to a pronounced economic asset. In view of all these facts, the furnace operator selects and mixes the ores and fuels which are available to him, and then adjusts his flux and controls his hearth temperature, by varying the amount of coke charged and the temperature of the blast, so the desired kind of iron will issue from the tap hole (see CAST IRON). Further notes on the varieties required for the various conversion processes will be given later.

WROUGHT IRON

Wrought iron, as compared to the total tonnage of steel, is an unimportant commodity. It amounts to less than 3% of the total production of steel. But it is important for its unique combination of physical properties, enabling it to survive since the time 75 years ago when it was the principal metal of engineering construction.

Puddling Process.—If about 600 lb. of pig iron and considerable iron ore are placed on the hearth of a small reverberatory furnace and melted, various reactions occur between the iron oxide from the ore and the impurities in the droplets of pig iron. The first reactions to occur may be simplified as follows:

$$2\,FeO + Si = SiO_2 + 2Fe$$
$$FeO + Mn = MnO + Fe$$

The iron thus reduced from the ore enters the pool of metal, and the silicon and manganese oxides join with the surplus ore to form a highly basic slag. This slag has the ability to absorb any phosphorus oxides which result from reactions between the phosphorus alloyed in the metal and the surplus iron oxide in the slag. The workmen stir the slag and iron together, an operation which is known as puddling; after the silicon and manganese have been substantially eliminated from the metal the carbon content begins to go down. The reaction may be written as follows:

$$[C]_{Fe} + O = CO.$$

Carbon monoxide gas bubbling upward causes the bath to boil. Removal of all these alloying elements leaves practically pure iron, of a much higher melting point. Toward the end of the process, therefore, the bath is converted into a metallic sponge of white hot, pasty iron, filled with liquid slag. This is cut into zoo lb. balls by the furnaceman, surplus slag squeezed from the dripping mass, and the resulting balls rolled into flat muck-bars. The metal is hot enough to weld together satisfactorily, and the process is accompanied by a great spray of slag sparks, squeezed out by the rolls. Muck-bars are cut to short lengths, arranged and wired together in piles, heated to a welding heat and re-rolled into marketable shapes.

Nature of Ferrite.—From a knowledge of the manufacturing process it may be understood that commercial wrought iron is essentially pure iron containing a greater or lesser number of slag particles.

The chemical changes which occur in the process of refining are thus indicated:

	Forge pig iron	Metallic portion of wrought iron
	%	%
Carbon	3·5 to 4·25	0·02
Manganese	0·25 to 1·0	0·005
Phosphorus	0·5 to 1·0	0·07
Sulphur	0·03 to 0·10	0·02
Silicon	1·0 to 2·0	0·03
Iron	95 to 92	99·855

About 3% of the best wrought iron by weight is slag.

A view of a polished section through a microscope shows the structure of wrought iron. The mirrorlike metal appears white in a photograph; the stony lustre of the slag particles appears grey. The slag itself is not a simple glass; it is a high iron silicate containing more or less manganese and phosphorus and frequently develops well-crystallized minerals. Slight etching of the polished surface under examination develops characteristic markings; the metallic portion seems to consist of a number of closely fitted or interlocking grains. If one of these grains were picked out, it would have an irregular surface; nevertheless it is undoubtedly true that its inner structure is that of a true crystal—that is to say, the atoms are arranged in regular rows, in geometric order. Such tiny crystals have a body-centred, cubic crystal structure and are called ferrite.

Properties of Wrought Iron.—Wrought iron has superior properties for forge welding, because at high heats the slag particles melt and spread into a film protecting the metal from atmospheric oxygen. The purity of the iron is responsible for its toughness, resistance to shock and bending. It also resists atmospheric and aqueous corrosion, either by virtue of purity of the metal or by virtue of the slag inclusions, or for some other reason. These special properties cause it to be in demand for pipe, chain cable, boiler stays, sheet iron and blacksmith's bar iron. For some of these purposes a variety known as charcoal iron (see IRON) is preferred. Wrought iron is moderately strong in tension, developing from 45,000 to 55,000 lb. per sq.in. ultimate strength. Furthermore it is a soft metal—Brine11 hardness measuring 75 to 80. Likewise the production of big masses of it is tedious, and puddling requires a large amount of exhausting labour from skilled workmen. These facts all combiaed to hamper competition with the harder and stronger steel—the Bessemer's process showing how to make the latter in great quantity, rapidly and almost automatically. In 1883 70% of all the pig iron made in England was made into puddled bar; in 1897 only 5%.

Aston's Process.—Mechanical puddling furnaces have been proposed and used to some extent, but the manufacture of metal in small batches is not in keeping with modem mass production. A more promising development consists of the process established in 1927 in America through James Aston. Knowing the essential characteristics of the ferrite and slag constituting wrought iron, he produced pure iron in a Bessemer converter, following the regular steel-making practice, and poured this iron into a pool of synthetic slag, which had been melted in a large cupola. Strong evolution of dissolved gas caused the metal to granulate into very fine particles; the resulting spongy mass of iron and slag was withdrawn, squeezed and rolled in the conventional manner.

BESSEMER STEEL

Early Steel-making Processes.—Prior to 1870 the principal metallic materials of construction were cast iron and wrought iron. The former could be made quite hard, but then was brittle; the latter resisted shock excellently, but was comparatively soft. There was a great and growing demand for metal which was both strong, wear resisting and tough, but there was no method of producing it cheaply enough to make, for example, railroad rails. Consequently, the discovery of the Bessemer process for making cheap steel was a godsend—an eager market was waiting; and in turn the satisfied market created other demands. Steel had been known for centuries. While accurate statistics are lacking one may reasonably guess that 250,000 tons a year of blister steel and crucible steel were being made in Europe in 1865. Blister steel

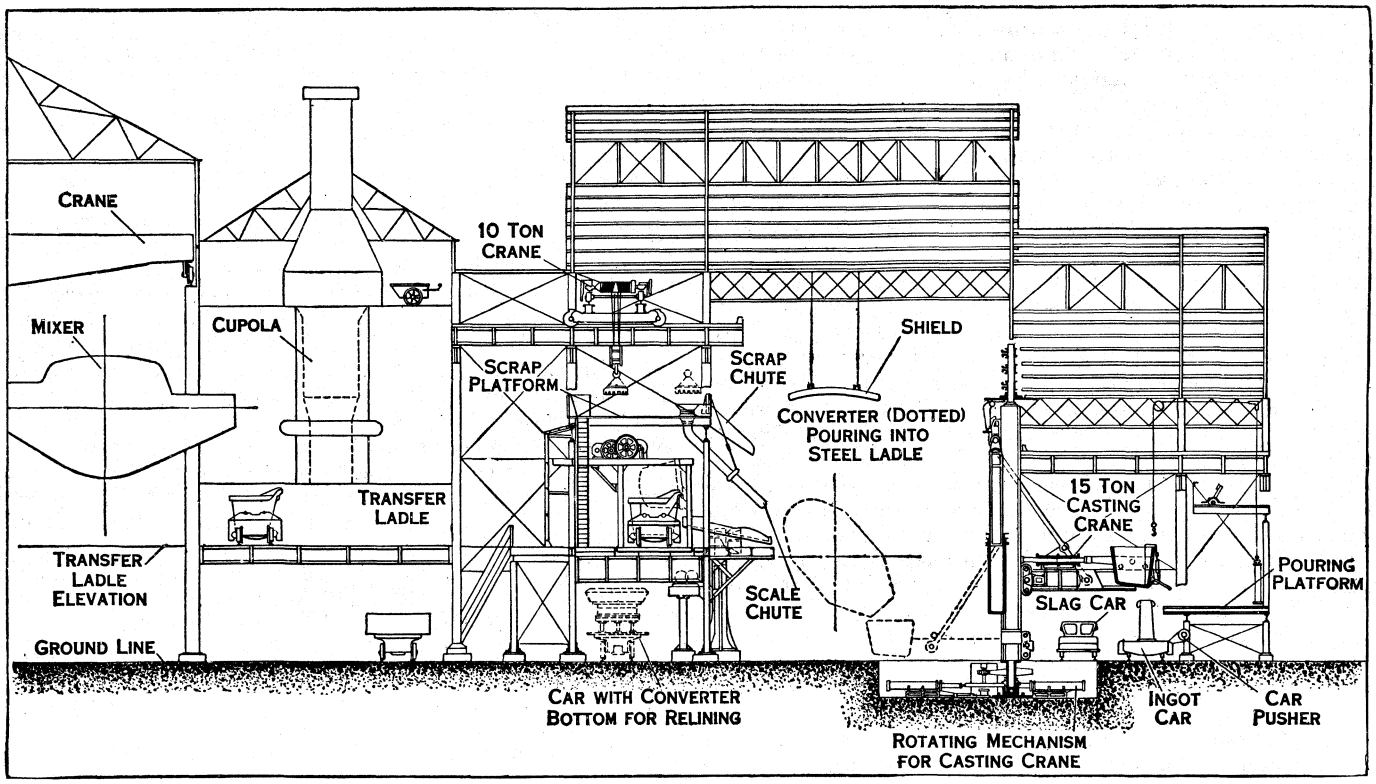


FIG. 2.— GENERAL CROSS SECTION OF CONVERTER HOUSE

was, and still is, made by packing wrought iron bars in a long stone box full of charcoal, and heating the container for several days at a full red. Carbon gradually is absorbed by the iron under these conditions, and it becomes steel. In order to improve the quality by equalizing the carbon content in this steel, and also eliminating the slag contained in the original wrought iron, blister steel is cut in short lengths and melted in a clay crucible (see CRUCIBLE STEEL).

For the manufacture of fine tools and cutlery such processes survive even yet, principally in the Sheffield region where the industry formerly thrived. But obviously this very indirect method of getting steel, bit by bit, was totally incapable of supplying the needs of the coming mechanical age.

Bessemer's Invention.— As has been pointed out, the alloyed impurities in pig iron can be eliminated by oxidizing them. In all the old refining processes, iron oxide in the form of ore, mill scale, or iron silicate slag (basic cinder) is the means nhereby the necessary oxygen is carried into the pig iron under purification. While experimenting on some methods for improving metal for cannon in 1856, it occurred to the English inventor Henry Bessemer that this oxygen for refining could be taken directly from the air if a blast were blown on or through the melted pig iron. On trial it not only purified the iron, but instead of blowing cold and freezing, the metal became hot enough to remain molten even when all the carbon was gone and hitherto infusible pure iron remained. The whole reaction required only a few minutes; at the end an ingot of mild steel could be cast, ready for the forge or rolling mill.

It took years of experimentation before the new process became a commercial success. The conservatism of engineers and constructors retarded the adoption of cheap steel and the useful mechanical auxiliaries, largely perfected by the American, Alexander L. Holley, which enables a modern plant with two converters to send forth a continuous procession of ingots, without halt, day and night (see BESSEMER, SIR HENRY; CONVERTER STEEL).

Converter House.—(See fig. 2.) Molten pig iron comes from the blast furnaces in ladle cars, and an overhead crane lifts the ladles and pours the contents into the mixer. By joining a reservoir of several hundred tons of metal, wide variations in chemical composition in a single cast are lost by dilution. A reservoir of uniform and promptly available raw material is thus established. Uniformity and continuity are foundations of rapid production of Bessemer steel; neither of these results when converting metal direct from the blast furnace or remelted pig iron from the cupola —although the latter sources may be used in emergency. At the proper time a ladle of iron, 10 to 25 tons depending upon the size of the converter, is poured from the mixer; it tilts by rolling on a circular track under positive control of a screw mechanism or hydraulic ram. A small locomotive pushes this full ladle car to the converter house, and by means of a launder the contents are run into the hot converter, with mouth tilted over to receive the charge. The blast is turned on, the converter tilted up to vertical position, and the blow is on.

Conversion Process.—The converter itself is a cylindrical steel pot perhaps 10 ft. in diameter by 20 ft. high, mounted on elevated trunnions and geared into a rack and pinion so it can be turned completely over. It is lined a foot thick nith a refractory mixture. The bottom bricks are perforated by many small openings, tuyères, through which air is sprayed into the metal at high enough pressure to keep it from trickling down into the wind box attached to the bottom of the converter shell, yet not so high as to throw too many splashings out the open mouth. Oxygen in the air blast burns the pig iron it first strikes. This product of reaction may be represented by FeO, and it is swiftly distributed throughout the churning mass. At the temperature of operation silicon and manganese atoms have a greater affinity for oxygen than iron has, so these two reactions occur:

$$Si + {}_2FeO = {}_2Fe + SiO_2$$
$$Mn + FeO = Fe + MnO$$

These oxides are insoluble in metal and accumulate into droplets of slag—a mixture of iron oxide, manganese oxide and silica. When the metals silicon, manganese and iron combine mith oxygen, or burn, much heat is released—enough to heat the incoming air and escaping nitrogen, to provide for radiation losses. and to increase the temperature of the remaining metal and slag so it is always quite liquid. During this early stage of the blow the red hot nitrogen coming from the mouth glows faintly. Gradually the carbon begins to burn, thus:

$$FeO+[C]_{Fe}=Fe+CO.$$

A roaring boil then takes place in the vessel; the carbon monoxide burns in a big, yellow, luminous flame at the converter mouth, and countless flying sparks of metal and slag add to the spectacle.

In only a few minutes the carbon is gone; the flame flickers, and suddenly contracts. This is the signal for turning the vessel over on its side, and stopping the blast. Inside the hot converter is now a seething mass of fluid iron, practically free of silicon, manganese and carbon, covered with a thin layer of slag. The metal, however, contains much gas in solution and if cast immediately would solidify in a spongy mass. Consequently some cupola-melted spiegel—a pure pig iron containing 20% manganese —is run into the converter. A rapid reaction ensues, wherein the steel is freed of oxygen by combination with the excess of manganese and carbon in the spiegel. The converter then tilts further over, discharging its contents into a waiting ladle. The blow has taken perhaps 12 min.; no greater time is necessary to add the spiegel, pour out the steel, turn the converter upside down to discharge any loose slag chunks, and back up to receive another ladle of liquid pig iron. A second converter alongside will be blowing while the first is dumping. In fact the whole equipment of the converter department is co-ordinated for a complete cycle every 12 to 15 min., and is built of the most rugged proportions, so delays from breakdowns will seldom occur.

Converter **Lining.**—The violent reactions at high temperatures cause considerable scour on the lining of the vessel; especially the tuyère brick at the bottom must be replaced after 20 to 25 blows. Holley is responsible for the plan of sectionalizing the converter shell; when a new bottom is required a car carrying a stout jack is placed under the upright converter, a series of bolts unloosed, and the jack lowered away, carrying with it the entire bottom part of the shell. This car is immediately replaced by another carrying a newly made bottom, already warm, ready for lifting and bolting into place. It is therefore unnecessary to leave a shell in the stand while it cools and the lining is repaired, dried and reheated—a matter of several days—but these sectional lining operations are done in a separate department and replacement of bottom or mouth portion requires less than 30 min. In American practice the lining material is a highly siliceous rock, ground with a little fire clay, moistened and tamped in place with pneumatic rammers. Such a lining is known as an acid lining, and steel made therein is called acid Bessemer steel.

Pig Iron Used.—Since the reactions described above leave untouched any sulphur or phosphorus, it is necessary that the pig iron entering the converter be quite low in these two elements. Furthermore silicon is limited by the rate of driving. It is the chief heat-producing element; if silicon in the pig is high the converter shell and its contents get superheated during continuous blowings and must be cooled either by dropping a quantity of cold scrap into the shell, by blowing steam in with the blast (which dissociates and absorbs heat), or by delays for radiation. On the other hand if the converter with a new bottom is a little cold, it is tilted partly over so some blast does not penetrate the iron, but burns the CO to CO_2 thus liberating more heat within the vessel. Maximum production may be had by blowing a pig iron with higher silicon and lower carbon; reducing the blowing time by charging mill scale or ore at the beginning of the blow; and charging scrap to absorb the excess heat generated. But in general the pig iron used for acid Bessemer practice, and the product therefrom will be about as follows:

	Carbon	Silicon	Sulphur	Phosphorus	Manganese
Pig iron . .	3½ to 4	1 to 1¼	0·05	0·09	½ to 1¾
Full blown .	0·03	0·01	0·05	0·10	0·03
With spiegel .	0·1 to 0·4	0·10	0·06	0·10	0·90

Growth of Uses.--Obviously such material as represented by the last analysis is immeasurably superior to wrought iron for railroad rails. The carbon content is responsible for hardness, wear resistance and strength which wrought iron could never acquire. Furthermore, the amount of carbon, and the corresponding degree of improvement in properties, is under control, for it is only necessary to place some charcoal in the steel ladle to make a higher carbon steel, or to use a spiegel or a ferro-manganese containing higher manganese and lower carbon when a milder or softer steel is desired. It is not surprising, then, that when the process was finally established on a producing basis in Bessemer's own plant in Sheffield, the product was rapidly absorbed for rails and tires. In 1868 there were 110,000 tons produced; in 1888 Bessemer steel reached its peak of production in Great Britain of 1,700,000 tons. Puddling had meanwhile declined; 70% of British pig iron went into wrought iron in 1883; only 5% in 1887. A similar story may be told of America. In 1867 460,000 tons of iron rails were made and sold for $83 per ton; that same year 2,550 tons of Bessemer steel rails were produced and some purchasers paid $170 a ton for them. By 1884, however, the last iron rails were made, steel had replaced them to an annual production of 1,500,000 tons a year, and the selling price was $32 per ton. In 1938 rails declined to a minor commodity in America and those were made of open-hearth steel, for reasons to be given later. Much Bessemer steel is still made into skelp for welded pipe, into wire and free machining steel (low in carbon, but high in sulphur and phosphorus).

THOMAS-GILCHRIST DISCOVERY

Control of Phosphorus.—This so-called acid process demands low-phosphorus ores and pig, and such material in Europe is relatively scarce and costly. Early efforts to remove phosphorus in the converter failed. Arguing from an analogy in the puddling furnace, where a slag rich in iron oxide will carry off phosphorus oxides, it was thought that if the converter blast was carried on after the carbon was gone, much iron oxide would go to the slag, and it would then be in a condition to absorb the phosphorus. When this was tried, however, the iron wasted away, ate into and ruined the lining, but unfortunately had no effect on the phosphorus. Not until 1876 did the Englishmen, Sidney G. Thomas and Percy **C.** Gilchrist discover that if the converter were lined with a basic material like burned limestone, dolomite or magnesite, and if burned lime were charged with the pig iron, then a basic slag would form and be maintained in such condition that it would absorb and hold phosphorous oxides produced during the blow. This is the basic Bessemer process now so widely used on the Continent for the production of so-called Thomas steel.

Basic Bessemer Process.—A modern basic plant is arranged much like its counterpart using the acid process. Converter shells are lined with different materials. Dolomite is freshly calcined in a cupola, ground with hot dehydrated tar, and the sticky mass tamped between the shell and a centre form. The perforated bottoms are lined two ft. thick, yet must be replaced daily.

In its modern development a heat of Thomas steel is made thus: Into a 10-ton converter 1½ tons of freshly burned lime are charged and then 10 tons of pig iron. The blast is turned on, the converter tipped up, and the blow proceeds exactly like an acid heat already described, but it continues after the carbon flame drops. In this last stage the following reaction occurs:

$$5FeO+2P=5Fe+P_2O_5$$

and the phosphorus joins with excess lime in the slag to form a calcium phosphate. There is no flame to indicate occurrences in the converter during this period. The duration of the after blow is judged from a knowledge of the phosphorus contained in the original pig iron. When the process is thought to be complete, the converter is tipped to its side, the blast turned off, and a spoonful of metal cast into an iron mould. This test ingot is chilled, hammered into a bar, and nicked, bent and broken. If the metal is brittle and coarsely crystalline, the air blast is resumed for a few seconds, and another test taken, and repeated until the metal is tough and fine grained. This finishes the blow. Next the slag must be skimmed off as quickly as possible, because phosphorus has a trick of returning to the metal on slight pretext; then the spiegel or other recarburizer and degasifier is added, and the steel poured into the ladle. About the only additional equipment in the converter house needed beyond that found in

an acid Bessemer plant is some handy means of caring for the large volume of slag produced. This slag, by the way, is ground and sold as fertilizer; it contains up to 20% of soluble phosphoric acid.

Thomas Steel.—In this Thomas-Gilchrist process, the pig iron must have relatively low silicon to limit the amount of slag formed. Phosphorus is the principal heat producing element, and it may be as high as 3%. It is doubly essential that a mixer be used to store pig iron, in order that phosphorus may never show wide fluctuations in analysis, heat to heat. Percentages in average analyses are as follows:

	Carbon	Silicon	Sulphur	Phosphorus	Manganese
Basic pig.	3½ to 4	0·5 to 1	0·05	2 to 2½	1 to 1½
Thomas steel	0·10 to 0·60	0·20	0·05	0·03 to 0·10	0·30 to 0·50

The process was introduced in Germany in 1879, and at the present time is used to refine the bulk of the pig iron produced from the Lorraine deposits in France, Germany, Luxembourg and Belgium.

Thomas steel provides satisfactory material for all classes of tonnage steels used on the continent, such as bars, boiler plate, pipe, structural steel and rails. But despite the fact that the Thomas-Gilchrist process was proposed to solve the problem of high phosphorus British ores, Thomas steel is not popular among English engineers, and hardly any of it is now made in England. This is probably due to the fact that the home ores do not smelt into a low-silicon high-phosphorus pig iron necessary for the economical operation of a basic converter, and further that the basic open-hearth furnace has meanwhile been developed to refine such phosphoric pig irons as are made.

OPEN-HEARTH PROCESS

As soon as the Bessemer process attained a production stage it was found that the mild steels intermediate in carbon content, strength and ductility between carbon-free wrought iron on the one hand and high carbon crucible steel on the other, were most useful materials for machinery and engineering structures. These mild steels were really new materials, never before procurable in quantity, and inventors attempted to make them in ways which would not infringe the Bessemer patents. An insuperable difficulty was the inability of any furnace, even when burning high volatile coal under forced draft, to melt them. As in the puddling process, when the refining reached a certain stage, the metal became a pasty sponge. This obstacle was met by Sir William Siemens, who resurrected a forgotten proposal to regenerate some of the waste heat (see FURNACE, METALLURGICAL). He passed the smoke through brick chequerwork; after the passages had thus been highly heated, air for combustion of the coal was drawn through the chamber. This pre-heated air had the effect of increasing the flame temperature materially. Using a furnace with such a device Emile and Pierre Martin made steel at Sireuil, France in 1864, by melting a good grade of pig iron, then adding some selected wrought iron scrap which alloyed with the pig iron, continuing these additions until the carbon content was reduced to the desired percentage mainly by dilution (the Martin pig and scrap process). William Siemens (*q.v.*) and his brother Friedrich found it necessary to erect an experimental furnace plant in Birmingham to develop the application of their ideas in the steel industry. By 1868 the principal features of the modern open-hearth process were there developed; namely, gaseous fuel, regenerative chequerwork for pre-heating both air and gas, a thin furnace roof of silica brick and the method of refining pig iron by ore or iron oxide (the Siemens pig and ore process). These entire furnaces, hearth, sidewalls and roof mere made of highly siliceous refractories; the only slags which would not corrode these contain an excess of silica—so-called acid slags. Not until Thomas had shown how to remove phosphorus by a basic, high lime slag in the basic lined converter did it occur to anyone to make on open-hearth furnace with hearth and side walls of sintered dolomite—lime and magnesia oxide—and to refine the steel under a high lime slag. J. H. Darby built the first of these basic open-hearth furnaces at Brymbo, Wales in 1884. The most available ores in both England and America smelt into pig iron well suited for such basic open-hearth refining; furthermore the product is distinctly superior in quality to Bessemer steel. Consequently at the present time the latter is used in America for the production of low-carbon steels for nonengineering purposes. Basic open-hearth steel, however, makes boiler and ship plate, structural steel, rails and all the higher carbon machine steels (and even alloy steels), such as shafting and forging billets. Production by processes is shown in the following table—it will be observed that the basic open hearth is competing with the basic converter even on the continent.

Steel Production in 1937

	United States	Great Britain	France	Germany
Acid Bessemer	3,449,927	233,000	46,000	none
Basic Bessemer	none		5,258,000	7,958,000
Acid open hearth	499,793	2,260,000	2,279,000	164,000
Basic open hearth	45,772,510	9,677,000		10,494,000
Electric	845,537	452,000	308,000	535,000
Crucible	934	no estimate	12,000	

Furnace Auxiliaries.— The essential furnace is often dwarfed by the auxiliaries found necessary for rapid and economical production. (See fig. 3; also FURNACE, METALLURGICAL.)

In the first place adequate fuel must be provided; consequently alongside is another building containing gas producers (see GAS INDUSTRY) of the continuous type. A series of such producers in operation discharge gas into one main pipe from which it is drawn to the furnaces as needed. The producer house must have adequate coal handling machinery; a plant with 10 60-ton furnaces would use 400 tons of coal a day, with means for hauling or sluicing the ashes anay, and boilers for raising steam to blow into the producers. Gas producers are usually found as standby equipment, even where other fuels are used, such as mixtures of blast furnace gas, by-product coke oven gas, natural gas, tar, and oil. Next a stock of adequate raw material is necessary. If open-hearth and blast furnaces are within the same fence, melted pig iron (hot metal) will be used. That requires a mixer for intermediate storage. Otherwise an ample stock of iron in pigs is required. Furthermore a big tonnage of steel scrap of various kinds is used—the proportions of pig iron and scrap charged into steelmaking furnaces now depends solely upon the relative availability and cost of these two materials. Scrap must be segregated as to nature and approximate analysis; big shears and drop balls (skull crackers) are necessary for cutting and breaking unwieldy pieces; travelling cranes and lifting magnets are installed for economical handling of this material. Bins and stockpiles must be provided for the various special metals used for alloying or degasifying the hot steel, for the limestone, fluorspar and other fluxes, for the silica, chrome, magnesite and other fire brick to repair the furnace, for the dolomite or silica rock used for making the bottoms. In basic open-hearth plants an auxiliary building is necessary for grinding, calcining and storing the dolomite continually needed for repairing the furnace bottom and side walls (banks). Spiegeleisen, if used for a deoxidizer, must be melted in a cupola or electric furnace.

Means must be provided for introducing the fuel into the furnace, and reversing the flow of flame at frequent intervals. This requires proper valves in the flues, with an appropriate series of interlocking operating devices. Latter-day trends in furnace design call for much shorter and more direct flues than shown in the cross sectional view, and the use of water cooled gate valves offering no obstruction to gas flow when open. Waste heat boilers are also quite frequently placed between regenerators and chimney, together with fans to pull the hot gases through them. A most interesting device is installed to charge solid material through the doors into the furnace itself. By this means long delays between heats to refill the furnace are avoided, together

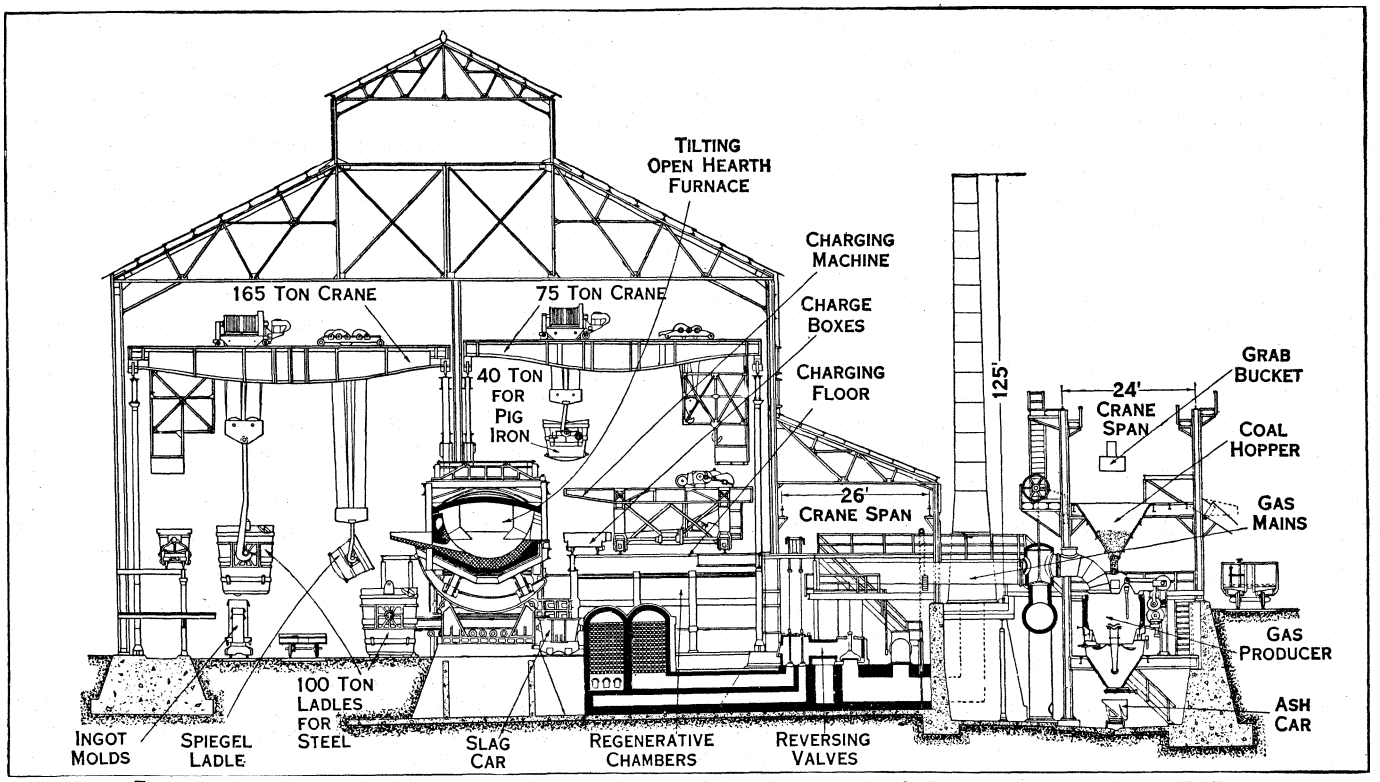


FIG. 3.—GENERAL DIAGRAM OF AN OPEN-HEARTH PLANT SHOWING GAS PRODUCERS AND CRANES FOR HANDLING METAL

with much exhausting labour. All solid materials are now loaded into charging boxes, cast steel trays about 24 in. wide and deep and about 4 ft. long, thus holding at least a ton of the bulkiest steel scrap. A complete charge for a furnace is assembled into 40 or 50 such boxes, placed on a train of small flat cars, and moved to a track running close to the furnace doors. On a wide gauge track alongside. the charging machine operates. Its ram engages an end socket on the box and is locked in. The ram then lifts the loaded box off the car, moves it forward through the open door into the furnace, slews it to either side and tips it upside down, discharging its contents in the correct place. These motions are then repeated in the reverse order. When the empty box is on the car, the charging machine moves sidewise, taking with it the entire train of loaded cars until the next full box is spotted directly in front of the proper door. This is then picked up, thrust into the furnace, and dumped. In this manner a 60-ton furnace can be loaded in less than an hour. Equipment must also be installed to pour the finished steel into ingot moulds, but this is an operation which, both in the principles involved, and in practice, is similar to casting a Bessemer heat, and will be described later.

Open-hearth Steel from Cold Metal.—The basic open-hearth process (1956) makes by far the most steel. Many steel-making furnaces are distant from blast furnaces, so they operate entirely on cold stock, and as noted, any proportion of pig and scrap may be charged, as economics require. This process as commonly practiced in a stationary furnace and its elementary chemistry are here briefly explained. After a furnace has been tapped and the bottom and banks repaired charging is begun. Plate scrap, if available, is spread out to protect the bottom, followed by several tons of limestone, depending upon the impurities to be removed from the pig and scrap. The furnace is then filled as full as possible, with scrap, pig iron and some iron ore; the doors are then closed, the flame given an excess of air and melting begins; as the mass melts and settles, the balance of the cold metal is added. Melting pig iron will trickle down over the white hot steel, still solid. Silicon and manganese in the pig iron droplets oxidize by the excess oxygen in the furnace atmosphere, and join with the iron oxide forming on the white hot steel and some of the lime on the bottom or furnace wall forming a slag. In four to five hours the moiten metal is virtually free from silicon, and much manganese has also gone into the slag. Vigorous stirring is necessary as chemical reactions only occur at the surfaces where metal and slag are in mutual contact. This is effected principally by gases rising from the limestone, and some two hours after the metal is fluid it continues to break up, thus

$$CaCO_3 = CaO + CO_2$$

The gas coming to the surface in big bubbles causes a characteristic boil. The lime also floats up, joining the slag as a base, not only releasing some of the iron oxide contained therein for refining reactions, such as

$$2P + 5FeO = P_2O_5 + 5Fe$$

but also maintaining the basic slag necessary to dissolve and hold this phosphorus oxide. When the lime is all up further boiling in the bath is due to the chemical reaction between iron oxide and carbon (which has been going on continually but its mechanical effect somewhat overshadowed by the lime boil).

$$FeO + [C]_{Fe} = Fe + CO.$$

The iron oxide is dissolved by the metal from the slag. Bubbles of carbon monoxide gas evolved continue to keep the metal and slag in motion. The active refining reagent in the open-hearth furnace is the same as in the Bessemer and the earlier refining processes, namely iron oxide, but its origin is different. In the open-hearth process iron oxide is formed by oxidation of the steel during melting, picked up from the rusty scrap, and added as desired to the slag in the form of ore. During the late refining period, the furnaceman frequently takes a spoonful of metal from the bath, pours test ingots and breaks them, judging from the fracture the content in phosphorus and carbon. It is necessary to regulate the proceedirigs so that phosphorus in the metal shall be down to the desired minimum some time before the carbon is down. This relative elimination can be controlled by adjusting the temperature (reversing the flow of gases more frequently increases the heat), changing the slag by adding either lime or ore, increasing its fluidity by adding fluorspar (CaF_2) or increasing the carbon by adding some low-phosphorus pig iron. In about three hours the carbon boil should subside, the bath should be low in phosphorus,

and the slag essentially a high lime silicate — to hold the phosphorus; the furnace is then driven hard to increase the metal's temperature sufficiently for casting. The slag and the metal have been slowly losing iron oxide and carbon respectively by mutual interaction, and the metal gives up considerable gas held in solution. Since 1930 much attention has been given to the relationship between composition and viscosity of the slag existing in the refining stages and the quality of the finished steel. Slag composition is rapidly estimated on the furnace floor by pouring a small "pancake" of slag in a standardized manner and examining its surface, colour and fracture. Its viscosity is measured by the distance the slag flows down a pipe-stem mould. Likewise carbon in the steel may be closely estimated by rapid magnetic tests; the rate of carbon drop is also an indicator of the state of oxidation in the heat. High grade steels are deoxidized by the controlled slag in the furnace, after which further ,deoxidizing substances like ferro-manganese or ferro-silicon may be added to the metal bath,. followed by various alloying elements like chromium if an alloy steel is to be made. When the word is given, the furnace crew thrusts a long heavy bar through an opening in the centre door, across the furnace into the bath; several battering-ram thrusts break through the plugged tap hole, and white-hot metal rushes down the spout into a ladle set beneath. This ladle is just large enough to hold the steel; slag which follows after overflows into a pit or slag ladle alongside.

VARIATIONS IN PROCESS

Use of Molten Pig. — Various methods deviate from the above routine and have been devised to adapt the open-hearth process to the economic conditions to be met by the steel-maker, especially as to the relative amount of scrap steel and molten pig iron available. These range from processes for handling a preponderance of scrap and a minor amount of molten pig iron (as is usual in America) to the Talbot process described below for handling up to 80% hot metal (as is practiced in England, 1939).

In American stationary furnaces of, say, 100 tons capacity the limestone and scrap are charged as indicated above and heated strongly until well melted. During this time the slag forms from oxidized iron and calcined lime. Within two hours all but the heaviest scrap has melted and molten pig iron is poured in. A rapid reaction starts between the iron oxide in slag and melted scrap and the carbon, phosphorus, and silicon in the molten pig iron. Carbon oxides boiling up through the slag cause it to froth and swell and much of this "flush slag" flows off through a hole in the back of the furnace well above the normal shore line. This slag carries a little sulphur, and much of the silicon, phosphorus and manganese in the pig iron, and the amount of finishing slag is correspondingly reduced.

Continuous Steel Making. — Benjamin Talbot first built furnaces for continuous production of steel at Pencoyd, Pa., in 1899, although the Talbot process is more popular in England (1939). Furnaces are of large capacity — 200 to 300 tons of metal — and are mounted like a mixer on trunnions; they can be tilted forward and slag skimmed or metal poured through a spout, normally far above the liquid bath. Most of the finishing slag and about 10 tons of steel from the previous heat are retained in the furnace and on this is charged enough burnt lime and ore so the first slag can be removed when the metal is 0.30% carbon above that desired. After heating the slag and furnace for 2 hours scrap as available is charged, heated another 2 hours, and about three-quarters of the required molten pig iron is poured in. Reaction is vigorous for about 4 hours, and then the remainder of the hot metal is added. The bath quickly comes to a good boil and the slag is carefully skimmed off 1 hour later. This slag carries most of the phosphorus; it may analyze 17% P_2O_5 and is a valuable by-product. The finishing slag is then made up of lime and scale (iron oxide) and the bath worked until carbon, sulphur, and phosphorus in the metal are reduced to the required point, taking about 3 hours, whereupon ferro-manganese is added and the steel is poured into waiting ladles. The analysis can be "caught on the run," and held for adjustments, alloying, or making up a second refining slag. The process, therefore, in addition to consuming large proportions of hot metal, is able to produce quality steels of varying specifications at will, thus being a prototype of the electric furnace, to be described later.

Duplex Processes.--Other means of speeding the rather deliberate open-hearth reactions are used extensively, perhaps the most important being a combination of acid Bessemer and basic open hearth. This enables the steel-makers to start with a high sulphur ore, smelting it to a high silicon, low sulphur pig iron, blowing the silicon and carbon out in a converter, and transferring the molten steel to a large tilting furnace where the phosphorus, oxide and gases are eliminated. In American practice 250-ton tilting furnaces are used; 50 tons of molten steel are reserved in the hearth, a highly basic combination of ore and lime is charged, melted. and about 150 tons of blown metal poured in. When the temperature and slag are correctly adjusted, a ladle of basic pig iron from a mixer is charged. A strong carbon boil ensues immediately, and the slag foams up and overflows, carrying much of the phosphorus and some sulphur. When the first reaction quiets down, a second ladle of pig iron causes it to resume, and drives out the rest of the phosphorus. The slag is then skimmed off, enough pig iron is added to bring the carbon to the desired percentage, and the metal finished and superheated for pouring. From such a furnace, 200 tons of steel can be taken every 3 or 4 hours.

Duplex processes of the sort described but using two open-hearth furnaces originated in Germany and are used for irons somewhat too low in phosphorus for the basic converter. In the first furnace, run at a rather low temperature, the phosphorus and silicon are eliminated into a lime slag rich enough for use as a fertilizer. The furnace is tapped, the slag separated, and the metal introduced into another and hotter furnace, wherein awaits a proper slag for rapid carbon elimination. This is called the Bertrand-Thiel process; the Hoesch modification recharges the partly purified metal back into the furnace from which it has just been drained. Super-refining molten basic steel in an electric furnace is another variety of duplexing which has been practised in America; by eliminating sulphur and oxidizing particles, good steel is made, but the difficulty of co-ordinating operations to avoid idle stand-by of costly furnaces has prevented the wider adoption of duplex processes.

Acid Steel. — Furnaces made with siliceous bottoms and banks, the descendants of the original open-hearth furnaces, still exist in considerable number. They make steel under slags which are essentially mixtures of iron, manganese and silicon oxides, having well over 50% of the latter, and are so quite acid in nature. Such acid steel has an enviable reputation for quality, but since the furnace reactions remove neither sulphur nor phosphorus, the raw materials and fuel must be selected with much more care.

Pig and scrap, as available, are charged cold into the furnace, which has a higher roof to withstand the higher refining temperature; during melting, nine-tenths of the manganese and silicon are oxidized, and join with the rust and burned iron to form a slag. Carbon is eliminated slowly by reaction with the iron oxide in the slag; a little ore is added some two hours after the charge is well melted to keep this reaction going until the residual carbon in the metal equals that required in the steel being made. Temperature is driven higher and higher. Toward the end of this refining period — which may require seven hours — some manganese and silicon re-enters the metal, reduced from the slag by reversible chemical reactions, and are very effective in removing oxygen and other dissolved gases At the end the metal is slowly losing carbon but gaining manganese and silicon. However, manganese is still too low for most steel specifications, so an appropriate amount of ferro-manganese is added some 20 min. before tapping A complete cycle of operations may require up to 16 hours when making steels for ordnance. The superiority of acid open-hearth steel is due to the better grade of raw material used, the small amount of slag formed (perhaps 7% of the metal), the more deliberate working of the heat enabling the furnaceman to bring his metal to the right analysis without making large additions of alloys, and the ability to eliminate gases and non-metallic impurities from a super-heated fluid metal while it is still in the furnace.

ELECTRIC STEEL

Electric furnaces (*q.v.*) are usually round in plan, with low side walls, flat domed roofs and invert bottoms, built inside a stout bowl of steel plates, which in turn is attached to some tilting device. Side walls are pierced by one or more doors and a pouring spout. The side wall and bottom linings may be either acid—silica brick and fused siliceous material—or basic magnesite. (The acid furnace is confined generally to small installations in foundries, and is merely a melting and super-heating device, since the unique carbide slags to be described later cannot be formed inside a siliceous lining.) Roofs are of silica brick, and are pierced for carbon or graphite electrodes, one for each phase of current, of proper size to carry the electricity without undue resistance. Furnace capacities range from ¼ ton for small foundries, to 50 tons for super-refining liquid steel. Size is limited by the size of electrodes available; of the latter, a carbon 40 in. in diameter is the maximum; a 7-ton furnace would be about 12 ft. in outer diameter, with 13 in. side walls, and hearth 5½ ft. inside height. In operation, the electrodes are automatically adjusted so the lower ends are constantly a correct distance above the slag. Electric currents of large amperage arc cross this gap, flow through the slag to the metal and there neutralize equal currents of opposite phase led in through the other electrodes. Heat is generated principally by the resistance offered by the air gap and the slag layer to the flow of this current. The electrodes are consumed gradually, combining with oxygen of the air within the furnace, producing a carbon monoxide atmosphere, desirable for steel refining.

Advantages of Electric **Heat.**—No virtue is given to electric steel by the electricity. It is merely a convenient source of heat, under close control. The advantages of electric furnaces for steel making are: (a) ability to generate a high temperature and thus cause certain desirable reactions to occur; (b) virtual absence of products of fuel combustion and their unwanted compounds of carbon, hydrogen, sulphur and oxygen; (c) the ability to remove a slag and make up new ones, thus controlling refining reactions; (d) the metal is hotter than the refractory, a prime advantage in cost over crucible melting; (e) less slagging of alloying elements, thus making for economy and control of chemical composition within narrow limits. Such advantages are illustrated in the process of super-refining molten metal from the open-hearth furnace; in such operations the basic electric furnace is a unit of a duplex or even a triplex process—the pig iron may be desiliconized in an acid converter, de-phosphorized in a basic open hearth, and de-oxidized and de-sulphurized in a basic electric furnace.

Super-refining Molten Steel.--Open-hearth steel is taken from the furnace when the carbon has dropped to the required figure, and a little ferro-silicon or aluminium added to the ladle to prevent further decarbonization during the transfer. In such condition the phosphorus and silicon are both very low—0·010% or less—while the sulphur depends upon the purity of the metal at the beginning, none being lost in the process so far; in fact the metal picks up a little from the furnace gases. If a nickel steel is to be made, the correct amount of shot nickel is added when this liquid metal is poured into the electric furnace. After the current has played long enough to remelt any crust of metal which may have chilled, a highly basic white slag is made up and melted, consisting mostly of burned lime with only enough silica sand and fluorspar to give it the proper fluidity. In quantity this would amount to about 3% of the metal. An excess of ground carbon is then shovelled in, the furnace closed, left under current for from 1½ to 5 hours, depending upon the quality of steel required, and the doors opened only for sampling or adjusting the slag. Under these conditions of a reducing atmosphere, a high lime slag, and intense heat, calcium carbide is formed by reaction between the lime and crushed carbon

$$CaO + 3C = CaC_2 + CO$$

Slag samples quenched in water give off much acetylene (*q.v.*) easily distinguished by its characteristic odour. Such a carbide slag not only reduces oxygen in the steel but is capable of abstracting the sulphur. The reaction for the latter may be something like this:

$$3MnS + 2CaO + CaC_2 = 3Mn + 3CaS + 2CO$$

By this means ordinary open-hearth charges which usually melt to 0·05% sulphur are reduced to one-half that amount in a four-hour cycle, while selected charges melting to 0·015% sulphur can be driven to less than 0·010% in a heat taking 8 hours. It will be observed from this reaction that some manganese is necessary. This will be residual in the open-hearth metal, for it has been found that if say 2% manganese is in the original pig iron, the resulting steel, containing 0·30 to 0.50 manganese will be of much better quality, sounder and cleaner, than from a low-manganese charge.

When the soapy slag stops its slight foaming, it is a sign that desulphurizing and deoxidizing are about completed, and the various alloys necessary to make the required analysis are added at intervals in order of their oxidizing power, namely, ferro-silicon first, then ferro-manganese, ferro-chromium, and finally ferro-vanadium. Carbon is picked up from the carbide slag and from these alloys. After all these alloys are melted and diffused the current is shut off and the metal lies quiet for 30 min. or more, to allow entrapped particles of slag to arise and the superheated metal to cool and liberate dissolved carbon monoxide gas. Slag is then most carefully skimmed, and the steel poured into a ladle which may contain a little carbon, ferro-silicon and ferro-zirconium. After 30 min. further cooling the metal is teemed into warm, scrupulously clean moulds with hot tops. A sectioned ingot will show no cavities as large as a pin head.

Quality of Deoxidized Steel.—Quality of such deoxidized and desulphurized steels rests in a number of characteristics, some not capable of evaluation, such as better response to heat treatment, less non-metallic inclusions, as shown under the microscope and after deep pickling in strong acid. A better gauge is the transverse properties. If a well made heat of basic open hearth steel is forged into a big gun, tension test pieces cut out of this forging will show high ductility if the piece is cut in a directon parallel to the axis of the gun. On the other hand if these test pieces-are cut tangentially to the bore, the ultimate strength is satisfactory but the ductility is not much more than half the longitudinal piece. Unfortunately this transverse weakness is in the very direction which must bear the heaviest stress when the gun is fired. An accepted explanation of this phenomenon is that the work of forging ranges the non-metallic impurities into layers parallel to the faces of compression, and interrupts the metallic continuity. Obviously, the cleaner the steel the less would be the transverse weakness. For that reason important forgings, such as hollow tubes to resist internal pressure, are commonly made of acid open-hearth steel. Super-refined basic electric steel is even better, as shown by the following typical tests from big gun forgings of nickel steel:

	Longitudina!	Tangential
Ultimate strength, lb. per sq. in.	110,000	110,000
Elastic limit, lb. per sq. in.	58,000	58,000
Elongation in 2 in., %	24	21
Contraction in area, %	56	42

Melting Cold Scrap.—By far the larger number of electric furnaces are of small capacity for melting cold scrap. While it is possible to refine impure pig iron in either the acid or basic electric furnace, it has been generally foucd more economical to start with clean, relatively heavy, high manganese scrap and melt without additions of iron ore. In a basic furnace considerable lime would be charged into the empty furnace; melting is done under the heaviest power input practicable. The slag formed on the steel is always black from the rust and oxide formed during melting. This slag is removed as soon as the charge is melted, and some ground carbon electrode butts are shovelled into the furnace and flapped under the metal. As the carbon dissolves, it first tends to deoxidize the steel

$$[O]_{Fe} + C = CO$$

and the carbon monoxide gas comes up in bubbles. Some surplus carbon helps bring the carbon to the required analysis. Then a

white or carbide slag is made up, and the refining and alloying is done with current of lower voltage and as described above.

Induction Furnaces.— The 1939 substitute for the crucible melting hole is the high frequency induction furnace. The furnace case is a small cubical box which can be tilted about one upper edge. It contains a cylindrical spiral coil of water cooled copper tubing which carries alternating current at about 2,500 cycles per second. The coil is electrically and thermally insulated, and inside it is rammed a magnesite refractory to form a crucible, into which is charged selected steel and ferro-alloys for simple melting and mixing without refining. The intense alternating magnetic field set up inside the coil induces eddy or Foucault (*q.v.*) currents in this metal to heat and melt it. Electrodynamic movement of the bath keeps the metal well stirred, which is of advantage in making high alloys of heavy metals, such as high speed tool steel (*q.v.*), but tends to stir in particles of incidental oxide slag. As a simple melting furnace of rapid action the induction furnace has no equal.

Statistics show that electric steel has practically supplanted crucible steel in America, but has not been so successful in Great Britain. Italy being rich in water power. but very poor in fuel, has at least 200 electric furnaces with annual capacity of one million tons, but nearly all of them produce tonnage steels. Much controversy exists as to the relative quality produced by the two processes. It is probably true that there is little difference when selected raw material is charged, an expert furnaceman is employed, and equally careful pouring, forging and annealing practice is adhered to—in other words, when equal care is given to the respective heats. But steel from either process can be disappointing when conditions get out of control The crucible is more convenient for smaller casts of plain high-carbon steels; the electric is more convenient for heavy ingots of lower carbon, higher alloy steels.

INGOTS

Gases in Liquid Metal.— Early attempts to make steel in England by Bessemer's process were failures because the metal when poured into ingot moulds boiled over and the remaining portion when solid would be full of blow-holes, like a Swiss cheese Robert Mushet noted that the only apparent difference between sound ingots and the spongy ones was that the former were made of high-manganese pig iron and a little manganese remained in the steel; consequently he proposed adding some of the metal after the blow. Thus originated the practice already mentioned of adding spiegel or ferro-manganese to heats of steel made by any of the Bessemer or open-hearth modifications. Superheated liquid steel absorbs gases from the atmosphere or oxygen from the slag. This gas is only slowly evolved as the steel cools off, but it boils out vigorously just at the freezing point. In the crucible and acid open-hearth process much of this oxygen is eliminated by holding the melted metal quietly in the furnace until reactions between the siliceous linings and the metal allow the latter to absorb some silicon which in turn is very effective in removing dissolved or combined oxygen existing in the steel, and causing it to solidify quietly without effervescing, which imparts superior physical properties. This time-consuming reaction is avoided when producing cheaper steels in great tonnages by adding the degasifyers to the steel in the ladle, or even as it is poured into the ingot. Melted spiegel-eisen is used for medium carbon Bessemer steels. Since spiegel ordinarily contains 20% manganese and 5% carbon, it will be observed that sufficient manganese to quiet the steel will also introduce considerable carbon. Should this be too much for the desired grade of steel, ferro-manganese is used instead. Since a relatively small amount of this is required small pieces are placed in the ladle. and melted by the inrushing steel; if the metal on casting still seems too effervescent, a few aluminium shot are thrown into each ingot. The principal effect of each of these metals is to rob harmful iron oxide existing in the steel of its oxygen, thereby transferring it to MnO, SiO_2 or Al_2O_3 as the case may be. These oxides are highly insoluble in metal, and tend to accumulate into slag particles and float; but there is little opportunity for elimination when the reactions occur in the ladle or ingot mould. Entrapment of submicroscopic inclusions is not an unmitigated evil; under proper control the effect is to restrict crystallization of the steel during solidification and in later heat treatment, and such fine grained steel has superior toughness and most other physical properties (except depth of hardening).

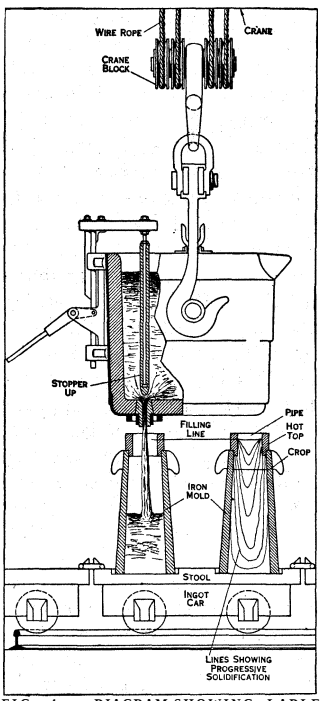


FIG. 4.— DIAGRAM SHOWING LADLE AND METHOD OF POURING INGOTS; AND LINES SHOWING PROGRESSIVE SOLIDIFICATION OF INGOTS

Teeming Practice.— It is usual practice to transfer steel from converter or open-hearth to ladle somewhat too hot to pour; also to use a ladle of correct size so most of the slag overflows. Ladles, therefore, contain from j to 200 tons of steel, depending on the furnace served (*see* fig. 4). They are strong steel pots lined with fire brick, and equipped with trunnions and shackles for crane transport. The hot metal is kept in the ladle sometimes as much as half an hour, to enable all trapped slag particles to float. Then the ladle is carried to the ingot moulds, and the metal teemed through a hole in the bottom. When one mould is filled, the metal stream is interrupted by lowering the stopper until the ladle may be moved to an empty mould. Splashing against the sides of the moulds must be avoided, for such splashings are the most general cause of surface defects on the finished articles.

Steel castings are ordinarily teemed in the same way; furnaces in steel foundries are usually very small as compared with furnaces serving rolling mills. 97% of all the steel made is cast into ingots.

Cavities in Ingots.— Well-killed steel contracts in volume when it changes from liquid to solid; consequently a mould poured level full will have a top cavity, or pipe, when solid. Good practice so proportions the chilling effect of the mould? the temperature of the steel and the rate of pouring that the ingot solidifies from the bottom up. A hot-top in the form of a firebrick collar, set on top of the mould, as shown, is a most useful device for keeping the top portion of the metal fluid until the last, and in condition to feed and fill the shrinkage cavity below (*see* fig. 4). A certain segregation or concentration of alloying elements also occurs toward the pipe; consequently all the defective top must be cropped as indicated and remelted as scrap. Segregation and piping is also minimized by casting ingots big-end-up and by slow pouring of rather cool metal. The latter is well accomplished by having several ingot-moulds on one stool, teeming into the central one, and allowing metal to rise in the others through connecting passages in the common base. Enough gas is left in most low carbon tonnage steels so a slight effervescence occurs in the mould, just enough to counteract the piping tendency. When properly made and cast, such ingots will have a flat top, a smooth solid surface, but a number of deepseated small blow holes. During subsequent rolling these are squeezed shut and the metal welds together more or less effectively. Metal of this sort is called "rimming" steel; the dense surface of the metallic ingot is an ideal start for thin sheet, which is almost all surface.

Stripping and Soaking.— Size of ingots depends upon the use to which the metal is to be put. Ingots of alloy steel and high grade tool steel sometimes weigh no more than 100 lb. Forging ingots are from two to five times the thickness of the biggest part of the resulting forging; those for rails, plates and structural shapes are adjusted to the size and capacity of rolling mill, and

the cross section of the desired product; for rolling mills they are generally square in cross section, with rounded corners, and about three times as high as thick. A common size is 2x2x6 ft. weighing about 6 tons. Forging ingots are frequently fluted hexagons or octagons in cross section. The moulds are heavy-walled iron castings, made of low-phosphorus low-sulphur pig iron, such as is suitable for the acid Bessemer process, sprayed with lime wash or other coating. When the metal in the ingot has well solidified, the train of moulds is moved to a stripper, an overhead crane with a vertical plunger which can be forced down by suitable gearing on top of the ingot, holding it down against the stool. A pair of stirrups then loop over the ears on either side of the mould, and lift; if the inner surface of the mould is in good condition and smooth, no difficulty is had in thus removing the mould, and it is then placed on an empty car alongside. At this time the surface of the ingot is at a full red heat, yet the interior may still be white hot To equalize this heat the ingot is placed in a soaking pit, a square fire brick chamber large enough to contain two to six ingots standing on end; an arched cover rolls aside for entrance. Auxiliary heat is supplied as necessary by a gas-air flame, operating through regenerative chequer-work, ports and auxiliary control as described for open-hearth furnaces. Pit capacity for at least 100 ingots is required to maintain a steady supply of properly heated metal to a modern rolling mill.

ROLLING MILLS

Hot Working. — A spongy lump of wrought iron, hot from the furnace, requires forging in order to squeeze out much of the trapped slag, and to consolidate the metal. Even the best ingot of steel is improved by hot work, such as forging or pressing; its fracture is changed from a coarse crystalline cleavage like sugar to a mossy or fibrous appearance associated with greatly increased toughness; it also becomes more amenable to heat treatment. Formerly all this was done on the blacksmith's anvil. Massive gun tubes and armour-plates are forged slowly in hydraulic presses; heavy engine parts, axles and cranks are beaten out by steam-hammers; repetition tools, levers and machine parts are forged under drop-hammers. In every instance the aim is to convert a steel casting (ingot) into a special shape and with improved physical properties.

Modern machines and structures--even foods and personal conveniences — require large quantities of steel parts of uniform cross section, such as plates, bars, beams, rails, pipes, sheets, etc. These are made in rolling-mills where the work is performed by passing the red hot metal through one pair of heavy rollers after another, so grooved and spaced that each succeeding pass is smaller and more nearly the required final shape. While the products of a rolling mill vary widely in weight and shape, a common characteristic is that each piece is of uniform cross section from end to end, and is of a length limited only by the size of the original ingot, or by the size of the runout floor.

The word mill may mean the entire steel making plant, just one department, or one stand of rolls in the department. Complete departments have various names, such as rail mills, structural mills, plate mills, merchant bar mills, depending upon the product they most efficiently produce. Each such mill contains a number of roll-stands of decreasing size and power, from the blooming or cogging mills which do the heaviest work, down through the intermediate stands to the last pass, finishing mill or finishing stand, which impresses the exact final cross section.

There still exist many rolling-mills, some producing the highest type of tool steel, which start with a small piece of metal (a 150 lb. ingot or a chunky rolled bar called a billet) and produce rods, bars, hoops or flats a fraction of an inch thick. Metal is passed back and forth by tongs in the hands of skilled labourers. Such roll stands are usually arranged side by side and the hot bars are looped from stand to stand, entering from alternate sides, until the final shape is produced. Sometimes curved guides are installed to do the work of alternate workmen; as the size of the bars increases hand labour cannot cope with the situation. Most rolled shapes start from white hot ingots, perhaps six tons in weight, which are taken from soaking pits by a travelling crane, placed on the first of a series of "tables" — power driven roller conveyors — which transport the metal wherever a distant electric switch operator directs.

Blooming mills are usually arranged so the ingot is passed back and forth several times through the same roll stand. This requires a screw-down device and indicating dial on top of the housing for lowering and reversing the rolls progressively as the piece becomes smaller. The spindles connecting the rolls to the driving engine or motor are of most rugged construction, for upwards of 20,000 h.p. is transmitted at times.

Heating Furnaces. — In a modern rail-mill the ingot, having been reduced to a long bloom perhaps 8 in. square in cross section, has its ends sheared off to sound, unpiped metal by massive guillotine shears operated by hydraulic power, and is cut into such lengths that each billet will make one or two rails of required length and cross section; these are then reheated before further rolling; other mills which reheat cold billets require special furnaces, now usually gas or oil fired, frequently having waste heat boilers or recuperators (see also FURNACE, METALLURGICAL; FURNACE, ELECTRIC). Furnaces have a long rectangular hearth, slightly inclined, as wide as the billet is long, and a low roof. Water-cooled skids carry the weight of the steel and prevent scraping on the brick furnace-bottom. At the cool end billets are pushed in sideuays by a plunger. one by one, moving all ahead closer to the hot end. Every time a cold piece enters the furnace, a hot one is pushed out the other end on a roller table leading to a roll stand; other continuous furnaces have water-cooled rollers or other devices built into the bottoms for moving lighter pieces such as wire coils through them at a slow steady rate.

Rail Manufacture. — A reheated bloom in a rail-mill may then be given four more passes in another reversing mill, called the first roughing stand, passing then to the first finishing stand. This is three-high, *i.e.*, there are three rolls in a stand. The forward pass is through a groove cut in the lower and the middle roll; the receiving table is then elevated bodily and a backward pass is made between a groove cut in the middle and upper roll. Four such passes and a final one through a finishing stand completes the rail; a total of 15 passes and one reheating will convert an ingot into a rail weighing 100 lb. per yard. Structural shapes such as angles, channels and I-beams, are rolled in a similar routine. Frequently rail mills, by simple change in rolls, are made to produce structural steel when there is no market for rails. Special and extra heavy equipment is necessary to roll the massive H-beams with deep flanges so popular for building columns.

Plate manufacturing departments are less complicated than a rail mill, although the machinery may be more rugged. First the ingot — 6 to 10 tons or even heavier — is rolled to a flat slab in a blooming mill, sheared into pieces, and the slabs reheated. Further work is done by cylindrical (ungrooved) rolls. Sometimes a single reversing a-high roll stand does all the work; at other times two three-high mills with elevating tables may be observed. On account of the enormous bending stresses carried by the rolls when rolling wide plates, many two-high reversing stands have been built as four-high mills, having two rather small working rolls, each backed up with a larger one for stiffness. Plates of more uniform thickness, edge to centre, may be made in this way. It should be observed that the action of a rolling-mill does not widen the piece very much — most of the change in volume results in increasing its length. Consequently a heavy slab is cut to a length which equals the width of the required plate, and it enters the plate rolls sideways. Cross rolling in this way results in a better plate; metal worked in only one direction acquires transverse weakness. This means that the tensile strength of test bars cut with their axes parallel with the direction of extension during rolling will be higher than when cut from the plate with axis in any other direction. Other interesting mechanical devices are included in a plate mill which cannot be described here in detail. Among them are plate straighteners, cooling beds, cross cut and edge shears, turnover devices, castor beds and magnetic grips. Side shearing on narrow plates may be avoided by using a universal mill, which is a roll stand to which is added a pair of stout

vertical rolls. The latter are adjustable, up to perhaps 48 in. apart, and are set a proper distance to keep the hot plastic plate the exact width during its formation.

MILLS FOR SEMI-FINISHED MATERIALS

Continuous **Mills.**—Four classes of semi-finished materials are manufactured in such tonnage that special mills are set up to produce them, namely: sheet bars, skelp, strip, and wire rods. These products are the raw material for special manufacturing plants often located at a distance from the steel furnaces. Sheet bars are worked into tinplate, galvanized, and uncoated sheet; pipe is made from skelp; strip is narrow sheet for hoops and bands; and rods are drawn into wire, from which all kinds of fencing, screening, cable, nails, and springs are made. Sheet bars and skelp are made in bar mills, frequently located immediately beyond a blooming mill, which take a 6 in. square bloom hot from the shear, and roll into the thin narrow plate without reheating. Such a plan requires the most rapid handling to complete the rolling before too much heat is radiated. This is done by placing a succession of two-high roll stands in tandem, within a few feet of each other, and guiding the bar automatically from one roll to the next. Since each pass elongates the piece, the speed of each roll is higher than the preceding, and the relation between speed and reduction must be nicely adjusted so the hot bar will neither buckle nor be stretched at any stage. A succession of eight or ten such rolls, with perhaps three pairs of vertical rolls to control the width—interspersed in the train—can produce standard width 8 in. sheet bars or skelp from 6 to 20 in. wide (suitable for forming into pipe up to 6 in. diameter), and from $\frac{1}{8}$ to $\frac{3}{8}$ in. thick, at the rate of 4,000 to 20,000 tons per week depending upon the sectional area of the bars manufactured. Since a mill of this sort can easily produce material far too long to ship, flying shears are set beyond the finishing roll to cut the bars to length. Many designs have been made, capable of square cutting a rapidly moving bar. Sheet bars are sometimes quenched by travelling down a long table under a series of water spray nozzles. Interesting piling devices are used.

Sheet Mills.—Sheets are $\frac{1}{8}$ in. thick or less, whereas plates have sufficient mass to retain heat until rolled to proper gauge, and a surface cbvered with mill scale is quite good enough for most purposes. Sheets, on account of their thinness and the excellent surface demanded by such finishing operations as galvanizing or lacquering, must be rolled in an entirely different manner. Many sheet mills are still operated by hand after the methods originated in Wales two centuries ago and have larger and more rugged equipment, generally producing material 18 to 30 gauge thick, whereas tin plate is smaller in area and thinner—28 to 38 gauge. The 1930s saw a replacement of many hand mills by a few continuous sheet mills, especially in the American industry.

Sheet bars are cut with length slightly greater than the width of the required sheet, heated to a dull red 850° C, and rolled sideways through a two-high mill with massive cylindrical rolls, 32 in. diameter. One workman catches the bars as they come through and passes them back to another over the top roll; a third screws down the top roll gradually to continue the reduction. The crew passes two bars back and forth very dextrously; when these bars have been flattened to about $\frac{3}{32}$ in. one is placed on top of the other, the top roll raised, and the pair rolled down until each is about twice as thick as the desired sheet. In the best practice, one pass is then given in the mill to be used for finishing, in order to "shape" the pack to this mill.

By this time, reheating is necessary; the pair is opened, that is the two sheets are separated, and placed in a furnace until the temperature is up to about 800° C. Low temperatures and a smoky flame are necessary to prevent surface oxidation in the furnace. A pair of these sheets are then further rolled to the required thickness in a finishing mill, more accurate in construction and requiring more skill to operate. For thin gauges, sheets are folded double and rolled in packs of four or even eight. Frequent opening and reheating is necessary in the latter stages of the process. They are then straightened and sheared to size.

Many surface finishes are required by customers who manufacture a multitude of objects of sheet metai. The sheets may be annealed either by being passed slowly through a long furnace with hot central zone—blue annealing—or by being piled in a tight box containing a prepared atmosphere to protect the steel from tarnish and heated for hours at a considerably lower temperature—box annealing; or the cold sheets may be given several passes through accurate rolls for a smooth surface and a somewhat stiffer temper. Interspersed with these cperations, the oxide or mill scale may be removed by pickling in weak sulphuric acid. Finally the cleaned cold-rolled sheets may be dipped in white metal for a protective coat, wiped, cooled, polished and boxed. Coating with zinc is called galvanizing; tin or tin sheet is thin steel dipped in pure tin; terne sheet is dipped in a lead-tin alloy.

Strip and Continuous Sheets.—Desire to eliminate the large amount of labour required for sheet working by the above described process has led to the recent production of sheets in continuous mills. Since 1900 it had been common to roll strip up to 3 in. wide and 16 gauge or less in thickness, in very long coils in a series of roll stands placed close together; mills have been built for wider and wider strip-sheet, until sheet 8 ft. wide was produced commercially in America in 1939, but no thinner than 16 gauge. In a narrow strip, hoop or cotton-tie mill, a continuous heating furnace feeds flat bars about the width of the finished piece, endwise into the first of a series of six tongue and groove rolls, perhaps 10 in. diameter. One edger may be installed after the third roll, and the remainder then be flat rolls. Then the bar passes through a series of three very accurate finishing rolls, sometimes being bent sharply, scraped, and air blasted before entering the last roll to remove the scale. These finishing rolls are cylindrical, and the guides are shifted sidewise at frequent intervals, to prevent the chilled strip from wearing the roll-surface irregularly; speeds are watched closely; the first roughing roll is very slow, the last very fast; in fact the trziling end of the billet may still be in the furnace when the front end is being reeled, zoo ft. away, at the speed of 1,000 ft. per minute. One great advantage of such close-set continuous mills is that the time of passage from furnace to finishing roll is the same for all parts of the billet; consequently the temperature at the last pass is uniform, and the thickness after cooling is also quite uniform. Finished strip is automatically turned on edge, looped back and forth on a broad slow moving conveyor belt passing through a muffle; emerging it is cool enough for reeling, cutting to length and bundling. About 40 men are required to operate such a strip mill producing from 10 to 20 tons of strip per hour, depending upon its width and gauge. Such strip has a surface covered with mill scale, or if this is scraped off, a blued colour formed during slow cooling. For higher finishes and stiffer tempers, the strip may be pickled and cold rolled rather slowly tJ accurate gauge and smooth surface.

In the new continuous sheet mills, slabs weighing up to a ton and a half, the product of a blooming mill, are reheated to the proper temperature and delivered to the first roll stand, where jets of high pressure, superheated steam strike the hot slab just as it enters the rolls, thus breaking loose most of the scale. This roll stand is set somewhat further from its successors than the space between later stands. Some of this table is utilized for a turning mechanism, so that the slab can be turned sidewise, since its original length should represent the width of the strip. Heavy machinery also holds the slab down while its edges are squeezed to the correct distance apart. The slab is also held here a little time to radiate down to the necessary temperature; the latter is fixed by the speed of the remaining stands and the desired delivery temperature. Once started on its way, the slab passes through three or four heavy, four-high roll stands comprising what is known as the roughing train. separated far enough so the slab is entirely free in its passage along the roller table from stand to stand. This roughing train will reduce the thickness of the $4\frac{1}{2}$ to 5-in. slab to somewhere around 1 in., and correspondingly increase its length. It is usual for these stands also to have vertical edging rolls set at their entering side to keep the width of the hot metal correct. The work rolls in all these four-high mills are relatively small in diameter and have very heavy, massive hacking-up rolls. Next in train comes a series of six four-high stands set fairly close together, each one rotating

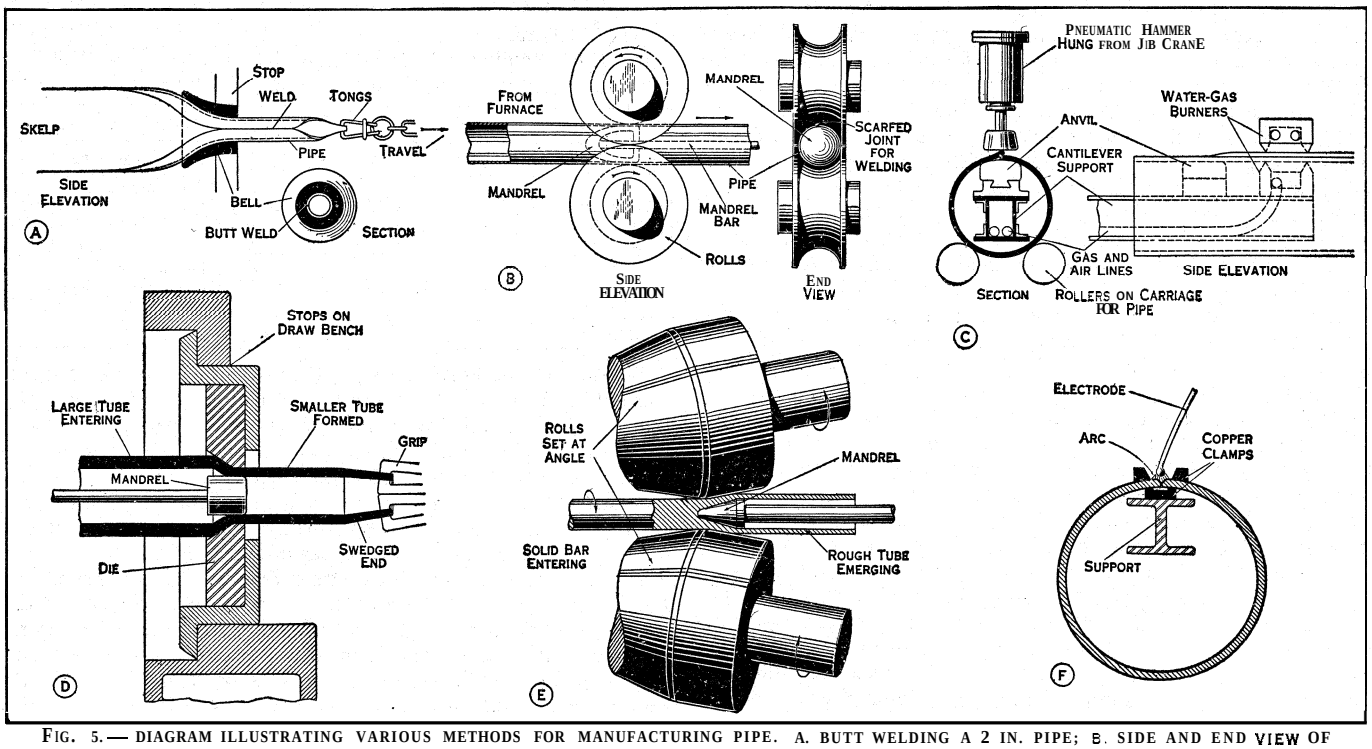


FIG. 5.— DIAGRAM ILLUSTRATING VARIOUS METHODS FOR MANUFACTURING PIPE. A. BUTT WELDING A 2 IN. PIPE; B. SIDE AND END VIEW OF LAP WELDING; C. HAMMER WELDING OF 30 IN. PIPE: D. DRAWING SEAMLESS PIPE; E. MANNESMAN METHOD; F. ARC WELDING OF 30 IN. PIPE

at a faster speed than its predecessor, the last one delivering sheet of required thickness from, say, $\frac{1}{4}$ in. down to $\frac{1}{16}$ in., at a speed of 30 miles an hour. The metal emerges from the last stand before the trailing end is clear of the first, so safe passage without breaking requires finger-tip control of the speed of the mills, as well as accurate and ready adjustment of the clearance between rolls—that is, the relative amount of reduction, stand to stand. All of these controls are electrical in nature and are centred in a pulpit where the operators are in full view of the entire operation. Temperature of delivery of the sheet is important for many applications. Instantaneous and automatic optical pyrometers, indicating and recording temperatures not only of the slab at the beginning, but of the finished sheet at the end, are essential items of equipment. Sometimes the hot-finished sheet is rapidly cooled by water sprays; at other times the sheet is delivered as hot as possible to the coiling devices and the tightly wound coil is cooled quite slowly.

This sheet-mill product may be cut or slit into such sizes as make it available for other operations, such as thin plate or thick sheet for tankage or barrels, or it may be slit into narrow strips suitable for making into pipe. However, if it is to be further rolled into thinner sheet, the mill scale is pickled off, and then the material is rolled through four-high cold rolling mills, usually set three in tandem. Reduced finally to the proper thickness and hardness, the coil is uncoiled through a leveller and automatic shear which cuts and piles the sheets, after which they are sent to the annealing department for proper annealing. This is now done in controlled atmosphere so that there is no scaling and even iittle discoloration. After a final pass through a four-high stand ("skin rolling and levelling"), the sheets are resquared, inspected, oiled, and shipped.

Pipe.—Skelp, the flat bars from which small sized pipe is made, is rolled in a continuous mill specially designed to produce bars true in thickness, width, and properly bevelled on the edges. Frequently the finishing stand is adjustable, and a skilled workman varies the roll spacing slightly in accordance with his estimate of the temperature of the metal issuing, thus compensating for the different amounts of contraction during cooling. Skelp is cut 20 ft. long, one end pointed, and then charged into a flat hearth, properly designed to produce a uniform white heat throughout; when reaching the welding temperature the metal appears to be covered with a shiny grease, which is molten iron oxide. The operator then catches the pointed end in tongs, and by means of a draw bench (see WIRE) draws the white hot bar through a welding bell (fig. 5-A) forming the flat bar into a tube and pressing the butted ends together into a true weld all in one operation. Further operations reduce the pipe, but only slightly, to the correct size, straighten it, remove the scale, shape and thread the ends, proof test it, and finally cover it with a protective coating.

Butt welding is done on pipe from $\frac{1}{8}$ to 3 in. nominal inside diameter. Common pipe from 2 to 18 in. is more usually made of flat plate by lap welding (see fig. 5-B). Plates are piled into a furnace, heated to a dull red, and run one by one through scarfing rolls, which form the necessary bevel on the edges for an overlapping seam. The hot steel is then drawn through a forming bell which curls it up into a tube (fig. 5-A). After reheating to the welding temperature this tube is caught between a pair of rolls and rolled over a manganese steel mandrel (fig. 5-B), and the joint welded by the high heat and great pressure at the point of contact. When the length has been rolled, the bar which has been holding the mandrel in posidon is withdrawn from the far end of the pipe, and the latter rolled away for the finishing operations already enumerated. It requires only a few seconds to weld a standard length pipe by either of these processes. Welded pipe over 30 in. in diameter is made by hammer welding or more recently by automatic arc-welding. In the former. the wide plate is curled on plate bending rolls and the overlapping joint heated and forged shut in sections During the heating cycle two water-gas burners play a flame on a portion of the joint from both inside and outside; when the correct temperature is reached the lower burner is replaced by an anvil and the upper by a pneumatic hammer. and the hot spot welded and hammered down flat (fig. 5-C). The next section is similarly treated. After welding the length is re-rolled for shape and annealed, the ends sized and shaped, and the pieces tested and dipped in anti-corrosive liquid.

For arc-welding, the edges of the plate are planed to a bevelled V opening (fig. 5-F), the pipe bent to shape in rolls, clamped between long copper bars, and the bevel filled with metal from a slowly travelling wire, from which an electric arc is struck to the steel plate below. Details of this and other welding methods are given in the article on **WELDING**.

Seamless **Tubing.**—In America, seamless tubing is preferred for all purposes where the internal pressure is high and service severe, and a rapidly increasing amount of such pipe is being made in diameters up to 12 in. First, a round billet at full red heat is pierced by inclined rolls and mandrel. As sketched in fig. j-E, two 36 in. rolls of special shape are set side by side, with axes crossing and about 10° askew. The shape is such that the rolls grip the end of the ingot and spin it forward slowly, forcing it over a mandrel set between them. The operation is such that the mandrel seeks and maintains a truly axial position. After piercing the inner and outer surfaces are smoothed and the tube brought to exact size by several rollings over a mandrel, as in lap welding. Further operations from straightening to shipping are performed with considerable care. Not only is such pipe more reliable for the lack of any welded seam, but the piercing operation is so strenuous that nothing but metal of good quality can endure it. Therefore the tubing can safely withstand a considerably higher pressure than the best of welded pipe. Seamless tubes after cold drawing to thin walls are much used for structural members on bicycles, automobiles and aircraft, and for shaping into metal furniture and machine parts. Cold drawing is done as sketched (fig. 5-D). A tube somewhat too large and thick in wall has the end swaged down slightly. All oxide is then pickled off, the tube washed, dried and dipped in tallow or other lubricant. The pointed end is thrust through a round die, and gripped by draw-bench tongs. Next, a mandrel is thrust through the tube from the far end until it has a position directly within the die, and then the tube drawn forcibly through the annular opening thus formed. In this way the outer and inner diameter may both be controlled. Each draw hardens the metal and makes it more brittle; after a few such passes, if the required size is not yet reached, the pipe is given a low temperature anneal to relieve the cold-working strains, and the process continued.

Rods and Wire.—As indicated above, wire rods are frequently rolled from 2 in. billets, 30 ft. long, on continuous mills, and the sixteenth or finishing pass delivers a 0.2 in. round to reels at a speed of 45 m. an hour. Such a mill will produce 1j tons per hour, with a complete labour force of 4j men. Other arrangements utilize a continuous mill for breaking down a 4 in. billet, and about a dozen loops fed by hand in a cross-country mill to finish. Rod reels are dumped automatically, and the rod cold-drawn through dies, with frequent annealings and other intermediate operations, into wire of various diameters, finishes and tempers. The operations are described more fully under WIRE. Most of this wire is stranded into cable or wire rope, woven into screens, netting, or fencing or made into nails. All such is done by automatic machinery so economically that the increase in cost of nails, for instance, over wire is 15 cents per 100 lb., which not only includes manufacture, but the cost of the keg as well.

CLASSIFICATION AND USES OF PLAIN CARBON STEELS

Production and Consumption.—Any classification which accounts for the destination of steel made by any combination of the above described processes must evidently be impossible on account of its complexity. As to process, it may be said that any of them can be made to produce steel which easily passes present commercial specifications, even for so severe a duty as railroad rails. The following figures show the distribution of American production of steel, 1938, according to *The Iron Age:*

Sheet, strip and tinplate	41%
Bars	15%
Pipe	11%
Wire	9%
Plate	8%
Structural shapes	8%
Track material	5%
Miscellaneous	3%

In England the quantity of plates and track material is relatively larger, because of a more active ship-building industry and large exports respectively. The feature of the American industry is the large increase in sheet production, and the rapid decline of track material.

A similar classification of the chief lanes of consumption in the United States is given in the table which follows. It should be noted in this connection that in England and the Continent the proportion of exports is very much larger, and the relative position of automobiles and other machinery would probably be reversed. Figures are average for' 1933–38 inclusive.

Industry	Proportion	Chief Purchases
Automotive	21%	Sheets, strip and bars
Building and construction	12%	Plates, structural shapes and reinforcing
Containers	10%	Sheet
Railroads	9%	Track material and plates
Exports	5%	..
Oil, gas, water	5%	Pipe
Machinery	4%	Bars and sheets
Furnishings for buildings	4%	Black plate and sheets
Agriculture	3%	Wire and galvanized sheet
Jobbers and distributors	15%	Wire, pipe, sheets, bars
Unclassified	12%	..

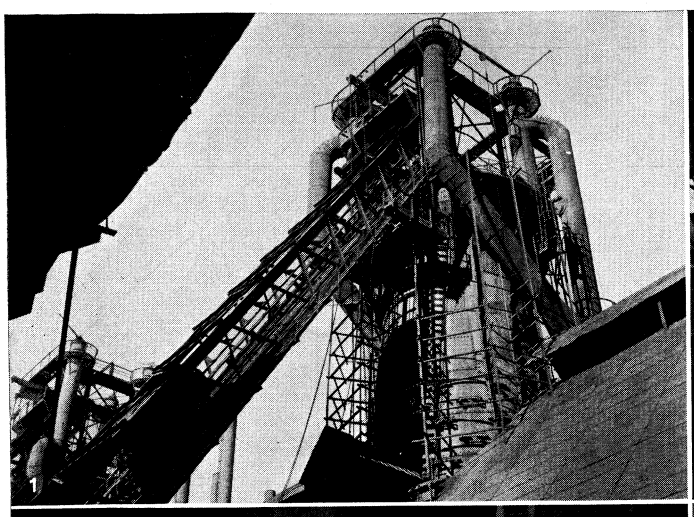
Grades **of** Carbon Steel.—Carbon is the principal alloying element used for hardening and strengthening iron- Consequently the utility of various iron-carbon alloys—the plain carbon steels which comprise such a large majority of the entire production—depends upon the amount of carbon present, and has led to the separation of the entire possible range into approximate grades: Ingot iron, made in a basic open-hearth furnace, has the lowest possible content of carbon and other alloying elements. It is used largely for sheets on account of its corrosion resistant properties. Extra soft or dead soft steel contains from 0.08 to 0.18% carbon, used where ductility, toughness, weldability or ease in cold working is desirable, and strength or stiffness a minor consideration, *i.e.,* for pipe, rivets, sheet, wire, and case hardened parts. Structural grade or mild steel contains from 0.15 to 0.25% carbon, used where a combination of strength and easy machineability is desired, for forging or flanging operations, *i.e.*, for buildings, bridges and railroad rolling stock, for boilers, drop forgings, and bolts. Medium grade contains 0.25 to 0.35% carbon and is even harder and stronger than mild steel, yet it may be hot-forged without difficulty, used for ship building, shafting, and forged machine parts. Medium hard steel contains from 0.35 to 0.65% carbon, and enters into the range where the final condition and reliability is much dependent upon the past mechanical and heat treatment; it is used for large forgings for locomotives and other prime movers, car axles, and in the higher carbons for railroad rails. Hard steel ranges from 0.65 to 0.85% carbon, and is used only after it is heat treated to a correct combination of strength and ductility, used for wrought steel wheels, locomotive tires, wood cutting tools, and sledges. Spring grades range from 0.85 to 1.05%, used in a heat treated condition, wherein a great range of hardness, resiliency and brittleness is possible, *i.e.,* automobile springs, cold chisels, rock drills and shear blades are made of these steels. High carbon tool steels range from 1.05 to 1.20%, used only after heat treatment for railroad springs, metal cutting and forming tools. A characteristic of these carbon steels is that each 0.01% of carbon increases the ultimate strength in the annealed condition by approximately 1,000 lbs. per sq.in., but at the expense of the ductility or toughness. Hardness also is increased.

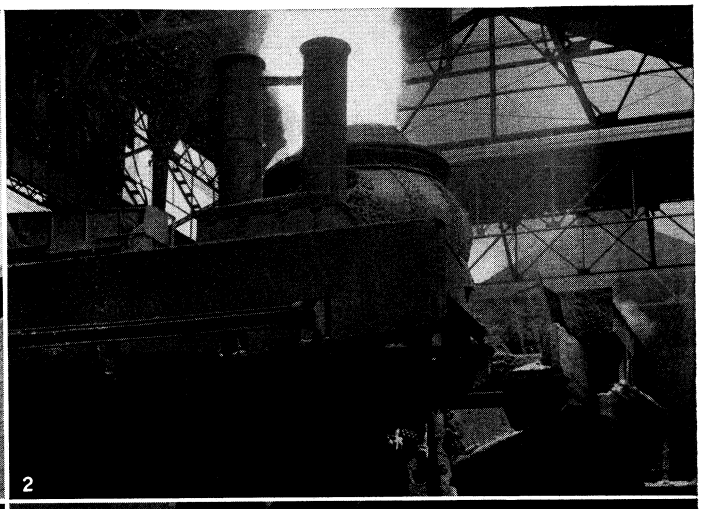
	Ultimate strength	Reduction in area	Brinell hardness
	Lbs. per sq. in.		
Rivets	50,000	30% in 8 in.	95
Medium hard forging	75,000	20%	134
Spring steel	125,000	10%	200
Same after quenching	200,000	0	600

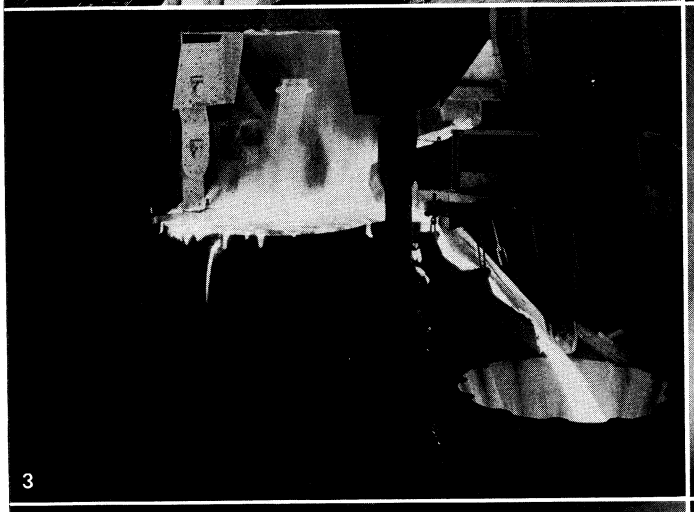
Combinations of even higher strengths with considerable ductility and impact resistance may be had only in alloy steels, of which a number have been developed with special properties.

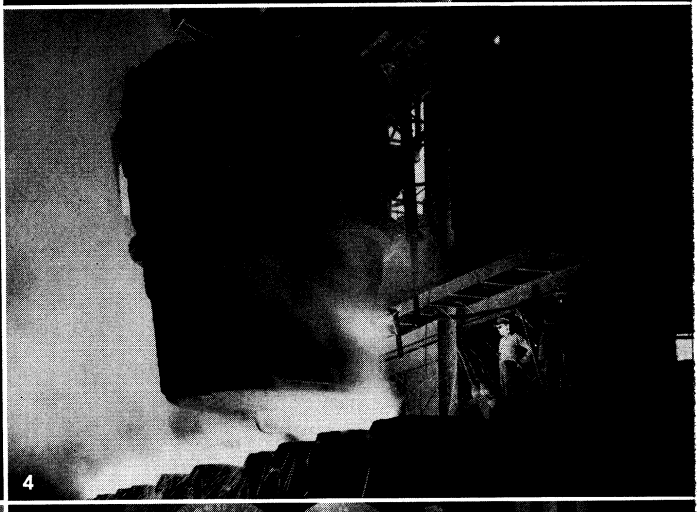
Use of alloy steels, which prior to 1910 was confined mostly to big guns, armour and projectiles, has spread rapidly into all metal working industries, among which the automotive leads. Production statistics are either lacking or uncertain because there is no agreement as to what constitutes an alloy steel. The trend (1939) is toward lower and lower contents of alloy made by basic open-hearth furnaces, operating under very special control for deoxidation and grain size. As pointed out in the article on STEELS, ALLOY, they are special steels, not merely a carbon steel to which

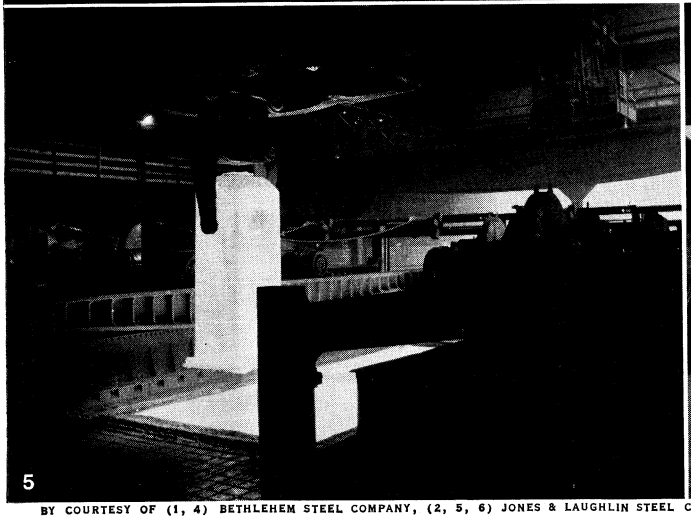
IRON AND STEEL

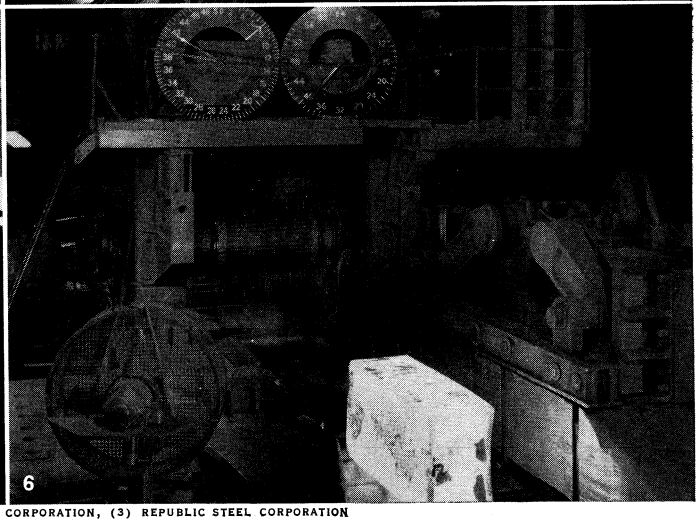










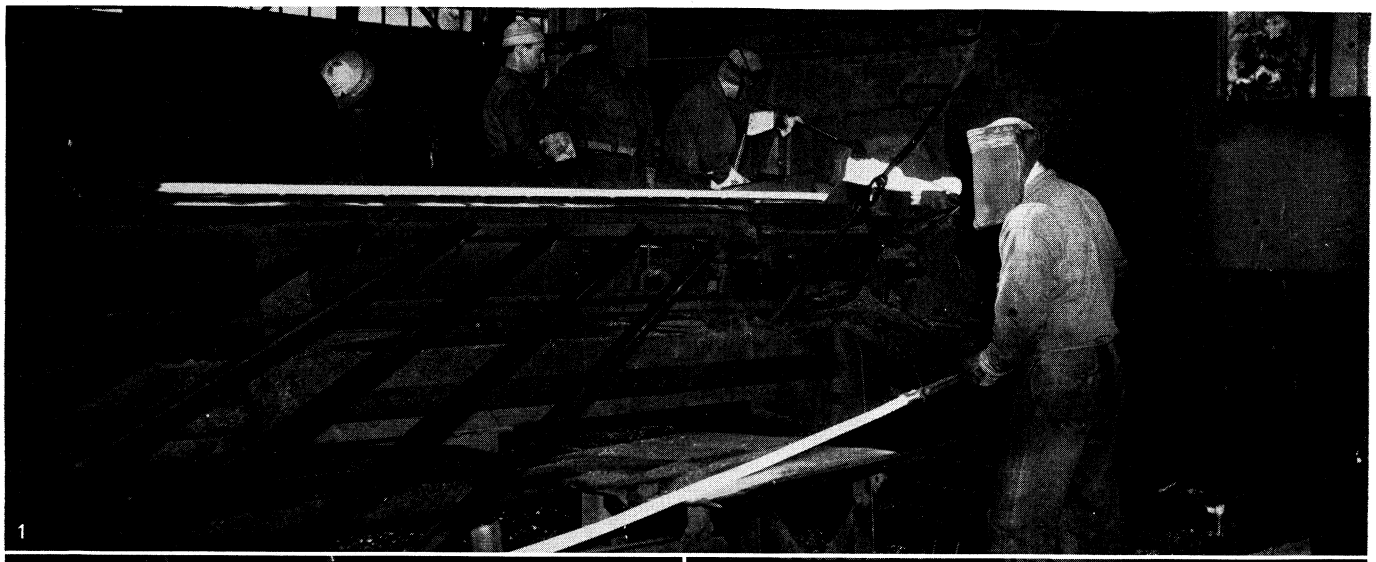


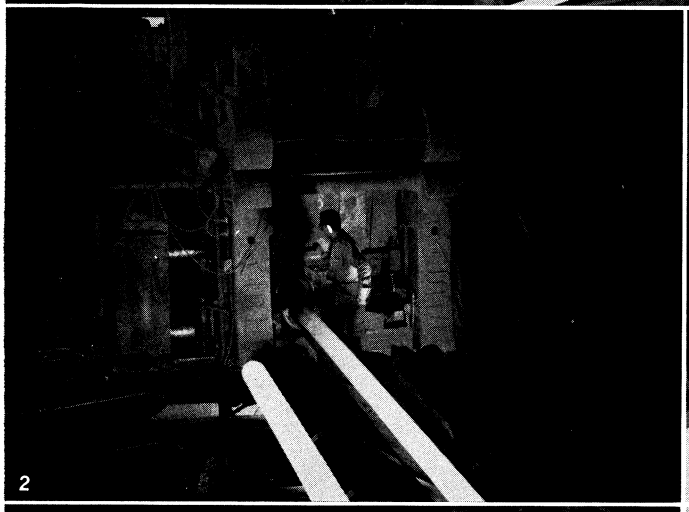
BY COURTESY OF (1, 4) BETHLEHEM STEEL COMPANY, (2, 5, 6) JONES & LAUGHLIN STEEL CORPORATION, (3) REPUBLIC STEEL CORPORATION

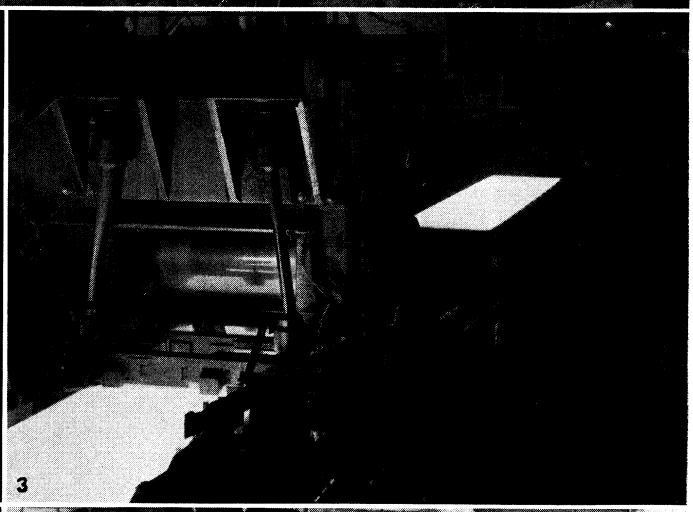
STEPS IN STEEL MAKING

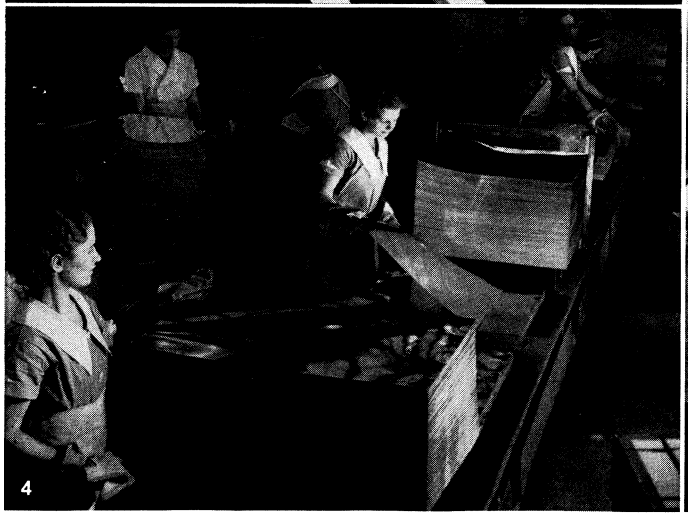
1. View of the upper part of a blast furnace, showing a skip car (lower left) on the inclined track carrying raw materials to the top for charging. These materials — iron ore, coke and limestone — are reduced to molten iron, the first step in the manufacture of steel. The iron is then tapped into waiting ladle cars which carry it to open-hearth furnaces, electric furnaces or Bessemer converters, where it is made into steel
2. A Bessemer converter in full blow. By forcing air through the molten iron, the carbon, manganese, silicon, other elements and impurities are oxidized and eliminated to form steel in about 15 minutes
3. The open-hearth process. The raw materials are charged into a large, shallow furnace hearth. About five hours are required for melting. For about six hours more the heat is allowed to "work" while the refining action takes place, forcing many of the impurities into the slag which forms on top of the molten metal. The picture shows the tapping of a finished heat of steel from the open hearth into a ladle (left). The slag floating on top runs off into the slag pot at the right
4. Pouring (teeming) molten steel from a ladle into ingot moulds
5. The moulds are stripped from the formed ingots, which are then sent to the soaking pits pictured. These furnaces heat the ingots thoroughly and uniformly. The ingots are then ready for the first rolling in the blooming mill
6. First rolling operations of the steel in the blooming mill, where the ingots are reduced and elongated as they pass back and forth through a set of rolls. Up to this point, the steps in making steel are similar, although hundreds of chemical formulae are used to vary its composition, and some variations in procedure are made during various steps according to the destined use of the steel

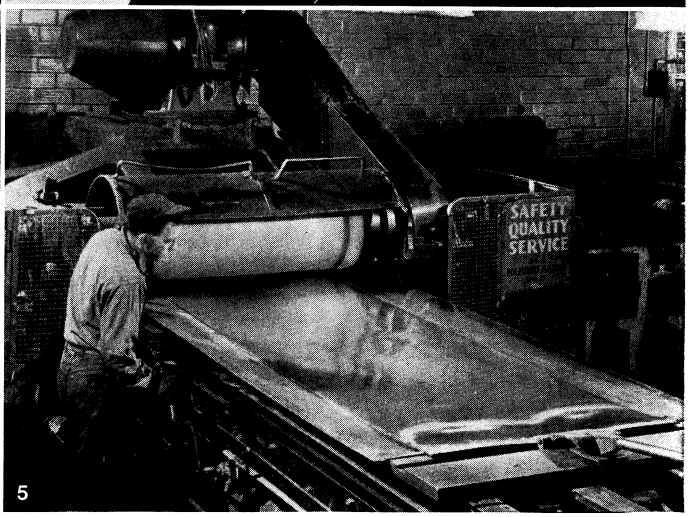
IKON AND STEEL











BY COURTESY OF (1-4) JONES & LAUGHLIN STEEL CORPORATION, (5) REPUBLIC STEEL CORPORATION

PROCESSES IN FINISHING STEEL

1. In the manufacture of welded pipe, blooms and billets are first rolled in the blooming mill, then rolled into skelp in the skelp mill. Buttweld pipe is made by drawing the heated skelp through a welding bell, as pictured
2. The Mannesmann process of making seamless pipe. The blooms are heated, then rolled into rounds at the round mill. The rounds are cut to desired length, centred for piercing and heated again to the proper temperature for piercing. Finally the pipe goes to the sizing mill, where it is brought to true diameter by a series of grooved rolls. In the picture, semifinished pipe is emerging from a seamless-tube mill
3. Ingots rolled in the blooming mill are cooled, conditioned and reheated to proper rolling temperature for operations known as descaling, roughing and finishing. In the picture the slab at the right has passed through the last roughing stand and is proceeding to the finishing train. The slab in the left foreground is entering the last roughing stand
4. Examining tin-plated steel. This type of steel is rolled from slabs on the continuous strip mill, wound into coils, placed in a continuous pickler, cold rolled and rewound before it is sent to the tin mill
5. Polishing machine which produces various degrees of brightness on sheets of stainless steel

some alloys have been added. Production of such material is at least 3% of the total steel made (1939).

Nickel and *Chromium.*—Although there are infinite possibilities in alloying, by far the most important steels are those containing nickel and chromium, used for crank shafts, axles, gears and other automotive and machine parts. Relatively few analyses are in use, the present tendency being to minimize the number of alloy steels in process so as to avoid mixtures of the stock. The popular nickel steels contain up to 3.5% nickel and 0.10 to 0.50 carbon. Chromium steels range from 0.60 to 1.50 chromium with the carbon in direct ratio from 0.15 to 1.10.

Kickel-chromium steels are more numerous. For machine parts, one series has nickel about 1·25%, chromium 0·6% and carbon 0·10 to 0·50; another has about 1·75% nickel, 1·0% chromium; a third has 3·5% nickel, chromium 1·5%. Nickel and chromium when added to steel increase its strength and hardness without an increase in brittleness. Nickel steels—not heat treated—are used for structural steel in long span bridges, and high strength boiler-plates; heat treated for gun tubes, engine forgings and castings, and shafting. Chromium steels are used for projectiles, for grinding rolls and for roller bearings, and with nickel or vanadium for armour plate and heat treated machine parts, axles, and gears. Rustless irons and steels contain 12 to 18% chromium and up to 8% nickel. (See also STAINLESS STEEL.)

Manganese is present in all steel, but when it adds up to between 1·0 and 2·0%, and carbon 0·30 to 0·50, the steel acquires special properties. These analyses are favoured in America for high strength castings, heat treated forgings, rifle barrels and for case hardening. So-called silicon structural steel used in long span bridges and for boiler plate, is really one of the lower manganese steels of this classification. The tough Hadfield manganese steel, used in castings for shock and wear resistance, contains 11 or 12% manganese and 1·0 to 1·2% carbon.

Vanadium is an element which has a powerful deoxidizing and scavenging effect; thus a vanadium-treatment on steel which shows very little of the element in the analysis makes for soundness, fine grain structure and reliability in forgings. From 0.5 to 2.0% is added along with other alloys to make high speed steels and tools for hot work.

Molybdenum is added to chromium, nickel, and chromium-nickel steels in from 0.2 to 0.3% to widen the range of heat treatment for given values, and to improve the forging and machining properties, and their resistance to creep when working at high temperature. Carbon-molybdenum steels of controlled grain size and hardenability are favoured by some American metallurgists.

High-speed Steel.—Carbon tool steels for cutting metals are heat treated by quenching from a high temperature, which gives them hardness, and then by reheating or tempering to a moderate degree to restore toughness. In use they must be operated at such low speeds that the friction between chip and tool-nose will not reheat the cutting edge above the drawing temperature, else the hardness and usefulness of the tool is destroyed. Better speeds could be made by using self-hardening tool steels, those which are hard after a slow cooling from a high temperature, such as the patented tungsten-manganese alloy invented by Robert Mushet in England sometime between 1860 and 1870, or the chromium-tungsten substitutes adapted by some American steel makers. During a 26-year research into the art of cutting metals, Frederick W. Taylor and Maunsel White discovered, 1898 to 1900, that if these steels were quenched from an austenitizing temperature, so high that it would utterly ruin a carbon steel, the hardness would be retained even when the cutting speed was so high that the nose of the tool and the chip leaving it were red hut. Modern high-speed steels possessing this property of red hardness fall into four general classes:

	High tungsten	Low tungsten	Molyb-denum	Cobalt
Carbon	0·65	0·65	0·85	0·75
Tungsten	18·0	14·0	2·0	18·0
Chromium	4·0	4·0	4·25	4·0
Vanadium	1·0	2·0	1·0	2·0
Molybdenum	..	..	8·0	1·0
Cobalt	..	..	..	8·0

These are crucible or electric steels carefully forged to break up the crystals of complex carbides forming during the solidification of the ingot and distribute them evenly throughout the bar. A well annealed bar is not very hard (Brinell 240) and can be machined into a complex tool like a milling cutter, and then heat treated; pre-heat to 850° C, heat rapidly to 1,300° C, cool in oil or an air blast, giving a Brinell hardness of at least 600. Reheating 30 min. at 600° C is then necessary to give the quality of red hardness; the Brinell hardness is even higher and the toughness materially better. As an indication of the revolution which these steels have effected in machine shop practice, a plain carbon tool steel will cut 16 ft. per min. on a medium steel forging, an air hardening steel 26 ft. per min., the same after being given the high quench 60 ft. per min. and a modern high speed steel 100 ft. per min. or more, all cuts being of same depth and feed, and on the same material Cobalt high speeds are for cutting extra hard or gritty substances.

Tungsten Steels.—Other alloys whose properties are due principally to tungsten, in addition to the air hardening tool steels and the high speed steels, are tool steels to which from 1 to 5% tungsten is added to improve the quality of the wood working or other tools which would be made of the plain carbon steels They are also good for making finishing cuts on metal after the most of it has been removed by deep cuts with high speed steel. Magnets are also made of steels with 6% tungsten and 0·7% carbon, quenched but not tempered.

SOME FERRO-ALLOYS

Ferro-alloys are highly important and include those metallic substances used for finishing carbon steel and manufacturing alloy steel. Most of them are electric furnace alloys of iron and carbon plus the third distinguishing metal, manganese, silicon, chromium or some other, although for some purposes the carbon content must be as low as possible. For such specifications the alloys are made using either metallic aluminium or silicon for the reducing agent.

It was early discovered that manganese must be added to make sound steel by Bessemer's process. As already noted, the usual ferro-alloy for this purpose is spiegel-eisen, a blast furnace product made from iron ore sufficiently high in manganese to smelt into a pig iron containing 10 to 30% of that element, with carbon about 5%. Spiegel cannot be used for low carbon steels because the required amount of manganese carries with it too much carbon. For such purposes, *ferro-manganese* is used, containing nominally 80% manganese and $6\frac{3}{4}$% carbon. This is also a product of the blast furnace when smelting an ore containing 40 to 50% manganese, low in iron. Since manganese and iron are so alike chemically, the actions in the furnace are very similar to those previously described. The output in ferro-manganese from 50% ore is only about one third as much as though common pig iron were produced; the blast is 250° F hotter and the coke consumption twice as much; about $\frac{1}{5}$ of the manganese is lost in the slag. While ferro-manganese can be made in an electric furnace of the pit type (see ferro-silicon) it cannot compete with the blast furnace product except under special economic conditions, as in Norway, or where carbon below 0·25% is required, as for high manganese alloy steels.

Ferro-silicon is the next most important alloy. A 12% silicon pig iron may be made in the blast furnace, but alloys higher in silicon are now used to deoxidize nearly all steel for castings, to quiet most tonnage steel from basic open-hearth furnaces, and to make several silicon alloy steels. Ferro-silicons are exclusively an electric furnace product and are made in several grades—50, 75, 80, and 95%. Carbon is about 0·5%, phosphorus and sulphur less than 0.10%—the former particularly must be kept to the minimum to prevent the alloy from absorbing moisture from the air and generating poisonous phosphine gas (PH_3). A pit-type electric furnace is employed, rectangular in cross section, with bottom built of carbon blocks. Into this shaft are suspended three carbon electrodes, one for each phase of current; a granular mixture of pure quartzite, clean iron turnings and coke is shovelled into the open top, filling the entire furnace. Passage of current

from electrodes to furnace bottom gives the necessary heat for the coke to reduce silicon metal from the rock. Carbon monoxide produced by the reaction rises and burns at the top of the charge column, and a molten alloy of iron and silicon collects on the hearth, from which it is tapped periodically.

Ferro-chromium.—This is one of the earliest ferro-alloys produced in an electric furnace. At present the commercial alloys contain about 67% chromium. The so-called high carbon alloys range from 4 to 8% carbon by units, whereas the low carbon alloys necessary to make stainless irons range from 0·20 to 2·0% carbon by steps. Chromium metal up to 98% pure is also commercial. Ferro-chromiums are ordinarily made in closed furnaces of the Heroult type, with bottoms laid in carbon blocks. A charge of chromium ore, iron or iron ore, anthracite coal for reducing, and flux for slagging impurities, is mixed and shovelled in, the doors closed and electric current turned on. Carbon reduces the metallic oxides in the intense localized heat; at the finish the molten charge is poured into slabs, broken, analyzed and graded for shipment. To reduce high carbon, these varieties are remelted with concentrated chromium oxide, under a lime-fluorspar slag. Nickel is added to molten steel as shot metal, or a nickel-steel scrap may be used to make alloy steel—nickel having no tendency to enter the furnace slag.

Ferro-vanadium is one of the most difficult alloys to make, on account of the activity of the element. The pure metal is not commercial. B. D. Saklatwalla developed various means of commercial alloy production, using a mixture of vanadium oxide, iron oxide and powdered aluminium, either in crucibles by means of the thermit reaction, or in shaft furnaces with the assistance of the electric arc. At present the ore is smelted in a reverberatory furnace, and the vanadium concentrated in the slag. This slag is ground, mixed with carbon, iron scale and fluxes (glass cullet, lime and fluorspar) and fed in a fine stream into a covered furnace, directly through the arc between graphite electrodes, thus effecting the reduction almost instantly in the intense heat. Reduced alloy and slag collect in the hearth and are tapped three or four times a day. A common analysis contains 35% vanadium.

Ferro-tungsten.—Tungsten ore is widely distributed, and the concentrate comes to the refiner in such complex mixtures of minerals that the first step is frequently the production of the oxide WO_3 by chemical means (see TUNGSTEN). This oxide is easily reduced to metallic powder without melting by mixing with fine carbon, sealing in a crucible and heating to 1,300° C for several hours. Ferro-tungsten, which has become more popular for making high speed steel, may contain from 60 to 85% tungsten, and is made in single-phase electric shaft furnaces. The bottom is one terminal; the electrode set above is surrounded by a shaft of loose brickwork, and a mixture of oxide ore, iron and carbon is filled in. As the reduced alloy builds up on the hearth it chills into a thicker and thicker button, because it has an unusually high melting point; when this solid metallic mass has grown to a point where its electrical resistance interferes with operations, the temporary furnace is torn down and the sow crushed, analyzed and classified.

METALLOGRAPHY AND HEAT TREATMENT

General Structure of Steel.—Much may be discovered about the general structure of the metal by a close scrutiny with the naked eye, or with a little magnifying glass. Such studies (macroscopy) include examination of the finished surfaces, of freshly broken fractures, and of rough polished sections etched in various ways. Information gained from a freshly broken fracture has not yet been systematized and correlated with microscopic appearance except as to grain size of the steel after heat treatment. To be of value it requires a keen eye to note small differences, and much practice and everyday familiarity with the fracture of satisfactory metal. In the hands of a skilled inspector it is the first step in securing uniformity in raw materials.

General Structure may best be exhibited on a roughly polished surface by etching in freshly prepared ammonium persulphate solution (10% $(NH_4)_2S_2O_8$). It shows immediately differences in grain size caused by differences in heat treatment or other cause.

Deep etching is much favoured in America for acceptance tests on high grade steel. It shows any non-uniformity in chemical composition or general bad quality. The smooth sample is held in hot hydrochloric acid (diluted 50%) for about 30 min. Impure spots, blowholes or cracks are eaten more deeply than elsewhere, and the result is an irregularly pitted surface.

During solidification of a steel ingot, excess of sulphur compounds will collect toward the centre and top part, where they are trapped and remain during further rolling and manufacture. The distribution of sulphur compounds in a smooth section may be shoun by pressing it firmly for about a minute against a sheet of photographic paper moistened with 2% sulphuric acid, then washing and fixing. The dark areas indicate the location of higher sulphur in the steel. Phosphorus also accumulates around the borders of the large metallic crystals which form in the ingot. and during rolling or forging are pressed out into stringers or sheets in ruling directions.

Ordinary plate or forging steel will always be found thus marked. In forging, these *flow* lines are arranged more or less parallel to the finished surface, and the dies are so constructed that the flow lines take an easy curve around corners. Any crinkling is associated with a weak brittle region. To show phosphorus segregations a polished surface is washed in alcohol, and immersed in 10% copper-ammonium chloride. A thin copper plate will coat out on those portions low in phosphorus, leaving high-phosphorus regions bright.

The fact that the hardness, toughness and general desirability of a piece of steel could be profoundly modified by a simple heating and cooling has been known since time immemorial—in fact what we now know as steel was perhaps not recognized as having great merit until the fortunate discovery of heat treatment was made. This is a quite mysterious happening, this heat treatment, and it is not surprising that down through the long centuries when the art was guarded as a closed secret, many superstitions arose regarding the efficacy of certain heating fires and quenching fluids, and much quackery had free scope to practice its hocus-pocus. Within the past century the chemist and physicist have done much to clear up the mystery by analyzing the various operations; we now know the essential differences between the various steels, irons, fuels, atmospheres, and quenching fluids. Only since the beginning of the century, however, have intensive studies with the microscope, pyrometer, hardness and tension testing machines, brought forth a knowledge of the changes which go forward in steel or iron during a heating and cooling cycle, and working hypotheses of the causes of hardening (see METALLOGRAPHY). Logically, an ingot in a soaking pit prior to rolling, or a billet in a heating furnace prior to forging, may be said to be undergoing heat treatment, but from a workshop viewpoint the term is restricted to a heating and cooling to restore original ductility and workability in a partly finished piece, or a heating and cooling—sometimes repeated—to induce special properties in the finished article.

Furnaces (*q.v.*), in regard to size, depend upon the pieces to be treated and the temperature required. A well designed furnace is one which easily attains the necessary temperature, and maintains that heat uniformly in all parts, with an atmosphere which does not deteriorate the furnace,-and yet has the desired effect or no effect, upon the metal being treated. Fuels may be coke or coal, gas, oil or electricity. No source of heat, pure heat, disassociated from the products of combustion, has any virtue over another source—it is merely a matter of which is the most convenient and economical. Gas and electricity are now favoured because of their ease of manipulation to give uniform temperature—choice depends upon the relative cost per thermal unit, and the atmosphere required. For instance, it is handiest to use electric resistors for heating elements in a furnace for annealing transformer sheets in a hydrogen atmosphere. Gas or oil fuel would probably be chosen for treatments on products such as roller bearings running into tons per day. Recuperators or regenerators are frequently installed to save heat. Mechanical devices for putting the metal in and taking it out, such as charging machines, furnace bottoms built on wheels or moved on rollers, revolving heating muffles and conveyors, are installed to save

labour wherever the weight of material receiving uniform treatment is very great. Temperature control is most important. Well conducted shops issue definite instructions on all important work giving the rate of increase in heat, duration at heat and speed of cooling. Continuous furnaces are devised to maintain this cycle automatically. Batch furnaces are controlled by hand, or by automatic control of the fuel burners through pyrometers (*q.v.*), which are installed in all furnaces, sometimes several in a single furnace, and indicate or make a permanent record of the temperature at all times. An important method of localized heating is by high frequency currents; pieces such as crankshafts are rapidly heated one at a time at only those bearing surfaces which are to be hardened.

Atmosphere within the fumace is important. In an open flame furnace scaling (or the production of oxide on the metal's surface) may be minimized by feeding rather less air than the gas or oil requires for complete combustion. This deficiency of oxygen means that little or none will be available to react with the hot metal. In long heating of thin sheet, or long annealing of tool steel, where the surface must be preserved, the work is protected from the furnace atmosphere by closed boxes or tubes. Protective atmospheres have been highly developed in the 1930–40 decade. Steel and gas are heated together in a muffle, or heated without a muffle by electric resistors or by flames contained in alloy tubes. Atmospheres for bright annealing are relatively easy to prepare of flue gas, partially burned fuel gas, or even gas engine exhaust; due to the comparatively low annealing temperature — 650" C — any mixture of an excess of carbon monoxide over carbon dioxide will protect the steel. It must be fairly dry to prevent tarnishing by steam on the cooling cycle. Protection during higher heating — goo° C. — for quenching is far more difficult because the reactions are much more rapid and the steel must neither oxidize nor must it gain or lose carbon. Such atmospheres are bone-dry and oxygen-free mixtures of hydrogen, nitrogen, and carbon monoxide; they may be prepared from burned natural gas (methane, CH_4) by removing excess oxygen by hot copper, washing out CO_2 with caustic, and absorbing moisture in activated alumina. On the other hand, certain reactions may be induced during heat treatment — for this purpose the material is packed in boxes with substances forming the necessary gaseous atmosphere, or the fumace is a closed muffle through which a stream of the proper gas slowly travels. Case hardening (*q.v.*), for instance, is done by packing the metal pieces in carbonaceous compounds and heating, or by piping in a gas which is principally carbon monoxide.

Quenching, to cool heated metal, may be done in various liquids, depending upon the speed required. All kinds of solutions of outlandish materials have been used, but there is no virtue in a quenching fluid except the ability to abstract heat quickly. In practice, the most drastic quench is given by a properly disposed nest of nozzles, spraying cold water at high pressure on the hot steel, Next comes a bath of iced brine; then cold water, then high flash point oil, then boiling water, then molten lead, then air blast, then quiet air, and even slower cooling may be done in 8 hours by burial in lime; a dying furnace may require from 24 hours up to seven days. Quenching baths require methods for circulating the medium, maintaining its correct temperature either by heating or refrigerating coils, and dashing it against the metal so no air or steam bubbles remain attached to the hot metal, else soft spots will occur on an otherwise hardened surface. Conveyors or other mechanical methods of getting the hot metal rapidly into the quench and removing it when cold, are installed to save labour. In order to understand what goes on during these heating and cooling cycles, an introduction to the science of metallography and the so-called iron-carbon equilibrium diagram is necessary.

Metallography (*q.v.*) is the study of the inner structure of metals and how this varies with the chemical composition of the alloy and its past heat treatment or the work that has been done on it. It also includes the study of the relationship between the inner structure of metal and the physical properties, such as strength, toughness, and hardness. In this study the use of a microscope is a long step in advance of the ancient practice of breaking the metal and looking at the fracture. It enables the student to magnify the apparent size of the grains a thousandfold. **A** sample of the piece under study is given a high polish, etched slightly in a suitable acid, and placed on a microscope stage with a special illuminating device for opaque objects (see MICROSCOPE). The resulting structure may by appropriate means be photographed for permanent record, and for study in connection with information on its past history, and its physical strength, hardness or electrical characteristics. Important physical properties affected by heat treatments include strength, toughness, hardness, electrical and magnetic characteristics, corrosion resistance. Of these, the first three are most relied upon. Machines and methods for making tension tests and determining the ultimate strength, elastic limit and ductility are described under MATERIALS. **STRENGTH** OF. Hardness is measured by the size of impression left by a steel ball or a diamond cone weighted down by a given load. Toughness or impact strength is measured by the amount of energy absorbed from a swinging hammer by the instantaneous fracture of a standardized test piece.

Evidence That Metal Is Crystalline. — Viewed through a microscope. an etched metal surface presents a mosaic patchwork of interlocking and nice-fitting grains.

Much evidence is at hand to support the idea that these granules, despite their irregular boundaries, are crystalline; *i.e.,* the ultimate atoms are in an orderly geometric arrangement of rows and ranks. The fact was finally proven by X-rays in a manner easiest explained by this analogy: If a street lamp is viewed through a window screen the brilliant centre appears to have a series of bright rays extending outward, caused by reflections of light from every wire so placed as to throw light back into the eye. The geometric pattern of rays is caused by the geometric arrangement of the wires; arguing by analogy, if the atoms of metal are arranged in definite geometric patterns, then an X-ray beam penetrating the crystal would be reflected in definite ways and emerge in a geometric pattern, in fact, a mathematician can predict the atomic spacing and arrangement from the diffraction pattern so produced. Thus it is found that wrought iron at room temperature is in the body centred cubic arrangement. That means that if the space occupied is subdivided by imaginary planes into a space-lattice of tiny cubes regularly placed on top and to both sides of each other, the iron atoms are located at the corner of each of these imaginary cubes, and each cube will have one atom in its centre.

INFORMATION FROM TEMPERATURE CHANGES

Allotropic Changes in Pure Iron. — Much information about metal can be gained by studying the rate at which its temperature changes during uniform cooling. As long as the temperature falls uniformly, the loss by radiation is accounted for by loss in sensible heat. But suppose the surroundings are unchanged yet the rate of cooling is arrested, or even reverses — evidently some chemical or physical change is taking place inside the metal which generates a portion of the heat which is being constantly radiated. Such spontaneous heat evolutions or absorptions, arrests in the time-temperature curves, in purest iron occur at 768°, 910°, 1,390° and 1,539° C. Pure iron or ferrite at room temperature consists of an aggregate of tiny crystals of so-called alpha iron, crystallized in body centred arrangement. On heating. this ferrite gradually loses its magnetism, becoming practically non-magnetic at 768° C., but without changing its atomic arrangements. This non-magnetic alpha iron has been called beta iron, and was erroneously thought to be the cause of the hardening phenomenon — it being given a fictitious hardness. At 910° C. alpha iron recrystallizes on heating with absorption of considerable heat and a contraction of 1½% in volume. The elementary cubes in the space lattice now have atoms at each corner and at the centre of each face, a face-centred cubic form known as gamma iron. At 1,390° the reverse change takes place: so-called delta iron existing between 1,390° and the melting point appears to be a form of non-magnetic alpha iron, stable at high temperature. At 1,539° the metal melts, with large absorption of heat and profound change in all physical

properties. Precisely the reverse changes occur on slow cooling, as noted in the thermometric chart. A, and A, lag somewhat on reversing the direction; *i.e.,* occur at slightly lower temperature on cooling than the reverse change during heating.

Temperature	Arrest	State
		Molten (amorphous)
1,539° C.	...	Melting and freezing point
		Delta iron (body-centred cubic)
1,390° C.	A4	Recrystallization
		Gamma iron (face-centred cubic)
910° C.	A3	Recrystallization
		Alpha iron (nonmagnetic alpha iron; body-centred cubic)
768° C.	A2	Magnetic point, no crystalline change
		Alpha iron (magnetic) (body-centred cubic)

Solidification of Steel.—It has been found that iron containing a little carbon starts to solidify on cooling at a lower temperature than 1,539° C. (the melting point of pure iron) and furthermore that this depression in the freezing point is greater and greater the more and more carbon is in the melt. This is plotted graphically in line ***AC*** in fig. 6. Line ***AC*** is called the liquidus; at all temperatures and compositions above and to the right of ***AC*** the alloy is molten. Hot solid iron at 1,130° C. will dissolve 2% carbon, and rather less as the temperature increases. This relationship is also plotted by the lines AH and *JE,* called the solidus. At all temperatures and compositions below and to the left of *JEC* the alloy is solid. The region between the liquidus and the solidus denotes that at those temperatures and compositions the alloy is in a two-phase solid plus liquid condition.

The way 2 1% carbon steel solidifies is worthy of study. Its condition at any temperature may be investigated by drawing a vertical ordinate at the composition representing 1% carbon. The diagram shows immediately that the first solid material appears on cooling to 1,450° C. However, this solid is not pure iron but a solid solution of carbon in iron whose chemical composition is found on the solidus (the point about 0.4%). This solid is much richer in iron than the melt, so its appearance leaves the melt richer in carbon, and it must be cooled further before more solid appears. Thus, by continuous solidification of iron poor in carbon and decreasing temperature, the sample reaches, let us say, 1,400° C. At 1,400° C. the melted portion has acquired a composition represented by about 1.6% carbon, and the solid appearing from it is a solid solution containing 0.7% carbon. And so it goes: At 1,350° C. the mother liquor has 2.2% carbon but the quantity of liquid is negligible. The solidified material has 1% carbon.

The first-formed solid material will act as a nucleus for the later which solidifies as the melt chills down. This causes the early-formed solid, low in carbon, to be in contact with later-formed solids higher in carbon. Yet at this lower temperature the material in the cores of the crystals has a greater capacity for carbon than it had before, since the solubility of carbon increases with decreasing temperature down to 1,130° C., and there is a tendency for carbon to pass from the high carbon melt, inward through the outer crystalline layers, until the carbon content of the solid solution becomes more nearly uniform. It requires a slow cooling or a long annealing to cause entire equalization of carbon; the "solid solution alloys" cast and cooled at normal rates usually show a cored structure under the microscope, caused by systematic variations in chemical composition between the material first solidified and the last-freezing mother liquid. Assuming that the cooling has been very slow, and equalization of carbon in the solid portions perfect, the last of the mother liquor in the 1% steel disappears at 1,350° C.; the metal is entirely solid.

AUSTENITE

Solid Solution.—Since the word solution ordinarily connotes a liquid, the term solid solution appears to be a contradiction of terms. The solid solution of iron and carbon is so important that it has been given a special name, austenite, in honour of the English metallurgist Sir William Roberts-Austen. If any steel is homogenized by long heating at 1,130° C., the temperature of maximum solubility of carbon in gamma iron, and can be examined by a light microscope at any temperature within the austenite or gamma phase field, it will look like a pure metal; *i.e.,* a series of abutting crystalline grains of uniform appearance—saving the slight coring which may remain after insufficient anneal, or some surplus material insoluble under any conditions. Thus the solid solution has some of the essential characteristics of a liquid solution—it is a uniform dispersion of atoms of one element among atoms of another, and the proportions may be anything within the limits of solubility. Austenite in fact is an aggregate of crystals of gamma iron; iron atoms are arranged in the face-centred cubic system, within which are tucked away the carbon atoms in the interstices of the space lattice.

Decomposition of **Austenite.**—Another similarity between the solid solution austenite and such liquid solutions as salt in water is that the mutual solubility of carbon in iron, or iron in carbon, whichever appears to be the excess element, changes with lowering temperature, and the then insoluble substance crystallizes out. Such changes can occur in the atomic arrangement in entirely solid metal. The latter is not a fixed and entirely rigid structure, except perhaps at absolute zero. The atoms, while they do not wander about at random, as in a liquid, are in a state of thermal agitation and are moving in small orbits or oscillating back and forth with more and more vigour as the temperature goes up.

Under such circumstances considerable rearrangement may take place by interchange of position, or by stranger atoms' slipping through the open spaces in the crystalline lattice. Such crystalline rearrangements generally occur in a reasonably small temperature interval, involve an evolution or absorption of heat, and are recorded on time-temperature or cooling curves.

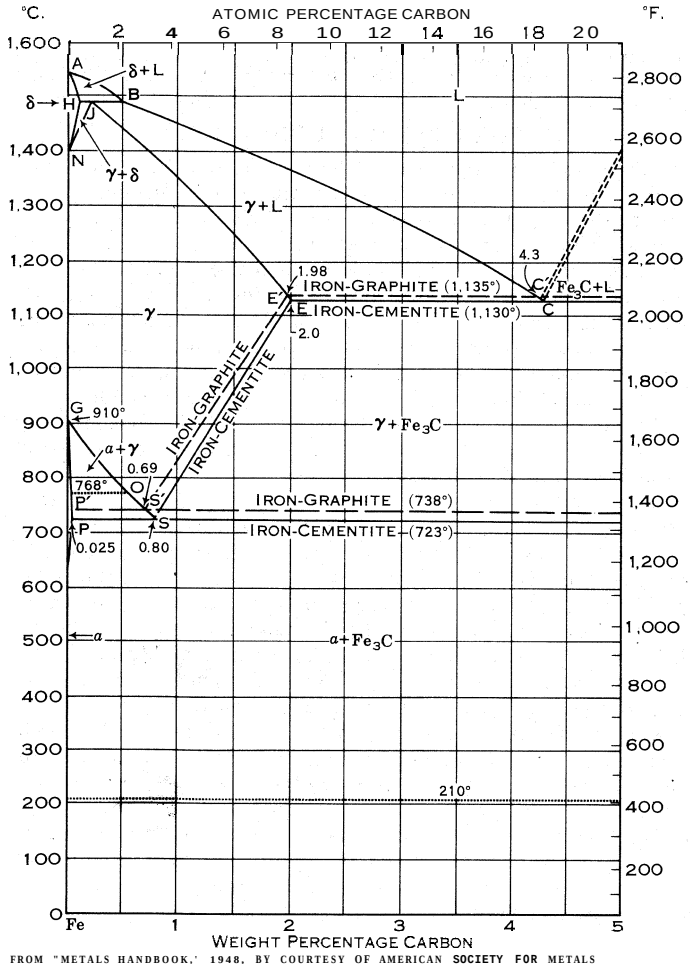
Cooling curves on a low carbon steel show that the change occurring in pure iron at 910° C. from gamma to alpha form is lowered progressively with the increasing carbon content. Furthermore a new and important evolution of heat occurs in all steels at about 723° C., increasing in intensity as the carbon goes up. These two temperature arrests, called A, and A,, coincide at 0.8% carbon. At higher carbons two diverging temperature effects are again noted. These facts are noted on fig. 6, the steel end of the iron-carbon equilibrium diagram, by the lines GSE and *PS.* This is an underlined V, a shape familiar to the physical chemist as noting the break-up of a solution into two mutually insoluble constituents.

In steel, the solution is austenite; the excess constituent first precipitated out in low carbon steels is iron, or ferrite, while that first appearing in the highest carbon steels is not carbon but an iron carbide, Fe_3C, cementite. An 0.8% carbon steel corresponds to the eutectoid. Since it appears in a solid solution it is termed a eutectoid. If examined under the microscope, a slowly cooled 0.8% carbon steel is made up of tiny flakelike lamellae of iron and iron carbide, arranged in rough parallelism and having a pearly lustre. Hence its name, pearlite. A cooling eutectoid steel reaching 723° C. is simultaneously saturated in both constituents—they separate out simultaneously, side by side, in closely intermixed platelets or lamellae.

Structure of Low Carbon Steels.—The mechanism may be illustrated by studying a cooling steel containing 0.25% carbon. Ferrite starts to be precipitated when the temperature reaches 840° C., and more and more pure ferrite precipitates out as the temperature falls, leaving a mother substance richer and richer in carbon. This action continues until at 723° C. the remaining solid solution has reached saturation (point *S,* 0.8% carbon, the eutectoid), and that portion then rearranges itself into pearlite. Medium carbon and hard steels have relatively less and less free ferrite and more and more pearlite. An 0.8% carbon steel is all pearlite. Slow-cooled higher carbon steels (so-called "hypereutectoid" steels) have excess cementite in white veinlets surrounding pearlite masses.

Reverse changes to those described above take place on heating; that is, the phases in a slowly cooled steel dissolve and the structure again reverts to a uniform solid solution when heated above the line GSE.

Structures in Quenched Steel.—The above described changes take place in a slowly cooled steel. If cooling is more rapid, time



FROM "METALS HANDBOOK," 1948, BY COURTESY OF AMERICAN SOCIETY FOR METALS

FIG. 6.— THE QUASI-EQUILIBRIUM OF Fe WITH Fe_3C (SOLID LINES) AND THE TRUE EQUILIBRIUM OF Fe AND C (DOTTED LINES)

is not given for the atomic rearrangements necessary for such complete recrystallization, and certain intermediate microstructures may be observed. The most rapid quenching of austenite may be able to preserve this structure unchanged in the cold metal. In fact this can be done, especially in steels with considerable alloying elements such as manganese or nickel. X-ray investigation of such a specimen of austenite proves that the metallic atoms build up a face-centred crystalline lattice characteristic of gamma iron. The carbon atoms are more or less uniformly distributed but not combined in any definite compound. Such quenched manganese steels are exceedingly tough; while they are not so hard as other steels under the Brinell test, it is impossible to cut them with a chisel; they resist wear, scour and impact well. High manganese steels are therefore suitable for such things as steam-shovel teeth and rail crossings.

High carbon steels, without alloys, can seldom be quenched rapidly enough to preserve much pure austenite. Under the microscope a polished and etched surface appears to be crisscrossed with sharp needles. This structure is called martensite; it is the hardest and most brittle condition of steel. X-ray studies show that the iron has completely transformed into a body-centred tetragonal crystalline lattice similar to a lattice of alpha iron strained by trapped atoms of carbon; it also indicates that the new crystals are exceedingly small, far below the ability of the microscope to see. The needlelike markings are relics of the larger austenite grains rather than actual structures of martensite.

At the interior of a quenched high carbon steel specimen, where the cooling rate is slightly slower than on the surface, the martensite needles may be mixed with rounded areas which etch much more rapidly, appearing black in fact. This structure is called fine pearlite; it also appears in a lower carbon steel rapidly quenched. In older literature fine pearlite was called primary troostite; none of the individual lamellae have grown to a point where they can be seen even at 5.000 magnifications; however, X-ray analysis and the electron microscope prove it to be an aggregate of excessively small lamellae.

Troostite, with hardness of 41 to 44 units on Rockwell "C" scale, is much softer than martensite (C-63 to C-65), but is noticeably less brittle.

Scientific studies since 1935 have shown that, while the temperature of transformation of the austenite solid solution into pearlite is lowered somewhat from 723" C. as the rate of cooling is increased, and the result is finer and finer pearlite (primary troostite), this change in carbon and alloy steels always occurs at high temperatures — above 500° C. Time is required for the process. however, and if enough time is not given at those high temperatures during a rapid quench, then the austenite is retained unchanged to a low temperature. and transforms almost instantly into martensite (a solid solution of carbon in tetragonal ferrite) at 150° to 100° C. If carbon steels are quenched into a molten salt bath at some intermediate temperature, say 400° C., and held there long enough, the austenite leisurely transforms into another acicular microstructure whose exact nature is as yet unknown. The name bainite has been given to this structure. In carbon steels bainite has medium hardness and superior toughness. In some alloy steels the intermediate structure appears during normal oil quenching, and its properties are not always so desirable.

If a quenched steel is moderately reheated (tempered or drawn) it loses a little of its hardness, but the added toughness is necessary for practical use. That is, tools are quenched and tempered. The microstructure is apparently unchanged, except that the acicular martensite etches much more rapidly. On reheating to higher and higher temperatures the atomic carbon first collects into submicroscopic crystals and the appearance under the microscope is uniformly structureless; later, as the carbide crystals grow, a cloudy microstructure, still unresolvable, appears and is called tempered martensite. If time and higher temperature below the transformation range (A_1) is sufficient, tiny globules of carbide appear throughout the entire mass, a structure known as spheroidized cementite. This is the most easily machineable condition for high carbon steels.

THEORY OF HARDENING AND TEMPERING

"Slip Interference." — These various actions which go on within solid steel at moderate temperatures are of the greatest commercial importance, for they control the important operations of hardening and tempering steels. In the simplest example these consist of slowly heating the steel to a temperature somewhat above line GSE, holding it there long enough for it to become a uniform solid solution, then quenching it rapidly, thus retarding the reverse reactions as much as possible, and finally reheating the quenched bar moderately to produce tempered martensite, still hard but much less brittle than the freshly quenched structures. The classically accepted explanation of the hardening phenomenon is known as the slip interference theory, definitely formulated and systematized by the U.S. metallurgists Zay Jeffries and R. S. Archer. It starts with the knowledge that metals are crystalline, and that metallic crystals when they are stressed beyond the elastic limit, do not tear apart irregularly, but one portion slides past another portion along definite crystalline planes without appearing to let go. Such motion is speedily jammed and stops because it tends to disarrange all the neighbouring crystals. The slip plane also heals immediately. Much of the hardness of quenched steel is believed to be due to the submicroscopic size of the constituent crystals; the boundaries of each one interfere with slip under stress in all the neighbours; since slip cannot occur, the metal resists deformation, and is therefore hard. In steel another hardening factor supplements this slip interference at the grain boundaries, namely, the presence of a great number of carbon atoms, cementite molecules or even tiniest cementite crystals uniformly dispersed through the ferrite grains. Such particles harden the entire metal from two causes: first, they prevent the start of any slip between crystalline layers as would billions of tiny

staples in the leaves of a book; and second, the slips once started despite this hindrance must drag against a multitude of anchors.

Hardening by Cold Work.—Since a ductile metal like iron deforms plastically under cold work or stress beyond the elastic limit by internal slip along crystalline planes: it would appear that this slip has the effect of breaking up the original crystals into numbers of small ones. For that reason cold work hardens the metal; finer grained metals are harder. Under the microscope the slip planes are seen only in special circumstances, but the original grains appear to be flattened out and assume a shape more or less parallel to the extension. In extreme cases: as in wire for suspension bridge cables, a high carbon steel with original tensile strength of about 80,000 lb. per sq.in. can be cold worked into a condition where it will carry 220,000 lb. per sq.in. before rupture. Microstructure of such a wire parallel to the direction of drawing shows the original crystalline boundaries flattened out until the structure seems to be fibrous.

Increase in hardness is accompanied by an increase in brittleness, so excessive cold work is liable to break the article, either during manufacture, or in its after history—season cracking. To avoid this danger, and to restore ductility, the piece may be annealed (*q.v.*) or reheated moderately to a point which does not affect the microscopic appearance yet the added atomic mobility at higher temperature permits such rearrangements as necessary to relieve internal stresses associated with work hardening.

Recrystallization.—A little higher heat on a cold worked piece of metal will cause the previous grain structure to be entirely replaced by a new arrangement. This is known as recrystallization. The recrystallization temperature varies with the amount of cold work previously done on the metal. Long stay at temperatures above this will cause the growth of large crystals. Such is to be avoided because it makes for a condition known as Stead's brittleness.

Slip planes started across a large crystal find less supporting material at the grain boundaries, and the self-healing action ordinarily occurring during plastic deformation is absent; the crystal splits transgranularly along the cleavage plane.

Refining the Grain.—Recrystallization by moderate heat after cold work is to be distinguished from recrystallization on a higher heating to above the line *GSE*. The alpha iron then transforms into crystals of gamma iron. Apparently the new crystalline arrangement is almost entirely independent of the old; if the temperature is maintained for some time the new set of austenite crystals grow in average size as the temperature or time increases. On slow cooling through the transformation range these new austenite grains eject the excess constituent to the borders, and the kernels are the locus of the pearlite regions.

Thus by a heating and cooling through the transformation range, the grain size of steel can be changed, refined or enlarged, as desired. After the desired austenite grain size is obtained, a common cooling operation is normalizing—cooling the steel in still air.

Burning.—Excessive heating of steel ruins it by burning. A burnt steel is brittle and the brittleness cannot be removed by heat treatment. Microscopic examination shows that the grain size is unusually large, due to the high temperature experienced, and the grain boundaries contain considerable oxide.

Burnt steel in fact has been heated beyond the solidus (line *JE*) and the high carbon regions in the austenite have actually melted. The melted metal absorbs furnace gases very quickly, which are responsible for the incurable damage done in the molten portions of the steel.

BIBLIOGRAPHY.—The fullest account of American practice is contained in J. M. Camp and C. B. Francis, *The Making, Shaping and Treating of Steel* (1939); for British and Continental see F. W. Harbord and J. W. Hall, *The Metallurgy of Steel* (1923); H. P. Tiemann, *Iron and Steel* (1933), a pocket dictionary of terms and a brief encyclopaedia of the whole subject; American Society for Metals, *Metals Handbook* (1948). Some fine text books cover only portions of the subject, such as Robert Forsythe, *The Blast Furnace and the Manufacture of Pig Iron* (1922); Walter Lister, *Practical Steelmaking* (1929); A. W. and Harry Brearley, *Ingots and Ingot Moulds* (1919); D. K. Bullens, *Steel and its Heat Treatment* (1939); Z. Jeffries and R. S. Archer, *The Science of Metals* (1939). Professional societies which devote much attention to the manufacture of iron and steel, and whose journals contain accounts and symposiums on the current state of the art are: (British) Iron and Steel Institute, American Iron and Steel Institute, and American Society for Metals. Leading journals of the trade are *The Iron Age, New York; Steel, Cleveland, Ohio; Iron and Coal Trades Review, London;* and *Stahl und Eisen*, Dusseldorf. (E. E. T.; R. E. GE.)

STATISTICS OF PRODUCTION

In tracing the development of the world's iron and steel output it is often customary to commence with Great Britain, for although the output of pig iron in Great Britain at mid-20th century was less than 10% of the world's total, and about the same in steel, nevertheless Great Britain was the birthplace of the modern iron and steel industry, and many of the developments connected with the industry originated there. Until 1871 the output of pig iron in Great Britain exceeded that of all other countries put together; in 1890 Great Britain was for the first time surpassed by the United States: in 1904 for the first time by Germany, and in 1921—because of a coal stoppage—for the first time by France. In 1931 the output of the U.S.S.R. exceeded Great Britain for the first time.

According to Robert F. Mushet the output of pig iron in Great Britain in 1720 was 17,350 tons, but T. S. Ashton, in his *Iron and Steel in the Industrial Revolution*, gives reasons for thinking this too low, preferring the estimate of William Rea, an ironmaster of Monmouth, who put the output of pig iron at this period at about 25,000 tons per annum; he also points out that Scrivener's *History* (p. 57) wrongly gives 1740 as the date of Mushet's estimate, an error which has been followed by many later writers. The 25,000 tons produced in 1720 had risen to 68,300 tons by 1788; but, whereas the majority of the furnaces in 1720 had been charcoal, 55 in 1788 were coke furnaces. It is not possible to describe the reactions of improvements in blast furnaces upon the demand for iron, nor of the demand for iron (created by engineering inventions) upon blast-furnace improvements; suffice it to say that by 1840 production of pig iron had risen to 1,396,000 tons; by 1860 to 3,890,000 tons; and by 1880 to 7,750,000 tons. Having nearly trebled in the 20 years between 1840 and 1860 and doubled between 1860 and 1880 the increase between 1880 and 1900 was no more than 16%. In the next several decades production lagged, but in the late 1940s it recovered close to the volume of the best years of the early part of the 20th century.

It was not until the development of the pneumatic converter in 1856, a discovery claimed by both Sir Henry Bessemer, an Englishman, and William Kelly, an American, that the production of steel at relatively low prices was made possible. This was followed by the discovery of the open-hearth process by Siemens Bros. in 1864–67. Between 1877 and 1883 another obstacle to low-cost production of high-grade steel was removed through the perfection by Sydney Gilchrist Thomas and his cousin of a technique for removing phosphorus from steel during the processing period. The influence of these improvements on steel production is indicated by the rapid expansion of output in Great Britain. From 220,000 tons in 1870, it had grown to 4,900,000 tons by 1900. By 1920 it had almost doubled again, and shortly after World War II steel production was around 15,000,000 tons a year, or three times larger than at the beginning of the 20th century.

It is impossible to trace, even in this broad outline, the progress of development in the other iron and steel producing countries. In all cases, except where the industry is of comparatively late growth, iron was first smelted with charcoal, and coke but slowly won its way; e.g., mineral fuel was first used in France in 1782, but by 1819 only two furnaces were using coke out of a total of 350 (*Memoirs of the Geological Survey of Great Britain*, vol. i. pt. 1, 1856, quoted by Ashton): but in all countries the great bulk of the steel output is made by the Siemens process, which, after its discovery, rapidly supplanted the pneumatic converter process because of its economy and regularity of operation.

In 1880 open-hearth production in Great Britain accounted for about 20% of the total output, but by mid-20th century it was almost 100%.

Pig Iron: World Output.—It will be seen from Table I that in the 100 years ended 1910, the average increase in world

production of pig iron in any decade was 60%, while because of the dislocation caused by World War I, a loss of 3% was experienced in the 10 years ended 1920. However, in the decade ended 1930, the upward trend was resumed with increases of 26% and 29% each in the next two decades. A contributory cause of the slow growth after 1910 was that following World War I a greater proportion of steel scrap was used in steelmaking. The rate of progress of steel output was rapid until 1929, but after that year irregular because of unsettled world conditions. The rate of increase was greater than in the case of pig iron output.

TABLE I.—*World Output of Pig Iron at the End of Each Decade, 1820 to 1920 and Certain Years from 1920 to 1947*

Year	Output: tons	Increase per cent per decade
1820	1,000,000	33*
1830	1,800,000	80
1840	2,700,000	50
1850	4,700,000	74
1860	7,220,000	54
1870	11,840,000	64
1880	18,160,000	53
1890	26,750,000	47
1900	39,810,000	49
1910	64,760,000	63
1920	62,850,000	— 3†
1925	75,690,000	..
1929	97,410,000	..
1930	79,240,000	26
1935	73,130,000	..
1940	102,400,000	29
1941	109,760,000	..
1942	107,180,000	..
1943	112,220,000	..
1944	105,870,000	..
1945	77,250,000	..
1946	77,920,000	..
1947	98,110,000	..

*Estimate of E. C. Eckel—Coal, *Iron and War*, p. 313. †Decrease.

Outputs of Pig Iron and Steel by Chief Countries.—Although output of pig iron in Great Britain reached a record of more than 10,260,000 tons in 1913 and never recovered completely from its subsequent decline, output of steel surpassed the production of that frequently and by wide margins. Output of steel in 1948 was nearly twice as large as in 1913. This high postwar level made Great Britain the first country among major world producers to exceed its highest annual output of the war period. Production in the United States, after a severe slump in the decade prior to World War II, climbed swiftly to new heights during the war, exceeding 80,000,000 tons in 1944. Near the end of the war and immediately following, with output greatly reduced in most of Europe, the United States was called on to produce more than half the world's annual output of steel.

TABLE II.—*World Production of Pig Iron by Decades, 1850 to 1920, and Certain Years from 1920 to 1947*
(In millions of tons)

	Great Britain	United States	Germany *	Saar	France †	Belgium	Russia	Other countries	Total
1850	2.25	0.63	0.30		0.41	0.14	?	0.97	4.70
1860	3.90	0.82	0.50		0.88	0.32	?	0.80	7.22
1870	5.96	1.67	1.24		1.16	0.56	0.36	0.89	11.84
1880	7.75	3.84	2.43		1.70	0.68	0.56	1.20	18.16
1890	7.90	9.20	4.03		1.93	0.77	0.89	2.03	26.75
1900	8.96	13.79	7.43		2.67	1.00	2.85	3.11	39.81
1910	10.01	27.30	12.89		3.97	1.82	2.98	5.79	64.76
1920	8.03	36.93	6.93	0.88	3.38	1.10	0.11	5.49	62.85
1925	6.26	36.70	10.01	1.43	8.36	2.50	1.30	9.13	75.69
1929	7.59	42.61	13.19	2.07	10.20	3.98	3.95	13.82	97.41
1930	6.19	31.75	9.54	1.88	9.88	3.31	4.90	11.79	79.24
1935	6.42	21.37	12.66		5.70	2.98	12.42	11.58	73.13
1940	8.20	42.32	14.42		3.62	1.76	14.72	17.36	102.40
1941	7.39	50.61	15.97		3.30	1.40	11.81	19.28	109.76
1942	7.73	54.38	15.90		3.78	1.25	3.94	20.20	107.18
1943	7.19	56.04	16.75		4.84	1.60	5.82	19.98	112.22
1944	6.74	56.13	14.17		2.85	0.71	7.58	17.70	105.87
1945	7.11	49.03	1.10	0.01	1.16	0.72	8.86	9.26	77.25
1946	7.76	41.53	2.17	0.24	3.39	2.13	9.84	10.82	77.92
1947	7.78	53.68	2.35	0.64	4.81	2.77	11.81	14.27	98.11

*Includes Luxembourg 1850 and 1860.
†After 1920 Lorraine is included with France.

TABLE III.—*World Production of Steel Ingots and Castings by Decades, 1870 to 1920, and Certain Years from 1920 to 1947*
(In millions of tons)

	Great Britain	United States	Germany*	Saar	France *	Belgium	Russia?	Other countries	Total
1870	0.22	0.04	0.13		0.08	..	0.01	0.03	0.51
1880	1.29	1.25	0.69		0.38	0.13	0.29	0.15	4.18
1890	3.58	4.28	2.10		0.67	0.22	0.38	1.05	12.28
1900	4.90	10.19	6.36		1.54	0.63	2.16	2.05	27.83
1910	6.37	26.09	12.89		3.36	1.91	3.48	5.23	59.33
1920	9.07	42.13	8.40	0.73	3.00	1.23	0.16	6.58	71.30
1925	7.39	45.39	12.00	1.55	7.33	2.51	1.84	10.92	88.93
1929	9.64	56.43	15.99	2.17	9.55	4.04	4.65	15.90	118.37
1930	7.33	40.70	11.36	1.91	9.33	3.30	5.46	13.71	93.10
1935	9.86	34.09	16.17		6.18	2.97	12.32	16.35	97.94
1940	12.98	59.81	19.56		4.34	1.86	18.01	22.35	138.91
1941	12.31	73.96	21.23		4.24	1.60	14.76	23.86	151.96
1942	12.94	76.81	20.96		4.42	1.36	7.97	25.22	149.68
1943	13.03	79.32	21.36		5.05	1.64	9.84	27.43	157.67
1944	12.14	80.04	19.00		3.04	0.62	11.81	23.20	149.85
1945	11.82	71.16	1.52	0.01	1.63	0.74	12.30	11.83	111.01
1946	12.70	59.47	2.65	0.29	4.34	2.26	12.79	14.41	108.91
1947	12.72	75.80	3.12	0.70	5.64	2.84	13.78	18.62	133.22

*Prior to 1920, Lorraine is included with Germany, but after that date with France. Austria is included with Germany, 1937–44.
†Includes Poland through 1919.

At the end of the war, world production of both pig iron and steel slumped from the record levels that had been attained. By 1947, however, steel output had recovered to the level of 1937, highest year prior to the war, and pig iron production also had recovered substantially.

Iron and Steel Exports.—Table IV, which gives the exports of iron and steel (as far as possible according to the board of trade's classification) from chief producing countries, shows that exports from Great Britain in 1948 had not yet reached the record figure of 1913, when they amounted to nearly 5,000,000 tons. The best British years after the latter date were 1923, when exports from European countries were curtailed because of the Ruhr occupation, and 1927, when arrears accumulated during the coal stoppage of 1926 were being worked off. The decline in the British export trade took place in spite of great reduction in prices, for, as shown by the board of trade's price index number, prices of iron and steel products had fallen from 1920 to about 1928, after which time prices about doubled.

TABLE IV.—*Exports of Iron and Steel and Manufactures Thereof from Chief Producing Countries in Various Years*
(In thousand tons)

	Great Britain	Germany *	France?	Belgium‡	United States
1913	4,969.2	6,202.0	620.0	1,551.0	2,906.5§
1920	3,251.2	1,723.3	870.1	920.7	4,708.5
1923	4,317.5	1,307.0	2,183.0	2,494.5	1,944.2
1925	3,731.4	3,211.5	3,946.5	3,153.8	1,695.7
1929	4,379.5	5,575.5	4,277.1	4,589.7	2,486.5
1930	3,159.7	4,540.8	4,276.8	3,912.0	1,629.4
1935	2,368.7	3,142.0	1,846.7	3,301.7	982.9
1938	1,959.6	‖	1,857.0	2,458.9	2,149.2
1947	1,942.8	‖	333.4	2,249.9	6,158.4
1948	2,094.0	‖	‖	3,467.5	4,209.6

*Includes Luxembourg and Saar in 1913 and Saar from Feb. 1935.
†Includes Saar from 1925 to Feb. 1935.
‡Includes Luxembourg from May 1922.
§Fiscal year ended June 30, 1913.
‖Not available.

Annual exports of iron and steel from Great Britain and Belgium-Luxembourg shortly after World War II showed little

change from the exports immediately preceding the war. Exports from the United States were several times larger than prior to the war.

After World War II, during which the great bulk of iron and steel produced nas immediately consumed, it was clear that the potential demand for iron and steel was considerable. but in the early postwar years most countries were too impoverished to make that demand effective, while most belligerent countries who before the war supplied capital for development were no longer able to do so on the same scale.

After World War I, France acquired Alsace and Lorraine from Germany. French production of iron and steel was greatly increased, leading to stronger competition in Europe. The German iron and steel industry underwent violent changes in the two wars but from second place among world producers between the two wars, that country's output was reduced at mid-century to a small, uncertain position. The industry in France. Belgium and Germany had always depended heavily on exports in proportion to domestic business.

The increase in production in the U.S.S R. of both pig iron and steel after 192j had probably never been equalled. In 1925 output of pig iron was 1,300,000 tons, while in 1939 it was 1j,-000,000 tons. an increase of more than 1,100%. Steel production in 1925 amounted to 1,840,000 tons, but by 1939 it had expanded to nearly 23,000,000 tons. a gain of more than 1,200% Thus. in 14 years the U S.S.R. rose from sixth in importance among world producers to a position of nearly a tie for second place behind the Cnited States.

U.S. Production. — The output of pig iron in the United States, the world's largest producer since 1897, was 30,966,000 tons in 1913 and of steel ingots 31,301,000 tons. The enormous contracts for munitions, machine tools, etc., placed by the Allies during World War I, as well as the demands for equipping its own army, necessitated the extension of existing iron and steel plants and the erection of new ones. After the war, the great increase in capacity was absorbed by the growing internal demand and by 1937 output of pig iron was 37,130,000 tons and of steel 50,570,-000 tons. These tonnages, somewhat less than in 1929. but the highest in the 1930s, were far surpassed during World War II and the postwar years.

Continued expansion after that war placed steel capacity in the United States four times larger than at the beginning of the century.

With the development of alloy steels, which greatly widened the field of steel consumption, together with such refinements in production as the continuous sheet and strip mill which acted to lower greatly the cost of steel: the saturation point of steel consumption seemed as far away at mid-20th century as it was when the pneumatic converter was invented. However, plastics. and new processes for producing and fabricating such nonferrous metals as aluminum, magnesium, copper and zinc alloy die castings, constituted a challenge to the steel industry's position. Yet, on the other hand. steel had supplanted wood on a large scale for such applications as small home building, interior constructions, etc.. which might counterbalance the effects of the greater use of plastics. etc. It might be reasonably, assumed. however. that the low cost of steel would for a long time support its position as the basic material of the modern world. This position apparently was more assured with huge new iron mining developments following World War II. (W. A. PH.; W. S. To.)

IRONBARK, the name applied to species of *Eucalyptus* (*q.v.*) in Australia. from the hardness of the bark.

IRON GATE (Eisern Tor). a shallow. rocky stretch of the Danube, about one and one-half miles in length, beginning just below the Island of Ada Kalah. From the Iron Gate, where the river bed falls. to the Black sea. is the lower course of the river. By the term Iron Gate is often understood the narrowing banks of the Danube where the Carpathian arc joins the Balkan mountains. More accurately, the name belongs to the rocky bed of the river at this juncture which, until the close of the 19th century. kept these waters treacherous to navigators and closed to shipping for three months of the year. At high tide the craggy rocks (one of them known as the Grandmother's Tooth) are not visible to the eye. but the water continues to rush and seethe past them, forced on by the current as it hits the underwater line of jagged stone ridges. In the 1890s a clearance was blasted through along the right bank of the Danube, making way for the Sip canal, opened in 1898. Responsibility for the operation and maintenance of the canal and for improving the navigability of the Iron Gate was vested in an international commission for the Danube in 1921, by a statute of the Versailles treaty.

The first rift in this arrangement came in 1936 when Adolf Hitler denounced the statute and recalled the delegates to the commission from the two German riparian states. After World War II, the old commission was replaced by a new Danube river commission made up of a bloc of Soviet-dominated states.

IRON MASK (*masque* **de** *fer*). The identity of the man in the iron mask, one of Louis XIV's political prisoners who died in the Bastille, is a famous historical mystery. In 1698, Saint-Mars, the new governor of the Bastille, brought with him from Île Ste. Marguerite a prisoner whom he kept masked and whose real name was not known. This prisoner died on Nov. 19. 1703; and his name was entered in the register of Saint Paul as Marchioly, aged about 45. Even during his lifetime, legend grew up around this person, and Saint-Mars himself admitted circulating fairy tales about him. He was soon suspected of being connected with the royal family. Voltaire added immensely to the legend by describing the mask as of iron, and the man as a natural brother of Louis XIV—a theory which Dumas in the *Vicomte de Bragelonne* did much to popularize.

It mas even asserted that this prince had a son who founded the Bonaparte family in Corsica; while other speculations identified him with Monmouth, Beaufort, Fouquet and even Molière.

It is believed that the man in the mask was either Count Mattioli or Eustache Dauger. Mattioli was the Mantuan minister who attempted to sell to France the frontier fortress of Casale, but revealed the transaction at the last moment, and was eventually secured by Louis' agents. In spite of the tempting argument from the name under which the prisoner was buried it is difficult to accept a solution which seeks to identify the mysterious "mask" with a man whose identity was generally known.

The other candidate, much more likely, is Eustache Dauger; but the principal problem for the investigator remains: who was Dauger? Several theories have been put forward on very slight evidence. It seems clear that he was a Catholic and not an Englishman; but the fact that at a time of emergency he was allowed to act as valet to Fouquet has drawn a red herring across the trail. Monsignor Barnes identified him with Abbé Pregnani, involved in the religious affairs of Charles II, and for that reason possessing dangerous information. That the prisoner was sent to Pinerolo from Dunkirk favours the idea of some connection with England; and Monsignor Barnes at first went on to claim that the abbe' was a natural son of the English king. This hypothesis linked up the problem with a second—that of James de la Cloche—and soon proved untenable.

The problem is probably more difficult than important. There is, however, a fascination in the interesting evidence, and in the possible theories which may be constructed from it.

The period was one in which intrigue was at its height, and the affairs of individuals were so intertwined with those of states that every figure of importance appears as the centre of a labyrinth whose key may be anywhere. Romantic imagination has done the rest.

IRON MOUNTAIN, a city of Michigan, U.S., the seat of Dickinson county, adjoining the city of Kingsford, is just north of the Menominee river, which separates the upper peninsula of Michigan from Wisconsin. Iron Mountain; the commercial centre of the county. was settled as a mining community in 1879 and incorporated in 1887. It was so named because of its proximity to a bluff heavily stratified with iron ore. Mining continued to be important in the economy until the 1930s, when ore deposits were virtually exhausted. Kingsford was incorporated in 1925 as an outgrowth of Ford Motor company operations.

The Iron Mountain-Kingsford area is studded with small plants

which manufacture metal parts; electric controls: chemicals; furniture, paper and other wood products; and wearing apparel. The Pine mountain ski slide, on nhich the world's foremost skiers have jumped distances up to 313 ft. is but one of many tourist attractions Iron Mountain is also the home of a large veterans' administration hospital. For comparative population figures for both cities see table in MICHIGAN: *Population.* (R. F. O'D.)

IRONSTONE, referring in the past to certain iron carbonate deposits, notably the clay ironstone concretions, this term later came to mean an iron-bearing formation. Iron, the fourth most abundant element in the earth's crust. occurs in nearlv all rocks. the iron content varying from nil to several per cent. In some sedimentary strata it exceeds 15%; such rocks are called an iron-bearing formation, an iron formation or ironstone.

Ironstones are sedimentary deposits of varied composition. They may be iron sulfides (pyrite), iron carbonate (siderite), iron silicates (chamoisite, greenalite, etc.) and iron oxides (hematite, etc.). These materials are generally mixed nith silica (commonly chert), clay, etc., and form strata of ironstone.

Among the best-known ironstones are those of Pre-Cambrian age in the Lake Superior region. These average 25% iron but in places are enriched and constitute iron ores. Since their discovery they have yielded about 2,000,000,000 tons of ore (50% or more iron). Silurian ferric oxide ironstones occur in the Appalachian region and are mined in the Birmingham district of Alabama.

Ironstones were precipitated in marine waters, in lakes and in swamps ("bog ore"). Their mineralogy is dependent on the oxidizing potential of the environment.

See F. J. Pettijohn, *Sedimentary* Rocks, pp. 449–467 (1957). (F. J. P.)

IRONWOOD, a name applied to many hard and heavy woods or to the trees that produce them. Certain ironwoods (e.g., *Krugiodendron, Olneya*) sink in water. Many are very difficult to work, and so require the use of machine tools rather than hand labour. Among the ironwoods of the United States, the most widely distributed are *Ostrya virginiana,* also called hop hornbeam. and *Carpinus caroliniana,* also called hornbeam and blue beech (see HORNBEAM). These trees, members of the birch family, range over eastern United States and adjacent Canada. Their wood is used for fuel, levers, fence posts and tool handles. Ironwoods of more southerly distribution in North America include desert ironwood (*Olneya* tesota) of southwestern United States and adjacent Mexico. Its wood makes excellent fuel and is used for novelties. Black ironwood (Krugiodendron *ferreum*), one of the world's densest woods (specific gravity 1.34–1.42), is native to southeastern United States, southern Mexico, British Honduras and the West Indies. Ironwoods of somewhat similar distribution are those derived from *Cyrilla racemiflora,* also called leatherwood; from species of *Jacquinia,* also called joewood; and from Exothea *paniculata,* known in Florida as butterbough or inkwood. Catalina ironwood in the California coastal islands is *Lyonothamnus floribundus. Reynosia septentrionalis,* found in Florida and the Bahamas, is known as red ironwood. The durable wood of *Hypelate trifoliata,* white ironwood, is used in Florida for fence posts. Woods known as ironwood in Jamaica include *Sloanea jamaicensis* and *Turpinia paniculata,* neither of commercial importance. The useful timber of Dialium *guianense* is called ironwood in British Honduras. Asiatic ironwoods include Xylia *dolabriformis* and *Mesua* ferrea, valuable timber trees. Among Australian trees that may be known as ironwood are scrub ironwood (*Myrtus acmenoides*); lemon ironwood (*Backhousia* citriodora); giant ironwood (*Syncarpia subargentea*); species of *Geijera,* also called axe-breaker; and *Notelaea ligustrina,* also called silkwood. Uganda ironwood (*Cynometra alexandri*), of Uganda and the Belgian Congo. and black ironwood (Olea *laurifoliaj*, of South Africa: are used for heavy construction. One of the most durable timbers of west tropical Africa is ekki, red or west African ironwood (Lophira procera var. *alata*). (J. W. TT.)

IRONWORK, in this article. refers to iron used in the interior or exterior design of buildings of all kinds. The earliest uses of iron were practical; it has only relatively recently been used ornamentally. An Egyptian sickle found under the sphinx at Karnak is thought to be over 5,000 years old. Iron tools were made by the Chinese as early as 2300 B.C. Glaucus of Chios is generally credited as having invented the welding of iron about 600 B.C. At Delhi. India, a solid pillar of malleable iron (23 ft., 8 in. high, with a diameter of 16 in. at the base and 12 in. at the top) probably dates to about A.D. 400. Wrought iron was first produced in the U.S. in 1622. See also BRONZE AND BRASS ORNAMENTAL WORK. (G. K. G.).

I. HISTORY

A. ASIA

1. India and Southeast Asia.—The manufacture of iron and steel by primitive small-scale methods has survived in southern India and Ceylon to the present day. The iron is smelted directly from the ore. and true carbon steel of high quality is made by melting the iron with a small proportion of green wood in a clay crucible heated to a high temperature. The slag heaps of ancient furnaces are common and the processes have probably been in use for more than 2,000 years, but it is unknown whether they are of indigenous invention or acquired. In southern India iron immediately succeeded stone as a material for tools and weapons. and prehistoric iron weapons began to come into use about 500 B.C. Alexander received a gift of Indian steel from the Punjab chiefs; steel dating from the 2nd century B C. has been found at Besnagar and in Ceylon, and tempered steel is referred to in the *Ummagga* Jataka. Indian iron and steel weapons have been famous throughout the middle ages, and the steel was exported to Persia and further west, where it formed the material of the Damascus blades of the Saracens. Buddhist begging bowls are generally made of iron. The wrought-iron pillar of Delhi, set up about A D. 400 by Kumaragupta I. in honour of his father, is over 23 ft. in height and weighs more than 6 tons; it demonstrates the abilities of Indian metalnorkers in handling large masses of material, for not until the latter part of the 19th century could anything of the same kind have been made in Europe. There are other large iron pillars at Dhar and at Mt Abu.

The decoration of iron and steel takes various forms. The shapes of weapons are usually of great elegance. and decoration is never permitted to interfere with utility. The most remarkable carved steel weapons are those of southern India (Tanjore), the Deccan and Rajputana; but the art extended to Malaysia and Indonesia, as will be seen in any of the fine chiseled creese from Bali. Decoration by the application of the second metal is effected by damascening or incrusting.

In koftgari, or true damascening, grooves are cut in the surface of the iron or steel to be ornamented, and gold or silver wire is laid in them. The mire is hammered until completely united with the ground metal. which may then be smoothed and polished to shon the design. The design may consist of geometrical or floral ornament or an inscription. In incrusted work. the required form is first carved on the surface of the ground metal, the edges of the carved area being slightly undercut. A thin plate of gold or silver of the same size is beaten down onto the carved surface. The edges of the applied metal slip into the undercut groove and are held tightly as a result of the hammering. See also INDIAN ART; INDONESIAN ARCHAEOLOGY; INDONESIAN ART. (A K. C.)

2. China.—Iron began to take its place in the brilliant Bronze Age culture of China about 500 B C. By the end of the 2nd century A.D. bronze weapons had been almost completely supplanted, while iron had been generally substituted for bronze in common use in utensils and vessels of various kinds. tools, chariot fittings and ex en small pieces of sculpture. These were commonly cast in sand molds were patterned after bronze prototypes and were typical in style and decoration of the Han period.

From the 9th century iron increasingly took the place of bronze in China as a material for sculpture, especially in the north and under the Sung dynasty. The few extant examples from the 11th century and later show work done on a larger scale and in coarser technique than the bronzes, though the modeling is usually more naturalistic.

Several iron pagodas, ranging in size from miniature models to

towers 30 or more metres in height, and dating from the 10th to the 14th century, give further evidence of the dexterity of the Chinese iron caster. These imitate in detail both the structural and decorative effects of the more common tile-roofed brick pagodas. Iron for temple furniture has long been in use, and a large number of the braziers, censers, caldrons and bells found today in the temples are of iron.

In China in the 17th century the iron picture was developed, the craftsmen seeking to reproduce in permanent form through the medium of wrought iron the effects of the popular ink sketches of the master painters. When completed, these pictorial compositions were mounted in windows, in lanterns or in frames as pictures. When in the latter form a paper or silk background often bore the signature and seal of the maker, heightening the resemblance to a painting. The craft flourished in Anwhei province and is still practised, though with less patience and fineness than formerly.

3. Japan. — The Iron Age in Japan is supposed to have begun in the and century B.C., though the chief early remains are weapons from the dolmens of the 2nd to the 8th centuries A.D. The Japanese iron founder attained a considerable skill at an early date and acquired a social position which was never attained by the bronze caster, or by the ironworkers in China where the Bronze Age tradition was much stronger.

It is apparent that iron was used in China chiefly as a substitute or imitative medium, worked often with great skill but with little artistic invention. In Japan, however, the ironworker developed a distinctive and original means of expression and high artistic attainment in furniture for the sword. With the rise of feudalism and the establishment of the samurai class after the wars of the 12th century, the equipment of the warriors became an object for the efforts of the artist.

At first these efforts were devoted to the embellishment of defensive armour, but from the 15th century the sword became the centre of attention. The blade is not properly part of our subject, but in the mountings. especially the guards (tsuba), we find exquisite artistry expressed chiefly in iron. A remarkably soft and pure variety of the metal especially free from sulfur was employed. It was worked by casting, hammering and chiseling; and innumerable surface effects were obtained by tooling, inlaying, incrustation, combination with other metals and patination by various, usually secret, processes.

Simple conventional patterns, crests and pictorial designs were the bases for the decoration. As these were often furnished by painters or designers the criterion of connoisseurship in Japan is the unsurpassed technical quality of the handling of the iron itself. With the promulgation of the edict of 1876, prohibiting the wearing of swords, this art came to an end, but the skill of the Japanese ironworker may still be noted in numerous small decorative objects. (B. MAR.)

B. EUROPE

1. Belgium and Holland. — The ironwork of these two small countries has been of great influence, and of greater quantity than the number of extant early examples might seem to indicate. Authorities generally agree that wrought ironwork in these countries prior to the 15th century was equal, if not superior, to contemporary craftsmanship in other countries. Yet so few pieces remain that the significance of craftsmen of the Low Countries has often been underestimated. During the 15th century design and craftsmen from the Low Countries began to make their influence evident across the channel in England. The outstanding craftsmen were of the Massys family of Louvain. Representative examples of this period are in the great church at Breda; the treasury door of the cathedral and some presses in the church of St. James, both at Liége; and hinges of the church of Notre Dame, Hal. The beautiful spires of Bruges, Ghent and Antwerp should also be mentioned. It is believed that the ironwork of St. George's chapel, Windsor, was executed in Belgium; its main features of Perpendicular Gothic with flamboyant details, are not approached by any similar English work.

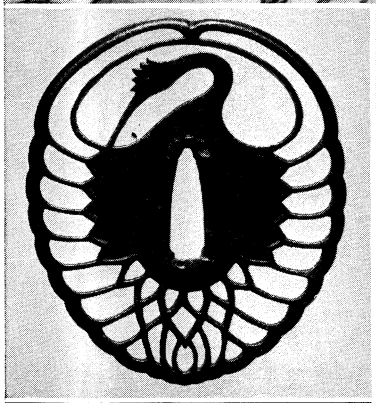
During the first half of the 16th century, before the Spanish occupation, there were diversified forms of ironwork, such as protective grilles for doors, windows and chapels, often in fleur-de-lis patterns; window gratings of vertical bars, frequently octagonal in section; and interlacing bars, producing rectangular or lozenge-shaped patterns. Only a few examples still exist; *e.g.,* some lunettes in the *hôtel de ville* of Brussels; a tabernacle grille from the chapel of the counts of Flanders and a window grille from St. Bavon, both from Ghent and now in the Victoria and Albert museum. London; and hinges at the *hôtels de ville* of Bruges and Ypres. Few Renaissance screens have survived.

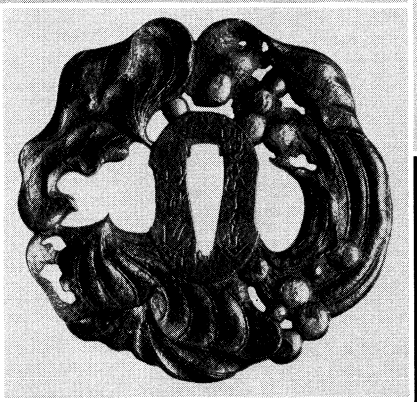
During the second half of the 16th century the cruelty of the duke of Alba and his 20,000 troops, together with the threat of the Inquisition, drove hundreds of artisans to England. The effect was to change the nature of ironwork there, and to produce the mannerisms characteristic of the so-called Jacobean style. After the Spanish domination there was little indigenous design in Holland and Belgium, and such ironwork as was produced, fell under the spell of French importations.

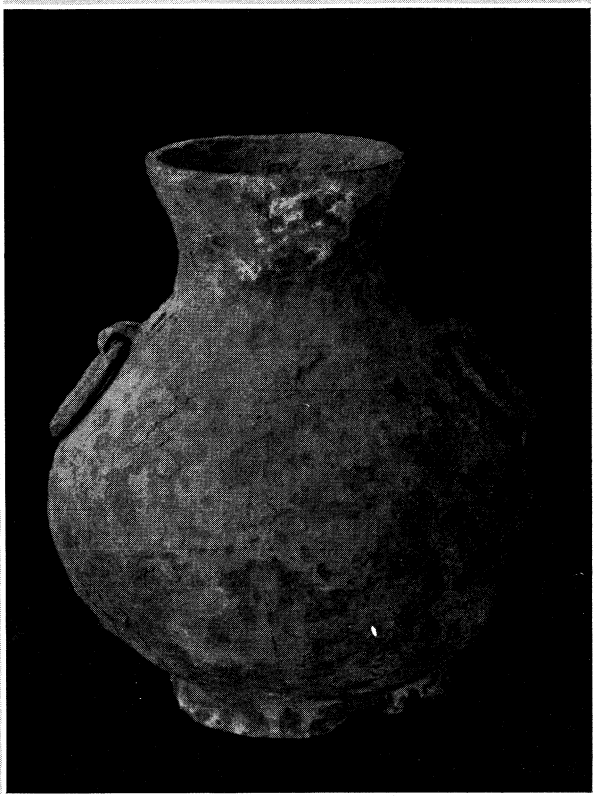
See Charles ffoulkes, *Belgian Ironwork* (1915). *(G. K. G.)*

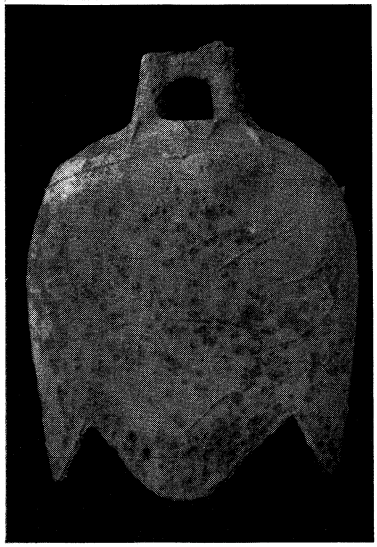
2. England. — The initial use of wrought iron was purely protective because violent attacks were frequent, and doors had to be strengthened with massive ironwork inside and out. Window openings, especially those of the treasuries of mansions and cathedrals, were for similar reasons filled with strong interlacing bars of solid iron; a good example remains at Canterbury cathedral. When in course of time the need for protective barriers ended, there came greater freedom of work and a definite ornamentation. Throughout England, medieval church doors are found with massive iron hinges, the bands worked in rich ornamental designs of scrollwork, varying from the plain hinge band with crescent, to the most elaborate filling of the door. Examples exist at Skipwith and Stillingfleet in Yorkshire, many in the eastern counties, others in Gloucester, Somerset and the west Midlands. The next important application of ironwork came with the erection of the great cathedrals and churches, whose shrines and treasures demanded protection. Winchester cathedral possesses the remains of one screen with a symmetrical arrangement of scrollwork. The grille above the tomb of Queen Eleanor at Westminster abbey recalls Thomas de Leghtone, a master craftsman in iron who had succeeded another great smith, Henry of Lewes. Tombs were enclosed within railings of vertical bars with ornamental finials at intervals, such as that of the Black Prince at Canterbury. A new development appeared in the early years of the 14th century when the smith, working in cold iron, attempted to reproduce Gothic stone tracery in metal. This work was more like that of a woodworker, than of a smith, often consisting of small pieces of iron chiseled and riveted, and fixed on a background of sheet iron. Many small objects such as door knockers, handles and escutcheons are to be found executed in the same manner. A typical monumental example is in Henry V's chantry at Westminster abbey, but the most magnificent is the great grille at St. George's chapel, Windsor, made to protect the tomb of Edward IV. For many years it was assumed to be the work of the Fleming, Quentin Massys, but it is now known to have been executed by an Englishman, John Tresilian.

Smithing declined in England during the 16th century. The development of the art during the Renaissance period was very uneven in the various countries of Europe. In England the smith fell behind and seemed to have lost interest, producing no very great or important work. He continued to make iron railings, balconies and small objects for architectural application, such as hinges, latches, locks and weathercocks. But toward the end of the 17th century, there was a growing interest in beautifying houses and laying out gardens and squares with a commensurate demand for balconies, staircases and garden gates. The man to whom the credit is usually given for the revival of ironwork in England was Jean Tijou, a Frenchman who together with many of his Protestant fellow craftsmen, had been forced to leave his country owing to the revocation of the Edict of Nantes in 1685. After some years in the Netherlands he came to England in 1689 where he enjoyed the patronage and favour of William III and his queen. His most important works for his royal patrons are to be seen in the immense







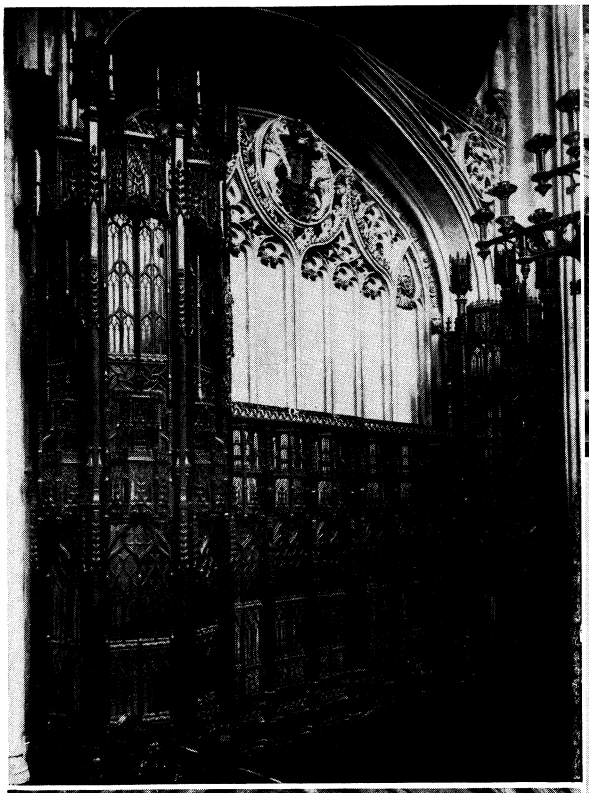


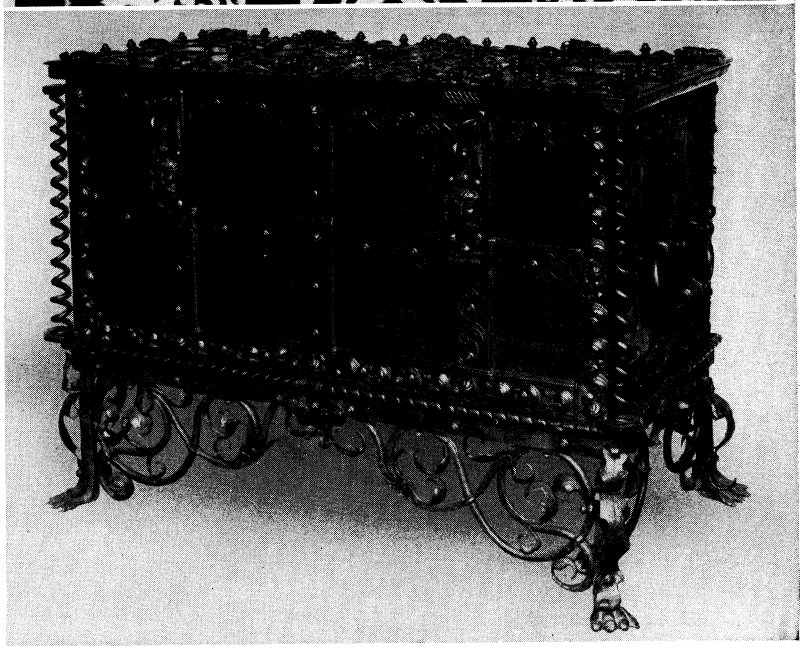
BY COURTESY OF (TOP LEFT) JOHN REILLY, JR., (TOP RIGHT) THE METROPOLITAN MUSEUM OF ART, N.Y., (CENTRE LEFT, CENTRE, BOTTOM CENTRE) MUSEUM OF FINE ARTS, BOSTON, (BOTTOM LEFT, BOTTOM RIGHT) CHICAGO NATURAL HISTORY MUSEUM

CHINESE AND JAPANESE IRONWORK

Top left: Chinese wrought iron landscape signed by T'ang P'eng, 18th century
Top right: Chinese *cast* iron statuette. Ming dynasty (1368–1622)
Centre left: Japanese iron sword guard. 17th or 18th century
Centre: Japanese iron sword guard by Yukinaka, 18th century
Bottom left: Chinese cast iron bell, Sung dynasty (960–1279)
Bottom centre: Chinese cast iron head of a Boahisattva, 16th century
Bottom right: Chinese cast iron vase, Han dynasty (206 B.C.–A.D. 221)

IRONWORK





BY COURTESY OF (TOP LEFT, BOTTOM RIGHT) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (TOP RIGHT) THE CONTROLLER OF H. M STATIONERY OFFICE, (BOTTOM LEFT) S. CLAYTON

ENGLISH, GERMAN AND FLEMISH WROUGHT IRONWORK

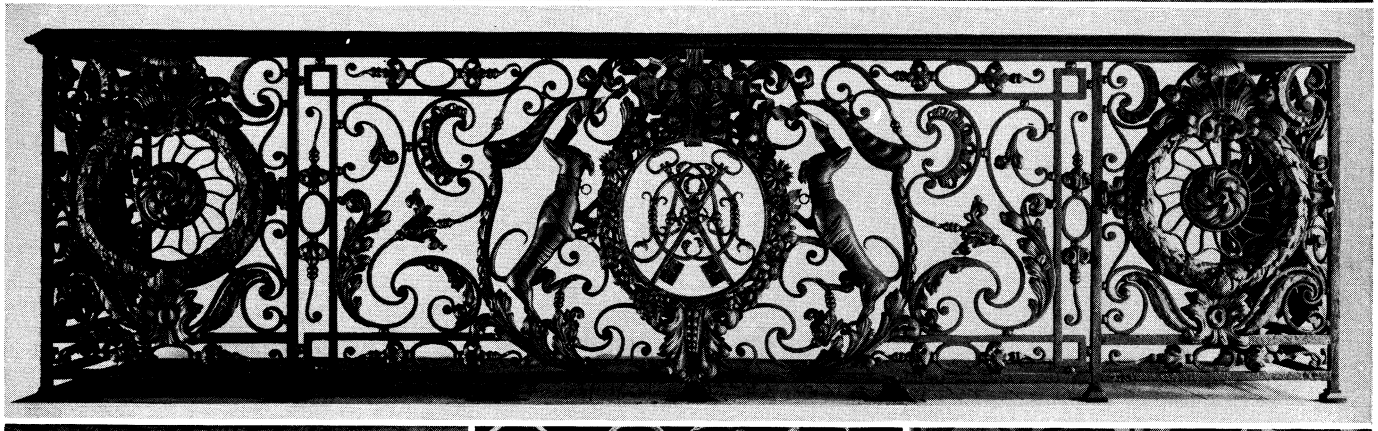
Top left: Iron grille by John Tresilian, 15th century at St. George's chapel, Windsor castle. It was originally made to protect the tomb of Edward IV

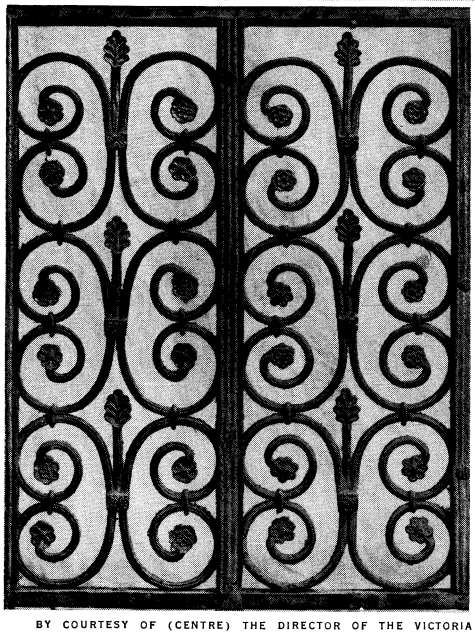
Top right: Iron gates, formerly at Devonshire House, London; 18th century

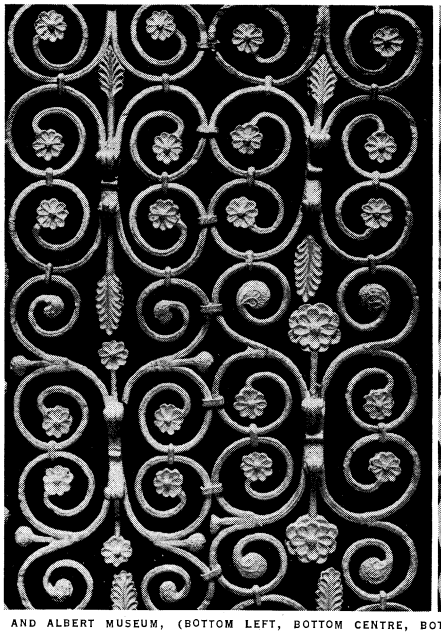
Centre right: Detail of tabernacle door formerly in the chapel of the Castle of the Counts of Flanders, Ghent; 16th century. In the Victoria and Albert museum

Bottom left: Iron-mounted south door of Uffington church, England; Early English period (13th century)

Bottom right: German coffer; Renaissance. In the Victoria and Albert museum





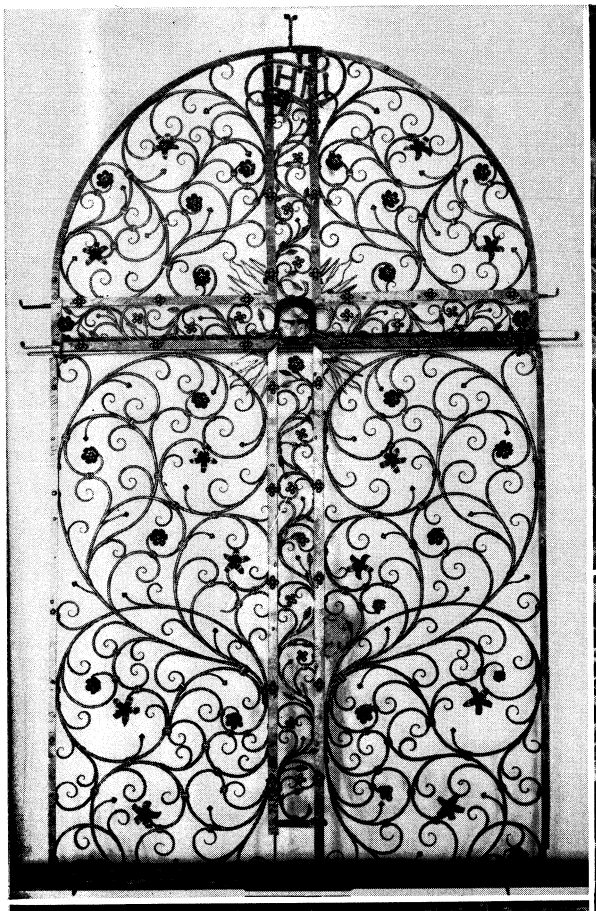


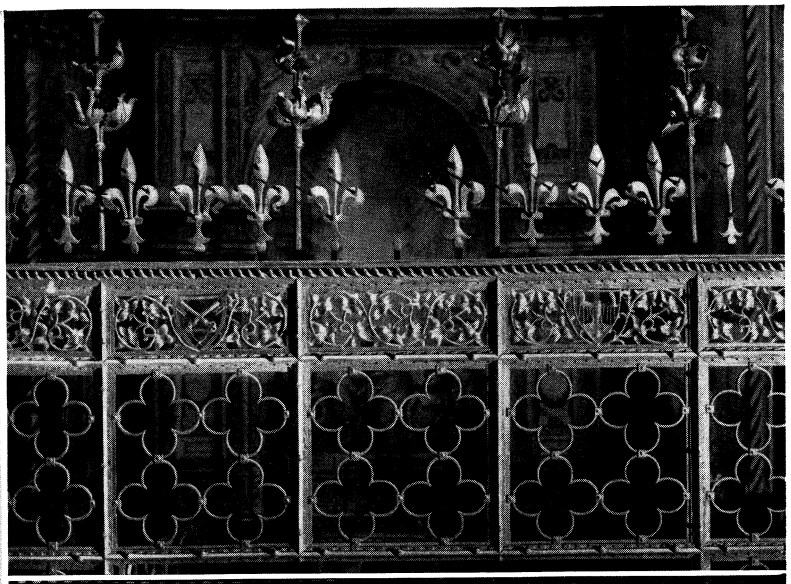
BY COURTESY OF (CENTRE) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (BOTTOM LEFT, BOTTOM CENTRE, BOTTOM RIGHT) F. CONTET; PHOTOGRAPH (TOP) ALINARI

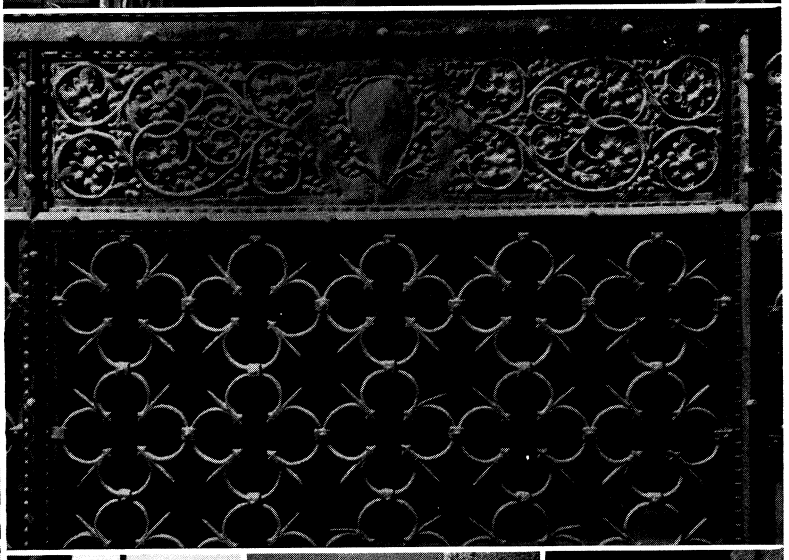
FRENCH WROUGHT IRON

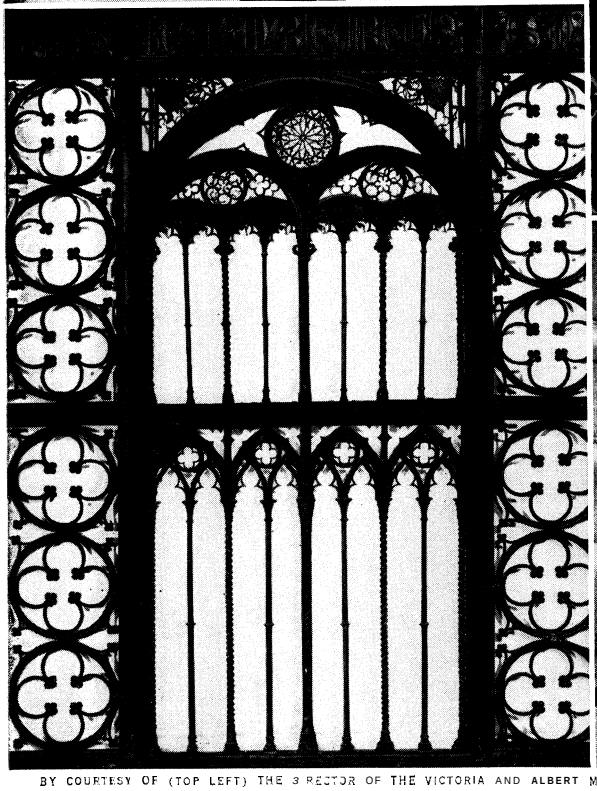
Top: Detail of right door, main façade, cathedral of Notre Dame, Paris; 13th century
Centre: Ironwork railing from a balcony at Versailles; late 18th century
Bottom left: Detail of a grille in the church of St. Etienne de Beauvais; 13th century
Bottom centre: Grille with stamped terminations; 13th century. In the Cluny museum
Bottom right: Detail of grille in the cathedral of Le Puy-en-Velay; 12th century

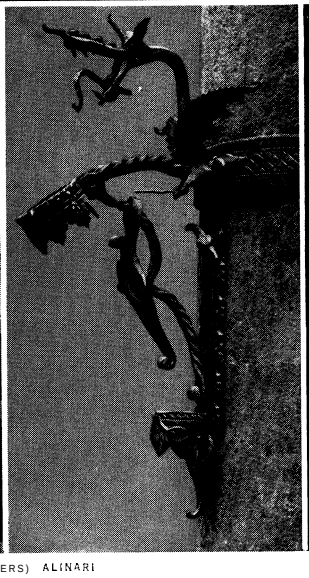
IRONWORK

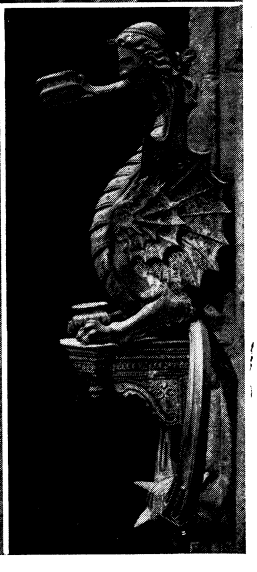












BY COURTESY OF (TOP LEFT) THE RECTOR OF THE VICTORIA AND ALBERT MUSEUM; PHOTOGRAPHS (ALL OTHERS) ALINARI

ITALIAN WROUGHT IRON

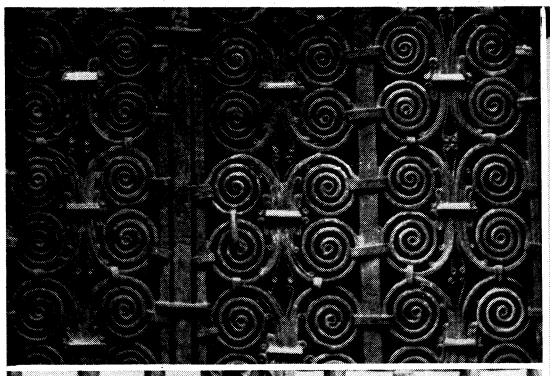
Top left: Venetian grille; 16th century. In the Victoria and Albert museum

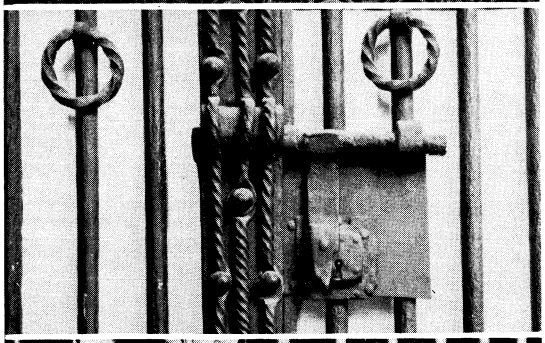
Top right: Chancel grille at left of nave, Orvieto cathedral: 14th century

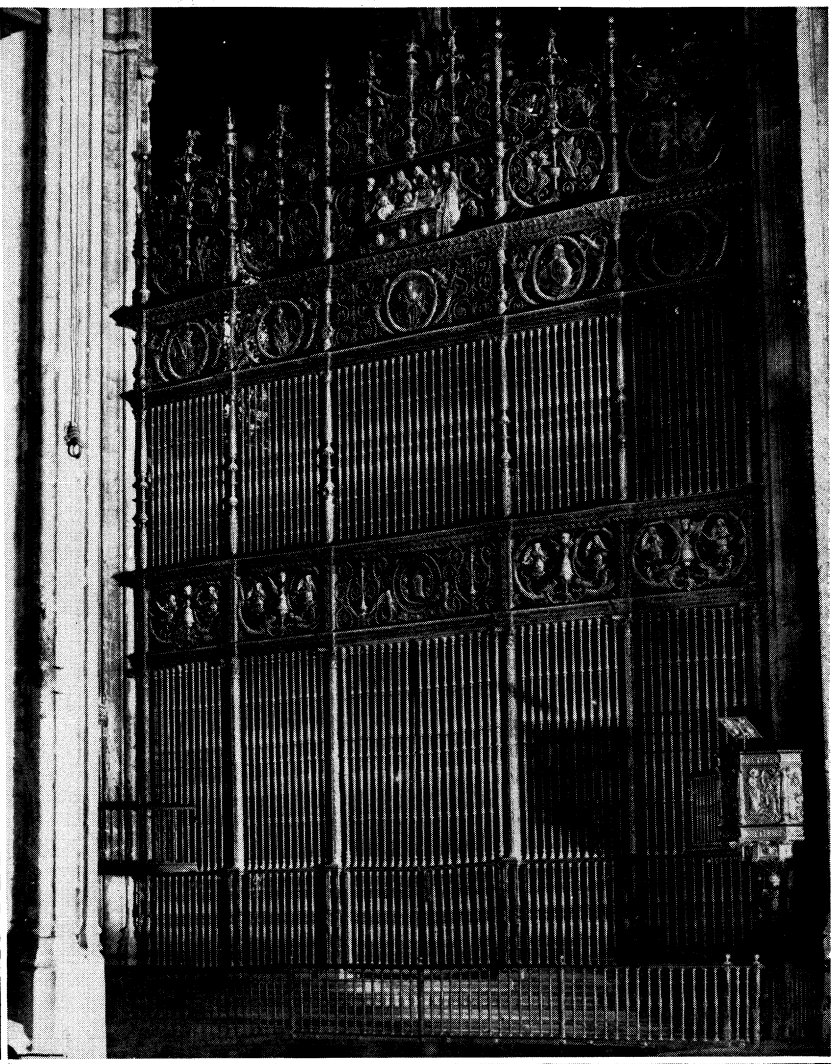
Centre right: Chancel grille of Cappella Bartolini-Salimbeni, S. Trinita, Florence; 15th century

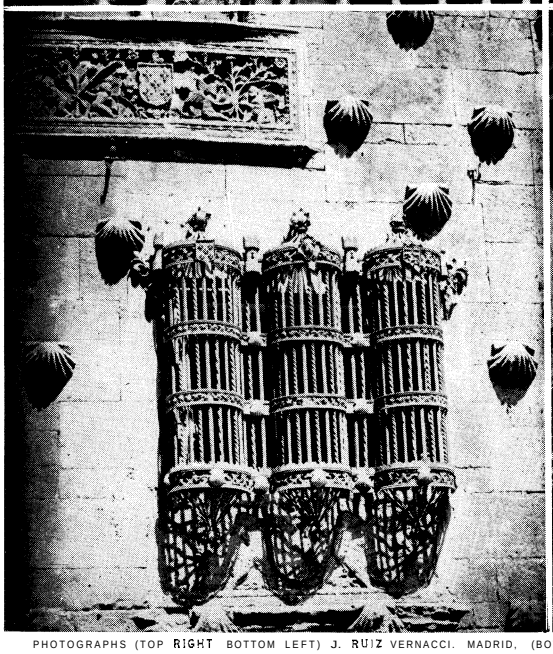
Bottom left: Chancel screen in the sacristy chapel, S. Croce, Florence; 14th century

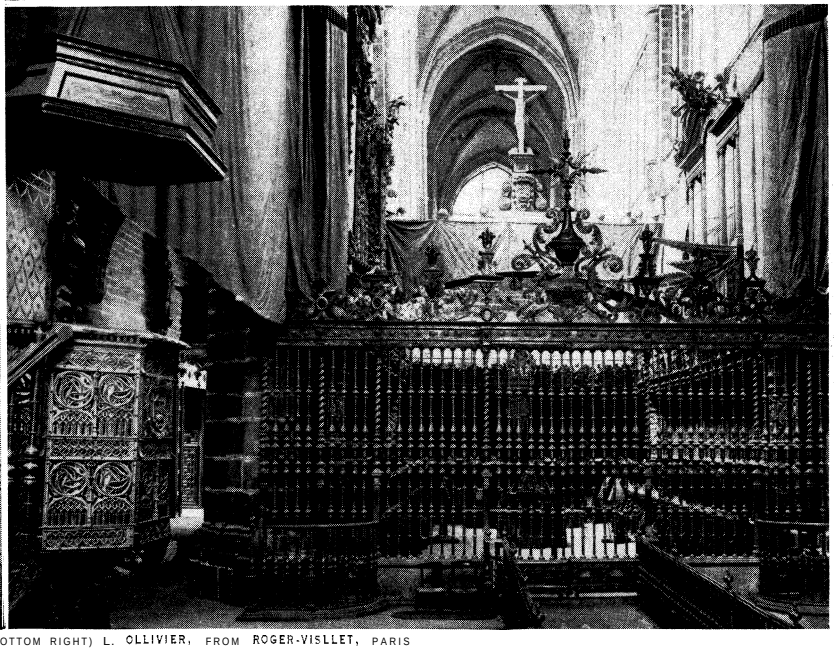
Bottom right: A lantern and two flag or standard holders. Left, lantern on the Strozzi palace, Florence, by Niccolo Grosso, 15th century; centre, flag holder, Piazza Postierla, Siena, 15th century; right, standard holder, Strozzi palace, by Niccolo Grosso











PHOTOGRAPHS (TOP RIGHT BOTTOM LEFT) J. RUIZ VERNACCI. MADRID, (BOTTOM RIGHT) L. OLLIVIER, FROM ROGER-VISLLET, PARIS

SPANISH WROUGHT IRON

Top left: Detail of window grille, west fapade, S. Maria del Mercado, Leon; 13th century

Top right: *Reja* or grille of the altar mayor, Seville cathedral; 16th century

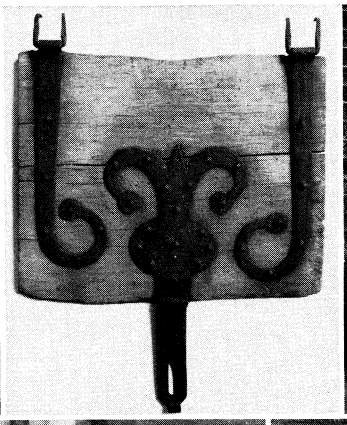
Second left: Detail of lock of cloister grille, Barcelona cathedral; 14th century

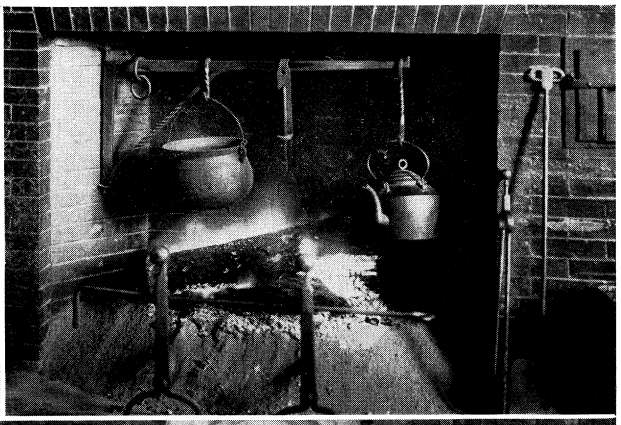
Third left: Detail of grille near transept portal, Cuenca cathedral; 16th century

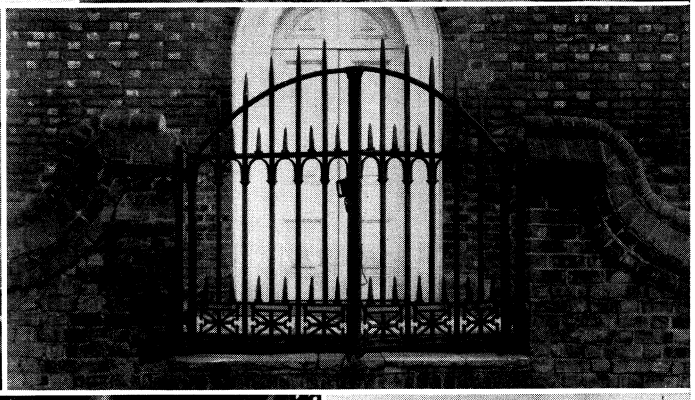
Bottom left: Window grilles of the Casa de las Conchas, Salamanca; 16th century

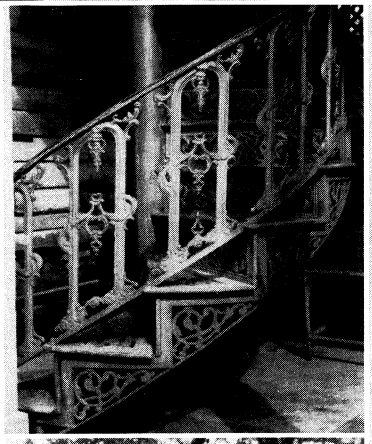
Bottom right: Gothic pulpit (left) and the *reja* of the altar mayor, Avila cathedral; 16th century

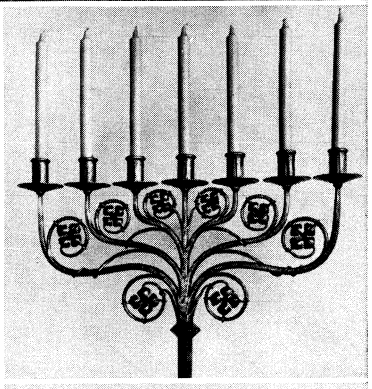
IRONWORK

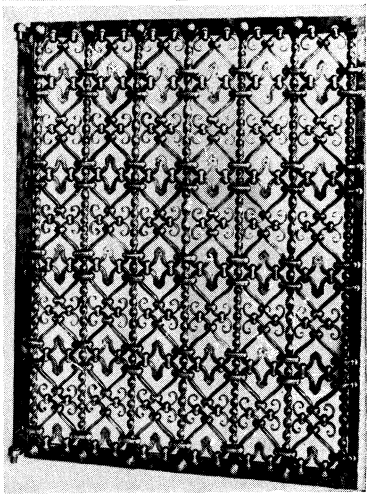












BY COURTESY OF (TOP LEFT, TOP CENTRE) PHILADELPHIA MUSEUM OF ART, (BOTTOM CENTRE, ABOVE AND BELOW) RICHARD KOCH, NEW ORLEANS. (BOTTOM RIGHT. ABOVE) SAMUEL YELLIN, METALWORKER (BOTTOM RIGHT, BELOW) YORK AND SAWYER, ARCHITECTS; PHOTOGRAPHS (CENTRE LEFT) TEBBS & KNELL, INC., (CENTRE RIGHT) B. RALLACE, (BOTTOM LEFT, GEORGE W. JOHNSON

U.S. CAST AND WROUGHT IRONWORK

Top *left:* Cast iron stove plate, dated 1741, from a German community in Pennsylvania

Top centre: Wrought iron hinges and hasp from a Conestoga wagon box, 1710. Pennsylvania German

Top right: Wrought iron fireplace tools, andirons and cast pot from a house in Brookline, Mass. Middle to late 18th century

Centre left: Wrought iron balcony railing on a residence in Savannah, Ga. First half of 19th century

Centre *right:* Cast iron gate, Bruton church, Williamsburg, Va.; 19th century

Bottom left: Wrought iron gate in Charleston, S.C. First half of 19th century

Bottom centre: Two examples of wrought ironwork in New Orleans: stairs and railing (above) and fence (below). Early 19th century

Bottom right: Two examples of the 20th century work of Samuel Yellin: wrought iron candelabrum (above) and wrought iron grille for the Central Savings bank, New York (below)

mass of screens and gates with which he embellished Bampton Court palace. He also executed work at Burleigh house, Stamford. Probably by the queen's wish he was associated with Sir Christopher Wren then engaged on the rebuilding of St. Paul's cathedral. Wren apparently was not very keen on ironwork, and probably exercised some restraint on Tijou, with the result that his work at St. Paul's is more dignified and freer from appendages than that at Hampton Court.

A great amount of fine ironwork of the 18th century may be studied in London in the form of gates, railings: lamp holders, door brackets. balconies, staircases; in almost every suburb may be seen gates and brackets. The precincts of the colleges of Oxford and Cambridge, as well as almost every old town in England, furnish a variety of handsome work. Throughout the 18th century the smith was a busy man; the general tendency of his work, unaffected by the rococo movement on the continent, was toward a less ornate but more characteristically English style, Perpendicular, severe, lofty and commanding, as contrasted with Tijou's French love of richness and mass of details.

At the end of the 18th century the work of the architect brothers Adam shows a departure from true smithing; its slender delicate bars are enriched with rosettes, anthemion and other ornament in brass or lead. The effect is pleasing and harmonizes with the architecture with which it is incorporated.

BIBLIOGRAPHY.—J. Starkie Gardner, *English Ironwork of tha XVIIth and XVIIIth Centuries* (1911), no better source can be referred to for either historical matter or exhaustive illustrations for the period covered; Francis Rowland Yerbury, *Georgian Details of Domestic Architecture* (1926); Mervyn E. Macartney, *The Practical Exemplar of Architecture,* series i–iv (1908–13), the illustrations are mostly of English work, although some are of Italian gates, railings, etc.

3. France.—Medieval door hinge ornaments were not basically different from those in England. and beautiful work is found on church doors, especiaily in central and northern France. It reaches a height of greater elaboration and magnificence than in England, the culminating example being the west doors of Notre Dame, Paris, the ironwork of which is so wonderful that it was attributed to superhuman authorship, Grilles at Troyes and Rouen reveal a high standard of excellence. Working the iron cold, and employing methods associated with carpentry, was immensely popular; it was applied to small objects such as door handles, knockers, ambry doors, and above all to locks. These exhibit an amazing amount of detail and a delicacy of finish such as could only come from a French craftsman.

The Gothic tradition survived in France until well into the 16th century, and was marked by the production of work of the highest skill. largely in the form of locks. knockers and caskets of chiseled iron. The introduction of the Renaissance style did not radically alter the direction of the smith's art—a strange fact when it is remembered how Germany and Spain were fabricating works of enormous size and magnificence in wrought iron. France, like England at that time. was content to make door furniture, in the form of locks, keys. bolts, escutcheons and the like, but did little ironwork of any great size. A school of locksmiths came into being under Francis I and Henry II, working from designs by Androuet du Cerceau in the 16th century, and Mathurin Jousse and Antoine Jacquard in the 17th. The bows and wards of keys were of unusually intricate design, and the locks of corresponding richness. Representative pieces may be seen at the Victoria and Albert museum: London. Among them is the famous Strozzi key, said to have been made for the apartments of Henry III, the bow of which takes the favoured form of two grotesque figures back to hack. But as far as architectural ironwork was concerned, France remained almost at a standstill until the accession of Louis XIII in 1610. Under that monarch, a worker at the forge himself, came a great revival. It seemed to be uninfluenced from without, at first weak. as if feeling its way, but by the end of the 17th century it had attained a marvelous pitch of perfection. It proved to be the beginning of a new movement. the force of which made itself felt in the adjoining countries and inspired ironworkers with new energy. Unfortunately, however. this at times dwindled into mere imitativeness. From the accession of Louis XIV the French ironworkers must be acknowledged as the cleverest in Europe, combining as they did gcod and fitting design with masterly execution. Their designs were often very daring, exploiting all the latent and previously unexplored possibilities of iron. They recognized its great adaptability and took every advantage of it, at the same time being conscious of its limitations. Their forms of expression aere endless.

Screens and gates were needed for parks, gardens and avenues, staircases for mansions and palaces. screens for churches and cathedrals. Among celebrated designers were Jean Lepautre. Daniel Marot and Jean Bérain. Earlier work had been of a simple character, balconies for instance, being in the form of a succession of balusters, but as the smith became more versatile and imaginative, they took the form of panels of flowing curved scrolls, rendered with a freedom never attained before. while constructive strength was observed and symmetry maintained. Enrichments were usually attached in hammered sheet iron. These may be considered the distinguishing features of Louis XIV work such as that at St. Cloud, Chantilly, Fontainebleau and elsewhere. But under Louis XIV all previous efforts were surpassed in the work for his palace at Versailles.

The art of ironwork received a further impetus by the introduction of what is known as the rococo style. The movement initiated in 1723 was due principally to the imagination of two artists, Just Aurèle Meissonier, architect, and Gilles Oppenordt. There was a balanced asymmetry in the design, and fantastic curves with a luxury of applied ornamentation. To the French smith it furnished the opportunity for a yet greater display of his skill. He was clever enough to secure a feeling of stability in his work by counterbalancing swirling masses of ornament with straight constructional lines; he knew how to introduce an iron screen of rococo style into a Gothic church or cathedral without giving offense to the eye or arousing any uncomfortable feeling of incongruity. With astonishing manipulative power he worked as if the material under his hand were soft and pliable, rather than solid and unyielding iron.

Later in the 18th century ironwork took on a more classical appearance, owing to the general revival of interest in ancient art, and many Greek and Roman details were introduced into the ornamentation. The amount of work executed was prodigious, and its beauty and craftsmanship may be seen in most cities of France; e.g , in Nancy.

Nearly all the adjacent countries mere seized with the desire to imitate this French rococo style. England excepted.

BIBLIOGRAPHY.—F. Contet, *Documents de Ferronnerie Ancienne: Époques Louis XV et Louis XVI,* series i–iv, *Périodes du XII^e au XVIII^e Siècles,* series v–vi (1908–22), a most exhaustive collection of well-reproduced examples of the periods covered; Armand Guérinet, *Monographie du Musée de Cluny,* part ii, *Recueil* de *Ferronniere Ancienne et Moderne:* Guillaume Janneau, *Le Fer à l'Exposition des Arts Decoratijs Moderne,* series i–ii (1925), an introduction by H. Martinie, *La Ferronnerie, Exposition des Arts Decoratifs* (192j).

4. Germany.— In the Romanesque period in Germany bronze was preferred to iron; the earliest examples of ironwork are later than those of France and England. The first iron grilles were imitations of French nork, having C-scrolls filling spaces between vertical bars. Typical examples of door hinges prior to the 14th century were those at Kaisheim, St. Magnus church, Brunswick, and St Elizabeth's church. Marburg (the latter having a curious cross in the middle). Throughout the Gothic period in Germany, the imitation of natural foliage was the basis of design.

There were no new marked developments in ironwork during the 14th century Smiths confined their efforts mostly to hinges. Up to this period the vine had been the only motif for elaborate hinges, but flat, lozenge-shaped leaves were introduced, such as at Schloss Lahneck on the Rhine.

During the 15th century grilles became more popular. One of the best examples is the grille in the chapel of Bishop Ernst. Magdeburg cathedral ic. 1498), with elaborate Gothic tracery, nine columns and a cornice. In hinges the cinquefoil displaced the quatrefoil, as at Orb, Oppenheim and Magdeburg. The Erfurt cathedral nas enriched with notable hinges having the vine pattern interpolated with rosettes and escutcheons of arms. Hinges for houses usually were the plain strap type, but when ornamented

they consisted of superimposed layers of sheet iron. As in other parts of Europe at this time, pierced sheet iron was fashioned into tracery of a semiarchitectural nature: much like Gothic windows. Pierced ornament and twisted rods were often combined to form grilles, with their extremities beaten into complicated foliage forms. German smiths were noted for their armour from the 14th through the 16th centuries.

During the Renaissance, ironwork in Germany was in use everywhere and for every purpose: for screens in churches, window grilles, stove guards, gates, fountain railings, well heads, grave crosses, door knockers, handles, locks, iron signs and small objects for domestic use. Smiths were their own designers, and more often than not planned intricate devices merely to show their skill in executing them. They set no limits to their problems, and so far as manipulative excellence went, they were the foremost nation of Europe. But clever as their workmanship undoubtedly was, their designs frequently showed a lack of stability and a tendency to run riot. Thus many of their most imposing works consist largely of filling panels with elaborate, interlacing scrollwork, and the sense of constructional and protective strength is missing.

An abundance of smiths' work is to be found in the southern parts of Germany. Iron bars, circular in section, were most frequently used, and the most common features are: interlacing bars, terminations of flowers with petals and twisted centres, foliage or human heads. All of these characteristics occur with almost monotonous repetition, witnessing to skill, but also lack of imagination and sense of design. The style may be studied in many German and Austrian cities; *i.e.*, Augsburg, Niirnberg, Frankfurt, Salzburg and Munich; the work at Innsbruck is also well known.

The German smith gave much attention to door knockers and handles, enclosing them in pierced and embossed escutcheons. as well as locks with very involved mechanism. German influence made itself strongly felt in Switzerland, Austria and Czechoslovakia.

The baroque and rococo periods are distinguished by a perfection of detail which exceeded that of German medieval or Renaissance ironwork. Although it too often lacked restraint and taste in design, the execution was amazingly skillful. Smiths used wrought iron as though it were a plastic material, meant to be employed in extravagant forms wherever possible. Some examples are at Zwiefalten. Weingarten and Klosterneuburg.

BIBLIOGRAPHY.—Ferdinand Stuttman, *Deutsche Schniedeeisen-Kunst: I–Mittelalter, II–Renaissance und Frühbarock* (1927); Lüer & Creutz, *Geschichte der Metalkunst,* a general history in German, illustrated by examples of all periods; Martin Gerlach, *Ornamente alter Schmiedeeisen* (189j), consists of 50 plates of photographs ably taken and well reproduced.

5. Italy.— The few extant examples of ironwork in Italy prior to the 14th century indicate a wide appreciation of how the material could best be worked with only the tools of the smith. Some noteworthy examples are: chancel grille at left of nave, Orvieto cathedral (1337); grille at baptistry of Prato cathedral (1345); chancel screen in the sacristy chapel of Santa Croce, Florence (1371); and the grille to the Capella degli Spagnoli, Santa Maria Novella, Florence.

In the 15th century armour was of such excellence that at a great Spanish tournament in 1434, only Italian weapons and armour were permitted — and that at a time when monumental Spanish cathedral screens had no peers.

Until the 16th century Italian smiths respected the natural characteristics of wrought iron by relying almost entirely upon those forms which could be wrought with hammer and anvil. The grille was generally made by dividing it into regular panels with vertical and horizontal bars (sometimes triangular in section and enriched with dentils). Often the quatrefoil filled some or all of these panels; they were made in Tuscany from a pierced plate, and in Venice from separate scrolls collared together. A respected example is in the Palazzo della Signoria, Siena. crowned by a *repoussé* frieze, and surmounted by a cresting of flowers; spikes and some animal heads.

It might have been thought that in the fountainhead of the Renaissance, ironwork would have proceeded at the same pace and with the same brilliant success as architecture, sculpture, bronze casting and the other arts. Strangely enough, little use of it is found in connection with the fine buildings of the revival. Bronze was favoured, and uhat in other countries is found in iron, has its counterpart in Italy in bronze. As time went on the smiths grew less inclined for the more difficult processes of hammering and welding, and contented themselves ultimately with thin, ribbon iron, the various parts of which were fastened together by collars. Work of the later periods may be distinguished, apart from the design, by this feature, whereas the English and French smiths vigorously faced the hardest methods of work, and the German and Spanish smiths invented difficulties for the sheer pleasure of overcoming them.

Notable centres of artistic ironwork were Florence, Siena, Vicenza, Venice, Lucca and Rome, where important pieces may be found in the form of gates. balconies, screens, fanlights. well covers and a mass of objects for domestic use, such as bowl stands, brackets and candlesticks.

In screenwork the favourite motif was the quatrefoil, which is found with many variations ever since the 14th century. Early examples are strong and virile, later ones tend to weakness. The C-shaped scroll is used in many combinations. The churches and palaces of Venice contain many examples. Peculiar to Italy are the lanterns and banner holders such as may still be seen at Florence, Siena and elsewhere, and the rare gondola prows of Venice. Of the ironworkers of the early Renaissance the most famous was Niccolo Grosso of Florence, nicknamed "Il Caparra" because he gave no credit but insisted on money on account. He worked at the end of the 15th century. Vasari thus eulogizes him: "He was truly unique in his craft. and has never had and never will have an equal." From his hand is the well-known lantern on the Strozzi palace in Florence, repeated with variations elsewhere in the same city. Siena can show other lanterns and banner holders attached to the facades of its palaces. Cressets are still to be seen at Lucca and a few other towns. The Victoria and Albert museum, London, contains two gondola prows, in fine pierced iron.

The decadence of 17th- and 18th-century ironwork paralleled that of architecture. Designs were borrowed directly from France and Germany. The metal was too often worked cold, using thin members and the resulting construction was flimsy. Scrolls were often encased in thin, grasslike leaves. Conventional or naturalistic floners were tacked on as seeming afterthoughts. Instead of using rods and bars, ribbonlike bands were used, with cast ornaments pinned on. Intersecting tracery was copied from Germany. The best examples of this period are confined to Venice and northern Italy, such as the screen in the south aisle chapel of San Ambrogio, Milan; the chapel enclosure in San Pietro, Mantua; and the screen in the Palazzo Capodilista, Padua.

See Guido Marangoni (ed.), *Enciclopedia delle moderne arti decorative italiane, II–Il ferro nattuto* (1926); Giulio Ferrari, *Il ferro nell' arte italiana* (1923), an Italian text illustrated with many of the best examples of Italian craftsmanship.

6. Spain.— Prior to the 15th century Spanish ironwork was basically similar to that in France and England. The Spanish smith accepted the limitations imposed by anvil and ancillary tools, but he skillfully exploited to the limit all manner of variations; *e.g.,* twisting square rods, coiling flat bars into C-shaped scrolls of all sizes and devising imaginative crestings to surmount the top of church chapel screens or domestic window grilles. Many Moorish craftsmen of extraordinary ability were enticed to remain in Spain as the Moors were slowly pushed southward; the resultant blending of Gothic with Moorish resulted in the so-called Mudéjar style.

Ironwork of the Renaissance period from about 1450 to 152j, reached a height of grandeur and magnificence attained in no other country. Of all the Spanish craftsmen the smith and the armourer were the busiest, especially during the 16th century. The particular manifestation of work in iron. which for more than a century towered above all the others, may be seen in the screens of monumental size (*rejas*) to be found in all the great cathedrals of Spain.

These immense structures, rising to 25 or 30 ft.. show several

horizontal bands or tiers of balusters, sometimes divided vertically by columns of hammered work and horizontally by friezes of hammered arabesque ornament. Usually such screens are surmounted by a cresting which is sometimes of simple ornament. but more often is a very elaborate design into which are introduced a large number of human figures. Shields of arms are freely incorporated. and the use of bright colour and gilding adds to their impressive beauty. The great balusters were always forged from the solid, and their presence in hundreds demonstrates the extraordinary skill and power of the Spanish smith. The *reja* shut off the high altar of the church or cathedral from the nave, and a further opportunity came to the smith when the choir was moved from the transept, to west of the crossing. This necessitated a second screen to enclose the east end of the choir. and naturally this screen could be in no way inferior to that in front of the high altar. Thus in many cathedrals two of these monumental *rejas* are found facing one another. It was the smith's opportunity, and he availed himself to the full. Monumental *rejas* may be seen in all the large cathedrals of Spain—Barcelona. Saragossa, Toledo, Seville. Burgos. Granada. Cordova and many others.

Ironwork on a smaller scale is found in gates, balconies and window screens; wrought-iron pulpits also exist. The panels of hammered and pierced iron, heightened with colours and gilding, were used in connection with domestic architecture; many doors were ornamented with elaborate nailheads or embossed studs.

BIBLIOGRAPHY.—A. Byne and M. Byne, *Provincial Houses in Spain* (1925), excellent as reference for informal use of wrought iron, *Rejeria of the Spanish Renaissance* (1914), one of the outstanding hooks on the subject. *Spanish Interiors and Furniture* (1921–25), excellent as reference for use of iron in interior settings, furniture, lighting fixtures, etc., *Spanish Ironwork* (1915); Andrew N. Prentice. *Renaissance Architecture and Ornament in Spain* (1893). (W. W. W.; G. K. G.)

C. United States

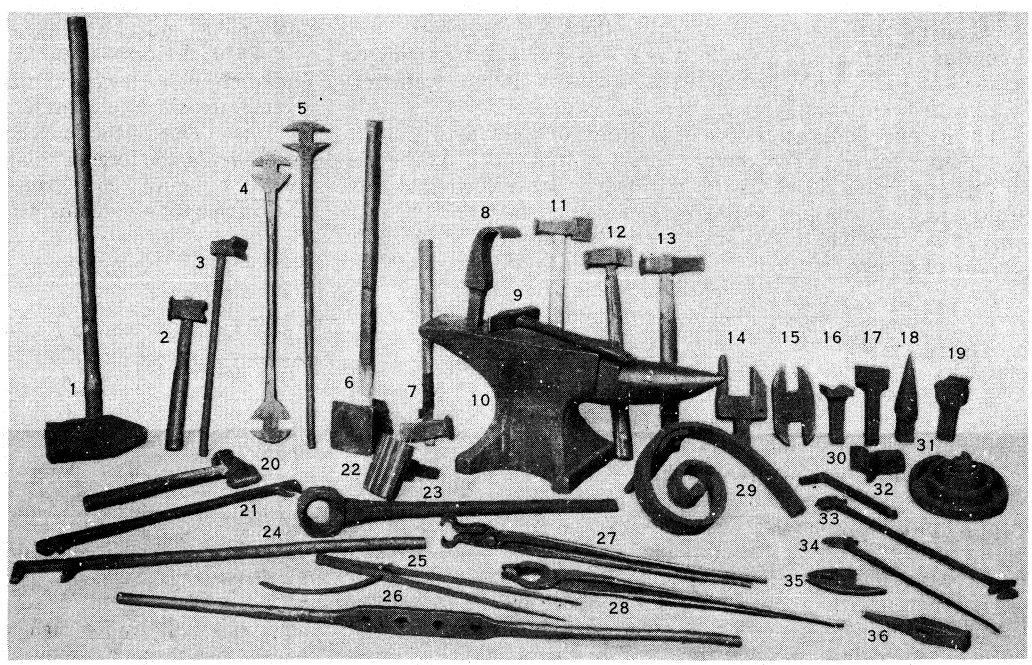
1. Early History.— The characteristics of the earliest ironwork in the various colonies naturally reflected those of the parent countries. The English were more sparing in its use in the Sew England colonies. than were the Germans in Pennsylvania or the French in Louisiana. In the 17th and 18th centuries ironwork was used mostly for such practical purposes as weathervanes. foot scrapers. strap hinges, latches. locks and particularly for the necessities and conveniences for fireplaces (firedogs. cranes, skewers. toasters, kettle warmers and spits). It was not until the late 18th century. nhen the threat of Indian raids and food shortages had waned, and the established communities enjoyed a sense of tranquility and prosperity, that smiths fashioned wrought iron into railings, fences, grilles, gates and balconies. Square or flat iron bars were generally used to produce designs that were usually light, airy and graceful, and rather in contrast to the contemporary European preference for sturdier forms.

The revolt against English political rule was reflected in the decline of English ironwork traditions, and in the steadily increased acceptance of the work by French and German craftsmen throughout all the 13 colonies.

Gradually ironwork designs tended to develop characteristics of an American or composite nature, as a logical consequence of the diverse origins of colonists and smiths. An innovation, which appeared toward the end of the 18th century, was the combination of structural wrought-iron rods or bars. nith lead or cast-iron ornamental features. While the use of wrought iron declined during the 19th century, during its last quarter the use of cast-iron columns and panels for non-residential buildings increased. These designs. timid or bold, decorative or structural, engendered the prototypes of commercial buildings for the ensuing decades.

Unfortunately the longevity of structures in U.S. cities has been short. There are fen examples of 18th or early 19th century iron-aork extant in New York. not many more in Boston, some in Philadelphia, but more in and near Washington, D C.. such as the excellent balconies and railings at the Octagon (headquarters of the American Institute of Architects). Charleston, S.C., has a rich legacy in gates. notably those at numbers 12, 23 and 36 Legare street, 63 Meeting street, and the unusually beautiful pair at St. Michael's church. The latter is credited to Justi. who came to Charleston from Germany in 1820. Two other gifted German artisans who settled in Charleston. were Werner in 1828, and Julius Ortman in 1847,

New Orleans has more ironwork than other U.S. cities, thanks to a group of citizens dedicated to the preservation of the old French Quarter. Its earliest ironwork was forged by Spanish and French smiths. Unfortunately fires, rust and remodeling have so taken toll of the Spanish ironwork, that almost the only remaining example of importance is the gateway of the Cabildo (town hall). It has moldings beaten from solid bars, like mady of the old *rejas* in Spanish cathedrals. After the Louisiana purchase in 1803. the influx of ironworkers from northern states brought about a broadening of influences that are apparent in designs and techniques. Ironnork of New Orleans can be roughly divided into three periods: (1) forged wrought iron by French and Spanish artisans with strongly marked European characteristics; (2) a transitional period nith wrought-iron structural members embellished nith cast-iron ornaments in the Directoire and Empire styles of France. plus some U.S. innovations; and (3) entire grilles, screens and treillage made entirely of cast iron. No other city in the U.S. has two- and even three-story iron porches and balconies which can compare with those of New Orleans. Some



FROM "WROUGHT IRON IN ARCHITECTURE" BY GERALD K. GEERLINGS, COPYRIGHT 1929 CHARLES SCRIBNER'S SONS; RENEWAL COPYRIGHT © 1956 GERALD K. GEERLINGS. USED BY PERMISSION OF CHARLES SCRIBNER'S SONS

FIG. 1.—WROUGHT-IRON SMITH'S TOOLS

(1) Sledge; (2, 3) Top swages; (4, 5) Twisting bars; (6) Flatter; (7) Set hammer; (8) Scroll starter; (9) Cross-peen hammer; (10) English anvil; (11) Top fuller: (12, 13) Hot chisels; (14, 15) Bottom scroll forks; (16) Bottom swage: (17) Bottom fuller; (18) Mandrel; (19) Bottom swage; (20) Top fuller; (21) Scroll fork; (22) Bottom swage; (23) Heading tool; (24) Special twisting bar; (25) Dividers; (26) Twisting bar: (27) Link tongs; (28) Hollow bit or bolt tongs; (29) Scroll form; (30) Bottom swage; (31) Scroll form; (32) Special tool; (33, 34) Twisting bars or scroll forks; (35) Bending tool used in vise; (36) Punch

FROM "WROUGHT IRON IN ARCHITECTURE" BY GERALD K. GEERLINGS, COPYRIGHT 1929 CHARLES SCRIBNER'S SONS: RENEWAL COPYRIGHT C 1956 GERALD K. GEERLINGS. USED BY PERMISSION OF CHARLES SCRIBNER S SONS

FIG. 2.—FORGING A FAGOT WELD. SHOWN ARE THE ANVIL AND FORGE FIRE. ALONGSIDE OF WHICH ARE THE WATER TROUGH, TOOL RACK AND VISE

of these lacy structures were built above the sidewalks, such as those on St. Peter street. Balconies sometimes not only extended across an entire façade, but continued undaunted around a corner, as on the original building of the Little theatre.

2. Mid-19th Century Onward.— Distinctive national characteristics in the design of ironwork gradually tended to disappear in Europe, due to increased travel and communications between countries. The influence of French Renaissance architecture (modified or revived) continued to exert a viable effect where the acceptance of the *art nouveau* (last quarter of the 19th century) was flaccid or denied. However, in England 18th century designs continued with slight modifications. In the U.S. probably the most important force, prior to World War I, was exercised by architects trained in Paris, with the result that ironwork designs were very similar to French work of this period.

The increased mechanization of all forms of manufacture understandably affected the character and use of ironwork. As the cost of cast iron came down, its use increased. Because wrought iron is produced by hand by beating red-hot iron on an anvil. not much change was possible through increased mechanization. whereas the casting of molten iron lent itself to improved equipment and techniques. The lowered cost of duplicating ornamental cast-iron components, the introduction of structural steel parts, and the widespread acceptance of porches and shop fronts made of iron, expanded the usage of ironwork to the modest building. whereas it had been generally confined to public or monumental structures. Foundries in the U.S. established a flourishing business in pierced cast-iron panels. modeled after Louisiana porch treillage.

Compared with prior periods, the last half of the 19th century will scarcely be commemorated as introducing enduring or beautiful ironwork forms. It was not until the first quarter of the 20th century that a master craftsman-designer gave impetus to a new conception of design forms and textures. Edgar Brandt of Paris broadened the scope of decorative usage by the rich inventiveness of his compositions, and by an entirely original approach which resulted in a wrought-iron texture that is akin to beaten silver. Examples of his work at the Exposition des Arts Decoratifs Moderne at Paris in 1925 had an immediate effect upon ironwork designed and executed in the U.S. during the great building boom which lasted until about 1930. During this period both wrought and cast iron enjoyed an unprecedented period of popularity, not only in the form of bank screens. entrance doors and grilles in commercial or public buildings. but as decorative grilles and gates in expensive private homes. In many cases the craftsmanship equaled that of representative examples of the Gothic or Renaissance periods in Europe.

One of the most gifted and dedicated iron craftsmen in the U.S., Samuel Yellin of Philadelphia. raised the standards of wrought-iron craftsmanship to its apex during the 1920s. He not only trained an atelier of craftsmen for the first time in the U.S., but by his efforts, nrought iron was recognized as being capable of enriching even the most monumental building. Yellin's influence was brought to an untimely termination by the depression of the early 1930s. As building activity declined after 1930, so did the use of ironwork, but it did not increase with the revival of building after World War II.

BIBLIOGRAPHY.—Wallace Nutting, *Early American Hardware* (1923); Albert H Sonn, *Early American Wrought Iron*, 3 vol (1928), illustrated with over 1,000 pencil drawings; Elizabeth Gibbon Curtis. *Gateways and Doorways of Charleston, South Carolina, in the Eighteenth and the Nineteenth Centuries* (1926); a collection of photographs by George W Johnson, *Iron Wovk* in *Charlerton, South Carolina,* in the *Art* Room of the New York Public Library.

11. *TECHNIQUE*

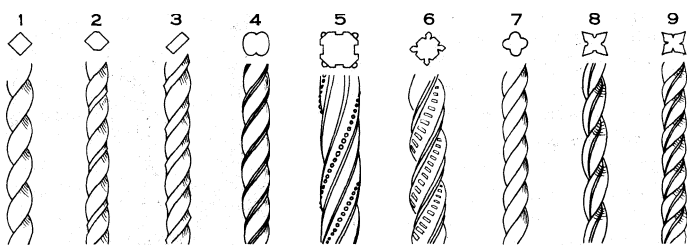
A. WROUGHT IRON

Wrought iron is the type of ironwork that is forged on an anvil. There are no fabrication similarities to cast iron. which is poured in a molten state into prepared sand molds. There are three kinds of iron, whose physical characteristics vary chiefly according to their carbon content: wrought iron has .04%; machine, open-hearth or Bessemer steel has .2% to .6%; cast iron has 2% to 6%.

1. Properties.—Wrought iron is fibrous in structure and light gray in colour. It can be hammered, twisted or stretched when hot or cold. The more it is hammered, the more brittle and hard it becomes. but it can be brought back to its original state by annealing (heating and then cooling slowly). It will not shatter u hen dropped

The grade of wrought iron least susceptible to rust, yet the most malleable and tough. is called Norway or Swedish iron. Among the chief sources of the ore are the bottoms of shallow Swedish lakes, where from 4 to 6 in. are deposited over a period of 15 to 30 years The usual forms of wrought iron available to the craftsman are rods or bars, and thin plates. It is from these that his final product must be fashioned on an anvil.

2. Fabrication.— From earliest times. the smith has had a forge to heat the iron, an adjacent water tank in which to cool it, an anvil on which to form it, plus a wide assortment of hammers and tools. One of the few changes has been the mechanization of the blower at the forge, in place of the hand- or foot-operated bellons. The smith knows from the colour of the heated iron when it is at the optimum temperature for a specific operation; dark red



FROM "WROUGHT IRON IN ARCHITECTURE" BY GERALD K. GEERLINGS, COPYRIGHT 1929 CHARLES SCRIBNER'S SONS; RENEWAL COPYRIGHT 1957 GERALD K. GEERLINGS. REPRODUCED BY PER. MISSION OF THE PUBLISHER

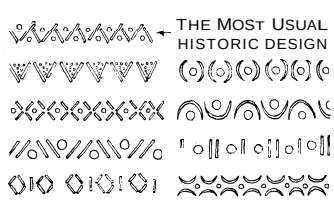
FIG. 3.— DRAWING SHOWING THE DECORATIVE POSSIBILITIES INHERENT IN TWISTED BARS

indicates suitability for surface finishing; bright or light red show that the iron is malleable but the surface will scale and it is therefore not suitable for finishing; light yello denotes a good forging temperature; and uhite designates the correct temperature for welding

The most important tool is the anvil. The English type, generally used for forging wrought iron, has a flat. top surface. which is used as a solid base for hammering the heated iron into shape, for welding, for splitting or for incising decorative chisel marks

in the hot iron. One end of the anvil is shaped like a pointed cone, and is used for forming curved surfaces. The other blunt end, or heel, has one or two square or rectangular holes on top, into which fit various tools which are used for holding one end of a bar, making twists or holding scroll forms.

3. Design.—The two most important factors in wrought-iron design, are: (1) the form of the material (bars, rods and thin sheets); and (2) the relatively short time period in which iron can be forged while hot. Although the Spanish craftsmen of the late 15th century proved they could work almost impossible shapes in their unsurpassed cathedral grilles, this type of ironwork is not considered a realistic exploitation of the material. Ideally wrought-iron design should use forged bars and rods in imaginative forms, practical, yet decorative. Ornamentation is most successful when it is an integral part of the design (twisted bars, scrolls, chisel mark incisions, etc.), rather than a realistic imitation of nature, riveted on afterward. From the anvil is derived the expression, "to strike while the iron is hot," and this implies spontaneity and rapid hammer blows. The wrought-iron craftsman should not be expected to repeat with meticulous exactitude one intricate component after another. In fact, wrought iron by a master craftsman is esteemed for the variations which naturally occur.



FROM WROUGHT IRON IN ARCHITECTURE BY GERALD K GEERLINGS COPYRIGHT 1929 CHARLES SCRIBNER S SONS RENEWAL COPYRIGHT 1957 GERALD K GEERLINGS RE PRODUCED BY PERMISSION OF THE PUBLISHER

FIG. 4.—CHISEL-MARK ORNAMENTATION

The individual components of a wrought-iron design are often plain or twisted rods, with or without chisel mark incisions. They are frequently composed as a series of straight, parallel members, or in combination with scrolls, or a repeat design of some geometric shape such as the quatrefoil. Where two curved members are tangent, they are characteristically secured together by bands or collars, rather than by welding. Where two straight bars intersect, it is accredited craftsmanship to make the vertical bar pierce or thread the horizontal member. Grilles consisting of two series of parallel small-diameter rods, one series at right angles to the other, were sometimes interlaced or woven in decadent periods.

The term *repousse'* refers to three-dimensional, ornamental wrought ironwork. Depending upon the depth of the relief; various fabrication techniques may be employed. Sheets $\frac{1}{16}$ in. or less in thickness, generally are used. The general configuration of the modeling is obtained by beating the back of the sheet; the final details are embossed on the front face, The finer the scale and detail, the more work which must be done when the iron is cold. *A repousse'* design may be pierced, but this term usually connotes a solid sheet forged into a mask, a shield or an entire embossed panel. The traditional means of setting off a cutout *repousse'* design was to superimpose it on a vermilion-coloured background panel. Modern approximations of *repousse'* work consist of mechanically stamped designs touched up with random hammer blows.

4. Care.—The texture of wrought iron is one of its principal assets, so painting it in order to prevent rust. is not nearly as desirable as preserving the highlights of the original finish with wax. Professional craftsmen recommend removing all traces of rust by rubbing with emery cloth, augmented by a few drops of turpentine if the rust is heavy. Then the entire surface should be rubbed with any good liquid floor wax, or beeswax dissolved or softened in turpentine. After about 15 minutes when the wax has set, the surface should be rubbed with a soft cloth. This treatment should be repeated about once every three months.

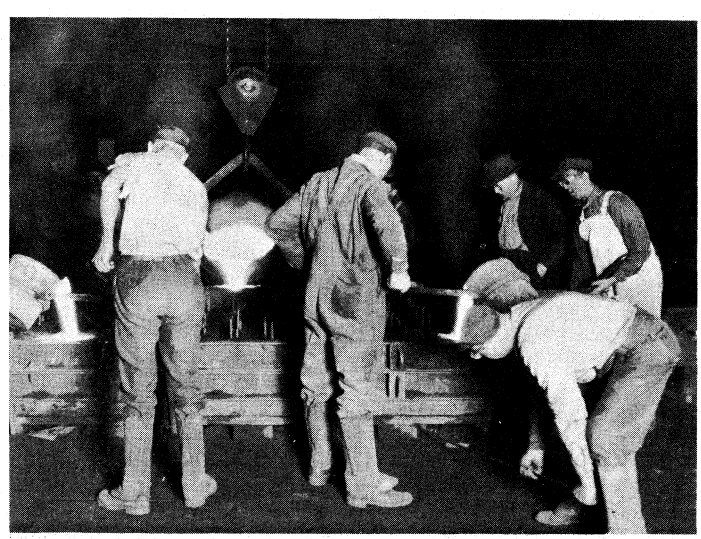
B. Cast Iron

1. Properties.—The carbon content of cast iron varies from 2% to 6%. Cast iron is melted in a furnace or cupola, stoked with alternate layers of coking iron, then poured into prepared sand molds. After the cast iron cools in the mold, the sand is cleaned off, and the work is virtually complete. Its shape is fixed, and while a casting can be slightly trued up by the judicious use of a hammer, it is in no sense as workable as wrought iron. Because it is brittle, it is almost certain to shatter if dropped.

2. Fabrication.—An iron casting is not the creation of a single craftsman, but the combined result of the skilled efforts of several groups of artisans. There must be an architect's or designer's drawings at full size, showing in detail all the features of the design. From these dranings full-size models or patterns must be made in wood, plaster or wax, depending upon the nature and the intricacy of the casting to be made. These patterns must be made slightly over-sized, according to a shrinkage scale; when the molten iron cools it will be slightly smaller than the patterns used in the molds.

The next step is to use the patterns to make sand molds, into which molten cast iron will be poured. For each casting there must be one sand mold for the back face of the casting (the cope), and another for the front or finished face (the drag). These two molds must be made so that when fitted and clamped together, there will be a space between. When this space is filled with molten metal and cooled, the result will be a casting with the desired size, shape, thickness and surface ornamentation of the pattern. If the casting is to be an ornamented panel, with a raised centre portion, a wood pattern might be used, with the ornamentation either carved in wood or applied. The drag mold (for the front face of the casting) is prepared by first placing on the foundry floor a plain-surfaced follow board. The pattern is placed on this, face up, supported by a bed board, in cases where the pattern has a raised centre portion. A parting powder is dusted on the face of the pattern (so that at a later stage the sand will not cling to the pattern when it is removed). Then the pattern is sprinkled or riddled with facing sand, which is firmly rammed as it is added. Finally heap sand is added until the rectangular, boxlike drag is filled to the top edge. A bottom board is then clamped on the top to hold the pattern and sand in place. Then the entire drag is turned upside down. The bed board, which had been on the floor and now is on the top, is removed. The pattern is then very carefully withdrawn from the sand, and its imprint inspected to be certain that it is a precise duplicate (reversed of course) of the pattern. Slight imperfections in the sand surface are filled if necessary. and loose sand is removed.

The next step is to repeat the same process for the cope, the sand mold for the back face of the casting. When completed, there thus will be two rectangular boxes, each rammed with sand, bearing the imprint of the pattern, and a space between them equal to the thickness of the metal. The drag remains on the foundry floor, but the cope is superimposed, being lifted in place with a crane if it is large. The sand of the (upper) cope mold has funnel-shaped openings provided (sprues), into which the mol-

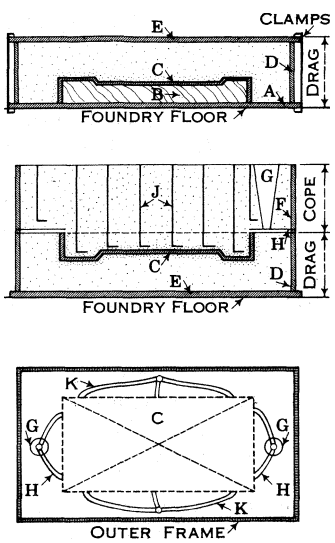


FROM "METAL CRAFTS IN ARCHITECTURE" BY GERALD K. GEERLINGS, COPYRIGHT 1929 CHARLES SCRIBNER'S SONS: RENEWAL COPYRIGHT C 1957 GERALD K. GEERLINGS. USED BY PERMISSION OF CHARLES SCRIBNER'S SONS

FIG. 5.— MOLTEN METAL BEING POURED INTO A MOLD

ten metal will be poured. Horizontal grooves are then made in the sand of the cope called gates. which will provide tunnels for the metal to flow from the vertical sprues. In addition, there are risers (grooves in the sand located as far as possible from the sprues) to allow gases and displaced air to escape. The molten cast iron is ladled until the metal begins to fill the risers. When pouring a very large casting, a reservoir or pouring basin is provided above the cope, to contain sufficient molten metal to supply the entire mold simultaneously.

Technical metallurgical knowledge is required both in preparing the cast iron in the furnace or cupola, and in determining when the iron is right for pouring. Mechanical skill is necessary in ladling the molten metal from the cupola into the mobile mixing ladle, and from the latter to the prepared sprues of the cope. Foundries usually operate on a schedule so that the pouring of all molds is done toward the end of the working day. About two or three minutes after a mold is poured, the iron is said to be set. At this stage there are two foundry practices. In one, the clamps which hold the cope and drag together, are loosened, the cope is removed, and the molder in charge estimates where the casting should be entirely uncovered or "stripped" of sand, or, whether to uncover only those parts of the casting which have the thickest metal, and to retard those areas where it is thinnest by shoveling on more sand in order to equalize the shrinkage rate between thick and thin parts. Skilled manipulation at this point determines the difference between a casting that is true and satisfactory, and one that is warped. and will consequently require tedious labour to straighten out. On the other hand, some foundries allow the casting to cool as slowly as possible, without removing any sand, and perform any straightening later. A casting which has cooled slowly is more readily straightened than one which has done so quickly.



FROM "WROUGHT IRON IN ARCHITECTURE" BY GERALD K GEERLINGS. COPYRIGHT 1929 CHARLES SCRIBNER'S SONS; RENEWAL COPYRIGHT 1957 GERALD K GEERLINGS. REPRODUCED BY PERMISSION OF THE PUBLISHER

FIG. 6.— CAST-IRON FABRICATION: TOP, DRAG BEING PREPARED; CENTRE. DRAG IN POSITION. WITH COPE SUPERIMPOSED. BOTTOM. COPE FROM ABOVE WITH GATES AND RISERS SHOWN

Key: (A) Follow board; (B) Bed board; (C) Pattern; (D) Drag outer frame; (E) Bottom board; (F) Cope outer frame; (G) Sprues; (H) Gates; (J) Gaggers to reinforce the sand; (K) Risers

After the castings have cooled overnight, they are sandblasted to remove any sand that may adhere. Unwanted protuberances, such as those nhere gates and risers were located. are ground or cut off. Following this, the process is not unlike the operations in a woodworking shop; edges and surfaces that must conform to narrow tolerances are trimmed and planed. Ornamental features in cast iron cannot be chased and polished as in cast bronze If the ornamental cast-iron details are not replicas of the original pattern, the only recourse is to make a new casting. *See* also CAST IRON.

3. Design.—From the foregoing description of fabrication, it is obvious that certain forms are more suitable to cast iron than to wrought iron For example, if repetitive balusters or columns, or panels nith low-relief ornamentation are desired, cast iron is the most suitable material In the U S. excellent examples are to be found in the cast-iron railings and porches of Charleston, S C , and New Orleans. Some of the patterns used in the 19th-century, are still being used today. The same is also true of ornamental fire backs (for the rear of fireplaces). Some good examples of 20th-century cast ironwork are. the imposing entrance and window spandrels of the Fidelity Mutual Life Insurance building. Philadelphia (Zantzinger, Borie & Medary, architects); the window frames and panels of the Integrity Trust Company building. Philadelphia (Paul Cret. architect); the entrance and show window of the Packard Motor building, Philadelphia (Albert Kahn. Inc.. architect. and Philip S. Tyre, resident architect) ; the mullions and window spandrels of the Home Savings bank. Albany, N.Y. (Dennison & Hirons, architects) ; and the entrance to the Federal Trust building. Newark, N.J. (Dennison & Hirons, architects. George E. Jones, associate architect).

4. Care.—The material has a fairly uniform, cold, gray colour when the casting is cooled and cleaned. The usual finish procedure is to give the casting an initial coat of red lead. red oxide of iron paint. or a gray priming coat, followed by whatever final coat is desired. If there is delicate modeling which will be lost under successive coats of paint, it is recommended practice to burn off the old paint, and start off again with a priming coat, followed with a finish coat.

BIBLIOGRAPHY.—Charles ffoulkes, *Decorative Ironwork, from the XIth to the XVIIIth Centuries* (1913), excellent for historical review, illustrated by many famous examples); J. Starkie Gardner, "Ironwork, from the Earliest Times to the End of the Eighteenth Century," parts i to iii, Victoria and Albert Museum *Art Handbooks*, invaluable for a complete historical survey of all European countries) ; Gerald K. Geerlings, *Wrought Iron in Architecture* (1929), *Metal Crafts in Architecture* (1929), historical review of European countries and United States, illustrated with best known examples oi ironwork; also text on craftsmanship) ; Ernst Schwartzkopf, *Plain and Ornamental Forging* (1916).

(G. K. G.)

IRONY, a form of speech in which the real meaning is concealed or contradicted by the words used (Gr. *eironia* from *eiron,* "one who says less than he means"). It is particularly employed for the purpose of mockery or contempt.

The Greek word was used for an understatement in the nature of dissimulation. It is especially exemplified in the assumed ignorance which Socrates adopted as a method of dialectic, the Socratic irony (see SOCRATES). In tragedy. what is called tragic irony is the device of making a character use words which mean one thing to him and another to those acquainted with the real issue.

IROQUOIS. During the colonial period the Iroquois were. north of Mexico, the native American people of greatest political importance. The name has been adopted for the entire linguistic family of which they were the most conspicuous representatives.

The Iroquoian family occupied three territories, a northern, southern and southeastern. In the northern area there lived, besides the Iroquois proper, the Conestoga or Susquehanna in Pennsylvania; the Erie and Neutrals south and north of Lake Erie; the Tionontati or Tobacco nation, and the Huron (*q.v.*) in Ontario; and a series of tribes on the St. Lawrence later merged with the Huron. The southern division consisted of the Cherokee (*q.v.*); the southeastern, of the Tuscarora (*q.v.*), Nottoway and Meherrin. These tribes were all semisedentary, practised maize agriculture, lived in villages palisaded in time of need. were divided into totemic, matrilineal clans, and manifested tendencies toward the formation of fairly cohesive confederacies. in which blood lineages integrated in clans, clans in tribes and tribes in leagues. Religion was relatively simple on the ritualistic side, and somewhat interwoven with political ceremonial. Warfare was frequent and ruthless, captives being either tortured, enslaved or adopted. In all these traits the Iroquoian tribes resembled the Muskogian (*q.v.*), and differed somewhat from the Algonkin (*q.v.*), who were patrilineal, on the whole less given to farming, less developed in political sense and cohesiveness. and less aggressive in warfare though perhaps equally brave. It is therefore likely that a culture of Algonkin type. probably carried by Algonkin peoples, once prevailed uniformly over northeastern United States and eastern Canada, and that into this there intruded cultures and peoples of southeastern origin, first the Mound Builders (*q.v.*) in the Ohio valley. and later the northern Iroquoians in the region of the lower Great Lakes; the aboriginal Algonkin, however, surviving as a fringe completely surrounding these north Iroquoians. In New York, where archaeological exploration has been unusually well co-ordinated, its results confirm this view. The most notable point of difference between the northern Iroquoians and the Cherokee and Muskogi of the southeast seems to be the somewhat higher status of woman among the former.

LEAGUE OF THE IROQUOIS

The Iroquois proper of history comprise the Mohawk, Oneida, Onondaga, Cayuga and Seneca, living in this order from east to n-est in central New Tork. According to tradition. Hiawatha, a Mohawk, and Dekanamida, reputed a Huron by birth, induced the five tribes to form a league which preserved the integrity of each, but united them in a common council, and common ceremonies, with a fixed number of chiefly delegates from each tribe. In a sense this was representative democracy; and each delegate was elected; but he was chosen by the members of a lineage as representative of that lineage, and therewith of a clan and tribe, so that a group-hereditary principle prevailed. Each such clan delegate had further to be approved by the tribal and league council. There was no head of the league; and deliberate action usually became effective only upon unanimity. Apparently this league differed from other native confederacies. which were common in the eastern United States and southeastern Canada, in being more precisely defined and organized. It allowed of the development of a tradition of political sagacity independent of the occasional superior individual, and this in turn permitted the fruits of wars to be conserved instead of dissipated, with success still further strengthening the established policy.

The league in its historic form is estimated to have been constituted only a generation before the coming of the whites among the Iroquois. about 1570. During this formative period the Iroquois drove from the St. Lawrence a series of tribes who joined the Huron. In the first half of the 17th century they harried and wore down the Conestoga, their kinsmen on the south, and the Algonkin tribes on their east. Their most striking successes came about the middle of the century, after they had acquired guns in friendly trade with the Dutch. In rapid succession they attacked and broke up four Iroquoian tribal aggregations to the west of them: Huron, 1648–50; Tionontati. 1649; Neutral, 1650–51; and Erie, 1653–56. Parts of some of these nations were transplanted among the Iroquois, where they gradually became absorbed; remnants fled. scattered. joined one another or alien tribes and became lost to history. The completeness of their destruction was perhaps partly due to their habit of concentration in large palisaded towns; the more scattered Algonkin generally withstood the Iroquois longer. The Illinois suffered badly at the hands of the Iroquois. the Delaware submitted in 1720 and all Virginia was harassed. Only the distant Ojibwa set a boundary to the Iroquois conquests in the west, and the Cherokee and Catawba of North Carolina to the south. though the latter were almost worn down in the struggle. The Tuscarora, an Iroquoian tribe of North Carolina who had voluntarily moved to New York. were formally admitted into the confederacy about 1715, this being henceforth the League of Six Nations. Other tribal remnants of various origin sought shelter with them, and these, with the absorption of captives, helped to make up the Iroquois losses in constant warfare. At that, the five tribes probably never numbered more than at present, 16,000.

From the first the Iroquois were consistent and bitter enemies of the French. who had shown amity to their traditional foes. They remained in friendship and trade with first the Dutch and then the English. who utilized them against their Indian enemies and the French, whereas the Iroquois profited in firearms. other trade articles, and the sanction if not protection of civilized powers. They undoubtedly greatly hampered French extension from Canada southward: but for the consistent Iroquois check, the English colonies would have been flanked behind by the French and the history of their development might have been very different. This is a remarkable achievement for a savage people that never put into the field an army greater than 2,000 men.

When the American Revolution broke out. the league as such took no part. but most of the tribes sided with the British: and were defeated by the Americans. The Mohawk and Cayuga mainly withdrew to Ontario, many of the Onondaga and Seneca remained on reservations in western New York and part of the Oneida after a time moved to Wisconsin. The present population is considerably diluted with white blood; two-thirds are on Canadian soil, including the descendants of seceding groups won over to the French inter-st at the end of the 17th century. The league is still perpetuated as a ceremonial form. (A. L. K.)

IRRATIONAL NUMBER: see NUMBER.

IRRAWADDY or IRAWADI, the principal river of Burma, traversing the centre of the country, and running throughout its entire course in British territory. It is formed by the confluence of the Mali and N'mai rivers (usually called Mali-kha and N'mai-kha, the khn being the Kachin word for river) in 25° 45′ N.

The N'mai is the eastern branch. The definite position of its source is still uncertain, and it seems to be made up of a number of considerable streams. all rising within a short distance of each other in about 28° 30′ N. It is shown on old maps as the Lu river of Tibet; but it is now quite certain that the Tibetan Lu river is the Salween. and that the N'mai has its source or sources near the southern boundary of Tibet, to the northeast or east of the source of the Mali. At the confluence the N'mai is larger than the Mali. The general width of its channel just above the confluence is 350 or 400 yd. In the rains this channel is filled up, but in the cold weather the average breadth of the river is from 150 to 200 yd. The N'mai is practically unnavigable. The Mali is the western branch. Like the main river, it is called Nam Kiu by the Shans. It rises in the hills to the north of the Hkamti country in about 27° 50′ N. Between Hkamti (*q.v.*) and the confluence it runs in a narrow channel through continuous hills. About 1 mi. above the confluence it is 150 yd. wide in January and 17 ft. deep, with a current of $3\frac{3}{4}$ mi. per hour.

Steam launches can only ascend from Myitkyina to the confluence in the height of the rains. Native boats ascend to Laikaw or Sawan 26° 2′ N., all the year around, but can get no farther at any season. From the confluence the river flows in a southerly direction as far as Bhamo. then turns west as far as the confluence of the Kaukkwe stream, a little above Katha. where it again turns in a southerly direction as far as the great bend near Mandalay, where it is joined by the Myit-nge. Thence it follows a westerly course and is joined by the Mu stream—an important source of water for irrigation in the Shwebo district—on the north bank. Beyond Myinmu it again assumes a southerly direction and is joined by its chief tributary, the Chindwin, described below. Between the confluence and Mandalay the river varies in width from 50 to 4.000 yards. It is narrowest in the three well-known defiles. The third or upper defile lies between Myitkyina and Bhamo and is entered 3 mi. below Sinbo by a channel only about 50 yd. wide and below this, throughout the defile, it averages about 100 yd. wide.

At the "Gates of the Irrawaddy" at Poshaw two prism-shaped rocks narrow the river to 50 yd.. and the water banks up in the middle with a whirlpool on each side of the raised pathway. All navigation ceases here in the floods. The defile ends at Hpatin, and below this the river widens out to a wet-season channel of 2 mi., and a breadth in the dry season of about 1 mi. At Sinkan, below Bhamo, the second defile begins. It is not so narrow nor is the current so strong as in the third defile. The narrowest place is more than 100 yd. wide. The hills are higher, but the defile is much shorter. At Shwegu the river leaves the hills and becomes a broad stream, flowing through a wide plain. The first defile is tame compared with the others. The river merely flows between low hills or high wooded banks. The banks are covered at this point with dense vegetation, and slope down to the water's edge. Here and there are places which are almost perpendicular, but are covered with forest growth. The course of the Irrawaddy after receiving the waters of the Myit-nge opposite Sagaing, as far as 17° N. lat., is exceedingly tortuous. Below the junction of the Chindwin and Irrauaddy, the tributary streams throughout the dry belt are but small, though some, especially those in the Minbu district, are important sources of water for irrigation, and others, like the Taw river, are used for floating teak logs to the main river. At Akauktaung, where a spur of the Arakan hills ends in a cliff 300 ft. high, the river enters the delta, the hills giving place to low alluvial plains, now protected on the west by embankments. From 17° N. lat. the Irrawaddy divides and subdivides, converting the lower portion of its valley into a network

of intercommunicating tidal creeks. It reaches the sea in about 16° N. lat. by nine principal mouths. Practically no water, however, now reaches the sea through the western and eastern mouths (the Bassein and Rangoon rivers respectively) though these are the ones used by sea-going ships to reach the ports of Bassein and Rangoon.

The largest tributary of the Irrawaddy is the Chindwin, its entire course being in Burmese territory. It is called Ningthi by the Manipuris. The Chindwin is formed by the junction of the Tanai, the Tawan and the Tarôn or Turông, but it is still uncertain which is the main stream. The Tanai previously was looked on as the chief source. It rises in about 25° 30' N. and 97° E.. on the Shwedaung-gyi peak of the Kumôn range, 12 mi. N. of Mogaung, and flows due north for the first part of its course until it reaches the Hukawng valley, when it turns to the west and flows through the middle of the plain to the end of the valley proper. There it curves round to the south, passes through the Tarôn or Turông valley, takes the name of the Chindwin. and maintains a general southerly course until it enters the Irrawaddy, after flowing through the entire length of the Upper and Lower Chindwin districts.

The Tarôn, Turông or Towang river seems to be the real main source of the Chindwin. It flows into the Hukawng valley from the north, and has a swift current with a succession of rapids. Its sources are in the hills to the south of Sadiya, rising from 10,000 to 11,000 ft. above sea level — mountains that are covered at least with winter snows. Below the Hukawng valley the Chindwin is interrupted at several places by falls or transverse reefs. **At** the village of Haksa there is a fall, which necessitates transshipment from large boats to canoes. Not far below this the Uyu river comes in on the left bank at Homalin, and from this point downward the steamers of the Irrawaddy Flotilla company ply for the greater part of the year. The Uyu flows through a fertile and well-cultivated valley, and during the rainy season it is navigable for a distance of 150 mi. from its mouth by steamers of light draught.

The area of the catchment basin of the Irrawaddy is 158,000 sq.mi.; the total length of the main river from its known source to the sea is about 1,250 mi. Throughout its course, except through the defiles, it is full of islands and sandbanks; its waters are extremely muddy, the mud being deposited partly in the delta, in part being carried far out to sea. The river commences to rise in March; about June it rises rapidly, and attains its maximum height about September. The total flood discharge is between 400,000,000 and 500,000,000 metric tons of 37 cu.ft. From Rangoon up to Bhamo the river is navigable a distance of nearly 900 mi. for large steamers all the year round; but small launches and steamers with weak engines are often unable to get up the second defile in the months of July, August and September, owing to the strong current. The Irrawaddy Flotilla company's steamers go up and down several times a week, but the mails are carried to Bhamo by a ferryboat from the railway terminus at Katha.

The river Irrawaddy itself supplies no main irrigation works; the great value of the river is as a highway. It is the only means of reaching such important centres as the oilfields of Yenangyaung and Singu. which are served as yet neither by road nor railway. The Irrawaddy is nowhere bridged. though crossed by two steam ferries (at Henzada and at Sagaing) to connect the railway system on either bank. (L. D. S.)

IRREDENTISTS, an Italian patriotic and political party which was prominent in the last quarter of the 19th century. The name was formed from the words Italia irredenta — unredeemed Italy — and the party had for its object the emancipation of all Italian lands still subject to foreign (*i.e.*, Austrian, French and British) rule. The lands which they claimed as Italian were south Tirol (Trentino), Gorz, Istria, Trieste, Tessino, Nice, Corsica and Malta. The agitation was, however, mainly superficial, and sank into insignificance when the French occupation of Tunis in 1881 offended the Italians deeply, and their government entered into those relations with Austria and Germany which led to the Triple Alliance. The name "Irredentists" is also used of any other nationalist group aiming at the emancipation of any of their countrymen subject to foreign control.

IRRIGATION is the artificial application of water to land. Modern irrigation and the associated practices of drainage, fertilization, mechanization and mass production for special markets under professional management are producing a revolutionary efficiency in agriculture that, along with an attractive and profitable way of life, best guarantees food and fibre for the fast-growing population of the world.

Normally vegetation grows on soil watered by rain. Where rain is so seasonal that it does not meet the requirements of a particular crop or is deficient or practically nonexistent, the drying of the soil to an ever increasing degree retards, until it eventually prevents, vegetable growth. Irrigation can give better results than nature itself produces by fitful rainfall, because water can be given regularly just when it is needed.

This article briefly sketches the historical background of irrigation and the development of ancient and modern mechanical aids, and deals with methods of securing irrigation water, storage of water, legal title to water, principal systems of irrigation, little-used systems, drainage in relation to irrigation, irrigation practices, supplemental irrigation and a brief survey of irrigation throughout the world in the second half of the 20th century. For another method of farming with a limited natural supply of water see DRY FARMING. For additional information on irrigation projects see DAMS. See also separate articles on individual states and countries, as EGYPT; IDAHO; etc., and on rivers, as COLORADO RIVER; NILE; etc. See also GROUND WATER; HYDROLOGY; SOIL.

This article is divided into the following sections:

I. Historical Background
  1. Ancient Mechanical Aids
  2. Modern Mechanical Aids
II. Methods of Securing Irrigation Water
  1. Canals
  2. Diversion Dams
III. Storage of Water
  1. Reservoirs
  2. Natural Underground Storage
IV. Legal Title to Water
V. Principal Systems of Irrigation
  1. Basin System
  2. Perennial System
VI. Other Systems
  1. Minor Systems
  2. Subirrigation
  3. Sewage Farming
VII. Drainage
VIII. Irrigation Practices
  1. Distribution
  2. Quantity
  3. Measurement
  4. Applying the Water
  5. Surface Irrigation
  6. Sprinkler Irrigation
  7. When and How Much to Irrigate
  8. Fertilization
IX. Supplemental Irrigation
  1. Optimum Plant Growth
X. Irrigation Throughout the World
  1. World Survey
  2. United States

I. HISTORICAL BACKGROUND

The use of irrigation as an aid to the growth of vegetation is an ancient art. (See AGRICULTURE, PRIMITIVE.) The probabilities seem to point to Egypt as its place of origin. The paintings and sculptures of ancient Egypt show that the peasantry bailed up water at least 4,000 years ago, and there is evidence of earlier irrigation there and in other parts of the ancient world which strengthens the belief that irrigation preceded, and made possible, the development of ancient civilization. Reliance was not placed entirely on direct labour; mechanical aids were invoked, and such machines as the shaduf, the sakia and Archimedes' screw were invented.

1. Ancient Mechanical Aids. — The simplest device for lifting water consists of a long tapering and nearly horizontal pole supported on a horizontal crossbeam some eight feet or ten feet above the ground. A skin or bucket is hung on a rope from the longer

and thinner end and a counterbalance placed on the shorter and thicker end. The worker pulls down on the rope to fill the bucket, after which the counterbalanced end drops and raises the bucket of water to his hand where it is emptied. Each of these devices can irrigate about two acres and two or more of them can be placed one above another for the higher lifts. In Egypt this is called a shaduf or shadoof, while in India the name is *denkli* or paecottah.

The Egyptian sakia (called a *harat* or Persian wheel in India) is operated by oxen. It is so arranged that a vertical wheel turns continuously. Two parallel endless ropes pass over the wheel and are attached to buckets spaced a short distance apart. While half the buckets are descending and filling, the other half are rising full of water. At the top they tilt automatically into a prepared channel leading to the field. Each machine can irrigate from 5 ac. to 12 ac., depending on the height of the lift.

The most ingenious of these old devices is the Archimedes' screw which was invented about 200 B.C. in Syracuse. A corkscrew-shaped tube is placed in or around a wooden cylinder some one or two feet in diameter. One end of this 10- to 15-ft. cylinder is under water and the other end rises about 3 ft. to the bank where water is discharged as the cylinder is rotated by hand. Knowledge of these mechanical aids probably spread to other ancient empires. All are still in constant use.

2. *Modern Mechanical* **Aids.**—Not until the era of steam, the internal-combustion engine and electricity, which brought with it the power to drive pumping plants of all kinds, was human and animal life relieved of almost all the duty of directly lifting water onto the soil. Irrigation makes use of such pumping plants in all sizes, ranging from one- or two-horsepower engines up to huge installations whose power is measured in thousands of horsepower and which are capable of dealing with great volumes of water.

Electric motors are now generally used for the larger pumping plants, diesel engines for those of moderate size and gasoline or liquid petroleum gas engines for smaller plants. Portable plants are available for areas up to several hundred acres. Usually the power and pump are directly connected in a single unit. Centrifugal pumps are preferred for lifting from open water while turbine pumps are used in wells of a few feet to hundreds of feet in depth. The axial-flow or propeller pump that was developed in New Orleans, La., for drainage of that city, is best for lifting large volumes of water through low heads or differences in elevation. Each power plant and pump is designed by hydraulic engineers especially for the work which it is to accomplish.

An important mechanical development after World War II was the use of 20- to 40-ft. lengths of lightweight portable aluminum pipe with special couplings which permit the pipe to be quickly assembled, dismantled and moved to a new location on the surface of the ground. This is especially useful in portable irrigation systems where the pipe is laid quickly over the ground, then dismantled and moved to another tract of land by one or two men, thus minimizing the investment necessary.

II. METHODS OF SECURING IRRIGATION WATER

Much irrigation water is pumped from ponds, reservoirs, lakes, streams, canals, pits and wells, occasionally as high as several hundred feet for valuable crops. The more abundant and cheaper water supplies are found in the larger streams and usually are obtained therefrom without pumping by diversion dams. Often these structures raise the level of the water in the river and sometimes provide storage. From them, canals and many other types of structures convey and distribute the water over the land.

1. Canals.—Man was not satisfied with his efforts to supply water to the fields and early saw that he could assist nature by taking nater from a river at a point higher upstream than the point immediately opposite his onn particular field, and thus take advantage of the difference of level betneen these two points, or the fall of the river. Take the case of the fall of a river being only 12 in. in one mile—as is not unusual. As some slope must be given to the water in a canal to make it flow, and if this is, say, six inches in one mile, the canal water will stand higher by six inches at the end of each mile of length than the river opposite to it. Obviously, therefore, if there is much difference between the level of the land that is to be irrigated and the water surface in the river at the point where the water is led into a canal, the latter, to be effective, must take off many miles upstream of the areas it is intended to serve.

2. *Diversion Dams.*— That the use of diversion dams (also called weirs or barrages) as an aid to heightening water level is old there is no doubt, yet only in modern times has the idea been used to any great extent. These structures are built across a river so that a higher level can be produced on the upstream side of the dam simply by closing sufficiently the sluices, or gates, placed in them. This enables the water floning at the higher level to irrigate the land much nearer the headuorks of the canals taking off from either bank. Thus these structures, like the canal already mentioned, are devices for doing, almost forever without any further labour than adjusting the sluices. what hitherto had to be done, laboriously and expensively, by the aid of manual or mechanical work.

When these structures are necessary in those parts of a river's course where there is no other foundation than sand or silt, water is seldom raised more than ten ft. Whatever heading up of the waters is necessary, it should avoid reducing the silt-carrying power of the river.

III. STORAGE OF WATER

1. Reservoirs.— At an early stage man must have realized the advantage of storing water against periods of shortage, as rivers and wells run low at times even if they do not run dry. At what date reservoirs first came into use as an additional aid to a regular supply is unknown; the remains of ancient reservoirs throughout the world, however, testify to the antiquity of the idea.

The earliest form was probably the earthen embanked reservoir, or tank, as it is called in India. The tank suffers from the disadvantage of retaining all the silt contained in the water stored in it. In time this leads to practical obliteration and a new tank has to be constructed elsewhere. Reservoirs with masonry dams were also built. These, too, became filled with silt, and not until modern times, and until the Periyar dam was built in India (1895) with sufficient sluiceway near its base to pass all the floodwaters and arrest only the later clean supply, was the problem tnet and a reservoir constructed which, in a silty river area, could be depended upon to keep itself clear of detritus. A magnificent example is the dam at Aswan, on the Nile in Egypt (1902–33), where the whole of the heavy flood passes through the structure without dropping any of its silt content and only clear water is stored. Thus a nearly perpetual life is guaranteed to the reservoir.

When dams are built in rivers where relatively little silt is carried, little provision for passing silt is made since it is anticipated that the reservoir will fill with silt only after a long time; then another storage dam will be built farther upstream. The original storage will be lost, but the difference in water level above and below the old dam will remain available for hydroelectric power.

In modern practice, storage reservoirs are often created by multipurpose dams that will make the water available for municipal supply, hydroelectric power, industry, irrigation and navigation while also giving protection against floods. Silt and polution control, fish and wildlife protection and recreation often are important by-products. A series of these dams on a stream and its tributaries often provides comprehensive, integrated, basin-wide development. In a few cases, water is stored in one drainage basin, or natershed, and conveyed for use into another. Seven of the world's eight greatest surface reservoirs are in the U.S. *See also* DAMS; RESERVOIRS.

2. *Natural Underground Storage.*— Throughout the ages man has availed himself of a small part of the enormous supplies (exceeding those of all reservoirs and lakes, including the Great Lakes) of underground water, often called ground water (q.v.). Most of this water has accumulated over long geological ages, but some is replaced by current rainfall as used Heavy pumping reduces the permanent supply and lowers the water table, or level of the water, in the ground, and both of these effects make pumping increasingly expensive, a condition already serious by the second half of the 20th century in the southaestern United States and

elsewhere.

Perhaps the largest and cheapest supplies of ground water for irrigation are found in humid deltas and coastal plains where the water is not too salty. There the heavy rainfall maintains a relatively inexhaustible underground supply and large river flows also are available. See also HYDROLOGY.

IV. LEGAL TITLE TO WATER

Population increases were accompanied by an alarming growth in the variety of industrial and other water uses in the second half of the 20th century. It appeared that availability of adequate water would largely determine where civilizations would develop.

The right to use specific supplies of water for irrigation and other purposes has caused militant and legal action throughout history. While these contests for water rights (*q.v.*) continued between nations, states, cities. industry, agriculture and individuals, in the 20th century resort to force was rare. The respective claims were customarily settled through the considerable body of applicable law and by negotiation.

Priority of appropriation and use may be advantageous. However, the trend of settlements is toward giving less weight to priority and to the English common-law principle of riparian rights, which entitled owners of land adjoining a defined natural watercourse to a reasonably undiminished and unpolluted flow but made little provision for irrigation; and toward giving predominant weight to the principle of beneficial use for the many.

Water is scarce in the western U.S. and serious difficulties have arisen regarding water rights. The arid states, however, enacted comprehensive statutes which enabled most disputes to be adjudicated satisfactorily. In the more humid eastern U.S. the growing use and scarcity of water increasingly drew attention to the urgent need for legislation defining rights to use both surface and underground waters. In the more acute situations, inventories of available water and of the community uses for it were made as a first step toward the complicated public relations, educational efforts and legislation that were needed. In any event, the prospective irrigator should consult competent local authorities and assure himself of a reasonably permanent right to the use of water before undertaking expensive irrigation.

V. PRINCIPAL SYSTEMS OF IRRIGATION

1. Basin System.—There are two main forms of irrigation. In the more primitive and inexpensive system the area to be served is surrounded by embankments, and is thus called a basin; into this a canal leads the waters from the river until a depth of three or four feet is attained. Many of these basins were of great size, the largest covering as much as 60,000 ac. The water is run off after a time and the exposed area is sown with crops which need no further watering to bring them to maturity. The system obviously originated in the fact that a river can be easily made to give a supply once a year during its flood period, whereas enormous expense would be required to make it do so at other times. It happens, also, that the production of food crops follows the flood season in many rivers; the system devised, therefore, was one which took advantage of a river's flood season.

Fig. 1, representing a basin system in upper Egypt, will serve to explain this system of irrigation, the firm lines representing canals, the broken lines embankments along the river and between basins. It will be seen, beginning on the east or right bank of the river (top of fig. 1), that a high-level canal flowing, like the river, to the north, from an upper system divides into two. The right branch waters all the desert slopes within its reach. The left branch passes, by a structure, under the main canal of the system, taken from the river close at hand (and therefore at a lower level: see Canals, above). This left branch irrigates the high strip of land bordering on the river. In years of very favourable flood, this high-level canal may not be wanted at all; irrigation could be done from the main canal with the great advantage that the main canal water would carry with it much more silt than would be carried from the tail end of the high-level canal which took off the river perhaps 25 mi. farther upstream. The main canal flows freely over the areas C and D and, if the flood is good, over B and a part of

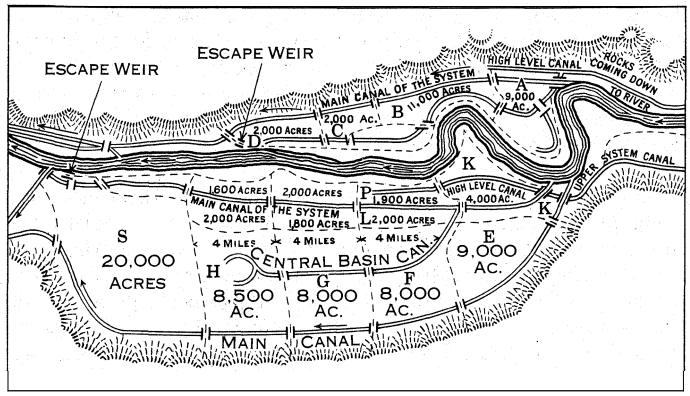


FIG. 1.—MAP OF A BASIN SYSTEM OF IRRIGATION
A, B, C, D, flat lands irrigated by the main canal
E, K, P, L, large basins irrigated by the high-level canal
F, G, H, S, basins irrigated by the central basin canal

A. It is carried around the next desert point, and to the north becomes the high-level canal. The masonry works required for this system are a structure to pass the high-level under the main canal near its head, bridges fitted with sluices where each canal passes through an embankment and an escape weir at the tail of the system to return the water to the river. The left (west) bank is similarly watered.

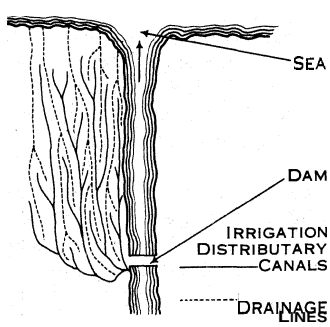
2. Perennial System.—The other modern and expensive system, where a perennial supply of water is made use of, is also fed by canals, but in this case the canal system is enormously developed compared with that of the basin system. In the latter, one canal only may be required to feed many basins by running through the higher-level basins and terminating at the middle of the last one of the series. In the perennial system, branch canals lead off from the main canal, lesser branches lead off from the main branches, and so on in ever decreasing size until as a last branch the smallest runlet is reached. The cost of this canalization is great, but the returns are correspondingly valuable. and usually about two crops can be grown each year instead of the single crop possible with basin irrigation.

Fig. 2 shows a perennial canal system. Only the main canals and principal branches are shown. The main canal may extend over any distance up to 200 mi. or even more. This plan also shows how efficient drainage is provided between the canals. A more detailed canalization from the branches is shown in fig. 3.

VI. OTHER SYSTEMS

1. Minor Systems.—Dating from Roman times, water meadows in England have been flooded in the wettest and coldest times of the year so that the warmer water might be used as a protection against frost. Warping is an old English practice of flooding land so that the suspended silt may be deposited to form a new topsoil on which crops will be grown under rainfall only.

2. Subirrigation.—In a few localities water is applied laterally and upward from ditches, drains or pipes located below the surface of the ground. It may result naturally or be installed artificially.



BY COURTESY OF THE U.S. BUREAU OF RECLAMATION

FIG. 2.—DIAGRAM SHOWING IRRIGATION PROPERLY COMBINED WITH DRAINAGE

3. Sewage Farming.—Many towns situated in inland districts, instead of passing their sewage into the nearest stream, deal with it by means of modern settling tank systems, from which the effluent is run off into small canals which irrigate suitable cultivable areas. The yield of crop produced is great, as such waters contain a very high percentage of nitrogenous matter. The drainage of Cairo, Egy., for instance, is said to be 30 times as valuable as the equivalent of Nile water, even in flood time when

the latter bears its fertilizing silt. Sewage irrigation is not commonly practised in the U.S.

VII. DRAINAGE

A necessary concomitant to irrigation is drainage of the soil. In few areas does nature provide it adequately without artificial aid. Poor drainage, resulting in excessive salts in the soils, popularly called alkali, has reduced yields in the arid western areas of the U.S. by some 20% and has occasionally caused abandonment of the land as was often true in ancient countries of the middle and far east. Heavy rainfall in parts of the eastern U.S. and elsewhere causes other difficulties.

For many years the supply of irrigation water was the only problem effectively considered by engineers; the disastrous results which followed in many, if not all, cases from a neglect of the provision of adequate drainage, however, awakened everyone to the necessity of supplying it if optimum moisture control was to be attained, and if fields were to continue fertile in order to raise maximum crops and to utilize longer grouing seasons.

Land may be smoothed with proper slopes and ditched so as to remove excess water before it enters the soil and thus prevent erosion, leaching of nutrients and standing pools of water on the surface, and to permit early spring planting. If carefully planned, this smoothing also can prepare the land for surface irrigation, thus serving two purposes by one earth-moving operation. After excess water enters the soil, its removal is an expensive and specialized undertaking that is not directly connected with irrigation, although it sometimes may be necessary for irrigated land. (See also LAND RECLAMATION.)

Much of the more promising surface irrigation occurs in humid or semihumid regions where it can be combined with drainage, usually in broad river valleys, alluvial deltas and coastal plains. Huge areas in these regions-await this type of development which, for example, has begun in the 20,000,000 ac. along the lower Mississippi river where the poorly distributed annual rainfall averages 50 in. Here combined ditching and leveling with heavy grading equipment is little more expensive than for irrigation alone, water supplies are cheap and relatively inexhaustible, expensive flood control and main drainage systems are already installed, the country is settled and large acreages are held under single ownerships that simplify organization, professional management and low-cost mass production under mechanization.

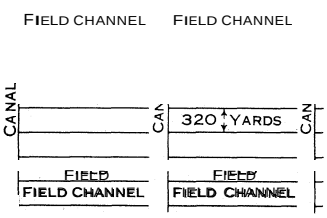


FIG. 3.—PLAN OF FIELD CHANNEL IRRIGATION

VIII. IRRIGATION PRACTICES

1. Distribution.— Where irrigation is carried on throughout much of the year, as in the perennial system, proper water distribution becomes a most important operation. It is often considered sufficient if during any one season two-thirds of the area commanded is actually supplied with water. This encourages that rotation of crops which seems to be a necessity of good farming, and also the lying fallow for a time of some part of the soil, which also appears to be a necessity in all countries during a portion of each year. Some crops, of course, require water much more often than others; much depends on the temperature at the time of irrigation; and seasons vary from year to year and from place to place. During the winter months in northern India magnificent wheat crops can be produced which have to be watered only two or three times. But to keep sugar cane, indigo or cotton alive in summer before the monsoon begins in India, or the Nile rises in Egypt, the fields should be watered at least once every 15 days, while rice requires an almost constant supply of water. Several irrigations per season are required over much of the U.S.

2. Quantity.— Even if the crops grown under irrigation were in each case identical, in different countries and at different seasons the conditions are so variable as to preclude a statement of volumes of water which would be applicable everywhere. The depth of water applied varies with its purpose, with the climate, season, soil, subsoil, drainage, crop and other factors. Usually, from 2 to 6 in. in depth of water may be given at every one of the several times of watering under the perennial system, whereas the one watering of the basin system may take 30 to 50 in.

Seasonal net requirements of delivered water in the U.S. average from 1 ft. in depth where the effective rainfall is more than 12 in. during the crop-growing season, to as high as 3 ft. where the annual precipitation is less than 10 in., the season long and temperature high.

3. Measurement.— Various devices have been perfected for accurately measuring the amount of water flowing past a particular point. The rate of flow is usually measured in cubic feet per second (second foot) and the volume in acre feet, that is, one acre foot being the volume equal to 43.560 cu.ft. required to cover one acre with water one foot deep. A flow of one cubic foot per second will furnish nearly two acre feet in 24 hours.

By measuring the water, analogously to measuring household water by a meter, it is possible to divide the water equitably among users, charge for the amount delivered and thus conserve scarce and valuable water. Measurement of the volume delivered also enables the irrigator to compute the depth of water that he is applying, a vital fact in attaining maximum production. Only by applying the right amount at the right time can optimum results be secured; otherwise irrigation may be ineffective or even harmful.

4. Applying the Water.— A proper control of irrigating water can save hard and expensive physical labour, assure uniform and satisfactory results and improve the yield as much as 100% over inefficient methods. Uncontrolled streams of water cause erosion, inefficiency, waste and uneven distribution and they may even create expensive damage claims. Makeshift devices and procedures may be worse than useless and expert advice is essential. Water is applied to land by flowing it over the surface or by sprinkling from pipes, either method being satisfactory if properly planned and used. The newer sprinkling method predominates in the eastern U.S. and the older surface method in the west.

Experience indicates that a plan for irrigating any field should be chosen so that it will be suitable for different crops, both because of the desirability of rotation and because other crops may become more profitable.

5. Surface Irrigation.— Where topography and soil are favourable, where skilled irrigators are obtainable, where pumping is unnecessary, where surface drainage would be helpful and where labour and farm equipment are more available than cash, or where many of these conditions exist, surface irrigation may be preferable. Small canals, ditches, flumes or pipes convey the water to the field

In order that water may flow uniformly and easily over the land, the surface must be reshaped to a suitable slope, only rarely made level. This leveling removes such humps and hollows as would interfere with the flow of water and improves the slope. The type and amount of leveling required is dependent upon the topography, depth and quality of soil, crops to be raised, method of irrigation to be employed, and flow of water available. A ground surface free of irregularities permits even distribution of water to the land and crop, a resultant saving in water and labour, and a uniform crop yield. Yields are increased, sometimes as much as 50% to 100%, as a result of leveling. Initial light leveling will nearly always pay in facilitating the distribution of the water in the fields, and usually initial heavy leveling will be advisable, especially for reducing costs on large acreages and where surface drainage is desirable. Efficient equipment is generally available for both light and heavy leveling.

Irrigation water is usually made to flow over the ground through furroms, small ditches or runlets sloping downward between rows of plants; corrugations, which are smaller and closer furrows through closely cultivated plants; flooding, where a shallow sheet of water is confined by small dikes or levees within sloping border strips, contour strips or level basins as it advances over the land; and, less satisfactorily, through wild flooding manually out of ditches without benefit of land preparation and water control as

just described. Other surface methods are used occasionally.

6. Sprinkler Irrigation. — For those not skilled in irrigation and where drainage is unnecessary, overhead sprinkling from pressure pipes. usually with revolving sprinklers and under engineering direction, offers the surest method of applying water. It may be used on most topography without leveling and without experienced irrigators and, where pumping would be necessary in any event, it may well be the best method. Sprinkling is widely and increasingly used under engineering direction.

7. When and How **Much** to Irrigate. — There are both practical and theoretical approaches to this question and, in addition, judgment must be developed through local experiment and experience. To get the full value and the best yields from irrigation. the moisture content in the soil must usually be kept well above the wilting point and slightly under the storage capacity of the soil in the root zone. When a crop wilts. irreparable damage usually has occurred. On the other hand: too much water can leach the plant nutrients from the soil, keep air out of the soil and cause erosion. In the latter 1950s studies, described later, were under way to determine the optimum soil-moisture content for specific crops at various stages of growth; they indicate that much better crop yields may become possible under carefully-controlled optimum moisture conditions.

8. Fertilization. — Of the many factors controlling plant growth. two limit growth more often than all of the others combined. namely, (1) a lack of adequate moisture control and (2) a lack of ample amounts of the so-called plant foods or plant nutrients. Through irrigation and drainage, farmers can deal satisfactorily with the moisture problem. By the addition of fertilizer (see FERTILIZERS ASD MANURES), often applied in the irrigation water, they can supply plant foods without which crop production would be limited. This combined use of irrigation, drainage and fertilizer opens up a new frontier for agriculture. Together they present one of the great advances of modern times for growing more and better crops without expanding acreage.

IX. SUPPLEMENTAL IRRIGATION

The older irrigation in the United States was generally developed before the middle of the 20th century by groups of farmers on large projects that by the late 1950s totaled about 28,000,000 ac. west of the 100° meridian which runs north and south through the centres of the Dakotas, Nebraska and Texas and through the western ends of Kansas and Oklahoma. There the annual rainfall of from ½ in. to 20 in. is very light during the growing season and heavy irrigation is essential.

On the other hand, supplemental irrigation has been practised mainly since mid-century by individual farmers on much smaller projects totaling by the late 1950s 3,000,000 ac. east of the 100° meridian. There the normal annual rainfall of between 20 in. and 50 in. is fairly adequate during the growing season and only light irrigation is required, although that small amount produces large returns. Seldom was water added artificially before 1950 except to a limited extent on lawns, golf courses, gardens. rice fields and horticultural crops. However, from 1950 to 1960 in the U.S. about as many acres were brought under eastern supplemental irrigation as were added to the larger and older western total irrigation; moreover, more irrigable land is available in the east than in the west.

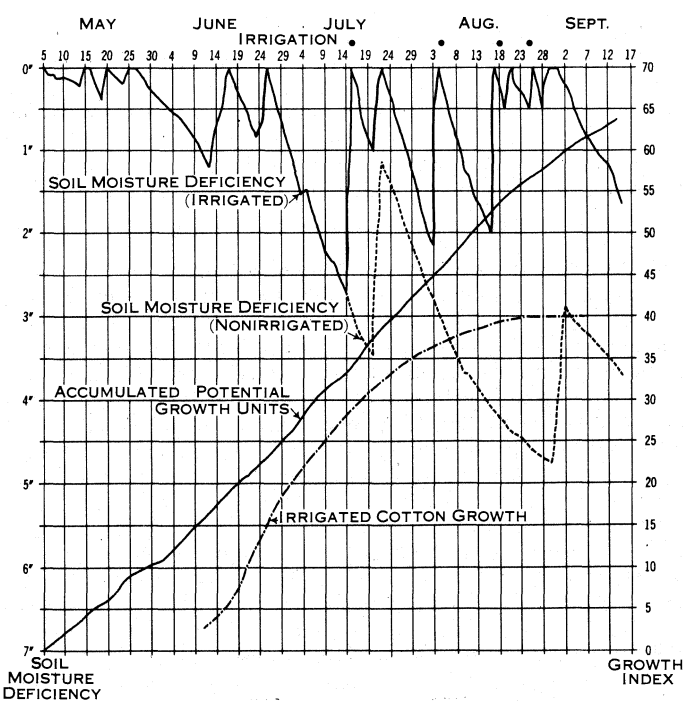
As efficient and expensive agriculture developed and as disastrous droughts afflicted much of the humid and semihumid eastern U.S in the 1950s, this region turned to supplemental irrigation mainly as insurance against droughts. It soon became apparent that added water also increased crop yields in most years, not only during obvious droughts in very bad years, and that even abundant annual rainfall seldom provided enough moisture at all of the times that it was needed. Next it was realized that maximum yields resulted only when the highest type of crop culture was combined with adequate water in the root zone of the soil reservoir at the right time in the growth schedule. Doubling of yields or a return of 100% on the annual cost of supplemental irrigation was not uncommon and it appeared that even larger returns might be anticipated as practices improved. Since supplemental irrigation is expensive in both first cost and operating cost, and since it is quite different from ordinary farming, it must be undertaken and conducted under expert advice. Only when it is accompanied by every modern aid to better agriculture will the best yields be obtained.

1. **Optimum** Plant Growth. — Studies in the nearly forgotten science of phenology, the relation of climate to the growth of plants. were undertaken by C. W. Thornthwaite and others having as their first objective the scientific scheduling of supplemental irrigation and of the crops grown thereunder. Unless supplemental irrigation is applied at the right time and in the right amounts to maintain optimum soil-moisture conditions, it is not only wasted but it may actually be harmful, and crop scheduling is essential to efficient production. Scientific supplemental irrigation requires that both of these practices be utilized. With optimum moisture, scheduling and nutrients provided, actual crop growth can be measured daily and necessary remedial action taken immediately. before permanent injury has occurred. to keep that growth up to its climatic and economic potential, with resulting yields that have seldom been attained in the past.

Fig. 4 shows an actual case relating growth to its potential under an optimum level of soil moisture. a relationship possible only where irrigation is available whenever needed as. for example, under individual pumping. Where canal water is delivered by rotation many days apart and in sufficient quantity to fill a badly depleted soil reservoir. as is often the case in the arid west, it may not be possible to maintain the optimum level.

The solid upper curve shows the soil moisture deficiency in the root zone nhen irrigation is used, and the dotted upper curve shows the deficiency as it would be without irrigation. all plotted downward on the left-hand scale. In this locality the heavy rainfall of 50 in annually frequently filled the soil reservoir to 0 on the scale. Irrigation was used only four times as shown by the solid dots at the top.

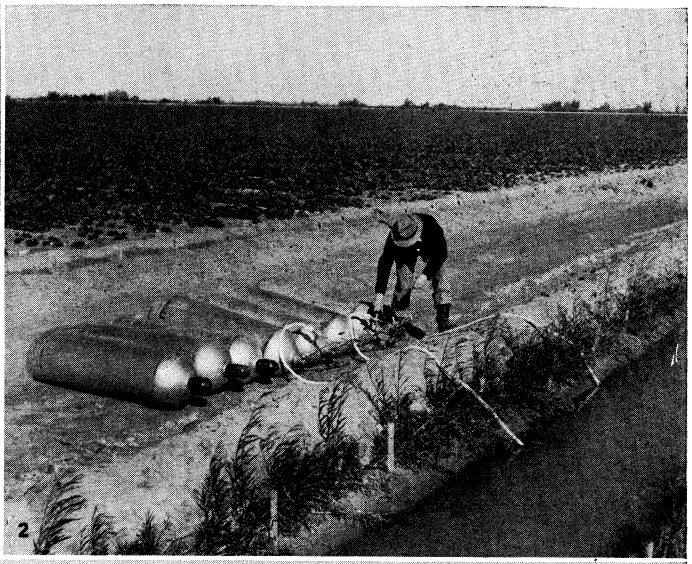
The solid line running upward to the right shows potential growth in this locality, and the dashed lower curve plots the actual measured daily gronth of the cotton plants. all plotted upward on the right-hand scale. When actual growth as plotted on this dashed curve began to drop away from potential growth to-

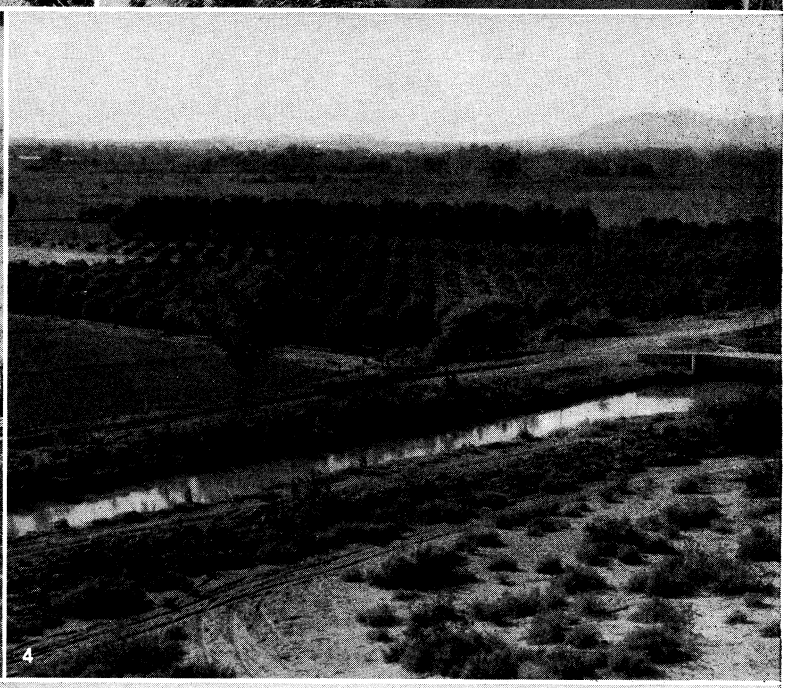


REPRINTED FROM THE JOURNAL OF THE IRRIGATION AND DRAINAGE DIVISION, PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, PROC. PAPER 1253, VOL. 83, IR 1, MAY 1957

FIG. 4.— ABOVE: SOIL MOISTURE DEFICIENCY IN THE SOIL OF THE ROOT ZONE. BELOW: ACCUMULATED POTENTIAL GROWTH UNITS AND THE ACTUAL GROWTH OF IRRIGATED COTTON. DATES AT WHICH IRRIGATION WAS APPLIED ARE INDICATED BY THE BLACK DOTS AT THE TOP OF THE CHART

IRRIGATION



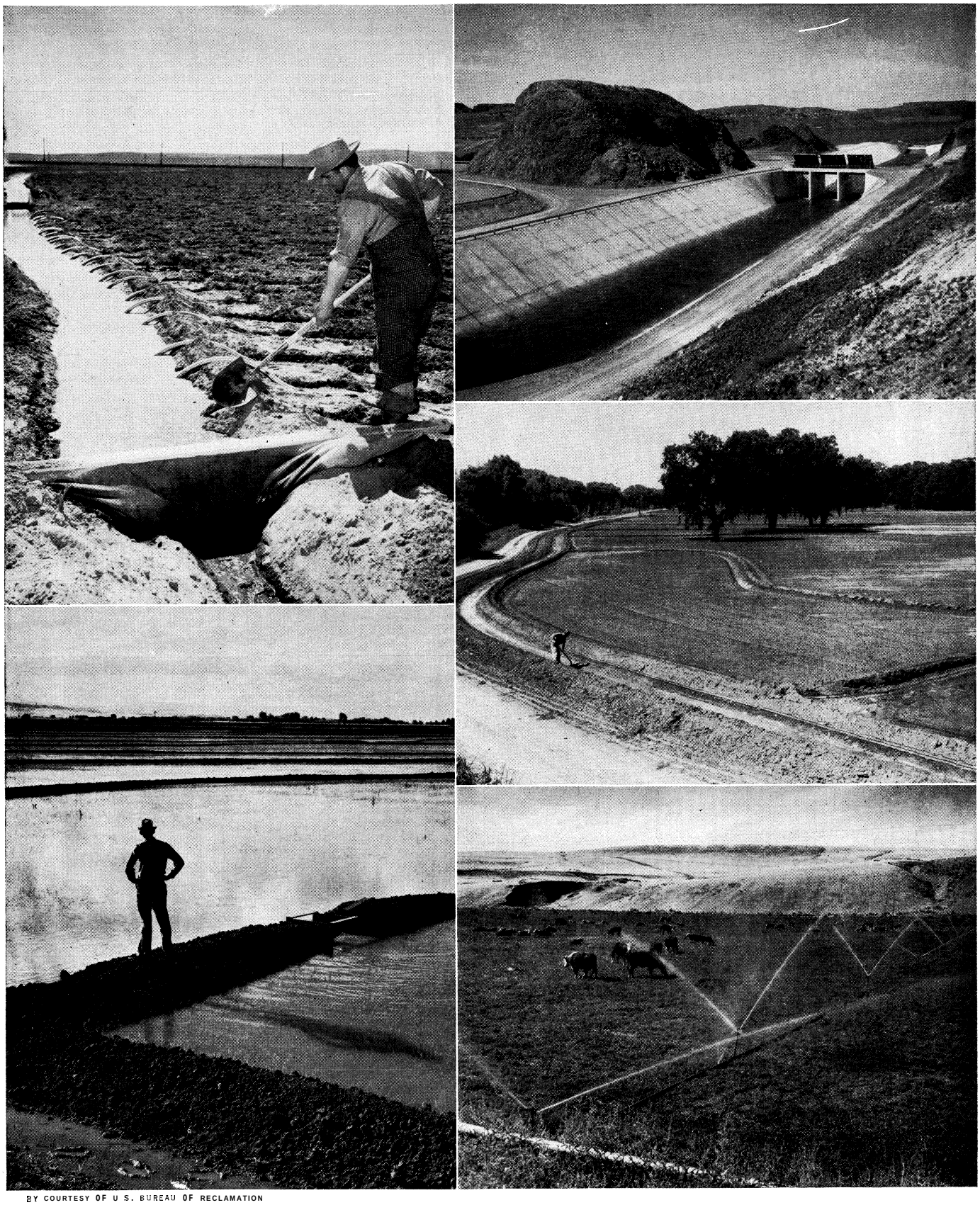


BY COURTESY OF (1-5) BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR; PHOTOGRAPH, (6) EWING GALLOWAY

IRRIGATION PROJECTS

1. Row crop irrigation. Small wooden tubes, called spiles, lead the water from the farm header ditch into the furrows. The mouth of each tube extends into the header ditch several inches, and the flow is regulated by driving a lath vertically against it and moving the lath sideways to open or close the opening
2. Nitrogen, in the form of ammonia. being fed from tanks directly into irrigation water for a lettuce field in California
3. Turning water from a lateral ditch into a farm ditch on the Salt River project, Arizona
4. An irrigation canal of the Yuma project, Arizona, with rich, productive land on the side that has been irrigated and raw desert land on the other side, which has not yet received water from the canal
5. The All-American canal, which serves the Imperial valley, California, with Colorado river water diverted and desilted at imperial dam
6. Sakiahs (irrigation wheels) above Asyut, Egypt, which provide water for the fields of rice and sugar cane

IRRIGATION



BY COURTESY OF U S. BUREAU OF RECLAMATION

IRRIGATION IN WESTERN U.S. STATES

Top left: Surface irrigation by furrows. Columbia basin project, Washington

Top right: Control structure in a feeder canal. Columbia basin project

Centre right: Land leveled and ditched for surface irrigation. Central valley project, California

Bottom left: Irrigated rice fields. Sacramento valley, California

Bottom right: Sprinkler irrigation in a cattle pasture. Columbia basin project

ward the end of July, remedial action should have been taken by irrigating, fertilizing. weeding, pest control or whatever appeared to be necessary. The curves are plotted daily to show nhen remedial action is necessary, usually several weeks before it becomes apparent on the plants.

The upward potential growth curve and the downward parts of the soil moisture deficiency curve are computed and plotted from evapo-transpiration, which is the moisture being used by the plants and being evaporated into the atmosphere (see DROUGHT).

X. IRRIGATION THROUGHOUT THE WORLD

1. World Survey. — As the second half of the 20th century was well under way. the total irrigated acreage of the world had nearly tripled since 1900. The largest acreages were credited to China, India, the United States. the U.S.S.R and Pakistan. The total for all countries was about 320,000,000 ac., as compared with a total of about 110,000,000 ac in 1900.

A general idea of the nature and expansion of modern irrigation and associated water control throughout the world was indicated by a few of the plans and accomplishments in the late 1950s. The government of Communist China announced readiness to start construction on the first and largest of the 46 dams projected to control the floods of the Yellow river. produce electric power far in excess of the previous total and greatly increase the irrigated acreage. Taiwan (Formosa) and South Korea were modernizing and increasing their irrigated land area by several per cent annually. There. and throughout much of the far east, large rice acreages limited to one crop annually would be able to grow two crops annually when additions to their water supply were secured. India completed Hirakud dam on the Mahandi river in the state of Orissa (1957), creating a storage capacity of more than 6 000,000 acre feet and permitting the eventual irrigation of some 670,000 ac. The project, entirely an Indian engineering effort. was begun in 1948. In Pakistan, construction was well along on the Warsak dam. planned to generate 240.000 kw. of electricity and effect the irrigation of 120,000 ac. Spain's effort to restore productivity to the Guadiana river valley and provide electricity for Madrid had brought about the irrigation of some 33,000 ac. of an expected ultimate 300,000 ac. Work was also started to use the Ebro river for the early irrigation of about 250,000 ac. and eventual service to 2,500,000 ac. Australia opened the Eildon reservoir to create an irrigation storage capacity of 2,750,000 acre feet of water near the source of the Goulburn river in the province of Victoria. Venezuela completed the nine-mile long earth dam on the Guarico river, expected to bring about the irrigation of 272,000 ac. of pasture and forage land.

In Italy. the Flumendosa project was planned to effect the irrigation of 123,joo ac in the Campidano di Cagliari, a plain in southwestern Sardinia, by three dams on the Flumendosa river and its tributaries. with connecting tunnels and irrigation distributaries. The most important feature of a four-year program in Japan was the proposed irrigation of 42.000 ac already under paddy and 40.000 upland acres in the Aichi region on the island of Honshu. This was reported as the nation's first attempt to irrigate ridge lands. Among the several objectives of the Bhumiphol project in Thailand was the provision of additional water for the irrigation of more than 2,000,000 ac. in the area served by a large new system in the Chao Phraya river basin.

Both total and supplemental irrigation are being rapidly extended and improved by governments throughout the world in a scientific manner that will ensure greatly increased crop yields by modern procedures.

See also articles on various countries.

2. United States. — Perhaps the most efficient development of irrigation may be found and studied in the United States. In a single year of the late 1950s, the United States bureau of reclamation announced a construction program that, upon completion. would provide water for 150,000 ac. not previously irrigated and additional supplies for 94,000 ac. Contracts were let for the construction of main features of Glen canyon dam, major structure of the comprehensive upper Colorado river basin storage project, and for Trinity dam in the expanding Central valley project of California. That state started construction of Oroville dam. initial and key unit of the Feather river project, which was planned to serve extensive areas in central and southern California hundreds of miles distant. Beyond the foregoing western expansion, and in the same year, the United States soil conservation service helped to place a comparable acreage under supplemental irrigation in eastern U.S.

Relatively small areas in the southwestern portion of the country were irrigated in prehistoric times. The customs and methods used were improved by the Spanish conquerors and their descendants. Modern irrigation in the U.S. west began with the arrival of the Mormons in Utah in 1847 and increased to about 31,000,000 ac. early in the second half of the 20th century. Taking into consideration the available land and the availability of water supplies of reasonable cost, it was estimated that some 20,000,000 ac. more of western land could be developed by irrigation and perhaps another inadequately supplied 10,000,000 ac. could be furnished with additional water. In the humid eastern U.S. it was felt that an equally large acreage might be brought under supplemental irrigation, as described above.

Irrigation development in the United States followed a natural course concurrent and interwoven with the settlement and development of the west. The first works were simple ditches built by the settlers for diverting water from streams to easily reached farm lands in the valleys near by. These settlers mere not financially able to build costly works and common practice involved the use of mood and temporary structures.

In course of time, however, many land and water corporations were formed. with the aid of invested capital, for the purpose of exploiting the agricultural resources of the west. There followed legislative action by the states to enlarge the powers of farmers' organizations, enabling them to bond their land and raise funds for building, purchasing and reconstructing irrigation systems. In 1902 congress passed the Reclamation act by which the federal government became an active participant in irrigation work. These agencies employed experienced engineers and designed and constructed more extensive and permanent irrigation works. The work of building new systems and remodeling and reconstructing existing enterprises continued. and the makeshifts of earlier periods were generally replaced by substantial structures of concrete and steel.

A degree of efficiency and permanence was attained in irrigation systems comparing favourably with those of any other country. The original Reclamation act was revised and greatly enlarged in scope and under it the U.S. reclamation service and its successor, the bureau of reclamation (est. 1924), built many of the world's largest irrigation structures. It investigated and planned a comprehensive development of all the available water resources of the western states for their optimum utilization for irrigation and related purposes in large integrated basin-wide projects involving many large storage reservoirs, transmountain diversions, etc. In co-operation with the U S. army corps of engineers. it continued to investigate and report on the comprehensive use of water resources for the arid west and to aid in construction and operation. The U.S. soil conservation service promoted irrigation in the humid east.

The United States was believed to rank first in the number. dimensions and permanency of its dams for storage of irrigation water; in the efficiency of mechanical equipment used to pump and control nater for irrigation; in the efficiency of works to convey water to and distribute it on farms; and in scientific agricultural applications.

Chemical and agricultural science, mechanization, agricultural education and mass production for special markets under professional management combined to bring about a very efficient agriculture which was correspondingly expensive; while governmental aids tended to support prices at only modest levels, if at all. Under these conditions farmers seldom can afford to spend the larger production costs without having adequate, even if expensive, irrigation water to assure a good crop.

The necessity of these expensive aids ior profitable modern agriculture established a trend toward increased acreage under a

single management in order to secure low-cost agricultural mass production analogous to large-unit industrial mass production. Costly irrigation and drainage accentuated this trend and made it increasingly difficult for the traditional small family farm unit of the U.S. to furnish a satisfactory living for the family. There were, indeed, exceptions under special conditions, when a single-family farm unit might be very efficient. Various types of farm organization were being studied with a view to increasing the acreage irrigated under a single management. Historically, irrigation has always forced individuals to organize into larger groups with larger investments and better management. It continued to play this important role.

BIBLIOGRAPHY.—E. H. Carrier, *The Thirsty Earth* (1928); Orson W. Israelsen, *Irrigation Principles and Practices,* 2nd ed. (1950); U.S. Bureau of Reclamation, *Irrigation Advisers' Guide* (1951); Harry Rubey, *Supplenzental Irrigation for Eastern United States* (1954, with 1956 additions); U.S. Department oi Agriculture, "Water," *The Yearbook of Agriculture* (1955); C. W. Thornthwaite and J. R. Mather, "The Water Balance," *Publications in Climatology,* vol, viii, no. 1 (1955); Sprinkler Irrigation Association, *Sprinkler Irrigation* (1955); I. E. Houk, *Irrigation Engineering,* 2 vol. (1951–56); Harry Rubey, "Irrigation-Drainage-Climatology ior Flat Humid Lands," *Proc. Anter. Soc. Civ. Engrs.* (1957); U.S. Department of Agriculture, *Conservation Irrigation in Humid Areas* (1957); N. D. Gulhati, "Worldwide View of Irrigation Developments," *Proc. Amer. Soc. Civ. Engrs.* (1958).

(H. RY.)

IRVINE, a royal and small. burgh and seaport of Ayrshire, Scot., standing on the Irvine, which with the Annick runs into the Garnock estuary; it is 8 mi. W. of Kilmarnock. Pop. (1951) 14,745. Area 2.8 sq.mi. Alexander II granted it a charter which was confirmed by Robert Bruce. About the end of the 17th century it was reckoned the third shipping port in Scotland, but its importance declined, partly because of the partial silting of the harbour, and partly because of the establishment of harbours at Ardrossan and Troon. Now mostly coastal shipping uses the harbour. The academy is a pre-Reformation foundation. While the town is essentially industrial, it lies in the centre of golfing country, there being two first class golf courses on the northern boundary—Bogside and Irvine municipal—and the well-known Gailes and Barassie golf courses on the southern boundary. Industries include ship repairing, the manufacture of cold-formed metal sections, iron founding, brass founding, pipe manufacture, hosiery works, sawmills, block works, chemical works, bottle works and horn products. The principal exports are bricks, tar, cement, fireclay goods, pipes, gravel and sand; imports include timber, limestone and cement.

IRVING, the name of a family of English actors.

SIR HENRY IRVING (1838–1905), the most famous English actor after David Garrick, was the son of Samuel and Mary Brodribb and was born at Keinton Mandeville, Somerset, on Feb. 6, 1838, being christened John Henry. As a youth he was employed as a clerk in the City of London, but in 1856 he decided to be an actor, taking the name of Henry Irving. His first appearance was at the Royal Lyceum theatre, Sunderland, as Gaston, duke of Orleans, in Bulwer-Lytton's *Richelieu.* For ten years he played in provincial stock companies, acting more than 500 parts. In 1866 he was engaged by Dion Boucicault to play in Manchester the leading part, Rawdon Scudamore, in *The Two Lives of Mary Leigh* which later, retitled *Hunted Down,* was transferred to the St. James's theatre, London. This led to Irving's engagement by Alfred Wigan at the newly opened Queen's theatre, and in 1870 he made his first conspicuous success as Digby Grant in James Albery's *The Two Roses* at the Vaudeville. His performance in this part and, on the night of his benefit, his dynamic recitation of Thomas Hood's *The Dream of Eugene Aram* inspired Hezekiah Bateman, the American impresario, to engage him as leading man at the Lyceum theatre. Bateman's enterprise was a failure until he allowed Irving to produce and to play the leading part of Mathias in *The Bells,* a version of Erckmann-Chatrian's *Le Juif Polonais* by Leopold Lewis. Irving's success as Mathias was immediate and sustained; the play ran for 150 nights and remained a feature of his repertory until his death in 1905. Irving, after playing the title role in W. G. Wills's *Charles I* and *Eugene Aram,* and in *Richelieu,* made in 1874 a bid for supremacy as an actor by appearing as Hamlet. The humanity and distinction of his performance won him public acknowledgment as the leader of his profession, and the play had an unprecedented run of 200 nights. When Bateman died in 1875 Irving. under the management of Mrs. Bateman, continued to play in partnership with her daughter Isabel until 1877, appearing successively in Shakespearean tragedy and contemporary plays.

In 1878 Irving became lessee and manager of the Lyceum. With Ellen Terry (*q.v.*) as Ophelia and Portia, he revived *Hamlet* and produced *The Merchant of Venice* (1879). His Shylock was as controversial as his Hamlet, the dignity with which he invested the Jew pleasing some as much as it offended others. The play became a mainstay of his repertory; he declared toward the end of his career "in all humility . . . mine is the only great Shylock." After the production of Tennyson's *The Cup* he invited Edwin Booth (*q.v.*) to play with him at the Lyceum, the English and American actors alternating in the parts of Othello and Iago. Irving's brilliantly conceived Iago was highly praised; his Othello, which lacked physical force, comparatively failed. In 1882–83 Irving and Ellen Terry had their greatest Shakespearean success in *Much Ado About Nothing.* Later in the year, Irving paid the first of several visits to the United States with the whole Lyceum company and with the scenic and lighting effects for which his theatre was famous. He continued in management of the Lyceum until 1899, producing *Twelfth Night* (1884), *Olivia* (a dramatization by Wills of Goldsmith's *Vicar of Wakefield;* 1885), *Faust* (1886), *Macbeth* (1888), *The Dead Heart* (1889) and *Ravenswood* (1890). In 1892 Irving's performance of Wolsey in *Henry VIII* was acclaimed, and in 1893 he produced Tennyson's *Becket,* in which, as the archbishop, he made a deep impression upon his audiences. Further productions, such as *King Arthur* and *Don Quixote* (1895), *Cymbeline* and *Richard III,* one of his most striking interpretations (1896), and *Peter the Great* (1898), did not meet increasing costs. In 1899 ill health and misfortunes, which included the destruction by fire of almost all his stocks of scenery, induced him to surrender his control of the Lyceum to a limited liability company. In 1902 the company went into liquidation and Irving's reign at the Lyceum ended. His farewell season at Drury Lane in 1905, however, showed that his powers as an actor and his popularity with the public were undimmed. On Oct. 13 of that year he died, shortly after playing Becket at the Theatre Royal in Bradford. He was buried in Westminster abbey.

Both on and off the stage Irving maintained a high ideal of his profession. In 1895 he received the honour of knighthood, the first ever accorded an actor. His acting, apart from his genius as a stage director, divided criticism, opinions differing as to whether his mannerisms of voice and deportment hindered or helped the expression of his ideas. He excelled in the portrayal of fear, horror, scorn or malignity. A commanding personality such as his was bound to colour whatever part he assumed, but the richness and originality of this colouring were as admirable as the intellect and imagination with which his interpretations were conceived.

In 1869 Irving married Florence O'Callaghan, but after the birth of their two sons, Henry Brodribb and Laurence Sidney Brodribb, Irving and his wife were legally separated.

HENRY BRODRIBB IRVING (1870–1919), elder son of Sir Henry Irving, was born in London on Aug. 5, 1870. He was educated at Marlborough and at New college, Oxford, where he joined the Oxford University Dramatic society. He was called to the bar in 1894, but soon abandoned a legal career for the stage. His first appearance in London was made in Sept. 1891 with John Hare at the Garrick theatre in T. W. Robertson's *School.* In 1894 he joined Ben Greet's company, where he met Dorothea Baird, whom he married in 1896. His first notable success was in Barrie's *The Admirable Crichton* (1902–03). In 1905 he appeared as Hamlet at the Adelphi theatre, where his scholarly and vital performance established him as a creative actor of distinction. Forming his own company, he produced a successful version of Robert Louis Stevenson's *Dr. Jekyll and Mr. Hyde* and Stephen Phillips' *The Sin of David.* He was lessee and manager of the Savoy theatre from 1913 until his death in London on Oct. 17,

1919. Irving was a keen student of criminology and published *The Life of Judge Jeffreys* (1898), *French Criminals of the Nineteenth Century* (1901), *A Book of Remarkable Criminals* (1918) and *Last Studies in Criminology* (1921).

LAURENCE SIDNEY BRODRIBB IRVING (1871–1914), younger brother of Henry Brodribb Irving, was born in London on Dec. 21, 1871. He was educated at Marlborough and, to enter the diplomatic service, studied for three years in St. Petersburg, but financial stringency prevented him from fulfilling this intention. Returning to England in 1893, he began his career as an actor in Frank Benson's Shakespearean company. In 1894 he made his first important appearance in London in Barrie's *Walker, London.* He married the actress Mabel Hackney and with her presented foreign plays of distinction to English audiences, notably *The Three Daughters of M. Dupont,* his own dramatization of Dostoevski's *Crime and Punishment* and M. Lengyel's *Typhoon.* In the last play (1912) he revealed himself as an actor of genius, which his brief appearances as Iago and as the Earl Skule in *The Pretenders* by Ibsen later in that year confirmed. In 1914 he took his company to Canada and was returning thence when he and his wife lost their lives in the sinking of the "Empress of Ireland" on May 28. 1914.

Laurence Irving wrote several plays, including *Peter the Great, Bonnie Dundee* and *Richard Lovelace.* His scholarship, allied to his unusual sensitivity, enabled him as an actor to portray with remarkable integrity the manners and characteristics of foreign peoples.

BIBLIOGRAPHY.—William Archer, *Henry Irving, Actor and Manager* (1883); C. Hiatt, *Henry Irving* (1899); P. H. Fitzgerald, *Sir Henry Irving: a Biography* (1906); Bram Stoker, *Personal Reminiscences of Henry Irving,* 2 vol (1906); W. H. Pollock, *Impressions of Henry Irving* (1908); A. Brereton, *The Life of Henry Irving,* 2 vol. (1908), *"H.B." and Laurence Irving* (1922); *E.* H. G. Craig, *Henry Irving* (1930); *L.* H. F. Irving, *Henry Irving: The Actor and His World* (1951). (L. H. F. I)

IRVING, EDWARD (1792–1834), Scottish church divine, whose followers founded the Catholic Apostolic Church (*q.v.*), was born at Annan, Dumfriesshire, on Aug. 4, 1792. At the age of 13 he entered the University of Edinburgh. In 1809 he graduated M.A., and in 1810, on the recommendation of Sir John Leslie, he was chosen master of an academy newly established at Haddington, where he became the tutor of Jane Welsh, afterward Mrs. Thomas Carlyle. He became engaged in 1812 to Isabella Martin, whom he married in 1823, but meanwhile he gradually fell in love with Jane Welsh, and she with him. He tried to get out of his engagement with Miss Martin, but was prevented by her family. Irving introduced Carlyle to Jane Welsh in 1821. He left Haddington for Kirkcaldy in 1812. Completing his divinity studies by a series of partial sessions, he was licensed to preach in June 1815, but continued to teach for three years. In the summer of 1818 he resigned his mastership and went to Edinburgh. He was meditating a missionary tour in Persia when, in 1819, he was appointed assistant to Thomas Chalmers in St. John's parish, Glasgow. Irving's preaching awakened little interest among the congregation of Chalmers, Chalmers himself, with no partiality for its bravuras and flourishes, comparing it to "Italian music, appreciated only by connoisseurs"; but as a missionary among the poorer classes he wielded an influence that was altogether unique. In 1822 he was ordained minister of the Caledonian church, Hatton garden. London. There his sermons at once attracted a crowd of fashionable people.

For years the subject of prophecy had occupied much of his thoughts, and his belief in the near approach of the second advent had received corroboration in the work of a Jesuit priest. writing under the assumed Jewish name of Juan Josafat Ben-Ezra. In 1827 he published a translation of it, accompanied with an eloquent preface. Probably the religious opinions of Irving had gained breadth and comprehensiveness from his intercourse with Samuel Taylor Coleridge, but gradually his chief interest in Coleridge's philosophy centred around that which was mystical and obscure, and it probably accounts for his adoption of the doctrine of millenarianism. The first stage of his later development, which foreshadowed the establishment of the Irvingite or Holy Catholic Apostolic Church, was associated with conferences at his friend Henry Drummond's seat at Albury concerning unfulfilled prophecy, followed by study of the prophetical books and especially of the Apocalypse, and by several series of sermons on prophecy both in London and the provinces. Crowds filled the largest churches of Edinburgh in the early summer mornings to hear his apocalyptic lectures in 1828. In 1830 his hopes were aroused by the seeming actual revival in a remote corner of Scotland of those apostolic gifts of prophecy and healing which he believed to be kept in abeyance by the absence of faith.

Irving welcomed the new power with a conviction which was unshaken by the remonstrances or desertion of his dearest friends, the recantation of some of the principal agents of the gifts, his own declension into a subordinate position, the meagre and barren results of the manifestations and their general rejection both by the church and the world. His excommunication by the presbytery of London, in 1830, for publishing his doctrines regarding the humanity of Jesus Christ, and the condemnation of these opinions by the general assembly of the Church of Scotland in the following year, were secondary episodes. The irregularities connected with the manifestation of the gifts gradually estranged his own congregation, and on the complaint of the trustees to the presbytery of London, whose authority they had formerly rejected, he was declared unfit to remain the minister of the National Scotch Church of Regent square. After he and those who adhered to him (describing themselves as of the Holy Catholic Apostolic Church) had in 1832 moved to a new building in Newman street, he was in March 1833 deposed from the ministry of the Church of Scotland by the presbytery of Annan on the original charge of heresy. With the sanction of the power he was now after some delay reordained "chief pastor of the church assembled in Newman street." He died on Dec. 7, 1834.

The writings of Edward Irving published during his lifetime were *For the Oracles* of *God, Four Orations* (1823); *For Judgment to come* (1823); *Babylon and Infidelity foredoomed* (1826); *Sermons,* etc. (3 vol., 1828); *Exposition of the Book of Revelation* (1831); an introduction to a translation of Ben-Ezra; and an introduction to Horne's *Commentary on the Psalms.* His collected works were published in 5 volumes, edited by Gavin Carlyle. *See* also the article CATHOLIC APOSTOLIC CHURCH.

The *Life of Edward Irving, by* Mrs. Oliphant, appeared in 1862 in 2 vol. Among a large number of biographies published previously, that by Washington Wilks (1854) has some merit. *See* also Hazlitt's *Spirit of the Age;* Coleridge's *Notes on English Divines;* Carlyle's *Miscellanies* and Carlyle's *Reminiscences,* vol. i. (1881).

IRVING, WASHINGTON (known by a number of pseudonyms including GEOFFREY CRAYON and DIEDRICH KNICKERBOCKER) (1783–1859), is variously called "first American man of letters," "dean" or "father of American literature," and "inventor of the short story." He was born in New York city on April 3, 1783, the year of the peace that ended the American Revolution. Much of the praise bestowed on him was deserved; some of it was owing primarily to his having been "first." Intellectually, Irving was a lesser man than many of his predecessors. He lacked the religious intensity of Mather, the philosophical acumen of Edwards, the versatility of Franklin, the statesmanship of Jefferson or the dedication of Paine. Yet he outlives them all in the history of American letters. His greatest literary success was won with *The Sketch Book* in 1819—precisely at the moment when British-American animosity had reached a new high—as if in answer to Sidney Smith's contemptuous query, "In all the four quarters of the globe, who reads an American book?" It was a book which all the world, especially many Englishmen, read with delight. While it gave little evidence that Irving was a man of great ideas, emotional depth or imaginative power, it established him as a talented writer, possessed of a temperament and a style, which he combined and varied deftly from sentiment and romance to wit and urbanity in ways to leave no doubt that here at last was an American whose elegant good taste was instinctive. Far from a bumptious provincial, he was a cosmopolite, speaking a language universally recognized in cultivated circles.

In the attainment of the graces of living, Irving was conditioned by his rearing. The favourite and last of 11 children of an austere

Presbyterian father and a more genially-minded Anglican mother, young Irving grew up in an atmosphere of indulgence. A disposition toward frailty and sensitivity got for him the best that family competence and brotherly favouritism could supply. He escaped the regularity of a collegiate education which his father required of his older sons, but because it was still customary for a gentleman to have a profession, even though he might not practice it, he read intermittently at the law, notably in the office of Josiah Ogden Hoffman, with whose pretty daughter Matilda he early fell in love. His "inveterate enemies, the fathers of the law," did not prevent his participation, as a gay-young-man-about-town, in the social whirl of the city or his association with young men bent, like himself, on enjoying life in terms of feminine society, theatrical entertainment and literary amusement. Associations of this kind led to his writing a series of whimsically satirical essays over the signature of "Jonathan Oldstyle. Gent.," published in Peter Irving's paper, the *Morning Chronicle*, during 1802–03. This youthful playing with the pen was interrupted by several trips up the Hudson, another into Canada in the interest of his health, and during 1804–06, an extended tour of Europe, during which his health improved markedly. his manners were given a brush and several notebooks were filled with experiences picked up in a constant round of sight-seeing, flirtatious pleasantries and frivolous entertainment.

On his return, he passed the bar examination late in 1806 "by the grace of God and Josiah Hoffman," his tutor and chief examiner; and soon thereafter he set up as a lawyer by moving into his brother John's office at No. 3 Wall street. But he argued no more cases than Oliver Wendell Holmes later healed broken bodies. During 1807–08 his chief occupation was to collaborate with his brother William and James K. Paulding in the writing of a series of 20 periodical essays entitled *Salmagundi*. To secure variety, they followed the Addisonian scheme of having the several subjects treated by several quaint gentlemen. each reminiscent of members of the Spectator club. They posed as "critics, amateurs, dilettanti, and cognoscenti" and proceeded, in true *Spectator* fashion, "to instruct the young, reform the old, correct the town, and castigate the age." They went on merrily, moralizing seldom, content to take "the world as it goes," yet gently satirizing the ways of the fashionable world, ridiculing the pretentions of political upstarts and social climbers, inserting squibs on the theatre, waging war against boorishness and mediocrity. "folly and stupidity," while teaching "parents how to govern their children, girls how to get husbands, and old maids how to do without them." Occasionally they mixed in a little pointed satire of Jefferson, his "rabble republican" followers and the "logocratic" democracy they sought to institute. *Salmagundi* made an impression. and became a mild terror in certain quarters of the town. While concerned primarily with passing phases of contemporary society, the essays retain significance as an index to the social milieu in which the Federalistically indoctrinated young men moved so easily.

His next book, *Diedrich Knickerbocker's History of New York* (1809), was planned merely as a parody of Samuel Mitchell's pretentious guidebook to New York city, but was eventually expanded into a comic history of the Dutch regime in New York, prefaced by a mock-pedantic account of the world from creation onward. Like *Salmagundi*, it embodies a great deal of contemporary social and political satire: born of youthful exuberance and effrontery.

The composition of this "first great book of comic literature written by an American" was interrupted in April 1809 by the sudden death of Matilda Hoffman. Grief incapacitated him for a while; but in the end the hard work necessary to complete *Knickerbocker*, the'success of the book and his transfer in 1811 to the newer and wider scene of Washington as a lobbyist in the interests of the Irving brothers' hardware-importing firm helped transmute his grief into the realm of memory. His life. however, seemed to him more or less aimless for some years more, during which he turned to a variety of pursuits. He prepared an American edition of Thomas Campbell's poems, edited the *Analectic Magazine* and acquired a staff colonelcy during the War of 1812. In 181 j. when his brothers' business (in which he had been a non-participating but profit-sharing member) declined, he sailed for Europe to look after the firm's interests in Liverpool, only to find that his efforts were not enough to stave off bankruptcy. What turned out more profitable in the end were the literary associations that he formed in London, and more especially a visit to Sir Walter Scott, who encouraged and stimulated him to renewed effort. The result was *The Sketch Book of GeoffreyCrayon, Gent.* (1819–20).

A true sketch book, miscellaneous and uneven, a composite of sentiment and romance, satire and whimsicality, fact and fiction. old and new world—its thirty-odd pieces include the first three so-called modern short stories ("The Legend of Sleepy Hollow," "Rip Van Winkle" and "The Spectre Bridegroom") and an essay, "English Writers on America," in which Irving spoke sane, abiding and forthright words on the nonsensical controversy which kept the British and the Americans in a bad humour with each other. The tremendous success of the book assured Irving, now reliant on his own resources, that he could live by his pen. and two years later he produced *Bracebridge Hall*, a sequel as it were to *The Sketch Book*. When critics pointed out literary borrowings and refurbishings of old tales in these two books, Irving set upon a studied search for novelty. Aware that his mind was not truly creative but rather receptive—that it needed some outside stimulation, such as travel, new associations. or old tales and anecdotes might provide—he resolved. "I shall occasionally shift my residence and write whatever is suggested by objects before me." Hence he traveled in Germany, Austria, France, Spain. the British Isles and later in his own country; his pictures are the transcriptions of an antiquary rather than the conceptions of a creator.

Seeking better health and expecting to exploit the wealth of German folklore, Irving went to Germany, where during the winter of 1822–23 (spent mainly in Dresden) he gathered the materials for a "German sketch book," *Tales of a Traveller* (1824). This proved to be little more than a hodgepodge of travel reminiscences and badly-assimilated ragtags of legendary lore, which the critics attacked savagely. Next he turned to Paris, where he collaborated in various dramatic and operatic productions, notably with John Howard Payne; and early in 1826 he accepted the invitation of Alexander H. Everett, then chargé d'affaires in Madrid, to attach himself to the American legation in Spain and there to translate M. F. de Navarrete's recent book on Columbus. Instead, he chose to produce his own *Columbus* (1828). followed by *The Companions of Columbus* (1831). Although both have long been superseded by later researches. they still supply readers with the essentials of Columbus' romantic life and exploits. Meanwhile Irving had become absorbed in the legends of Granada and of the Moorish past, and residence in the old Alhambra provided a fit setting for the composition of his *Conquest of Granada* (1829) and *The Alhambra* (1832), the latter the Spanish counterpart of *The Sketch Book*.

After 17 years' absence. Irving returned to New York in 1832. where he was warmly received. Impressed by the opening of the western frontier, he made an adventuresome journey west and produced in rapid succession *A Tour of the Prairies* (1835), *Astoria* (1836) and *The Adventures of Captain Bonneville* (1837) Except for four years (1842–1846) of distinguished service as minister to Spain, Irving spent the remainder of his life at his home "Sunnyside" on the Hudson, surrounded and revered by friends and relatives, and devoted to literary pursuits, chiefly biographical: *Oliver Goldsmith* (1849), *Mahomet and His Successors* (1850) and a 5-volume life of his namesake, *George Washington* (1855–1859). He died on Nov. 28, 1859.

BIBLIOGRAPHY.—The standard edition is *Works of Washington Irving*, 21 vol. (1860–61). A useful short text, with introduction, is *Washington Irving, Representative Selections*, ed. by Henry A. Pochmann (1934). The definitive biography is Stanley T. Williams, *Life of Washington Irving*, 2 vol. (1935). The best bibliographical information is in T. H. Johnson, *Literary History of the United States*, III, 578–583 (1948). (H. A. P.)

IRVING, a city of central Dallas county, Tex.. U.S., a residential community west of Dallas (*q.v.*) and within its metropolitan area. The tomnsites Kit and Gorbett preceded Irving, but when the Rock Island railroad shifted its proposed route the present location of Irving was determined in 1902 by Otis Brown and J. O. Schulze. Irving's population increased rapidly after

1950; for comparative population figures *see* table in TEXAS: *Population* (E. C. BE.)

IRVINGTON, a city in Essex and Union counties, N.J., U.S., bordering Newark and 10 mi. W. of New York city in the New York-Northeastern New Jersey metropolitan area. Pop. (1960) 59,379; for comparative population figures *see* table in NEW JERSEY: *Population.* It is highly industrialized; products manufactured there include foods, machinery, jewelry, toy electric trains, paints, electronics, plastics, tools and castings. The city has several parks and playgrounds, a large library, a hospital and many national club organizations.

The area was settled in the 1690s and was a part of Newark. By 1812 it became an independent township, called Camptown; this name was changed in 1852 to Irvington in honour of the writer Washington Irving. The city was incorporated in 1898. In its early history it was noted for its shipbuilding, its horse racing and its position. after 1802, as a relay station for the New York-Philadelphia stagecoach run. (W. L. CA.)

ISAAC, the only son of Abraham and Sarah and father of Jacob and Esau. He thus occupies a middle position between the two major figures in the ancestry of Israel. Apart from the incidents described in Gen. xxii (the rescue of Isaac from the sacrificial altar), Gen. xxiv (the wooing of Rebecca by proxy) and Gen. xxvii (the rivalry between his sons), the only incidents of his life are those included in Gen. xxvi, which describes mainly his dealings with Abimelech, king of Gerar. It is to be noted that these events can be closely paralleled from the Abraham narratives. Isaac is, in fact, the least distinguished and most vague of the three great patriarchal characters, and the most significant points in the passages which deal with him are (1) the mention of Beersheba as his home (*e.g.*, Gen. xxvi, 23, 33) and (2) the fact of his sowing corn, thus passing from the stage of pure nomadism to that of seminomadism (Gen. xxvi, 12). *See* GENESIS.

ISAAC I (COMNENUS), emperor of the east (1057–1059), was the son of an officer of Basil II named Manuel Comnenus. In 1057 he joined with the nobles of the capital in a conspiracy against Micnael VI, and after the latter's deposition was invested with the crown, thus founding the Comneni dynasty.

The first care of the new emperor was to reward his noble partisans with appointments that removed them from Constantinople, and his next was to repair the beggared finances of the empire. He revoked numerous pensions and grants conferred by his predecessors upon idle courtiers, and, meeting the reproach of sacrilege made by the patriarch of Constantinople by a decree of exile, resumed a proportion of the revenues of the monasteries.

Isaac's only military expedition was against the Hungarians and Petchenegs, who began to ravage the northern frontiers in 1059. Shortly after this successful campaign he was seized with an illness, and, believing it mortal, appointed as his successor Constantine Ducas, to the exclusion of his own brother John. Although he recovered, Isaac did not resume the purple, but retired to the monastery of Studion and spent the remaining two years of his life as a monk. alternating menial offices with literary studies. His *Scholia* to the *Iliad* and other works on the Homeric poems are still extant in manuscript. He died in 1061.

ISAAC II (ANGELUS), emperor of the east 1185–95 and again 1203–04, was the successor of Andronicus I. He inaugurated his reign by a decisive victory over the Normans in Sicily, but elsewhere his policy was less successful. He failed in an attempt to recover Cyprus from a rebellious noble, and by the oppressiveness of his taxes drove the Bulgarians and Vlachs to revolt (1186).

In 1187 Alexis Branas, the general sent against the rebels, treacherously turned against his master and attempted to seize Constantinople, but he was defeated and slain. The emperor's attention was next demanded in the east, where several claimants to the throne successively rose and fell.

In 1189 Frederick Barbarossa of Germany sought and obtained leave to lead his troops on the third crusade through the Byzantine territory; but he had no sooner crossed the border than Isaac, who had meanwhile sought an alliance with Saladin, threw every impediment in his way, and was compelled only by force of arms to fulfill his engagements. The next five years were disturbed by fresh rebellions of the Vlachs.

During one of these, in 1195. Alexius, the emperor's brother, taking advantage of the latter's absence from camp on a hunting expedition, proclaimed himself emperor, and was readily recognized by the soldiers. Isaac was blinded and imprisoned in Constantinople. After eight years he was raised for six months to his throne once more. *(See* CRUSADES.) Isaac died in 1204.

ISAAC OF ANTIOCH (called the Great) is the name used to distinguish Isaac of Amida, a 5th-century Syriac writer, from two Edessene Isaacs, one a late 5th-century monophysite priest who settled at Antioch and the other a monophysite at the time of Bishop Paul (512) but who became orthodox under Bishop Asclepius (522). Jacob of Edessa distinguishes the three Isaacs; Gennadius knows of two. According to Zacharias Rhetor, Isaac visited Rome, and Dionysius Telmaharensis mentions his poems on the secular games of 404 and the capture of Rome (410) by Alaric. The Jacobite patriarch bar Shushan (d. 1073) calls him the disciple of Ephraem's pupil, Zenobius. If Isaac is the author of the poem on the destruction of Antioch by earthquake in 459, the date of his death must be later than this, but some, *e.g.,* Duval, ascribe the poem to the earlier Edessene Isaac. Bar Shushan collected Isaac's writings but included many which have to be allotted to his namesakes and some even to Isaac of Kineveh, while some ascribed to Ephraem may be Isaac's, so great is the copyists' confusion, which modern scholars have not yet fully resolved.

See editions by G. Bickell (1873) and P. Bedjan (1903). See also A. Baumstark, *Geschichte der syrischen Literatur,* pp. 63–66 (1922). (W. D. McH.)

ISAAC, HEINRICH (born *c.* 1450), Belgian composer. The exact date and place of his birth are unknown, but about 1477 he apparently went to Florence, and for many years was organist at the Medici chapel. After Lorenzo di Medici's death he found his way to Vienna and obtained an appointment as composer at Maximilian's court at Innsbruck. In 1515 he returned to Florence.

His church music, of which much has been preserved, is masterly in form and Shows great skill and ingenuity in the leading of the parts. But side by side with monumental masses he wrote, while in Florence, light secular compositions of a kind suited to the atmosphere of the Medici court. He also helped Lorenzo with his *canti carnascialeschi* for May-day celebrations. Later, at Innsbruck, he wrote the very simple and beautiful German songs on which his fame rests. Many of his melodies were treasured among the people and revived again and again to suit new words. Thus, *Innsbruck ich muss dich lassen,* written it is said to words by the emperor Maximilian, served for the hymn *O Welt, ich muss dich lassen,* for Paul Fleming's *In allen meinen Taten,* and for two chorales in Bach's *Matthew Passion* (nos. 16, 44).

Of Isaac's ten published masses, five are included in *Misse Heinrici Izac* (1906); two in the Wittenberg edition (1541), *Carminum* and *Une musque de Biscay;* one in the *Liber quindecim missarum* (1539), the famous *O praeclara,* written on one four-note subject throughout; and two in Ott's collection, *Missae 13 vocum* (1539).

ISAACS, JORGE (1837–1895), Colombian poet and novelist, whose best work, *María,* is the most famous Latin-American novel.

Isaacs was born at Cali, in the province of Cauca. Colombia, in April 1837, the son of a prosperous English Jew. He received an excellent education, first at Bogotá and later in England. During the War of the Cauca (1860–63) he was reduced to poverty by the destruction of his patrimony in the Cauca valley.

Settling in Bogotá in 1864 he published a slight volume of *Poesías,* which attracted considerable attention, and in 1867 the novel, *María,* which won immediate recognition and remains his chief title to fame. Seizing the opportunity thus opened to him for a political career, he entered public life, and in 1871–72 was appointed consul general in Chile.

On his return he served in the provincial legislatures of Cauca, Cundinamarca and Antioquia, and filled numerous political, educational and editorial positions. He died in Abagüé on April 17, 1895.

Although he continued to write until his death, and was a generous contributor to periodical literature, none of his later efforts fulfilled the promise of his first two volumes. An idyllic picture,

very likely autobiographical, of life among the Cordilleras of his native Cauca valley, *María* was called by one eminent critic "the poem of America," and was translated into several foreign languages.

Among his poems, notable are "Río Moro" ("River Moro"), "La Noche Callada" ("The Silent Night") and "La Tumba del Soldado" ("The Soldier's Tomb"); *Saulo* is part of an uncompleted drama; *La* Revolucidn *radical en Antioquia* is his most important prose work outside fiction.

ISABELA, Philippine province in northeastern Luzon (*q.v.*). Area 4,069 sq.mi.; pop. (1948) 264,495, (1958) 317,960. The eastern section comprises the rugged, sparsely populated Sierra Madre which extends to the Philippine sea. Central and western Isabela lie in the fertile Cagayan valley, an important pioneer area since the early 1930s. Rice is the main crop with surpluses shipped to Manila; corn is the leading local food crop. The production of Virginia tobacco is significant. The provincial capital and agricultural centre is Ilagan. (R. E. HE.)

ISABELLA (1451–1504), LA CATÓLICA, queen of Castile, daughter of John II of Castile by his second wife, Isabella, granddaughter of John I of Portugal, was born at Madrigal on April 22, 1451. On the accession of her brother, Henry IV (1454), she was withdrawn by her mother to Arevals. Removed by Henry to the court, her hand was sought in application by many suitors, among whom were Alphonso of Portugal, Pedro Giron and Ferdinand of Aragon, whom she ultimately married on Oct. 19, 1469. An offer of the crown of Castile was made to her by the revolutionary leaders in the civil war; she declined it and in 1468 was recognized by her brother as lawful heir. On his death, she was proclaimed queen of Castile and Leon (Dec. 13, 1474). Spain undoubtedly owed to Isabella's clear intellect, resolute energy and unselfish patriotism much of that greatness which it acquired under "the Catholic sovereigns." The moral influence of the queen's personal character over the Castilian court was incalculably great; from the debasement and degradation of the preceding reign she raised it to being "the nursery of virtue and of generous ambition." She did much for letters in Spain by founding the palace school and by her protection of Peter Martyr d'Anghiera. The very sincerity of her piety and strength of her religious convictions led her at times into great errors of state policy; her efforts for the introduction of the Inquisition into Castile and for the proscription of the Jews are cases in point. It was a happy intuition that led her to give credence to the scheme of Columbus and to finance his undertaking, offering in a generous impulse to pawn her personal jewels if the treasury funds proved inadequate. She died at Medina del Campo on Nov. 24, 1504.

ISABELLA II (1830–1904), queen of Spain, was born in Madrid on Oct. 10,1830, the daughter of Ferdinand VII and Maria Christina. In virtue of the so-called Salic law of 1713, which however had been set aside in 1830, her uncle Don Carlos (*q.v.*) disputed her title on Ferdinand's death (Sept. 29, 1833). During the Carlist War (1833–40), when Maria Christina was regent, the government began suppressing the monasteries and selling their estates to raise money and to secure the purchasers' loyalty. The queen regent abdicated in 1840; Baldomero Espartero (*q.v.*), declared regent in 1841, was deposed after a pronunciamiento by R. M. Narváez in 1843; and Isabella was then declared of age (Nov. 8, 1843). Her marriage to her debilitated cousin, Don Francisco de Asís de Borbón, in 1846, simultaneous with that of her sister to the duc de Montpensier, embittered Anglo-French relations. Her reign was a succession of governmental changes, palace intrigues and pronunciamientos: Narváez, leader of the Moderados, was prime minister five times in all; the Progresistas under Espartero were in office from 1854 to 1856; and Leopoldo O'Donnell's second ministry (Unión Liberal, 1858–63) was the longest continuous one. Her private life gave rise to scandal and her capriciousness alienated her most patient servants. In Sept. 1868, Juan Prim and J. B. Topete (*qq.v.*) pronounced against her, Francisco Serrano (*q.v.*) defeated her army at Alcolea and she went into exile. In Paris on June 25, 1870, she abdicated in favour of her son Alphonso XII. She died in Paris on April 9, 1904.

ISABELLA OF BAVARIA (1370–1435), otherwise called ISABEAU, queen of France, was the daughter of Stephen II, duke of Bavaria. She was born in 1370 and was married to Charles VI of France on July 17, 1385, and crowned at Paris on Aug. 22, 1389. She fell under the influence of the dissolute court in which she lived and, the king having become insane (Aug. 1392), consorted chiefly with Louis of Orléans. After the assassination of the duke of Orléans (Nov. 23, 1407) she supported the Armagnacs until, having quarreled with them and with her surviving son, the young dauphin (afterward Charles VII), she went over to the side of the Burgundians (1418). By the treaty of Troyes (May 21, 1420), she gave her daughter Catherine in marriage to the king of England, Henry V, whom she recognized as the heir to the king of France. She died in Sept. 1435 and was interred without funeral honours in the abbey of St. Denis.

ISABELLA OF HAINAUT (1170–1190), queen of France, was the daughter of Baldwin V, court of Hainaut, and Margaret, sister of Philip of Alsace, and was born in 1170 at Lille. She was married in 1180 to Philip II Augustus and brought to him as her dowry the province of Artois. This marriage brought about the revolt of the house of Champagne; so that Isabella's coronation could not take place at Reims, and she was crowned at St. Denis instead on May 29, 1180.

In 1184, Philip, waging war against Flanders, was angered at seeing Baldwin support his enemies and called a council at Senlis for the purpose of repudiating his wife. But Isabella succeeded in dissuading him from this purpose. She died in 1190. Her son became Louis VIII of France.

ISABEY, JEAN BAPTISTE (1767–1855), French painter of miniatures, was born at Nancy on April 11, 1767. He went to Paris in 1785 and later became a pupil of J. L. David. Employed at Versailles on portraits of the dukes of Angoulême and Berry, he was given a commission by Marie Antoinette, the first of many which he received up to his death (in Paris, April 18, 1855) from the successive rulers of France. Patronized by Josephine and Napoleon, he arranged the ceremonies of their coronation and prepared drawings for the publication intended as its official commemoration, a work for which he was paid by Louis XVIII, whose portrait he executed in 1814. Although Isabey did homage to Napoleon on his return from Elba, he continued to enjoy the favour of the Restoration, and took part in arrangements for the coronation of Charles X.

The monarchy of July conferred on him an important post in connection with the royal collections, and Napoleon III granted him a pension and the cross of commander of the Legion of Honour. "Review of Troops by the First Consul" was one of his most important compositions, and "Isabey's Boat," a drawing of himself and family, had an immense success at the Salon of 1820. His portrait of "Napoleon at Malmaison" is held to be the best likeness of the ruler ever executed. His son and pupil Louis Gabriel Eugbne Isabey (1804–86) was a genre and marine painter and water colourist.

See Marion W. Osmond, Jean Baptiste Isabey, the Fortunate Painter (1947).

ISAEUS (c. 420 B.C.–*c.* 350 B.C.), a professional speech writer at Athens specializing in testamentary law, whose lucidity and logical method were a landmark in the development of forensic oratory. Accounts of his life are scanty and contradictory. His father is said to have been called Diagoras, which is not an Athenian name. According to one ancient source Isaeus was a Chalcidian, according to another an Athenian. To account for this discrepancy it has been suggested that his family belonged to a settlement of Athenian citizens at Chalcis. At any rate he spent his professional life in Athens, either as a citizen or as a resident alien. He appears to have taken no part in public life, but this is in itself no evidence that he was an alien: he may merely have had no desire to speak in public.

His profession was to write speeches for clients. He appears to have confined himself entirely to forensic speeches and almost entirely to those concerned with private suits. He had a minute knowledge of the laws of inheritance and expert skill in exploiting this knowledge to win a case. Too much weight should not be attached to ancient reports that he was a pupil of Isocrates and

Lysias. Of Isocrates' influence his work shows little trace. The influence of Lysias is indeed unmistakable, but probably, as Dionysius of Halicarnassus says in his work on the Attic orators, Isaeus merely imitated him. Ancient stories of his personal relations with Demosthenes can largely be discounted, but there is no doubt that Demosthenes' writing owed much to him.

The author of the pseudo-Plutarchean life of Isaeus says that 64 speeches were ascribed to him of which he believed 50 to be genuine. Eleven are extant and a considerable part of a 12th has been preserved in Dionysius' essay on Isaeus. In most cases dating can only be tentative, but all belong to the first half of the 4th century B.C. Every one of the 11 speeches deals, directly or indirectly, with a will. Six relate to disputed claims to an inheritance and three to prosecutions for false witness in testamentary suits. The fifth speech concerns an action brought to compel a man to discharge his obligations as surety in connection with a will, and the 11th the indictment of a guardian for ill-treatment of his ward. The incomplete 12th speech is not connected with a will case; it refers to an appeal to a law court by a certain Euphiletus against the decision of his demesmen to strike him off the register. Many fragments and titles of other speeches have also survived.

The professional speech writer was faced with a difficult problem. It was essential to present a case in a convincing and persuasive form, but if the writer's skill were too transparent, the jurors would be on their guard and the client's case might suffer., It is clear that Antiphon's self-conscious artistry had been found unsuitable for practical oratory. Lysias had allayed suspicions by writing in a simple style and by skillfully adapting the language and manner of a speech to the character of each particular client. Such characterization is not to be found in the work of Isaeus, but he resembles Lysias in the simplicity and clarity of his language and in avoiding pretentious embellishments. He makes sparing use of such linguistic adornments as antithesis, parison and anaphora. On the other hand he indulges freely in the so-called "figures of thought"; *e.g.,* rhetorical questions and the imaginary objections of an opponent.

Scholars have pointed out some divergences from strict Attic idiom in his writing; it is possible that these may be due to manuscript corruption. In general his style is lucid and businesslike, and the very fact that it lacked literary charm probably added to its effectiveness.

In the arrangement of his matter Isaeus shows himself remarkably independent of the rules for subdivision prescribed by rhetoricians. He follows no single plan but varies the structure according to the needs of each particular speech. He shows particular skill in interweaving narrative and proof, thereby avoiding a long, unbroken relation of facts, which in testamentary cases might be complicated and difficult to follow.

Perhaps Isaeus' most significant contribution to forensic oratory lay in his method of argument; he appears to have been the first orator to build up his case point by point with logic and reason. At the same time he took pains to make his arguments intelligible, partly by frequent repetition and recapitulation at the end of a speech.

BIBLIOGRAPHY.—The text of Isaeus' extant speeches was edited by T. Thaiheim, Teubner series (1903); with commentary but excluding fragments, by W. Wyse (1904); with translation by P. Roussel, Budé series (1922) and by E. S. Forster, Loeb series (1927). *See* also F. Blass, *Die attische Beredsamkeit,* vol. ii, 2nd ed. (1892); R. C. Jebb, *The Attic Orators From Antiphon to Isaeus,* vol. ii, 2nd ed. (1893). For the technicalities of Attic law *see* J. H. Lipsius, *Das attische Recht und Rechtsverjahren* (1905–1915). (*H. L.* H.-W.)

ISAIAH. It is important to realize that practically all we know of the life and career of the Prophet Isaiah of Jerusalem is contained in the book of Isaiah. But the book itself, as it lies before us in our Bibles contains much more material than that which is directly concerned with the life and work of the prophet. In its present form, as a book, it is a comparatively late production, compiled out of a series of prophetic collections made by a succession of redactors and editors. "These collections embody a nucleus of Isaianic material—the actual prophecies of Isaiah himself—which was added to and enlarged as time went on. But even in the earliest form of compilation which critical analysis can detect this Isaianic material has been combined with non-Isaianic matter." As we shall see, at least one, if not two other writers contributed largely to the book as we have it. As the late G. Buchanan Gray well remarks in his commentary on Isaiah (p. xii.), "No full justice can be done to a book which is a great monument to Jewish religion after the exile if all our attention is devoted to determining whether this or that passage is genuine and dismissing it as not 'genuine' if it is not the work of Isaiah. In reference to works such as the Book of Isaiah the term 'genuine' is indeed misleading. None of the nameless writers may have possessed the religious genius of Isaiah, but together they represent the play of the earlier prophetic teaching on the Jewish Church. In religion as elsewhere, great personalities count first, and it is the privilege of a student of the Book of Isaiah to come face to face with one, if not two, such personalities; but the religious community is the necessary outcome, or field of action, of the great religious personality and his teaching, and the student of the Book of Isaiah has but half entered into his inheritance if he communes with Isaiah and the great exilic prophet, but fails to feel the life of that post-exilic community, which not only preserved for themselves and for us the words of the earlier prophets, but preserved them in books which were also made to breathe the hopes and aspirations that sustained the Jews through centuries of isolation, oppression and temptation."

The book falls into two main divisions: (a) Chapters i.–xxxix.; (b) Chapters xl.–lxvi. The whole of the material contained in (b) is post-exilic in date; that contained in (a) is partly post-exilic and partly earlier. The material directly or indirectly connected with the prophet Isaiah of Jerusalem is all contained in (a).

Analysis of the Book.—One of the great triumphs of Old Testament Criticism is revealed by the criticai anaiysis of the Book of Isaiah. It is no part of our present task to trace the history of the development of this criticism. Suffice it to say that it reached its high watermark in the works of Duhm (Jesaia) 2nd ed. 1902 and Marti (Jesaia) 1900. Invaluable work had been done in this country by T. K. Cheyne in a succession of works, the most important of which for our present purpose is the *Introduction to the Book of Isaiah,* 1898. Since the publication of these treatises a certain amount of reaction has taken place in Isaianic criticism. It will be convenient for our purpose to follow Duhm and Marti as guides and to notice as we proceed the more important modifications that have come to the front since.

Chapter 1 forms a general preface to the whole Isaianic collection. The chapter is itself composite and was probably put together in its present shape by editors. The themes it deals with may be summarized as follows: (1) An address on Israel's faithlessness c. 701 B.C. (vv. 2–17), (2) the sin of Judah and the choice given (vv. 18–20) c. 701 B.C., (3) a dirge over Jerusalem's declension, passing over into a threat (vv. 21–26) before 701 B.C.; (4) a post-exilic addition dealing with the deliverance of a remnant and the annihilation of Apostates (vv. 27–28); (5) a fragment against nature-worship (vv. 29–31) *c.* 722 B.C. All these passages may be regarded as Isaianic except vv. 27–28. Note the heading v.1 which was added bv an editor to the whole book of collected prophecies. The rest of chapters i.–xxxix. can broadly be divided into four books, viz., Bk. 1 first collection of Isaiah's prophecies, Chapters ii.–xii.; Bk. 2 an intermediate collection of oracles mainly concerning foreign nations, Chapters xiii.–xxiii.; Bk. 3 a third collection of Isaianic prophecies dealing mainly with the deliverance of Jerusalem with an eschatological preface and appendix, chapters xxiv.–xxxv.; Bk. 4 a historical appendix to the collected form of Isaianic prophecies, chapters xxxvi.–xxxix.

1. The first collection of Isaiah's prophecies, Chapters ii.–xii. This is itself composed of minor collections (notice ii.1–iv.6 and vi.1–ix.7). We come to the earliest minor collection contained in chapter ii.1–iv.6. These chapters are carefully arranged being provided with an eschatological preface ii.2–4–, and a Messianic appendix iv. 2–6. Both these apocalyptic passages may be regarded as dependent upon Old Tradition (so Gressmann) and are probably older than Isaiah himself. Thus in the striking section ii. 2–4, which recurs in Micah iv. 1–4 both prophets are probably citing from a common source containing early features, *e.g.,*

that Mount Zion is made higher than all the mountains and here assumes the position of the Mountain of the Gods of old myth. Isaiah takes this old story as a sort of text with its idealistic description of the future and sets against it a picture in striking contrast with the evils of the present. The section that follows ii. 6–21 has for its main theme Israel's Sin and the Day of Doom, and gives the prophet's conception of the Day of Yahweh (note especially chapter ii. 11–17 and the passage against idolatry v.18 sqq.). A section follows on Judah's impending ruin, completed by c. 735 B.C., contained in iii. 1–15 and this again by a powerful passage directed against the ladies of Jerusalem, iii. 16–iv.1. The whole section is completed by iv. 2–6, apocalyptic in character. Here vv. 5–6 may form a later addition. The general theme of the passage is the felicity of the redeemed community after it has been purged by judgment.

Chapter v. forms a section by itself and may be dated c. 735 B.C. The theme of the chapter is the parable of the vineyard and its application. The parable is contained in vv. 1–7 (cf. Matt. xxi. 32 sqq.); vv. 8–24 contain a denunciation in the form of six woes directed against the upper classes (vv. 25–30 should follow chapter x. 4). The whole composition is a very powerful piece of writing.

The second minor collection (Chapters vi.1 to ix.8) contains important material. Chapter vi. gives an account of Isaiah's inaugural vision, date about 738, and may have been composed to form an introduction to the group that follows which consists of (a) chapter vii. (prophecies of the period of the Syro-Ephraimitish war); (for the sign of Emmanuel, vii. 14–16, see article EMMANUEL); (b) viii. 1–4, *c.* 734 B.C., and vv. 5–10 and 11–15 all of the same period. An epilogue of uncertain date follows in vv. 16–18. This is an important section which seems to have been written down when the failure of the prophetic addresses contained in vii. 1–8, 15, had become evident. The Prophet now solemnly consigns "the testimony" to an inner circle of disciples.

The final section culminates in the description of the Messianic King (viii. 18–ix. 6). The text of the opening verses seems to have been much edited, in fact rewritten to form an introduction to what follows. The grand picture of the Messianic King given in ix. 1–6 is probably from Isaiah's hands, though some critics have denied this. The date of the Messianic passage is uncertain; perhaps it may be assigned to the youthful period of Isaiah's life, when he despaired of the Davidic House as represented by Ahaz (contrast xi. 1–9). The section that follows ix. 7–x. 4, to which should be attached v. 26–30 may be dated about 735 B.C. It is an artistically constructed poem with a refrain and may be entitled "Yahweh's Outstretched Hand." It is mainly directed against north Israel and is a splendid example of Isaiah's poetical genius. A collection of oracles against Assyria with a Messianic appendix follows in Chapter x. 5–xi. 16. The Messianic section forms an appropriate conclusion. The Isaianic material here is fragmentary in character and has been edited to a certain extent by later hands. The general date of the fragments appears to be between 711 and 701 B.C. The date of the Messianic appendices xl. 1–9 and 10–16 is uncertain, but vv. 1–9 may be Isaianic while 10–16 probably belong to a later age; xl. 1–9 form perhaps the grandest of all the Messianic passages of the O.T. Its wonderful picture of the Golden Age marked by universal peace and its serene outlook on a transformed world are worthy of Isaiah. These features reflect the serenity of old age. Isaiah probably composed the passage towards the end of his life: notice the prophet's revived hope in the Davidic dynasty. Chapter xii. (probably post-exilic) forms the lyrical epilogue to the first complete Isaianic collection embodied in chapters ii.–xii. Chapter xii. is largely composed of reminiscences of the Psalter.

Book 2 forms an intermediate collection of oracles mainly concerning foreign nations, chapters xiii.–xxiii. The bulk of this section consists of ten "oracles" (burdens); and interspersed among these are four passages without titles which undoubtedly come from Isaiah's hand, viz. (a) xiv. 24–27 (b) xvii. 12–14 (c) Chapter xviii. and (d) Chapter xx. Of the ten oracles Chapter xvii. 1–6, 9–11, and xxii. 1–8, 12–14, may be assigned with confidence to Isaiah, while chapter xv. to xvi. 12 may be an older prophecy adopted by Isaiah and re-affirmed in a special postscript (Chapter xvi. 13–14). The only "oracles" which bear no relation to Isaiah or his age are Chapter xiii. 2–xiv. 23 against Babylon, which was probably composed during the Exile; chapter xix. against Egypt, Chapter xxi. and Chapter xxiii. Not improbably this collection in its original form, consisting of ten oracles had an independent existence. The editor of the complete Isaianic collection took over this book which contained a genuine Isaianic element by inserting the four passages mentioned above and then incorporated the whole into the collected form of Isaiah's prophecies. It should be noted that it occupies in the complete book a similar position to corresponding groups of oracles in Ezekiel (Chapters xxv.–xxxii.) and Jeremiah (according to the LXX arrangement). Probably this editor is responsible for the heading, chapter xiii. 1, or at least for the words which *Isaiah* Ben *Amoz* saw. The poem on the Fall of Babylon consists of (a) a prophecy directed against Babylon xiii. 2–22 and (b) a triumphal ode on the downfall of the oppressive power, xiv. (4b)–21. This latter is certainly one of the finest compositions in the O.T. The date of composition probably belongs to the latter years of the Exile and therefore is more or less contemporary with Deutero-Isaiah. Note the contrast in tone between this oracle and that of Chapter xxi. Chapter xvii. 1–11, containing an oracle about Ephraim and Syria, may be dated about 735 B.C. and the second of the appended Isaianic fragments, Chapter xvii. 12–14, about 702 B.C. This is a very fine piece of writing. The third of the appended fragments, containing an address to the Ethiopian Ambassadors, may be dated about the same time (Chapter xviii.). Chapter xix., an oracle about the fall of Egypt, seems to be of composite origin, vv. 1–15 perhaps may be dated between 528 and 485 B.C., while the remarkable verses, 16–25, forming an appendix, seem to belong to a later date still. Note the broad universalistic spirit of the passage which can hardly belong to an earlier time than the Greek period. Sellin, however, takes a different view. He dates vv. 1–17 prior to 663 B.C., and even vv. 18–25 he thinks are pre-Exilic. Chapter xx. contains the fourth of the appended Isaianic pieces. It may perhaps be dated about 711 B.C. in the reign of Sargon. The words translated Egypt (Misraim) and Ethiopia (Cush) may however be referred to a different provenance, if Winckler can be followed in assuming the existence of a Muṣri and Cush in north Arabia: it is possible that these terms have been confused with Egypt and Ethiopia in this chapter and occasionally elsewhere in the O.T. Chapter xxi. 1–10 containing a vision of the fall of Babylon may be dated about the end of the Exile. It is followed by two fragmentary oracles on Edom, and Kedar, and has appended to it an Isaianic fragment xxi. 16–17 which may be dated about 711 B.C. Chapter xxii. 1–14, an oracle on the Valley of Vision, may be dated about 701 B.C. Appended to this oracle is an interesting political invective directed against Shebna with a later appendix (Chapter xxii. 15 sqq.). The final chapter of this Section Chapter xxiii. deals in its present form with the Fall of Tyre and perhaps with the siege which the prophecy has in view is the one conducted by Nebuchadnezzar 586–573 B.C. (vv. 13 and 15–18 may be post Exilic additions). Duhm has proposed a brilliant solution by slightly altering the text in 8 and substituting Sidon for Tyre (Sidon is mentioned in vv. 2,4 and 12). The reference will then be to the devastation of Sidon by Artaxerxes III. A later editor again altered it so as to make it refer to the siege of Tyre by Alexander the Great. Book iii. contains the third collection of Isaianic prophecies dealing mainly with the deliverance of Jerusalem, with an eschatological preface and appendix. The centre of this group of chapters is largely composed of material from Isaiah's hand dating apparently from the crisis of Sennacherib's invasion in 701 B.C. To the post-exilic editor who combined this collection with the two preceding books, the dominating interest was eschatological.

The invasion of Sennacherib was invested with an eschatological significance, and was "regarded as typical of the last great attempt to extinguish the people of Yahweh" at the end of the age. This editor will also have been responsible for prefixing the eschatological preface (chs. xxiv.–xxvii.) and affixing the eschatological appendix (chs. xxxiv.–xxxv.) to the central group.

The third collection thus falls into three main parts, viz., I. Eschatological Preface (Chs. xxiv.–xxvii.). II. Prophecies dealing mainly with the Deliverance of Jerusalem (Chs. xxviii.–xxxiii.). III. Eschatological Appendix (Chs. xxxiv.–xxxv.). Chapters xxiv.–xxvii. are characterized by certain remarkable features. When the lyrical passages or songs are taken away there emerges a uniform apocalypse. The songs in question are (a) xxv. 1–5 (commemorating the destruction of a strong city); (b) xxv. 9–11 (the taunt song on Moab); (c) xxvi. 1–19 (a poetical meditation); and (d) the song in xxvii. 2–5. The subject of the main apocalyptic section is a great catastrophe which convulses the entire world. A picture of world-wide desolation is drawn in vivid colours. This is followed by a description of the divine judgment on the evil powers (heavenly and earthly) and of Yahweh's enthronement on Mount Zion (Ch. xxiv.). Finally the "Coronation festival" — " a feast of fat things for all peoples"— is described (xxv. 6–8). The date of this section is hard to determine. The earliest assignable date is in the reign of Artaxerxes Ochus and probably the limits are 350–330 B.C. A number of distinguished scholars, however, date these compositions late in the Maccabean period, but on insecure grounds. The doctrinal importance of the chapters is considerable. Thus ch. xxvi. 19 contains perhaps the first clear allusion to the doctrine of the resurrection; cf. the oracles contained in chapters xxviii.–xxxiii. Doubts have been raised as to the Isaianic character of xxviii. 23–29, a little poem in the style of the Wisdom literature which may well be Isaiah's. Ch. xxix. 17–24 is almost certainly post-exilic (the humble and needy of *v.* 19 are the oppressed pious so often mentioned in the Psalms). Ch. xxx. 18–26 also post-exilic. Ch. xxx. 27–33 doubtfully Isaianic, perhaps post-exilic. Chapters xxxii.–xxxiii. contain a description of the renovated state in the Messianic age and form a contrast with preceding chapters especially as regards the upper classes. With the exception of vv. 6–8 Chapter xxxii. might have been written by Isaiah. If so, with chapter xxxiii., it must be a product of the prophet's old age. Though the subject of chapter xxxiii. is undoubtedly the deliverance of Jerusalem from Sennacherib it is highly improbable that the chapter is a composition by Isaiah. It seems rather to be a sort of liturgical meditation by a post-exilic poet on the deliverance of Jerusalem. It is in fact a composition parallel to xxvi. 1–19 (cf. xxxvii. 22–32, also post-exilic). Sellin, however, warmly defends the Isaianic character of the passage, as well as of the previous chapters xxxiv.–xxxv., probably written by the same hand to form the eschatological appendix to the preceding group. Edom figures prominently in xxxiv.; but the apocalyptic character of the passage is not modified by this fact — Edom in fact became a symbolical name for the oppressive world-power. The earliest possible date of composition would be about 400 B.C.

A further appendix to the Isaianic collection ending at Chapter xxxiii. is contained in Chapters xxxvi.–xxxix. These chapters which are mainly narrative in character have been excerpted from the Book of Kings. They correspond to 2 Kings xviii. 8–xx. 19. The only divergencies are (a) the omission in the Isaiah text of the section contained in 2 Kings xviii. 14–16 and (b) the insertion in the Isaiah text of Hezekiah's psalm of thanksgiving Is. xxxviii. 9–20, apparently a late post-exilic composition. See further HEZEKIAH.

The Deutero-Isaiah. — With Chapter xl. a new section of the book of Isaiah begins. Here the background is entirely different from that of the earlier chapters contained in part I. The oppressive world-power is no longer Assyria but Babylon. The Exile is not so much predicted as pre-supposed. The chapters are the work of a great lyrical poet who sees everything through a sort of golden haze. Chapters xl.–xlviii., apart from some small interpolations, are the work of this writer who apparently composed them c. 538 B.C., *i.e.*, after Cyrus had appeared on the scene, but before his capture of Babylon. Theologically the chapters are of great importance, insisting as they do on the unique character of Yahweh who is the sole God — there is but one God Yahweh and Israel is his prophet. The chapters were apparently written in Babylonia. Chapters xlix.–lv., which by a majority of critics are ascribed to "Deutero-Isaiah" (style and phraseology are practically the same), are distinguished from the preceding chapters by the disappearance from them of the themes so prominent in the earlier chapters. Cyrus is no longer referred to. The Exodus from Babylon is no longer insisted upon. The future glory of Zion-Jerusalem is prominently dwelt upon, and the gathering in of the exiles scattered throughout the world is described. Possibly these chapters were composed, as Cornill suggests, "under the immediate impression produced by the issue of the edict in which Cyrus gave permission to the exiles to return home."

It is important to note Sellin's reminder that the whole work of Deutero-Isaiah is eschatological. "With the victory of Cyrus there dawns for him those last times which for centuries had been the object of a burning hope. By this everything is to be explained— the miraculous march through the wilderness, the picture of the New Jerusalem, the conversion of the heathen and the overthrow of the world-power" (cf. also xlix. 26: li. 6 sqq.). It has been commonly assumed that the prophecies of Deutero-Isaiah were circulated by this author in written form; but recently the view that the discourses were spoken orally at different times (perhaps in some place where the exiles met) has gained ground.

Trito-Isaiah.—With Ch. lvi. an entirely new section of the Book begins. Here everything breathes a different atmosphere. Zion's felicity — the day of longed-for salvation — has not yet dawned. But the obstacle is no longer Babylon, but godless members of the Jerusalem community and heretics. There is here no question of a Return — a new Exodus. The Jews are settled in the Holy Land; Jerusalem is no longer in ruins, but has a settled population; the Temple has been re-built. But matters are not well with the restored community. There are grave symptoms of internal weakness. Social conditions are unsatisfactory; the rich oppress the poor. The old Israelitish population of the land (in Judaea and Samaria) is unwilling to submit to the "yoke of the Law" and threatens to build a rival Temple. The chapters form a distinct group by themselves, though the various items are strung rather loosely together. They were evidently written at a critical time, when it was all-important to strengthen the faith of the strict, religious party by kindling hope among them in the coming salvation. The godless are to be brought into judgment, and redress is to come for the pious followed by the glorification of the Holy City.

Apart from some inconsiderable additions the chapters are regarded by many modern scholars, including Duhm and Marti, as having emanated from one author, who is styled for the sake of convenience the "Trito-Isaiah." He wrote in the middle of the fifth century, apparently (c. 450 B.C.), a few years before the arrival of Nehemiah in Jerusalem.

There are certain difficulties about the hypothesis of Trito-Isaiah which have been well summarized by Sellin, who points out that the themes which are prominent in the time of Malachi and Nehemiah are absent from these chapters. Moreover, there are two, if not three, passages which imply that the Temple was not in existence at the time when the author wrote (cf. lxiii. 18; lxiv. 8 *sq.*; and lxvi. 1–5). Possibly the first two of these passages are late interpolations, while the third does not necessarily imply the non-existence of the Jerusalem Temple. If these chapters are not a literary unity the best alternative view as to their origin is perhaps the following: a post-Exilic editor taking a section of writing which belonged to Deutero-Isaiah, viz., Chapters lx.–lxii., combined this, "with the work of a Jerusalemite prophet of the period between 586 and 520" (Sellin) and enlarged it with additions of his own.

It is impossible here to do more than refer to the so-called "Servant Songs" about which a whole literature has grown up (xlii. 1–4; xlix, 1–6; l. 4–9; lii. 13–liii. 12). Is the servant here a collective term for the true Israel, or does it stand for an individual and if so for whom? The commonly accepted view has been some form or other of the first or collective interpretation (see J. Skinner, The Cambridge Bible ad loc.); but recently several scholars have adopted the individualistic interpretation; so especially Sellin who now identifies the servant with Moses, though he formerly thought of Jehoiachin. See further discussions by S. A. Cook, Camb. Ancient History, iii. 489 sqq., and H. Wheeler

Robinson, *The* Cross and *the Servant.*

The Origin of the Book of Isaiah.— It may be inferred from Ecclus. xlviii. 20–25 that the book as we have it was then already in existence *c.* 200–180 B.C.; further it seems probable that about 400 B.C. a Book of Isaiah was in existence which contained chapters i.–xxxv. of our present book, to which chapters xxxvi.–xxxix. were added later. Between 400 and 200 B.C. the work of Deutero- and Trito-Isaiah which at first circulated independently, were added to the Isaianic collection. Not improbably the juxtaposition may have been due to Deutero-Isaiah himself. for there are linguistic points of contact between the later chapters and the work of Isaiah of Jerusalem. The earlier history of the Isaianic collection is wrapped in obscurity. It is clear that the prophet himself was primarily a preacher and delivered his discourses orally; they were written down only at a later stage. (Cf. the analogous case of Jeremiah, Jer. xxxvi.) Fragments of the prophet's discourses were no doubt carefully treasured by his disciples (cf. Is. viii. 16; xxx. 8). The collections were formed and later still further collections, the whole being brought up to date by eschatological additions.

The Life and Activity of Isaiah.— The prophet Isaiah, the son of a certain Amoz, was the father of two sons who bore highly symbolical names, viz., Shear-Jashub ("a remnant shall return") and Mahar-shalal-hash-baz ("swift spoil, speedy prey"). The prophet's family probably belonged to the aristocracy of Jerusalem and may have had connections with the royal house. The prophet seems to have been able to enter the presence of the king at will (cf. Chapter vii.). His active career extended from about 738 B.C. (cf. Is. vi. 1) to at least 701 B.C. and probably later 690 B.C. (?). He may have been martyred under Manasseh as Jewish legend attests. The prophet lived through a succession of political crises connected with the intervention of Assyria in western Asia, viz.: the Syro-Ephraimitish War 734 B.C.; the fall of Samaria, 722 B.C.; the siege of Ashdod by Sargon, 711 B.C.; the death of Sargon, 705 B.C.; and the invasion of Sennacherib in 701 B.C. Isaiah has well been called "the prophet of Faith." He stands a sublime figure for faith in the supremacy of the spiritual over the earthly; for the potency of high ideas and ideals over brute force and power. To have combined such a lofty faith with practical statesmanship — for Isaiah was essentially a man of action — is an achievement worthy of the greatest men of any age.

BIBLIOGRAPHY.—Cheyne, *Introduction to the Book of Isaiah* (1898); Commentaries by Duhm, Marti, G. A. Smith, Box, Skinner; S. R. Driver, *Isaiah His life and times* (1888). Further Literature in Sellin, *Introduction to the Old Testament* (1923); C. Boutflower, *The Book of Isaiah in The Light of Assyrian Monuments* (1930). (G. H. B.)

ISAIAH, ASCENSION OF, an interesting apocryphal book of the Old Testament. Its various constituents — the Martyrdom of Isaiah, the Testament of Hezekiah and the Vision of Isaiah — circulated independently as early as the 1st century. The first of these was of Jewish origin, and is of less interest than the other two, which were the work of Christian writers. The Vision of Isaiah is important for the knowledge it affords of 1st-century beliefs in certain circles as to the doctrines of the Trinity, the Incarnation, the Resurrection, the Seven Heavens. etc. The long-lost Testament of Hezekiah, which is, in the opinion of Charles, to be identified with iii. 13b–iv, 18 of the present work, is unquestionably of great value because of the insight it gives into the history of the Christian church at the close of the 1st century. Its descriptions of the worldliness and lawlessness which prevailed among the elders and pastors, *i.e.*, the bishops and priests, of the widespread covetousness and vainglory as well as the growing heresies among Christians generally: agree with similar accounts in II Peter, II Timothy and Clement of Rome.

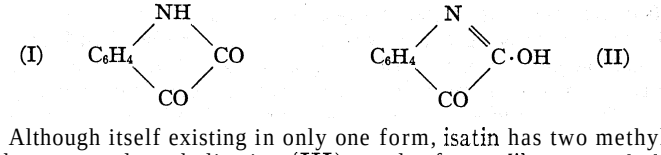
Of the three original sources, (1) the Martyrdom of Isaiah consists of i, 1, 2^a, 6^b–13^a, ii, 1–8, 10–iii, 12, v, 1^b–14, and is but an imperfect survival of the original work. (2) The Testament of Hezekiah is to be found in iii, 13^b–iv, 18, in a mutilated form, without beginning or end. (3) The Vision of Isaiah is vi–xi, 1–40. Its archetype existed independently in Greek, and differs in many respects from the form in mhich it was republished by the editor of the entire work. This editor had the three documents mentioned at his disposal; the first was of Jewish, the others of Christian origin; he reduced or enlarged them as it suited his purpose, and put them together as they stand in the present text. As regards the dates of the different elements, the Martyrdom belongs to the 1st century A.D., the Testament of Hezekiah to the period A.D. 88–100, the Vision of Isaiah to the close of the 1st century A.D., but the work as it now stands is probably not earlier than the latter half of the 2nd century.

See R H. Charles, *The Ascension of Isaiah* (1900), in *The Apocr. and Pseudepig. of the O.T.*, ii, 155–162 (1913), and in the S.P.C.K. "Translations of Early Documents" (1918). (W. O. E. O.)

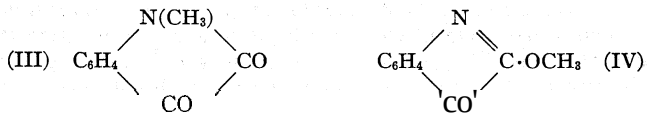
ISALLOBAR, a line entered on a meteorological chart connecting points having the same change in pressure in a given period of time preceding the time of observations represented on the chart. By international agreement, three-hour pressure changes or tendencies are transmitted by all stations and ships to the collecting-distributing centres with each observation. Isallobars may be drawn for these values or for those of 12-hour or 24-hour intervals obtained by comparison with pressure observations taken 12 or 24 hours previously. (H. R. B.)

ISAR (identical with *Isère*, in Celtic "the rapid"), a river of Germany. It rises in the Tirolese Alps. at an altitude of 5.840 ft. It winds in deep, narrow gorges through the Alps, and at Tölz (2,100 ft.), enters the Bavarian plain. which it traverses in a generally north and northeast direction, and enters the Danube immediately below Deggendorf. It is 163 mi. long with a drainage area of 3,461 sq.mi. Below Munich the stream is 140 to 350 yd. wide. and is studded with islands It is not navigable, except for rafts. The Isar is essentially the national stream of the Bavarians; it traverses the finest corn land in the kingdom On its banks lie the cities of Munich and Landshut, and the venerable episcopal see of Freising. See DANUBE.

ISATIN, in chemistry, an oxygenated derivative of indole (q.v.) prepared originally by oxidizing indigo nith nitric or chromic acid. It crystallizes in orange-red prisms melting at 200°-201° C. Isatin is of practical importance in the manufacture of vat colours For example. it yields Ciba red G (thioindigo scarlet G) by condensation with 2-hydroxythionaphthene and subsequent bromination of the condensation product Isatin is also of outstanding scientific interest because it was one of the first recognized examples of tautomerism (q.v.). It is a chemical individual nith two personalities Certain of its reactions suggest the lactam constitution (I) whereas others indicate the lactim configuration (II).



Although itself existing in only one form, isatin has two methyl ethers: pseudomethylisatin (III) made from dibromomethyloxindole, and methylisatin (IV) prepared by



the interaction of methyl iodide and silver isatin.

Isatin and its homologues are produced by condensing aniline and its homologues with hydroxylamine sulfate and chloral hydrate; an intermediate isatinimide is formed which on hydrolysis furnishes the corresponding isatin.

ISAURIA, a district in the interior of Asia Minor. The nucleus of it was that section of the Taurus which lies directly south of Iconium and Lystra. Lycaonia had all the Iconian plain; but Isauria began as soon as the foothills mere reached. When the Romans first encountered the Isaurians (early in the 1st century B.C.), they regarded Cilicia Trachea as part of Isauria, mhich thus extended to the sea; the whole basin of the Calycadnus was reckoned Isaurian, and the cities in the valley of its southern branch formed what was known as the Isaurian Decapolis. Toward the end of the 3rd century A.D., however, all Cilicia was detached for administrative purposes from the northern slope oi Taurus; Pisidia mas also detached, and made to include Iconium. In compensation Isauria received the eastern part of Pamphylia. Restricted again in the 4th century, Isauria ended as the wild district about Isaura Palaea and the heads of the Calycadnus. During the war of the pirates against Rome, the Isaurians took so active a part that the proconsul P. Servilius followed them into

their fastnesses, and reduced the whole people to submission. The Isaurians were afterward placed under the rule of Amyntas, king of Galatia; but it is evident that they continued to retain their predatory habits and virtual independence. In the 4th century they are described by Ammianus Marcellinus as the scourge of the neighbouring provinces of Asia Minor; but they are said to have been effectually subdued in the reign of Justinian. Isauria passed into the hands of Turcomans and Yuruks with the Seljuk conquest.

This comparatively obscure people had the honour of producing two Byzantine emperors, Zeno, whose native name was Traskalisseus Rousoumbladeotes, and Leo III, who ascended the throne of Constantinople in A.D. 718, reigned until 741, and became the founder of a dynasty of three generations. The ruins of Isaura Palaea are mainly remarkable for their fine situation and their fortifications and tombs. Those of Isaura Nea have disappeared, but numerous inscriptions and many sculptured steles, built into the houses of Dorla, prove the site. It was the latter, and not the former town, that Servilius reduced by cutting off the water supply. The site was identified by W. M. Ramsay in 1901.

ISCHIA (Gr. Pithekoussa, "the apes' island," Lat. Aenaria, in poetry *Inarime*), an island off the coast of Campania, Italy, province of Napoli, 16 mi. S.W. of Naples and 7 mi. S.W. of the Capo Miseno, the nearest point of the mainland. Pop. (1951) 31,813. It is situated at the west extremity of the gulf of Naples, and is the largest island near Naples, measuring about 19 mi. in circumference and 18 sq.mi. in area. It belongs to the same volcanic system as the mainland near it, and the Monte Epomeo (anc. Epopeus, "viewpoint"), the highest point of the island (2,589 ft.), lies on the north edge of the principal crater, which is surrounded by 12 smaller cones. The island was occupied by Greek settlers but its Eretrian and Chalcidian inhabitants abandoned it about 500 B.C. owing to an eruption, and it is said to have been deserted almost at once by the greater part of the garrison which Hieron I of Syracuse had placed there about 470 B.C., owing to the same cause. Later on it came into the possession of Naples, but passed into Roman hands in 326, when Naples lost its independence.

Several eruptions are recorded in Roman times. The last of which we have any knowledge occurred in 1301, but the island was visited by earthquakes in 1881 and 1883, 1,700 lives being lost in the latter year, when the town of Casamicciola on the north side of the island was almost entirely destroyed The hot springs (147°), are alkaline and saline, and are much visited by bathers, especially in summer. They were known in Roman times, and many votive altars dedicated to Apollo and the nymphs have been found. The island is mountainous, beautiful and fertile. Wine, corn, oil and fruit are produced, especially the former, while the mountain slopes are clothed with woods. Tiles and pottery are made. Straw-plaiting is a considerable industry at Lacco; and a certain amount of fishing is also done. The potter's clay of Ischia served for the ancient potteries of Cumae and Puteoli. The chief towns are Ischia on the east coast, capital and seat of a bishop, pop. (1951) 7,064, with a 15th-century castle, to which Vittoria Colonna retired after the death of her husband in 1525; Casamicciola, population (1951) 3,297 on the north; and Forìo on the west coast, population (1951) 3,997 There is communication with Naples, both by steamer direct, and also by steamer to Torregaveta, and thence by rail

See G Algranati, *Ischia* (1930). (T. A.; X.)

ISCHL, spa and town in Upper Austria, Bundesland, annexed to Germany, 1938–45. Between the Ischl and Traun rivers on a peninsula at an altitude of 1,530 ft., it is one of the most fashionable watering places in Europe, famous for its mild climate, its saline and sulfur drinking springs, mud, sulfur and brine baths. Much of its popularity has been due to the fact that it was from 1822 the summer residence of the Austrian imperial family. Ischl is a centre of the Austrian salt industry which has been carried on since the 12th century. Pop. (1951) 13,422.

ISENTROPIC CHART. The isentropic chart is used in weather forecasting and in problems of meteorological research. It was first suggested by Sir Napier Shaw in Great Britain in 1933 and later. in 1936, by Carl-Gustav Rossby in the U.S., when the network of weather stations taking upper air observations (see UPPER AIR SOUNDINGS) became sufficient to make construction practical. An isentropic chart shows the moisture distribution and flow of air along a surface of constant entropy, which in meteorology is also a surface of constant potential temperature. (See METEOROLOGY.) The isentropic surface is not at a constant level but varies in height from place to place over the earth, the variation being indicated on the isentropic chart by lines (isobars) showing the pressure at which the isentropic surface is iound. The moisture distribution is shown by lines of constant mixing ratio expressing the number of grams of moisture per kilogram of air (dry). The flow of air at the isentropic surface is represented by winds recorded from pilot balloon (*q.v.*) observations and stream lines computed from the field of pressure and temperature.

Air particles tend to flow along isentropic surfaces rather than at constant levels. By virtue of this fact the life history of air currents can be conveniently followed from day to day by means of isentropic charts. In addition, they give a lucid picture of the physical processes which produce the weather.

See Jerome Namias, An Introduction to Air Mass and Isentropic Analysis, American Meteorological Society (1940). (J. Ns.)

ISEO, LAKE OF, a lake in Lombardy, north Italy (anc. Lacus Sebinus), at the southern foot of the Alps, between the provinces of Bergamo and Brescia. The Oglio enters the north end at Lovere and leaves the south end at Sarnico to join the Po. Area 25 sq.mi., length 16 mi., greatest width 3 mi., greatest depth 823 ft., height of surface above sea level 610 ft. It contains the island of Siviano, culminating in Monte Isola (1,834 ft.) crowned by a chapel, while to the south is the islet of San Paolo, occupied by the buildings of a small disused Franciscan convent and to the north the equally tiny island of Loreto, with a ruined chapel containing frescoes. At the southern end of the lake are the small towns of Iseo (15 mi. by rail from Brescia) and of Sarnico. Toward the head of the lake, the deep wide valley of the Oglio is seen, dominated by the glittering snows of the Adamello (11,660 ft.). Along the east shore there is a fine carriage road.

ISÈRE, a de'partement of France, formed in 1790 out of the northern part of the old province of Dauphin&. Pop. (1954) 626,116. It is bounded north by the de'partement of the Ain, east by Savoie, south by the Hautes Alpes and the Drôme and west by the Loire and the Rhône de'partement. Area, 3,180 sq.mi. The de'partement consists of most of the upper course of the Isère river (*q.v.*) and of the Drac, among the French Alps, and of the lower land towards the great bend of the RhBne at Lyons (Bas Dauphin&). At Vienne the average annual temperature is 5.3° above that of Paris, but winters are cold amongst the mountains, and rainfall increases there to nearly 80 in. The de'partement is divided into three separate arrondissements (Grenoble, la Tour-du-Pin and Vienne). 45 cantons and 566 communes. It is in the region of the 14th army corps (Lyons). Its capital is Grenoble which is the seat of a court of appeal, of an académie (educational division), and of a bishop now in the province of Lyons, but before the Revolution in that of Vienne: other important towns are Vienne, St. Marcellin and la Tour du Pin. It contains coal and iron mines, slate and stone quarries, and several mineral springs. The forests cover much ground. Flourishing industries are those of cement, glove making, silk weaving and paper making, metal work of various kinds, etc. Wheat, oats, vines, mulberries, chestnuts, tobacco, etc. are grown. The pastures feed horses, mules and cattle, while sheep from Provence migrate into the department in summer. Crémieu is a hill town with ancient fortifications and market. La Grande Chartreuse is in the de'partement.

ISÈRE (anc. ISARA), tributary of the RhBne, southeast France, 180 mi. long, with a descent of 7,550 ft. and a drainage area of 4,275 sq.mi. It flows through the *départements* of Savoie, Isère and Drôme. It rises as a torrent in the Galise glaciers of the French Graian alps, and has successive sections of its course orientated southeast, northwest and northeast-southwest, crossing the geological outcrops for the most part obliquely, and receiving the Arly and Arc, among other streams. After traversing the northern part of the axis of the Belledonne chain, it enters the wider Graisivaudan valley, floored by Jurassic strata, which is parallel to the Belledonne and flows southwestward to its union with its southern feeder, the Drac, just below Grenoble; it becomes navigable at Montmélian.

ISERLOHN, a town in North Rhine-Westphalia, Germany, on the Baar, 17 mi. W. of Arnsberg, and 30 mi. E.N.E. from Barmen by rail. Pop. (1910) 46.221. Iserlohn is a very old town, its guild of armourers being referred to as ancient in 1443. Both in the town and neighbourhood there are numerous foundries and works for iron, brass, steel and bronze goods, while other manufactures include wire, needles and pins, fishhooks, machinery, umbrella frames. thimbles, bits and furniture.

ISFAHAN (the *Aspadana* of Ptolemy and *Spahan* of the Pahlevi texts), an Iranian Ostar or province and city. The province is bounded by the provinces of Kashan on the north, Khuzistan on the west, Yezd on the east and Fars on the south. Grain

cultivation in some districts is very large and much is exported to other parts of Iran; but the cultivation of the poppy, cotton and tobacco constitutes the chief wealth of Isfahan province. The general elevation lies between 5,000 ft. in the east and 9,000 ft. in the west. Population 1,516,443, (1956).

The city of Isfahan, formerly the capital of Iran, is now only the administrative headquarters of the province. Choosing Isfahan for his capital, Shah Abbas I made of it a large and imposing city. Its magnificence gave rise to the saying *Isfahán nisf-i-jahán* (Isfahan is half the world). The city lies in 32° 39' N. and 51° 40' E., at an elevation of 5,330 ft. along the north bank of the Zayinda Rud, which is crossed by three fine masonry bridges. The Allah Verdi Khan bridge consists of 33 arches, is 388 yd. in length with a paved roadway of 12 yd. breadth, and has galleried arcades on each side for foot passengers. Farther down the river is the even more beautiful bridge, the *Pul-Khajoo,* with its storied recesses and galleries and arcades that provide the population with a favourite place of rest and recreation. It was built by Shah Abbas II, in the middle of the 17th century. A little farther is a much earlier bridge and, well down the stream, the Sharistan bridge, the foundation piers of which date from Sassanian times. The water supply of the city is principally from open canals led off from the river and from several streams and canals which come down from the hills in the northwest. Pop. (1956) was 254,708. There are a few Zoroastrians and Bahais. Viewed from the air, the city presents an immense expanse of mingled buildings and gardens, 30 mi. in circuit; but, with the exception of the bazaars and other scattered agglomerations of houses, there is no continuous inhabited area, except in the centre. The city lies in a level tract of country which extends for miles to the east and north. Bare rugged mountains all but enclose the city on the south, west and northwest. A feature of the landscape is the large number of handsome towers which dot the plain, providing shelter for pigeons whose fertilizing manure forms a lucrative source of revenue.

The Modern City.—Although present-day Isfahan is in part a city of vanished glory, it is still a city of remarkable beauty. Many of its finest buildings having suffered from neglect during the 19th century, an official was sent from Tehran in 1902 to inspect the crown buildings and to report on their condition. Pursuant to his report it was decided to repair and renovate some, while others were demolished and their timber, bricks and stone sold to local builders. Many of the gardens for which in the early days it was famous, became wildernesses. But of the many fine buildings constructed by the Safavis the most important still remain, as do scores of lesser structures.

The heart of the city and central point of interest at the present time is the Maidan-i-Shah, an immense and still imposing rectangular space, 560 yd. from north to south by 174 yd., bordered by brick buildings of two stories of recessed arches or arcades. On the south side of the *maidan* is an arched portal leading to the famous Masjid-i-Shah, or royal mosque, completely covered with enamelled tile of great brilliancy, which was built by Shah Abbas I (1611) and is certainly one of the most beautiful buildings in the world. It has recently been put in perfect repair. On the eastern side stands the low-domed Masjid-i Sheik Lutf Ullah (1621), dedicated to the saintly uncle of Shah Abbas and his own private place of worship. The interior is of dazzling perfection, entirely covered with a combination of faience mosaic and painted tile. Opposite, on the west side, is the Ali Kapu (highest gate or sublime porte), a lofty building in the form of an archway crowned in the fore part by an immense open balcony (which formerly served as an audience hall and a vantage point from which the court could view the games and processions below). This gateway leads into the gardens of the former royal palace, which covers a considerable area with its courts and pavilions, one of which, the Chihil Situn (hall of 40 pillars), was famous as the verandah and throneroom of Shah Abbas. On the north side of the *maidan* is the gateway, covered with brick of faience, leading to the Royal (Kaisarieh) bazaar. Well to the N.E. of the centre of the town still stands the great Masjid-i-Jami or Cathedral mosque, historically and architecturally the most important building in Isfahan. It is a huge ensemble of more than a score of different constructions, some dating probably from the 10th century. Here are scores of superbly constructed rib vaults and two magnificent Seljuq dome chambers. The smaller one, which architects regard as the most perfect building in Isfahan and some are ready to say the most beautiful dome chamber extant, is dated 1088. It has remained in perfect condition.

From the precincts of the palace mentioned above runs the grand avenue or Chahar Bagh (four gardens), an avenue laid out by Shah Abbas I, nearly ¾ mi, in length and 200 ft. broad, leading to the bridge of Allah Verdi Khan and the high road to Shiraz. It was originally laid out with watercourses and fountains, and poplar and sycamore trees. On the east side of the avenue is the Masjid and the Madrassa Mader-i-Shah Sultan Husain, built in 1710, designed as a college for the training of mullahs and dervishes, and described by Curzon in 1892 as "one of the stateliest ruins that he saw in Persia." Never much damaged, it was restored to perfect condition recently. The bazaars of Isfahan lie behind the northern and eastern sides of the *maidan,* and in them it is possible to walk for three mi. or more under covered shade. They have all the characteristic features of other Asiatic marts and the trade carried on preserves for Isfahan some at least of the prestige which once belonged to the city. Brocaded cloths, printed cottons, felt goods, saddles, native weapons, lacquered ware, pottery, articles of silver filigree-work and of metal are among the characteristic merchandise.

Julfa, across the Zayinda Rud, is the Armenian suburb of Isfahan. Here Shah Abbas, about 1603, transplanted several thousand families of Christian Armenians from Julfa on the Araxes and settled them on the outskirts of his capital. They are strictly orthodox and have a cathedral and several handsome churches, decorated with the finest Iranian polychrome tile (haft *rangi*) and in the cathedral are Italian mural paintings done by journeymen artists in the 17th century. The population of the suburb has tended to decline in recent years.

In Isfahan itself the Church Missionary society has a church, medical mission, industrial home and schools and hostels both for boys and girls. Among these the Stuart Memorial college is the leading educational institution in this part of Iran.

From Isfahan there are several roads, to Tehran (240 mi.), to Shiraz (290 mi.) and to Kerman (400 mi.) via Yezd.

The temperature varies from a maximum of 97.8" F. in July to 23.8° in Jan. The relative humidity is 63 as compared with 54 at Tehaan and 67 at Bushire. The average rainfall over a period of 17 years was 4.74 in.

BIBLIOGRAPHY.—C. Texier, *L'Arménie,* la Perse, etc. (1840); Flandin, et Coste, Voyage en Perse (1843–54); C. J. Wills, In the Land of the Lion and Sun (1883); E. Stack, Six Months in Persia (1882), vol. II, chap. ii; Mme. J. Dieulafoy, La Perse, la *Chaldée et* le *Susianne* (1887); Mrs. Bishop, Journeys in Persia and Kurdistan (1891), vol. II, letters xii and xiii; G. N. Curzon, Persia and the Persian Question (1892), Vol. ii; E. G. Browne, A Year Among the *Persians* (1893); W. Schulz-Baumgartner, "Isfahan die persische Kunstmetropole," Deutsch Rund, G. (1901), p. 433 ff.; "Isfahan, l'ancienne Capitale des Shahs de Perse," A travers *le* Monde (1905, Dec.); A. V. Williams Jackson, *Persia* Past and Present (1906); C. Anet, Through *Persia* in a Motor-car (1907). For more than a hundred illustrations and extensive text on the monuments and the arts of Isfahan and environs, see A Survey of Persian Art, A. U. Pope, ed. (1938): for Architecture and Architectural Ornament, Vol II, pp. 949–64, 1004–12, 1179–1201, 1332–34, 1349–52; Vol. IV, pls. 275, 283–300, 303, 363–66, 386–90, 414–17; 458–59, 463–86, 493, 495, 497, 501–07, 546–53; for the bridges, Vol. II, pp. 123–40; for the city plan, Vol. II, pp. 1406–16; A. Godard, "Historiques du Masjid-e Djuma d'Isfahan," *Athar-é-Iran,* 1936, tome I, fasc. II and "Isfahan," *Athar-é-Iran,* 1937, tome II, fasc. I; M. B. Smith, "Monars of Isfahan," *Athar-é-Iran,* 1936, Tome I, fasc. II.

(A. U. P.)

History — The natural advantages of Isfahan must always have made it a place of importance. In the most ancient cuneiform documents, referring to a period between 3000 and 2000 B.C., the province of Anshan, which certainly included Isfahan, was the limit of the geographical knowledge of the Babylonians, typifying the extreme east, as Syria (or Martu-ki) typified the west. The two provinces of Anshan and Subarta, by which we must understand the country from Isfahan to Shuster, were ruled in those remote ages by the same king, who undoubtedly belonged

to the great Turanian family; and from this first notice of Anshan down to the 7th century B.C. the region seems to have remained more or less dependent on the paramount power of Susa. The western Iranians, after separating from their eastern brethren on the Oxus as early perhaps as 3000 B.C., are believed to have bifurcated into two branches, westward into Media and southward towards Persia. The first substantial settlement of the southern branch would seem to have been at Isfahan, where *Jem*, the eponym of the Persian race, is said to have founded a famous castle, the remains of which were visible as late as the 10th century A.D. At the commencement of the 7th century B.C., Persia and Anshan are still found in the annals of Sennacherib amongst the tributaries of Elymais, confederated against Assyria; but shortly afterwards the great Susian monarchy, which had lasted for full 2,000 years, crumbled away under continued pressure from the west, and the Aryans of Anshan recovered their independence, founding for the first time a national dynasty, and establishing their seat of government at Gabae on the site of the modern city of Isfahan. The royal city of Gabae was known as a foundation of the Achaemenidae as late as the time of Strabo, and the inscriptions show that Achaemenes and his successors did actually rule at Anshan until the great Cyrus set out on his career of western victory. The provincial name of Anshan or Assan seems after the age of Cyrus to have given place to Gabene or Gabiane, which alone appears in the Greek accounts of the wars of Alexander and his successors, and in the geographical descriptions of Strabo. Gabae or Gavi became gradually corrupted to *Jai* during the Sassanian period, and it was thus by the latter name that the old city of Isfahan was generally known at the time of the Arab invasion. Subsequently the title of Jai became replaced by *Sheheristin* or *Medineh*, "the city" *par excellence*, while a suburb which took the name. of *Yahudieh*, or the "Jews' town," gradually rose into notice and superseded the old capital.

Sheheristān and *Yahudieh* in the early ages of Islam are described as independent cities, each surrounded by a separate wall; but about the middle of the 10th century the famous Buyid king, known as the *Rukn-addaula (al-Dowleh)*, united the two and many of the adjoining villages in one general enclosure which was about 10 mi. in circumference. The city, which had now resumed its old name of Isfahan, continued to flourish till the time of Timur (A.D. 1387), who is said to have erected a *Kelleh Minār* or "skull tower" of 70,000 heads at the gate of the city, as a warning to deter other communities from resisting his arms. Isfahan, however, recovered and when the Safavid dynasty, who succeeded to power in the 16th century, transferred their place of residence to it from Kazvin, it rose rapidly in population and wealth. It was under Shah Abbas I, the most illustrious sovereign of this house, that Isfahan attained its greatest prosperity. This monarch adopted every possible expedient, by stimulating commerce, and encouraging arts and manufactures, to attract visitors to his favourite capital. He built several magnificent palaces, decorated in the richest style, planted gardens and avenues, and distributed among them the waters of the Zendeh-rud in an endless series of reservoirs, fountains and cascades. The baths, mosques, colleges, bazaars and caravanserais of the city received an equal share of his attention, and European artificers and merchants were encouraged to settle in his capital. Ambassadors visited his court from many of the first states of Europe, and factories were permanently established for the merchants of England, France, Holland, the Hanseatic' towns, Spain, Portugal and Moscow. The celebrated traveller Chardin, who passed a great portion of his life at Isfahan in the latter half of the 17th century, has left a detailed and most interesting account of the statistics of the city at that period. He estimated the population at 600,000. There were 1,500 flourishing villages in the immediate neighbourhood; the enceinte of the city and suburbs was reckoned at 24 mi. while the old walls surrounding the city itself measured 20,000 paces. In the interior were counted 162 mosques, 48 public colleges, 1,802 caravanserais, 273 baths ,and 12 cemeteries. The adjoining suburb of Julfa was also a most flourishing place. The first blow to the prosperity of modern Isfahan was given by the Afghan invasion at the beginning of the 18th century, since which date, although continuing till the end of the century to be the nominal head of the empire, the city has gradually dwindled in political importance.

ISHII, KIKUJIRO, VISCOUNT (1866–1945), Japanese diplomatist, was born at Chiba, Japan. He intended to become a lawyer, but his studies in international law gave him a deep interest in foreign affairs. His early days were full of incident: the Meiji reconstructions took place before his eyes, and the constant stream of foreign influences aroused in him a desire to see and understand other countries. Leaving the law faculty of the Imperial university in Tokyo in 1890, he was made attaché to the Japanese legation in Paris. During his stay in Paris he applied himself to the study of European languages and became proficient in French and English. He was made third secretary in 1893, and about this time he devoted much attention to economics and international trade. He was distressed to observe that Japan did not hold such a position in the world's mart as in the opinion of most Japanese she deserved, and he set himself to find out the causes of the trouble. He endeavoured to form a Franco-Japanese mutual trade association, and although his efforts did not at first meet with the full success he desired, a certain stimulus was at once felt.

Some fruits of Ishii's labours were seen in the commercial mission which was sent from France to Japan in 1925.

In 1896 he was appointed consul to Chemulpho (Jinsen) in Korea. After this he was made second secretary and later first secretary at the Japanese legation in Peking. He was, therefore, in Peking in an official capacity during the Boxer rising. In 1900 he was appointed secretary of the head office and chief of the telegraph section of the home office department, which post he held until he became director of the commerce bureau in 1904. In 1907 he was sent to San Francisco and Vancouver in connection with the anti-Japanese riots there. His success in this matter was the direct cause of his appointment in the following year as vice-minister for foreign affairs. His love of France and understanding of French problems made him an easy favourite for the ambassadorship to Paris in 1912, and on his return he took over the portfolio for foreign affairs in the new government. He was chief of the foreign office for the period 1915–16, and in the latter year he was created viscount, having been made baron in 1912. He played a great part in American-Japanese relations and was a special envoy to the United States in 1917. He was nominated a member of the house of peers in 1916. In 1920 Viscount Ishii was for the third time officially delegated to Paris. In 1927 he became one of the Japanese delegates to the naval disarmament conference at Geneva.

He returned to Japan in the autumn of 1927, and retired from diplomatic service.

Perhaps Ishii's greatest claim on his country's gratitude was his work in connection with the so-called "gentlemen's agreement" made between Washington and Tokyo in 1917. Lansing was the United States representative in the negotiations, for which reason the arrangement is sometimes called the "Lansing-Ishii pact." The western coast of the United States made representations to congress deploring the increasing immigration of Asiatics, notably Chinese and Japanese. It was claimed that owing to the Asiatic standard of living being lower than that of Americans, there was a serious possibility of California becoming a Japanese colony, and the aid of legislation was invoked. The Lansing-Ishii pourparlers resulted in the postponement of suggested legislative measures, and a yearly maximum (tentatively fixed at 150) was proposed. Japan, through Ishii, agreed not to issue passports for more than this number annually to enter the United States as residents, and it was through Japan's alleged breach of faith in connection with this agreement that the Immigration Restriction act was passed by congress in 1924. In substance, this act was one of the proposals originally shelved by the labours of Lansing and Ishii. In Dec. 1920 he became Japanese delegate to the 11th session of the council of the League of Nations. In Aug. 1923 he became president of the council of the League and in the following month a vice-president of the assembly. In Sept. 1925 he was again a vice-president of the assembly.

In March 1926 he was president of the council at its 39th session, and acted temporarily as president of the assembly. He was killed in an air raid on Tokyo in 1945. (A. N. J. W.)

ISHIM, a town of the Uralsk region, Tyumen oblast, Russian Soviet Federated Socialist Republic U.S.S.R. in 56° 10′ N. and 69° 18′ E., on the Ishim river, a left bank tributary of the Irtish. Average January temperature, −3.8° F.; average July, 66.0° F.; rainfall 17.5 in. per annum. half of which falls between June and August. Pop. (1935) 18,153. A railway from Sverdlovsk (Ekaterinburg) to Omsk passes through the town. It is an agricultural centre, with fairs in December and May to which tallow, butter, skins, hides, cattle, horses, bristles, groceries and the products of local *kustar* (peasant) industries are sent.

ISHMAEL was the son of Abraham and his Egyptian concubine, Hagar. Through the jealousy of Sarah, mother and son were driven from the tribe, and saved from death by thirst through the miraculous discovery of a well (Gen. xxi, 8–20). Ishmael grows up an archer (Gen. xxi, 20) and a "wild ass of a man" (Gen. xvi, 12), living to the south and east of Palestine. He is the ancestor of 12 tribes of desert rangers (Gen. xxv, 12–18), of whom the most important seem to be Nebaioth (Assyrian Nabaitu and Pliny's Nabataei) and Kedar (Assyrian Kidru and Pliny's Cedrei).

A third tribe, Dumah, may be the Domata of Pliny, and Jetur seems to be the eponymous ancestor of the Itureans.

Ishmael, therefore, is used in a wide sense of the wilder, roving peoples encircling Canaan from the northeast to the south, related to but on a lower rank than the sons of Isaac. It is practically identical with the term Arabia as used by the Assyrians. Nothing certain is known of the history of these mixed populations. They are represented as warlike nomads and with a certain reputation for wisdom (Baruch iii, 23). Not improbably they spoke a dialect (or dialects) akin to Arabic or Aramaic. According to the Mohammedans, Ishmael, who is recognized as their ancestor, lies buried with his mother in the Kaaba in Mecca.

See T. Noldeke, Ency. Bib., *s.v.,* and the articles EDOM, MIDIAN.

ISHTAR or ISTAR, the name of the chief goddess of Babylonia and Assyria, the counterpart of the Phoenician Astarte (*q.v.*). The earliest written form of the name is Ash-dar, an Accadian rendering of the older Sumerian Innini, "Lady of Heaven." Ishtar was the Semitic deity identified with the Sumerian virgin mother-goddess, who was always associated with the planet Venus. For this reason Ashdar, Ishtar, is undoubtedly the same deity as the south Arabian Athtar, god of the planet Venus. At all events it is now generally recognized that the name is Semitic in its origin. Where the name originated is likewise uncertain, but the indications point to Erech, where we find the worship of a great Sumerian mother-goddess having no association with a male counterpart flourishing in the oldest period of Babylonian history. She appears under various names, among which are Nana, Innanna, Nina and Anunit.

As early as the days of Khammurabi we find these various names which represented originally different goddesses, though all manifest as the chief trait the life-giving power united in Ishtar. Even when the older names are employed it is always the great mother-goddess who is meant.

Ishtar is the one goddess in the pantheon who retains her independent position despite and throughout all changes that the Babylonian-Assyrian religion undergoes.

ISIDORE OF ALEXANDRIA (*fl.* c. A.D. 500), Neoplatonic philosopher, succeeded Marinus (the successor of Proclus) in the headship of the school of Plato at Athens. His main claim to distinction is that he was the teacher of Damascius, the last and one of the greatest of the Neoplatonic successors of Plato, who wrote Isidore's life in the customary enthusiastic manner of Neoplatonic biography.

Another Isidore, of Gaza, was one of the philosophers who accompanied Damascius to Persia after the closing of the schools of Athens in 529.

ISIDORE OF SEVILLE, in Latin called ISIDORUS HISPALENSIS (*c.* 560–636), Spanish encyclopaedist, theologian and historian, probably belonging to a family from Cartagena, succeeded his brother Leander as archbishop of Seville in A.D. 600 and headed the Spanish synod of Toledo in *633.* His summary of all knowledge accessible to him, Etymologiae or Origines, remained for many centuries one of the most important reference books: almost 1,000 medieval manuscripts of it are still in existence. In its 20 sections, Isidore handed down to posterity much that he had extracted from works of previous encyclopaedists (*e.g.,* Cassiodorus), specialists and Latin writers of all kinds, on the seven liberal arts. medicine, law, history, church matters, theology, anthropology, zoology, cosmology, psychology, architecture, agriculture, etc.

Other special treatises by him were devoted to linguistic matters (*Differentiarum* libri and, perhaps, *Synonymorum libri*), to natural science and cosmology (De *natura rerum* and De *ordine* creaturarum) and to history (a continuation of Jerome's and Gennadius' De *viris illustribus;* a re-elaboration and continuation of Jerome's history, under the title Chronica maiora; and a *Historia* Gothorum, *Vandalorum* et *Sueborum*). As a theologian, he wrote *Quaestiones* in *Vetus* Testamentum; biographies of 86 persons of the Bible (De ortu et *obitu patrum*); a handbook of morals and theology in the form of a collection of Sententiae, mainly based on Gregory the Great's *Moralia;* a treatise De *fide* catholica *contra* Judaeos (8th-century Old German trans. ed. by K. Weinhold, Paderborn, 1874); De haeresibus; a liturgical work De *ecclesiasticis officiis;* and a Regula *monachorum.* The Collectio *canonum Isidoriana* (ed. by P. Hinsch, Leipzig, 1863) is considered apocryphal by most scholars, but seems to have been compiled in Spain in the times of Isidore himself: it became one of the main sources of the great canonic compilations of the 12th century such as the *Decretum* Gratiani.

BIBLIOGRAPHY.—*Opera omnia* ed. by M. de La Bigne (1580), by J. du Breul (1601) and by F. Arevalo (1797–1803); reprinted by J. P. Migne, Patrologia Latina, lxxxi-lxxxiv (1850). For the Etymologiae (1472), see the edition by W. M. Lindsay (1911); for the Chronica and the *Historia* Gothorum, that by T. Mommsen in Monumenta Germaniae Historica, *Auctores Antiquissimi,* Chronica Minora, ii (1894); for the De natura *rerum,* that by G. Becker (1857); and for the De haeresibus, that by A. C. Vega (1940).

See also E. Brehaut, An *Encyclopaedist* of the Dark Ages (1912). (L. M.-Po.)

ISIN (modem Ishan Bahriyat). The ancient city of Isin has been identified with this site, which lies 14 mi. due south of Afaj, Iraq, in 31° 51′ N. and 45° 17′ E. The city of Isin was of late foundation and does not appear in inscriptions until the last years of the Ur-Engur dynasty of Ur.

After the final overthrow of the Sumerians of that city state the two dominant principalities in Babylonia were Larsa and Isin, which were of Semitic origin. From 2357 B.C. these two states had each a synchronous dynasty. In spite of various changes and the growth of the first dynasty of Babylon Isin managed to maintain itself, until in 2126 B.C. when it was conquered by the Elamites who had previously made themselves masters of Larsa.

Finally both cities were united to the Babylonian empire under Hammurabi.

The site consists of a low mound of about 200 ac., extending from northeast to northwest. A large building was built on the summit. Excavations by S. Langdon showed that the site was occupied in Neo-Babylonian times. A further mound was discovered there.

ISINGLASS, a pure form of commercial gelatin obtained from the swimming bladder or sound of several species of fish. The sturgeon is the most valuable, various species of which, especially *Acipenser* stellatus (the seuruga), A. *ruthenus* (the sterlet) and A. *güldenstädtii* (the ossétr), flourish in the Volga and other Russian rivers, in the Caspian and Black seas, and in the Arctic ocean, and yield the "Russian isinglass"; a large fish, *Silurus parkerii,* and probably some other fish, yield the "Brazilian isinglass"; other less definitely characterized fish yield the "Penang" product; while the common cod, the hake and other Gadidae also yield a variety of isinglass. The sounds, having been removed from the fish and cleansed, undergo no other preparation than desiccation or drying, an operation needing much care; but in this process they are subjected to several different treatments. If the sound be unopened the product appears in commerce as "pipe," "purse" or "lump isinglass"; if opened and unfolded, as "leaf"

or "honeycomb"; if folded and dried, as "book," and if rolled out, as "ribbon isinglass."

The finest isinglass is prepared by steeping the sounds in hot water in order to remove mucus, etc.; they are then cut open and the inner membrane exposed to the air; after drying, the outer membrane is removed by rubbing and beating. To increase its availability, the raw material is sorted, soaked in water till it becomes flexible, and then trimmed. The trimmed sheets are sometimes passed between steel rollers. which reduce them to the thickness of paper; it then appears as a semitransparent ribbon. This is dried and, if necessary, cut into strips.

The principal use of isinglass is for clarifying wines, beers and other liquids. Of secondary importance is its use for culinary and confectionery purposes; *e.g.*, in making jellies and stiffening jams. Mixed with gum, it is employed to give a lustre to ribbons and silk. It also has valuable agglutinating properties; on being dissolved in two parts of pure alcohol. it forms a diamond cement. cooling to a white. opaque. hard solid; it also dissolves in strong acetic acid to form a powerful cement, which is especially useful for repairing glass, pottery and like substances.

ISIS, the most famous of the Egyptian goddesses. She was of human form, in early times distinguished only by the hieroglyph of her name upon her head. Later she commonly wore the horns of a cow, and the cow was sacred to her; it is doubtful, however. whether she had any animal representation in early times, nor had she possession of any considerable locality until a late period, when Philae, Behbet and other large temples were dedicated to her worship. Yet she was of great importance in mythology, religion and magic, appearing constantly in the very ancient Pyramid texts as the devoted sister-wife of Osiris and mother of Horus. In the divine genealogies she is daughter of Keb and Nut (earth and sky). She was supreme in magical power, cunning and knowledge.

Isis was identified with Demeter by Herodotus, and described as the goddess who was held to be the greatest by the Egyptians: he states that she and Osiris, unlike other deities, were worshiped throughout the land. The importance of Isis had increased greatly since the end of the New Kingdom. The great temple of Philae was begun under the 30th dynasty; that of Behbet seems to have been built by Ptolemy II. The cult of Isis spread into Greece with that of Serapis (*q.v.*), early in the 3rd century B.C. In Egypt itself Isea, or shrines of Isis, swarmed. At Coptos Isis became a leading divinity on a par with the early god Min. About 80 B.C. Sulla founded an Isiac college in Rome, but their altars within the city were overthrown by the consuls no less than four times in the decade from 58 to 48 B.C., and the worship of Isis at Rome continued to be limited or suppressed by a succession of enactments which were enforced until the reign of Caligula. The Isiac mysteries were a representation of the chief events in the myth of Isis and Osiris—the murder of Osiris. the lamentations of Isis and her wanderings. followed by the triumph of Horus over Seth and the resurrection of the slain god—accompanied by music and an exposition of the inner meaning of the spectacle. These were traditional in ancient Egypt, and in their later development were no doubt affected by the Eleusinian mysteries of Demeter. They appealed powerfully to the imagination and the religious sense. The initiated went through rites of purification. and practised a degree of asceticism: but for many the festival was believed to be an occasion for dark orgies.

Isis nursing the child Horus (Harpokhrates) was a very common figure in the Deltaic period, and in these later days was still a favourite representation. The Isis temples discovered at Pompeii and in Rome showed that ancient monuments as well as objects of small size were brought from Egypt to Italy for dedication to her worship, but the goddess absorbed the attributes of all female divinities; she was goddess of the earth and its fruits, the Nile, the sea, the underworld. love, healing and magic. The worship of Isis survived in Italy into the 5th century.

At Philae the temple of Isis was frequented until the middle of the 6th century when the last remaining shrine of Isis was finally closed.

See G. Lafaye, art. "Isis" in Daremberg et Saglio, *Dictionnaire des antiquités* (1900); *id. Hist. du culte des divinités d'Alexandrie hors de l'Égypte* (1883); Meyer and Drexler, art. "Isis" in Roscher's *Lexicon der griech. und röm. Mythologie* (1891–92) (very elaborate); E. A. W. Budge, *Gods of the Egyptians*, vol. ii, ch. xiii; A. Rusch, *De Serapide et Zside in Graecia cultis* (dissertation) (1906). (The author especially collects the evidence from Greek inscriptions earlier than the Roman conquest; he contends that the mysteries of Isis were not equated with the Eleusinian mysteries.)

ISKENDERUN (formerly ALEXANDRETTA), a port, administrative centre of an *ilce* (district) and the largest town in Hatay *il* (province), Turkey, is situated on the eastern shore of the Gulf of Iskenderun. 27 mi. N. of Antioch (Antakya) and about 60 mi. S.E. of Adana. Pop. (1960) 63.736. Lying on an alluvial plain below the Amanus mountains (Nur Daglari), the town is modern with fine buildings and avenues decorated with subtropical plants. It is also a winter resort and has a military base. Iskenderun preserves the name but probably not the exact site of the city, Alexandria ad Issum, founded to commemorate Alexander the Great's victory over the Persians at Issus (333 B.C.). The name "Little Alexandria" may date from the 4th century A.D. The port was the main outlet for overland trade from Iran and India until the construction of the Suez canal. Its rapid growth after it was returned by France to Turkey in 1939 (*see* HATAY) was due to improved port facilities. It serves as a gateway to eastern and southeastern Anatolia and is connected by rail and road with other parts of Turkey. A main road to the south, crossing the Amanus range through the historic Belen pass, leads to Antioch, northern Syria (Aleppo) and thence Iraq. (N. Tu.; S. Er.; E. Tu.)

ISLA, JOSÉ FRANCISCO DE (1703–1781), Spanish satirist, was born at Villavidanes (León) on March 24, 1703. He joined the Jesuits in 1719, was banished from Spain with his order in 1767, and settled at Bologna, It., where he died on Nov. 2, 1781. His earliest publication was a *Carta de un residente en Roma* (1725), a panegyric of trifling interest, and he wrote *La Juventud triunfante* (1727) in collaboration with Luis de Lovada.

He first showed his gifts in the *Triunfo del amor y de la lealtad: Dia Grande de Navarra,* a satirical description of the ceremonies at Pamplona in honour of Ferdinand VI's accession; its sly humour so far escaped the victims that they thanked the writer for his appreciation of their local efforts, but the true significance of the work was discovered shortly afterward, and the protests were so violent that Isla was transferred by his superiors to another district.

Isla gained a great reputation as an effective preacher, and his posthumous *Sermones morales* (1792–93) justify his fame in this respect. His position in the history of Spanish literature is due to his *Historia del famoso predicador fray Gerundio de Campazas, alias Zotes* (1758), a novel which wittily caricatures the bombastic eloquence of pulpit orators in Spain.

See R. Gaudeau, *Les Prêcheurs burlesques en Espagne au XVIIIe siècle* (1891); V. Cian, *L'Immigrazione dei Gesuiti spagnuoli letterati in Italia* (Turin, 1895).

ISLAM (Arabic, "submission" to the will of God) is the name which all Moslems give to their religion; it claims to be a divine revelation communicated to the world through Mohammed, who was the last of a succession of inspired prophets, beginning with Adam. Its doctrine and practice are based upon (1) the Word of God, the Koran (*q.v.*), (2) the traditions (Hadith), or rather the sayings and manner of life (Sunna) of Mohammed, as contained in the traditions.

Doctrine.—The Moslem creed is "There is no god but God (Allah): Mohammed is the apostle of God." The acceptance of this fhith is held to imply belief in (1) God, (2) the angels, (3) the inspired books, (4) the prophets, (5) the day of judgment and (6) God's predestination of good and evil. In the Koran the unity of God is emphasized as against the mistaken conception of the Christian Trinity, and the divine nature is expounded through an enumeration of his various qualities under the three categories of power, unity and goodness. Around the throne of God are the angels, pure, sexless beings, some of whom bear the throne, while others praise him continually; they are also his messengers and are sent to help the faithful in their fight with unbelievers. Some

are the guardian angels of men, others are the watchmen of hell.

God created the world in six days, and set Adam in the garden of paradise, but, tempted by Satan, Adam fell. Intermediate between men and angels are the Jinn, male and female, created from fire; some are believers, others are infidels. The devil is sometimes described as one of the angels, sometimes as one of the Jinn; he was expelled from heaven because he refused to prostrate himself before Adam at his Lord's command.

God has revealed himself to man through prophets, to some of whom he has given a book; *e.g.*, to Moses the Law (*taurat*), to Jesus the Gospel (injil), to Mohammed the Koran. A prophet has been sent by God to each people, but Mohammed is "the seal of the prophets" (*i.e.*, the last of the series). His mission at first was to warn men of imminent judgment, and in the earlier chapters of the Koran descriptions of the resurrection, the last judgment and paradise and hell frequently occur.

Practice. — The religious practices obligatory on the believer are (1) recital of the creed, (2) performance of divine worship five times a day, (3) fasting in the month of Ramadan, (4) payment of the legal alms and (5) the pilgrimage to Mecca.

The creed must be recited at least once in a lifetime aloud, correctly, with full understanding of its meaning and with heartfelt belief in its truth.

Every man who professes Islam is required in ordinary life to worship God five times in each day. In the Koran only four times are mentioned. "Wherefore glorify God, when the evening overtaketh you, and when ye rise in the morning, and unto him be praise in heaven and earth; and in the evening and when ye rest at noon" (xxx, 16–17), but commentators say the "evening" includes the sunset and after sunset. The five times therefore are: dawn or just before sunrise, just after noon, before sunset, just after sunset and just after the day has closed. Tradition decides within what limits the ritual may be delayed without impairing its validity.

The service (salat — incorrectly translated "prayer" — for which the word du'a is used) is preceded by the lesser ablution (*wudu*) consisting in the washing of face, hands (to the elbows) and feet in prescribed manner. Complete washing of the body (*ghusl*) is required only after legal pollution. The worshipper faces the kiblah (direction of prayer), which was at first Jerusalem, but was changed by the prophet to Mecca. In a mosque the *kiblah* is indicated by a niche (*mihrab*) in one of the walls. The service consists of prescribed ejaculations, and the recital of parts of the Koran, always including the first sura, accompanied by prostrations of the body. (*See* Mohammed Ali, *The Holy Koran,* preface xviii–xxv.) Detailed physical positions are prescribed for each part of the worship; these vary slightly in the four Sunnite schools. On a journey, in time of war or in other special circumstances, the set form of worship may be modified in accordance with appointed rules. In place of the prayer just after noon, there is the prayer of the assembly, which is observed on a Friday (yaum *al-jum'a,* "the day of assembly") in a mosque, and is usually accompanied by a bidding prayer or declamation (khutba) delivered from a step of the pulpit (mimbar). Special services are also prescribed for certain occasions, as on the eclipse of the sun or the moon, etc. Among the Sufis special attention is given to informal prayer consisting chiefly in the continual repetition of the name of God (*dhikr*). (See SUFIISM.) This is still a characteristic of some of the dervish (*q.v.*) communities.

The command to fast begins with the words, "O ye who believe! There is prescribed for you the fast, as it was prescribed for those before you." The expression "those before you" has been taken to refer to the Jews, who fasted on the day of atonement, but more probably refers to the long fast of 36 days observed by the eastern Christians. In the passage of the Koran referred to (ii, 179–181) Moslems are required to fast during the month of Ramadan, "wherein the Koran was revealed," but if one is on a journey or sick, he may fast "another number of days," and if he is able to fast and does not, "he may redeem it by feeding a poor man," but "if ye fast, it is better for you." This fast was probably instituted in the second year at Medina. At that time the corrected lunar year was in use, and Ramadan, the ninth month, was always in the winter. A few years later Mohammed decreed the use of the uncorrected lunar year, which remains the standard of time for the Moslem world, so that the month of fasting now occurs at all seasons of the year in turn. The fast is severe and means entire abstinence from food and drink from sunrise to sunset each day of the month. The fast is associated with the statement that in this month God sent down the Koran from the seventh heaven to Gabriel in the lowest that it might be revealed to the prophet.

Alms are of two kinds: (1) the legal and determined (zakat), and (2) voluntary (sadakat). The former were given in cattle, grain, fruit, merchandise and money once a year after a year's possession. For cattle a somewhat elaborate scale is adopted. Of grain and fruit $\frac{1}{10}$ is given if watered by rain, $\frac{1}{20}$ if the result of irrigation. Of the value of merchandise and of money $\frac{1}{40}$ is prescribed. In the early days of Islam the alms were collected by officialsand used for the building of mosques and similar religious purposes. At the present time the carrying out of these prescriptions is left to the conscience of the believers, who pay the alms to any needy fellow-Moslem.

The fifth religious duty of the Moslem is the pilgrimage (hadj) to Mecca, which should be performed once by every Moslem "if he is able," that is, if he can provide or obtain the means to support himself on pilgrimage and his family during his absence, and if he is physically capable. The pilgrimage is made at one time of the Moslem year, namely, from the 7th to the 10th of the month Dhu'l-Hijja. For the arrangements for the journey from various countries to Mecca, *see* CARAVAN. When the pilgrim arrives within 5 or 6 mi. of the holy city, he puts off his ordinary dress after ablution and prayer, and puts on the two seamless wrappers which form the dress of the pilgrim (the *ihram*), who goes without head-covering or boots or shoes. He must not shave at all or trim the nails or anoint the head during the ceremonial period. The chief parts of the ceremonial are the visit to the sacred mosque (masjid *al-haram*); the kissing of the black stone; the compassing of the Kaaba (the *tawaf*) seven times, three times running, four times slowly; the visit to the Makam Ibrahim; the ascent of Mount Safa and running from it to Mount Marwa seven times; the visit to Mount 'Arafat; hearing a sermon; and going to Muzdalifa, where he stays the night; the throwing of stones at the three pillars in Mina on the great feast day; and the offering of sacrifice there. (For the localities *see* MECCA.) After the accomplishment of these ceremonies the ordinary dress is resumed, the pilgrimage is finished, but the pilgrim usually remains another three days in Mecca, then visits Medina to pay his respects to the tomb of Mohammed. Beside the *hadj* (great pilgrimage) Islam also recognizes the merit of the *'umra* (or lesser pilgrimage); *i.e.*, a religious visit to Mecca at any time accompanied by most of the ceremonies of the *hadj*.

THE DEVELOPMENT OF ISLAM

The battle of Siffin (657) between 'Ali and Mu'awiya was the occasion of the first breach in the unity of Islam, and the results remain to this day. The occasion was in the first case political in connection with the disputed succession to the caliphate (*q.v.*). After the battle 'Ali was compelled to submit his claims to arbitration, whereupon a number of his supporters (the Khawarij) broke away from him, declaring arbitration inadmissible where a clear mandate was to be found in the Book of God.

The most important sectarian divisions in Islam — Sunnites, Shiites and Khawarij — have their origin in divergent theories on the office of the caliph (khalifa), the head of the Moslem community as successor of the prophet.

Sunnites.—The Sunnites (Sunnis) form by far the larger number: by 1953 about 300,000,000 out of a total of nearly 350,000,000. They hold that the caliphate is an elective office and must be occupied by a member of the Meccan tribe of the Quraysh. They derive their name from the Sunna, or "path," *i.e.*, the traditional practice of Mohammed, as set forth in the Hadith (or Traditions); of these traditions six collections are regarded as authoritative by the Sunnites, viz., (1) the Kitab al-jami' as-Sahih of Bukhari (*q.v.*) (810–870), the most respected throughout the Moslem world and most carefully compiled; (2) the Sahih of Moslem

(817–875) with an introduction on the science of tradition; (3) the Kitab *as-Sunan* of Abu Da'ud (817–888); (4) the *Jami' as-Sahih* of Tirmidhi (*q.v.*); (5) the Kitab *as-Sunan* of Nasa'i (830–915); and (6) the *Kitab as-Sunan* of Ibn Maja (824–866). To the Koran and the Hadith, as authoritative sources of religious doctrine and practice, the Sunnites add *ijma'*, the universal consent which is held to justify practices or beliefs, although they are not warranted by the Koran or tradition and may be inconsistent with the apparent teaching of one or both of these. These beliefs and practices, which had often come from the pre-Islamic customs of those who had become believers, seemed to have escaped notice until the Abbasid period. They were too deeply rooted in the lives of men to be abolished. It became necessary either to find a tradition to abrogate the earlier forbidding one, or to acknowledge that ijma' is higher than the tradition. The former expedient mas resorted to by some later theologians (*e.g.*, Nawawi) by a fiction that such a tradition existed though it was not found now in writing. But in earlier times some (as Ibn Kutayba) had adopted the latter alternative. saying that the truth can be derived much earlier from the ijma' than from the tradition. because it is not open to the same chances of corruption in its transmission as the latter. Tradition itself was found to confirm this view, for the prophet is related to have said, "My people does not agree to an error."

But ijma' itself has been used in different senses: (1) the ijma' of Nedina was used to indicate the authority coming from the practices of the people of Medina (see below). (2) The ijma' of the whole community of Moslems is that most commonly recognized. It was used to support fealty to the Abbasid dynasty. By it the six books of tradition mentioned above are recognized as authoritative. and it is the justification of the conception of Mohammed as superhuman. (3) Some of the more thoughtful theologians recognized only the ijma' of the doctors or the teachers of Islam (the *mujtahidun*), these being restricted by the orthodox to the first few generations after Mohammed, while the Shiites allow the existence of such up to the present time.

The fourth basis of Islam. according to the Sunnites, is *kiyas* (*i.e.*, analogy). It is that process by which a belief or practice is justified on the ground of something similar but not identical in the Koran, the tradition or ijma'. Originally it seems to have been instituted as a check upon the use of private opinion (*ra'y*) in the teaching of doctrine. The extent to which it may be used is a subject of much discussion among theologians. Some would apply it only to a "material similarity," others to similarity of motive or cause as well.

By the 9th century there were established in the Sunnite world the four schools of law, which exist to the present day—Hanafi, Maliki, Shafiite and Hanbalite (for these and the wide extension of the concept of law in Islam, see ISLAMIC LAW). They assiduously cultivated the various branches of Moslem theology and law, and the students they trained became the *ulema* or *ulama* (learned), who filled such an important place in the history of Sunnite countries. In former times the colleges of Damascus, Baghdad, Nishapur, Bukhara. Cairo. Kairouan (Qairwan), Seville. Cbrdova were thronged by thousands of students; and the Xzhar university in Cairo still preserves some of the characteristics of these earlier seats of learning. From their ranks were chosen the *cadis* (judges), the *muftis* (the authoritative exponents of the sacred law), and in countries like Turkey, in which they enjoyed the confidence of the government, they occupied numerous other official positions. and acquired wealth and power. The *ulema* have constituted the only equivalent in the Moslem world to the priesthood in Christendom and have been active in the defense of orthodoxy and in resisting foreign influences. The Turkish republic has deprived them of most of their power, and in many other countries their influence has greatly declined. Among the Sunnites the various order of dervishes (*q.v.*) achieved a vast expansion.

The foundations of Sunnite theology for succeeding generations were laid in the 10th century by Abu'l-Hasan al-Xsh'ari (see ASH'ARI, AL-); he was for 40 years a Mu'tazilite, then became orthodox, and at once applied rational methods for the support and interpretation of the orthodox faith. Before him, reason had not been allowed any scope in orthodox theology. He was not the first to use it; some teachers (*e.g.*, al-Junayd) had employed it in teaching, but only in secret and for the few. The methods of scholastic philosophy were now introduced into Moslem theology. The chief characteristic of his religious teaching was the adoption of the via media between materialistic grossness and the ideas of pure speculative philosophy. Thus he taught, as to the attributes of God, that they exist, but are not to be compared with human attributes; as to God's visibility, that he can be seen but without the limitations of human sight. As to the great question of free will, Ash'ari denied man's power but asserted man's responsibility. So he passed in review the doctrines of God, faith. the Koran, sin, intercession, etc.. and for the first time in the history of Islam produced a systematic theology. The teaching of Ash'ari seems to have spread slowly in Iraq and parts of Iran, and was developed and perfected by Abu Bakr al-Bakilani. the Cadi. (*d.* 1012) but up to the middle of the 5th century of Islam (*c.* A.D. 1058) was suspected elsewhere and confounded with Mu'tazilism. The Ash'arite al-Juwayni (known as Imam al-Haramayn) was persecuted under Toghrul Beg (*c.* 1053) and exiled but was restored under Alp Arslan by the vizier Nizam al-Mulk, who founded an Ash'arite college (the Nizamiyya). In the west, Ibn Hazm (*q.v.*) fiercely opposed the system, but Ghazali established its orthodoxy in the east, and it spread from Persia to Syria and Egypt under the Aypubids and Mamelukes and thence to the Almohades in Africa under Ibn Tumart (1130). It remains the predominating influence to the present day, its only serious rival being the theological system of al-Maturidi, a Hanafi (d. 945), whose creed as represented in that of an-Nasafi is still used largely by the Turks. Since the 12th century no great theological movement has been made in Islam. The quiet of religious life has thrice been broken by Wahhabism (*q.v.*) in Arabia, by Babism (*q.v.*) in Persia and by the Ahmadiyyah (see below) in India.

Shiites.—Historically the next most important group, but by the 1950s shrunk in numbers to about 30,000,000, is that of the Shiites (Shi'ah, *i.e.*, "the party of Ali"). They regard Ali and his descendants as the only rightful caliphs. For them the caliphate was a God-given office and not one to be given by human appointment. Belief in this was an ordinance of God. an article of the faith. He who did not accept it as such was an unbeliever. This party originated among the mixed population of Iraq, partly Arab and Aramaean, partly Persian. These, on their conversion to Islam, brought with them many of their older beliefs, including Gnostic elements derived from the old religions of Babylonia, and the monarchical tradition of Persia. The idea of an absolute personal and hereditary monarchy was thus developed among the subjects of Ali. But in Islam there is no separation between politics and theology. The theological position of the Shiites was that the superhuman power of Mohammed descended to the members of his house (Ali and his children), so that they could interpret the will of God and tell future events.

The Shiites quite early broke up into a number of sects, several of which no longer exist. The most important modern one is that of the Twelvers (the Ithna'ashariyya), so called because they accept as imams twelve of the descendants of Ali. It is said that the 12th imam, Mohammed, disappeared about 874 but that he is still living and will return in the last days to establish the Shiite faith in the world. This has been the official creed of Persia since the beginning of the 16th century, and that of most of the Shiites of India, as well as those of Iraq and southern Lebanon. The Isma'ilis or Seveners are the followers of Isma'il. whom they regard as the 7th imam, rather than his younger brother, Musa (797), who is accepted by the Twelvers. To the Isma'ilis belong the Karmatians (*q.v.*), the Fatimites (*q.v.*), the Assassins (*q.v.*) and the Druzes (*q.v.*). The Zaydites are the followers of Zayd, a grandson of Husain, and are the most moderate of the Shiites, for though holding that the imamate belongs only to the descendants of Ali by Fatima, and that any of these might be imam (even though two or three should be in existence at the same time), they allow that circumstances might justify the appointment of another caliph for the time. Thus they acknowledge the imamates of Abu Bakr and Omar, though Ali was more entitled to the office. One

branch of the Zaydites, arising in the Yemen about 893, has remained there until the present day.

The Shiites differ from the Sunnites not only in their political theory of the caliphate, but in matters of law and ceremonial. They reject all the Sunnite books of Hadith or tradition, but have collections of traditions of their own and claim to follow the Sunna, or way, of the prophet, even as the Sunnites do. An allegorical and mystical interpretation reconciles the words of the Koran with the inordinate respect paid to Ali; the Sunnite doctrine of the uncreated Koran is denied. To the creed "There is no god but God; Mohammed is the apostle of God," they add, "and Ali is the vice-regent of God" (wnli, properly "confidant"). There are some modifications in detail as to the four main religious duties of Islam—the prescriptions of ritual purity. in particular, being made the main duty of the faithful. The prayers are almost exactly the same. but to take part in public worship is not obligatory, as there is at present no legitimate imam whose authority can direct the prayer of the congregation. . Pilgrimage to Mecca may be performed by a hired substitute, or its place can be taken by a visit to the tombs of Shiite saints; *e.g.*, that of Ali at Najaf, of Husain at Karbala. of Riza at Meshhed, or of the "unstained Fatima" (daughter of Musa, the 7th imam) at Kum. The Shiites are much the most zealous of Moslems in the worship of saints (real or supposed descendants of Ali) and in pilgrimages to their graves. and they have a characteristic eagerness to be buried in those holy places. They celebrate many religious feasts. Of these the great sacrificial feast (id al-azha; Turkish kurban *bairam*) is also Sunnite; the first ten days of the month Muharram are dedicated to the mourning for the death of Husain at Karbala which is celebrated by passion plays (ta'ziya), while the universal joy of the Nawruz, or the new year of the old Persian calendar, receives a Moslem sanction by the tradition that on this day the prophet conferred the caliphate on Ali. Shiite law permits temporary marriages (*mut'a*), provided that a dower is specified. and that a period—a year, a month or a day—is fixed. Another special doctrine is that it is lawful for a man in case of danger or persecution to deny his faith (taqiyya, "caution") and pass himself off as a Sunnite.

Khawarij.—The third sect (originating like the other two in disputes over the caliphate) added to their political doctrine that this office was open to any believer whom the faithful might consider fitted for it, even though he be a black slave; certain theological doctrines on the subject of sin (*e.g.*, they regarded anyone who had committed one of the greater sins as no longer a believer); and rejection of the doctrine of justification by faith without works. Under the Umayyads they were a source of trouble to the government through their constant risings, but under the Abbasids they became restricted to eastern Arabia, and only a few of them now survive there and in north Africa.

Apart from these three important groups which had their origin in primitive times and exist to the present day, there has been in Islam an immense activity in theological speculation. resulting in the formation of many sects, the majority of which have ceased to exist. The first impulse to these speculations appears to have come from contact with Christian theologians in Damascus during the Umayyad caliphate. Two sects arose under these influences—that of the Murjiites and that of the Kadarites. The Murjiites ("postponers") were so called because they postponed the judgment of human actions until the day of judgment. In politics they accepted the Umayyads as de *facto* rulers, since they were Moslems, and left the judgment of their actions to God. As theologians they taught that religion consists in belief (imam) in the unity of God and in his apostle, and in that alone; consequently no one who held this faith would perish eternally, though he had been a sinner. This was opposed to the Kharijite doctrine that the unrepentant sinner would perish eternally, even though he had professed Islam.

The Kadarites were concerned with the doctrine of predestination and free will. So long as Moslems were fighting the battles of Islam they naturally paid most attention to those revelations which laid stress on the absolute determination of a man's destiny by God. They fought with great bravery because they believed that God had foreordained their death or life, and they could not escape his will. In the quieter realm of town and court life and in their disputations with Christians they were called upon to reconcile this belief with the appeals made in the Koran to man's own self-determination to good, to courage, etc. The Kadarites declared that man had power over his own actions. But the teaching of predestination had gained too great a hold on Moslems to be thus displaced. The teaching of the Kadarites was held to be heresy, and one of its first professors. Ma'bad al-Juhani, was put to death in 699.

Many of the Kadarites were also Mu'tazilites, whose founder was Wasil ibn Ata, who separated himself (whence his followers were called Mu'tazilites. "separatists") from his teacher Hasan al-Basri and founded a school which became numerous and influential. The Mu'tazilites objected to the attributes of God being considered in any way as entities beside God; they explained away the anthropomorphisms used in speaking of the deity: they regarded the Koran as created and emphasized human responsibility in matters of religion. Briefly, they asserted the supremacy of reason ('aql) as distinct from faith received by tradition (naql). They also called themselves "the people of justice and unity" (*ahl al-'adl wat-tauhid*). Such a faith as this naturally found favour rather with the thinking classes than with the uneducated multitude, and so went through many vicissitudes. At the time of its appearance and until the reign of Ma'mun its adherents were few and uninfluential. After discussions among the theologians Ma'mun took the decided step of proclaiming that the Koran was created, and that a belief in this dogma was necessary. Mu'tazilites were appointed to official posts, and an inquisition (*mihna*) was appointed to enforce belief in their doctrine This movement was strongly opposed by the orthodox and especially by Ahmad ibn Hanbal. By him the founding of theology on reason was rejected, and he sufferedpersecution for his faith. Mu'tazilism retained its sway until 849, when the caliph Mutawakkil again declared the Koran uncreate and restored orthodoxy.

According to an early tradition Mohammed said that Islam would be divided into 73 sects. of which 72 would perish and one would be saved. The Arabic writers on the heretical sects of Islam feel compelled therefore to restrict their number of 72, but as they adopt diverse classifications the number of sects they describe amounts to several hundred.

LATER MOVEMENTS

In modern times the most important sectarian developments have been those of the Wahhabis (*q.v.*), the Babis (see BABISM) and the Ahmadiyya. The last of these movements was started by Mirza Ghulam Ahmad, who, in 1879, began to preach in the village of Kadian in the province of the Punjab, India. He claimed to be not only the promised Mahdi but also the promised Messiah—personages generally held to be distinct in ordinary Moslem theology. Another modification he introduced into Islamic doctrine had reference to the death of Jesus; the commonly accepted belief maintains that Jesus was taken by God alive into heaven. while a phantom was crucified in his place; in opposition to this he declared that Jesus was actually crucified but was taken down from the cross while still alive by his disciples, was healed of his wounds and afterward made his way into Kashmir, where he finally died, his tomb being still in existence in the city of Srinagar. Having thus removed the ground for any expectation of the second coming of Jesus from heaven to earth, he explained that he himself was the Messiah, not as being an incarnation of Jesus (for he rejected the doctrine of transmigration), but as having come in the likeness of Jesus—being Jesus for this generation just as John the Baptist was Elijah, because he came in the spirit and power of Elijah.

In proof that he had come in the spirit and power of Jesus, Mirza Ghulam Ahmad adduced the likeness of his own character and personality to that of Jesus, his gentleness of spirit. the peaceful character of his teaching. his miracles and the appropriateness of his teaching to the need of the age. In harmony with this pacific claim, he expounded the doctrine of jihad (usually interpreted as meaning war against unbelievers) as a striving after righteousness.

Mirza Ghulam Ahmad died in 1908, and a few years after his death his followers split into two parties, one having its headquarters in Kadian and the other in Lahore. Both these sections of the community succeeded in enlisting the services of devoted, self-sacrificing men, who are unceasingly active as propagandists, controversialists and pamphleteers. They set up an extensive missionary activity, not only in India, west Africa, Mauritius and Java (where their efforts are mainly directed toward persuading their coreligionists to join the Ahmadiyya sect), but also in Berlin, Chicago and London. Their missionaries devoted special efforts to winning European converts and have achieved a considerable measure of success. In their literature they give such a presentation of Islam as they consider calculated to attract persons who have received an education on modern lines, and thus not only attract non-Moslems, and rebut the attacks made on Islam by Christian controversialists, but win back to the faith Moslems who have come under agnostic or rationalist influences.

Apart from these organized movements, there was considerable theological activity in the Moslem world in the first half of the 20th century. This expressed itself especially in apologetic literature, which endeavours to present Islam in a form acceptable to the contemporary generation and to discard those special features which had exposed it to hostile criticism; thus polygamy, slavery and intolerance are declared to receive no sanction from the Koran, as rightly interpreted; in Islam the reconciliation of religion and science is effected. and the demands of the modern spirit of enlightenment are satisfied. Of such modernist literature there has been a considerable output, especially in Egypt and India; it naturally appeals most to those readers who have come under European influences and excites considerable opposition among more conservative orthodox circles, who remain loyal to the traditional schools of thought and resent the rejection of traditional mediaeval theology by the modem thinkers. The older sects continued to flourish, and the new thought did not attempt to organize itself on sectarian lines and thus remained largely a matter of individual opinion.

This lack of sectarian development is possibly in great measure due to the absorbing attraction that political problems exercised upon the Moslem world. Anxiety as to the fate of Turkey after World War I, the withdrawal of the holy cities from the control of the caliph and the occupation of Jerusalem by unbelievers, the separation of the sultanate from the caliphate in 1922 and the abolition of the caliphate altogether in 1924 were circumstances that profoundly stirred the minds of pious Moslems all the world over and did not create an atmosphere favourable to the calm consideration of purely dogmatic problems. Moreover, in many Moslem countries some form of nationalism obscured the larger vision of a united Islamic world; in Turkey it took at one time the extreme form of Pan-Turanism, or Pan-Turkism, which aimed at the union of all sections of the Turkish people in one vast confederacy and sought to purge the national life from all foreign admixture, in language, literature and political institutions; in India nationalist feeling prompted first a Hindu-Moslem entente, but subsequently led to the separation of Pakistan as an independent Moslem state in 1947; among the Moslem populations of Russia the formation of Soviet Socialist republics evoked nationalistic movements which temporarily thrust purely religious interests into the background; in Java and Sumatra the Moslems took the lead in establishing the new state of Indonesia (1949).

But Islam is so closely bound up with every aspect of the life of a Moslem people that even a purely nationalist political movement may react strongly on the religious life. This was notably the case in Turkey, where the government, besides abolishing the caliphate, confiscated the religious endowments and suppressed the religious orders; polygamy was practically made illegal; the date of Ramadan was fixed in accordance with astronomical science instead of being made dependent on reports that the moon had been seen (as had been the immemorial custom in the Islamic world); and the discontinuance of the wearing of the veil by women and the adoption of hats by men were typical of a changed attitude toward the established usages of Moslem society.

The breach with the past was nowhere so violent as in Turkey, but throughout the whole Islamic world there were indications of a changed attitude toward religious questions.

The old orthodoxy still held the allegiance of the masses, as well as many of the educated, but others, especially those whose education had brought them under European influences, sought a restatement of their religion, more in harmony with their general outlook upon life.

To those seeking a solution in the realization of some nationalist ideal, there remained little save a sentimental attachment to Islam, while they deprived it of any control over law and social organization; the reformers, on the other hand, claim for the precepts of Islam control over all the relations of human life, but seek to restore it to its primitive simplicity, believing that thus it can be brought into harmony with modern thought and modem conditions.

BIBLIOGRAPHY.—The fullest bibliographies are given in the *Encyclopaedia of Islam,* 4 vol. and suppl. (Leyden, 1908–38). *See* also H. Lammens, *Islam: Beliefs and Institutions* (London, New York, 1929); H. A. R. Gibb, *Mohammedanism,* 2nd ed. (London, New York, 1953); G. Pfannmiiller, *Handbuch der Islamliteratur* (Berlin, 1923). Periodicals, such as *Revue des etudes Islamiques, The Moslem World, The Middle East Journal,* give bibliographies of current publications.

Works of first importance are I. Goldziher, *Muhammedanische Studien* (Halle, 1889), *Vorlesungen über den Islam* (1925); C. Snouck Hurgronje, *Mohammedanism* (1916); C. H. Becker, *Islamstudien,* 2 vol. (Leipzig, 1924); L. Massignon, *Annuaire du monde musulman* (Paris, 1925); De Lacy E. O'Leary, *Arabic Thought and Its Place in History* (New York, London, 1939).

For theological movements, *see* D. B. Macdonald, *Development of Muslim Theology, Jurisprudence and Constitutional Theory,* with bibliography (New York, 1903); A. S. Tritton, *Muslim Theology* (London, 1947); for philosophical movements, T. J. de Boer, *History of Philosophy in Islam* (London, 1903); Max Horten, *Die Philosophie des Islam* (Munich, 1924); for propaganda, T. W. Arnold, *The Preaching of Islam,* 3rd ed. (London, 1935); for modern movements, S. G. Wilson, *Modern Movements among Moslems* (New York, 1916); Ahmed Muhiddin, *Die Kulturbewegung im modernen Türkentum* (1921); J. R. Mott (ed.), *The Moslem World of To-day* (London and Garden City, N. Y., 1925); H. A. R. Gibb, *Modern Trends in Islam* (Chicago, Cambridge, 1947). (T. W. A.; H. A. R. G.)

ISLAMIC ARCHITECTURE. Islamic architecture may be defined as the architecture of the peoples who have embraced the Islamic faith. The term Arab should never be used in this connection for it is completely misleading. The conquering Arabs, when they did begin to have architectural ambitions, employed the local people and drew upon their technical skill and architectural traditions.

THE FIRST THREE CENTURIES

In the time of Mohammed the Arabs had nothing worthy of the name of architecture. Only a small part of the population was settled and these lived in dwellings which were scarcely more than hovels.

When the hostility of the people of Mecca had caused Mohammed to migrate to Medina in A.D. 622, he built a house for himself consisting of a mud-brick enclosure about 50 yd. square. Against the outer side of the east wall were hujra ("small huts") for his wives. There is a description of them by an eyewitness who saw them just before they were demolished by order of al-Walid in 707: "There were four houses of mud brick, with rooms partitioned by palm branches, and five made of palm branches plastered with mud and not subdivided. Over the doors were curtains of black haircloth. One could reach the roof with the hand." (Ibn Sa'd, Tabaqat, I, 2, p. 180.) The courtyard, which afterward served as a place of prayer, was at first quite open, but, as the companions complained of being exposed to the burning heat of the sun, a shelter was erected, consisting of palm trunks used as columns supporting a roof of palm leaves and mud. Such was the house of the leader of the community at Medina. Nor did Mohammed wish to alter these conditions; he was entirely without architectural ambitions, and Ibn Sa'd quotes the following saying of his: "The most unprofitable thing that eateth up the wealth of a Believer is building." (Tabaqat, I, 2, p. 181; VIII, p. 120.)

The men who formed the armies of the conquest were mainly Bedouin, but even those who came from permanent settlements, such as Mecca and Medina, knew nothing of art and architecture.

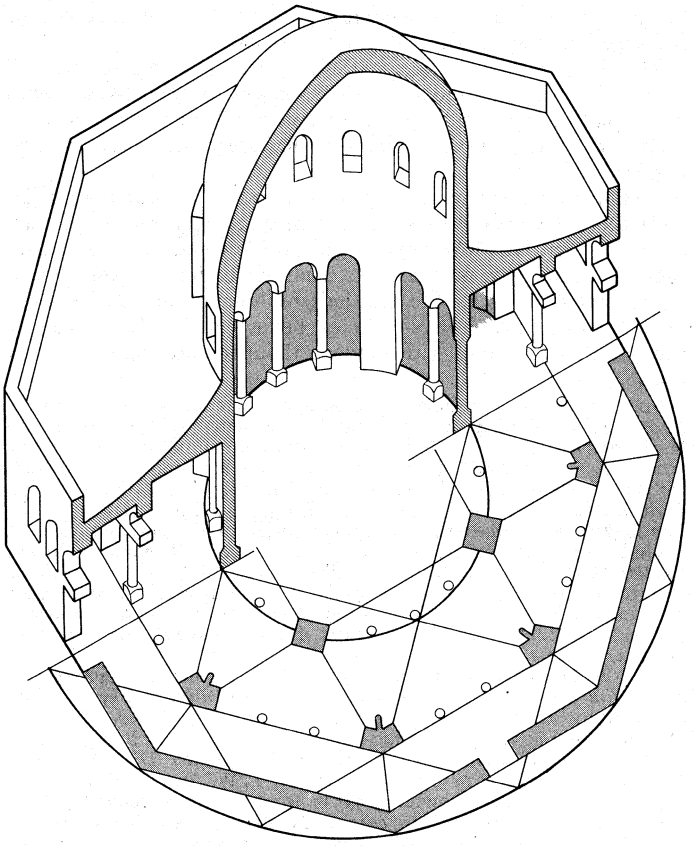


FIG. I.— THE DOME OF THE ROCK, JERUSALEM

Their advance was fanwise: those who advanced northward entered territory which had been under Hellenistic influence for 1,000 years, and those who advanced northeast entered territory which had been under Persian influence for even longer. And not only the cultural but also the material conditions were different. Syria was a country of excellent building materials. Syrian limestone was the best of its kind and cedar wood was plentiful, for the Lebanon had not yet been deforested. So those who invaded Syria found themselves in a country of splendid buildings—churches of cut stone, with arcades on marble columns and gable roofs of cedar, and with large surfaces covered with coloured glass mosaic on a glistening gold background. On the other hand, those who invaded Mesopotamia and Persia met with buildings of brick, sometimes of mud brick, sometimes vaulted but more often with flat roofs of palm trunks, palm leaves and mud. Hence the duality observed in early Moslem architecture.

In these early days the invaders, when they conquered a town in Syria, usually took one of the churches and converted it, a very simple matter, for the qibla (direction of Mecca) being due south and the churches being turned toward the east, it was only necessary to close the western entrances, make fresh ones in the north side and pray across the aisles. That this is exactly what happened can be verified in the Great mosque of Hama, where the west front of the Kanisat al-Uzma ("Great church"), which was converted into a mosque in 637, forms the west side of the sanctuary.

But the situation was different in Iraq, for there the Arabs founded new towns, so pre-existing buildings could not be employed. At Basra, founded *c.* 635, the first mosque was simply a rectangle marked out on the ground. According to another account it was enclosed by a fence of reeds. At Al Kufah, founded in 638, an area about 100 yd. square was enclosed not by walls but by a ditch only, the sole architectural feature being a shelter on columns (taken from the ruins of Hira) which ran along the southwest side of the mosque.

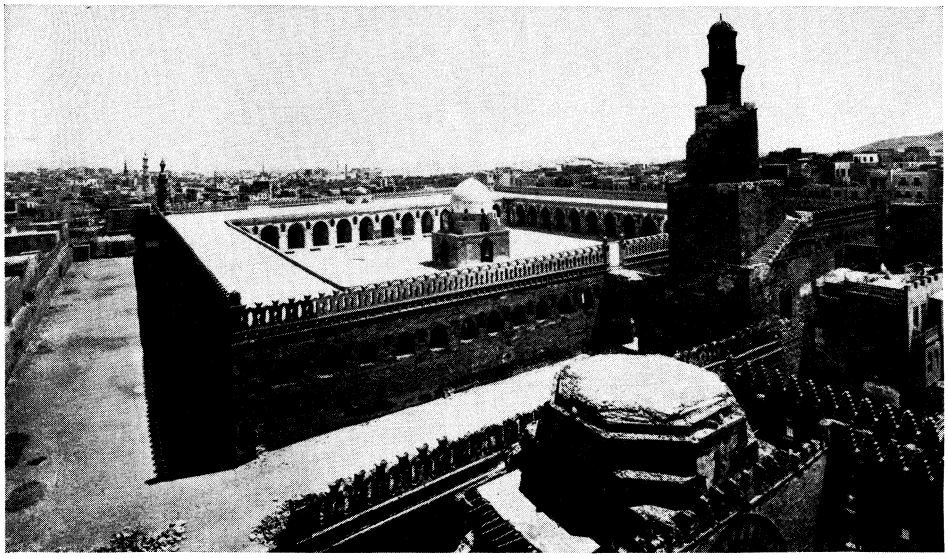
The first mosque in Egypt. the mosque of 'Amr built in 641–642, was equally primitive. It measured 50 X 30 cubits (about 80 × 50 ft.) and had six doors and a low roof, probably of palm trunks resting on palm-trunk columns.

The first mosques worthy of the name of architecture were the second Great mosques at Basra (665) and Al Kufah (670). The latter was built by a man "who had been one of the builders of Khusrau," and he designed the mosque with five rous of columns on the qibla side and two rows only on the other three sides. The columns, which were very tall. were not surmounted by arches, and it is obvious that the sanctuary must have looked like an apadana, or hall of columns, of the ancient Persian kings.

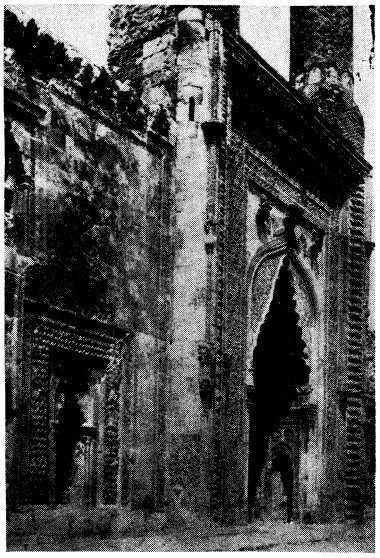
The oldest existing Moslem monument is the Dome of the Rock at Jerusalem, built by the caliph Abd al-Malik and finished in 691. It is a concentric annular structure consisting of a wooden dome 20.44 m. in diameter, set on a high drum and pierced with 16 windows. The dome rests on 4 piers and 12 columns which are placed in a circle and so arranged that 3 columns alternate with each pier. This circle of supports is placed in the centre of a large octagon averaging 20.60 m. a side, formed by eight walls 9½ m. high (excluding the parapet which adds 2.60 m.), each pierced in their upper half by five windows. Between the outer octagon and the inner circle is an intermediate octagonal arcade, the arches being borne by 8 piers and 16 columns. It is not a mosque but a *mash*had (shrine), built over the rock from which Mohammed was believed to have made his ascent to heaven on the horse Borak. The decoration is of the most splendid kind. The exterior was originally covered to half its height by marble paneling, and from there upward with glass mosaic on a glistening gold background. Internally all the arcades were likewise decorated with mosaic and the malls with quartered marble paneling; *i.e.,* each slab was cut in half and opened like a book, the result being that the veining ran toward the joint. The process is then repeated so that four slabs make a unit. Although this is the most beautiful way of using marble for paneling, it does not appear to have been employed after 750.

About 20 years after the completion of the Dome of the Rock, al-Walid (A.D. 705–715) built the Aqsa mosque at Jerusalem and the Great mosque at Damascus. In the former (nhich is not a conversion of a church built under Justinian, as is often erroneously stated, for Justinian's church stood elsewhere and lasted until after A.D. 800), the arcades ran at right angles to the qibla wall, in the latter parallel to it. The arcades in both cases were built in two tiers in order to obtain a great height of ceiling with comparatively short columns taken from other buildings, a system adopted later at Cordoba. At Damascus the mosque was built in what had been the temenos. or sacred enclosure, of a pagan temple, measuring about 136 m. from east to west and 100 m. from north to south. Three arcades, cut through their centre by a transept, were built parallel to the south wall and a single arcade round the other three sides. Of the four axial entrances of the temenos, three were preserved in the mosque, the fourth being blocked up by the mihrab (prayer niche indicating the direction of Mecca). Here again the same splendid decoration in marble and mosaic was employed as in the Dome of the Rock at Jerusalem. At the four corners of the ancient temenos were four square towers; these became the first minarets in Islam. (At Medina, where there was no minaret until al-Walid's time, the call to prayer was made from the roof of a neighbouring house.) Ibn al-Faqih (903) says: "The minarets which are in the Damascus mosque were originally watch-towers in the Greek days . . ." And Masudi says: "Then came Christianity and it (the temenos) became a church; then came Islam and it became a mosque and the four *sawami* (*i.e.,* the four corner towers) were not changed; they serve for the call to prayer at the present day."

The Omayyad caliphs were great builders of palaces, many of which have a fortified appearance externally. This is to be explained by the route taken by the armies of the conquest. They passed a long line of Roman frontier forts which ran from the Gulf of 'Aqaba to Damascus and beyond. Some of these were lived in by Omayyad princes; *e.g.,* Qastal and Azraq. Having been in the habit of occupying forts. they apparently came to look upon a rectangular enclosure flanked by towers as a necessary feature of a princely residence. Their palaces were richly decorated with

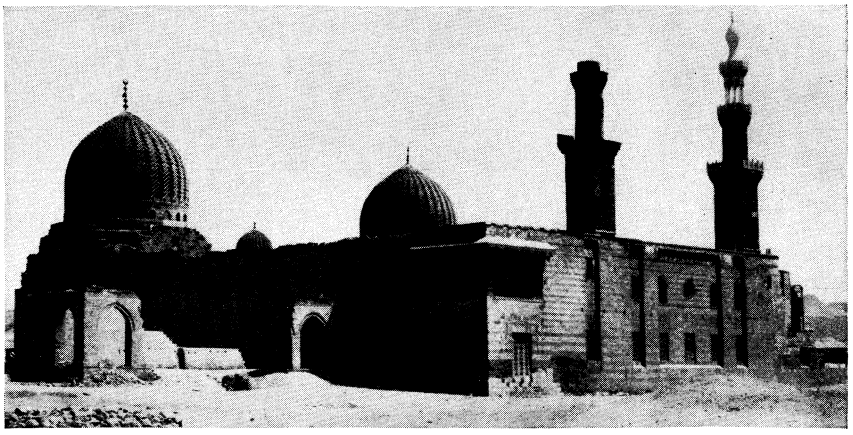


Mosque of Ibn Tulun, Cairo; 876–879

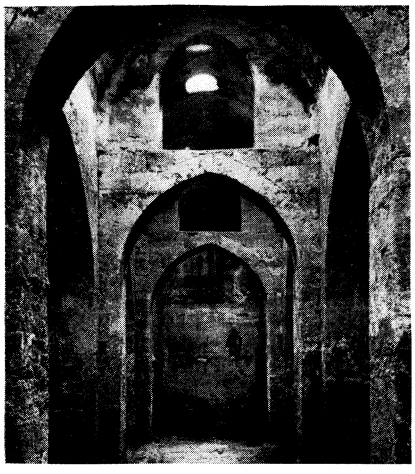


Tschifte Minare. Sivas. Turkey; 1271

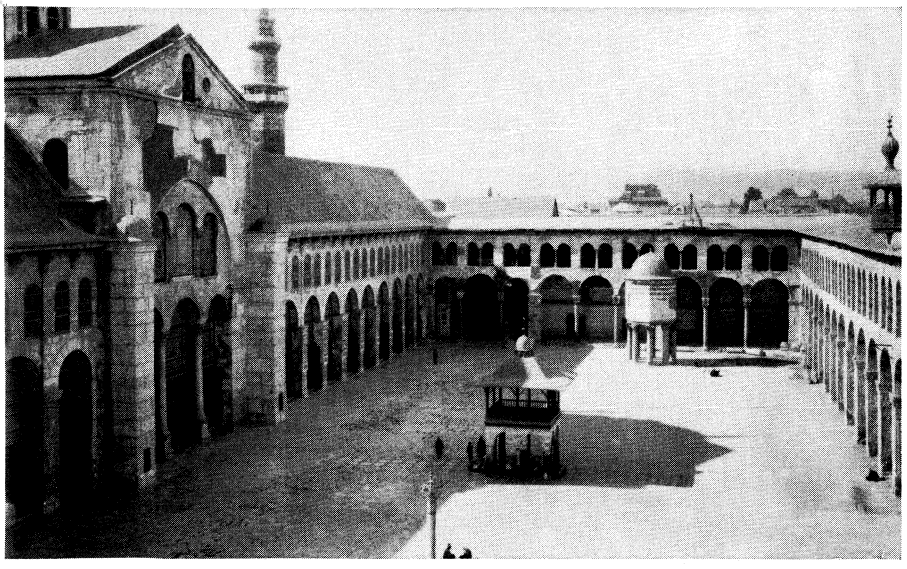
Mosque of Suleiman the Magnificent, Istanbul, by Sinan; 1556–66



Mosque and mausoleums of the sultans Barquq and Farag, Cairo; 1400–11



Cistern of Er Ramie, Palestine: dated 789

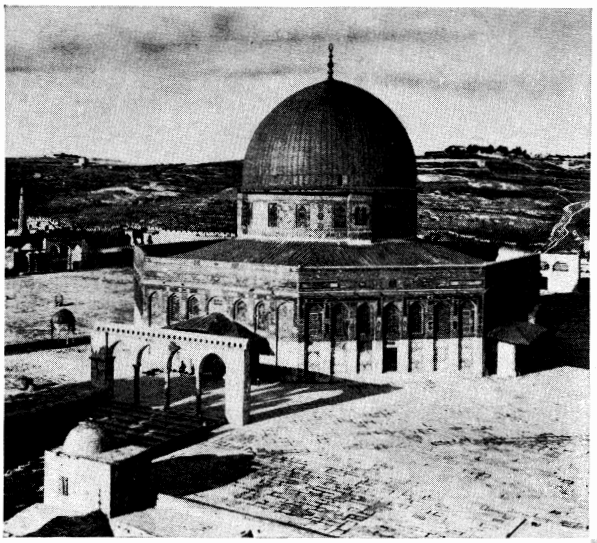


Great Mosque of Damascus by al-Walid; 705–715

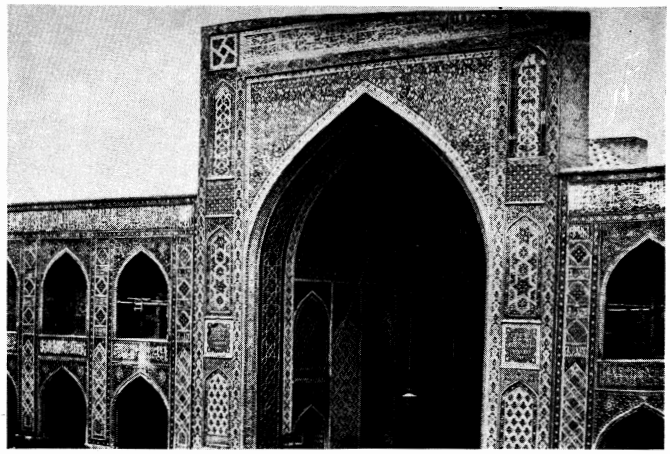
MOSQUES AND MONUMENTS

BY COURTESY OF (TOP LEFT CENTRE LEFT, CENTRE RIGHT BOTTOM LEFT. BOTTOM RIGHT) K A.C. CRESWELL

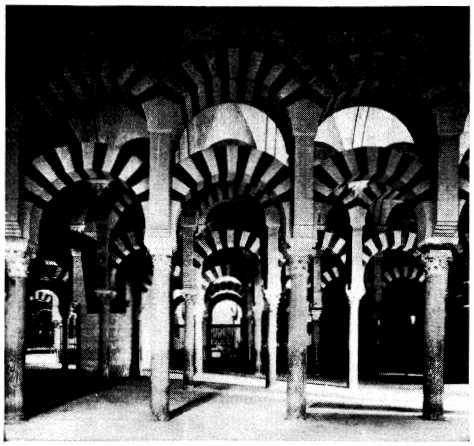
ISLAMIC ARCHITECTURE



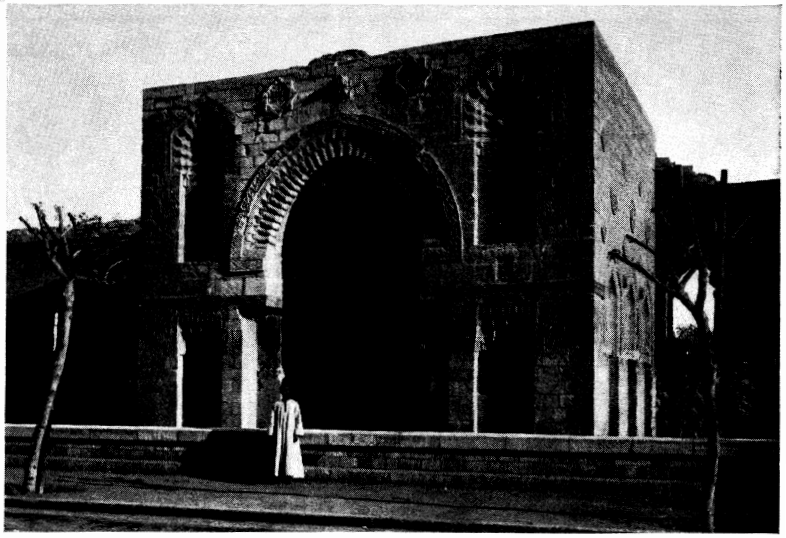
Dome of the Rock, Jerusalem, by Abd al-Malik; completed in 691



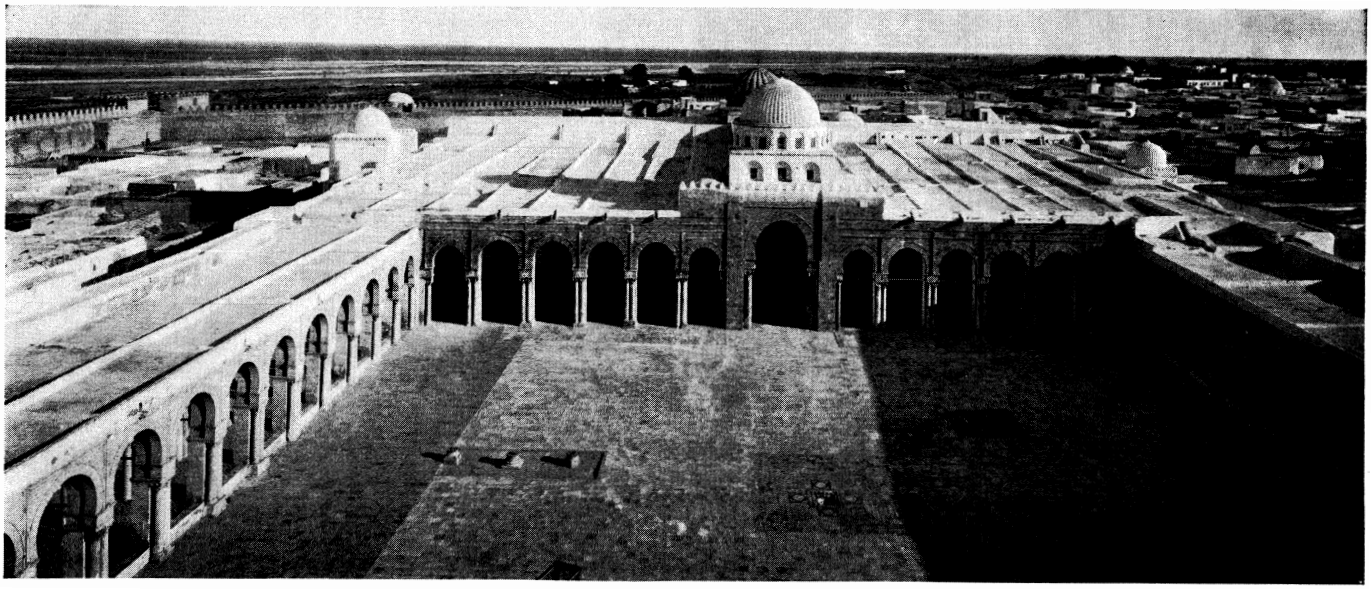
Mosque of Gawhar Shad, Meshed, Iran; dedicated 1418



Sanctuary of the Great Mosque of Córdoba, Spain; 787



Mosaue of Baybars, Egypt; 1266–69



Great Mosque of Kairouan, Tunisia; founded in the 7th century, rebuilt 836

RELIGIOUS BUILDINGS, 7TH TO 15TH CENTURIES

BY COURTESY OF (TOP LEFT, CENTRE LEFT, CENTRE RIGHT, BOTTOM) K.A.C. CRESWELL, (TOP RIGHT) A. U. POPE

marble paneling and mosaics; *e.g.*, al-Walid's palace at Minya on the Sea of Tiberias (mod. Sea of Galilee), Hisham's palace at Mefjir (4 mi. north of Jericho). Some, like the one at Qusayr Amra, were even decorated with fresco paintings of human figures, for the prohibition against painting did not become formal until *c.* 800. Others even had a hunting enclosure several miles long attached to them; *e.g.*, Mefjir and Qasr al-Hair ash-Sharqi, hence the latter's name for Miskawaihi, under the year 315 H. (925–926) says, "This year there was a rising of the disbanded cavalry, who went out to the Oratory, plundered the Palace of the Pleiades (at Baghdad) and slaughtered the game in the Hair."

The fall of the Omayyad dynasty in 750 and the transfer of the capital of the caliphate from Damascus to Baghdad by the Abbasid caliph al-Mansur, was as far-reaching in its effect as the transfer of the capital of the Roman empire from Rome to Constantinople. Hitherto its capital had been in territory which, since the time of Alexander, had been in the sphere of Hellenistic culture. This was replaced by the cultural influences of Sasanian Persia, to which sphere Iraq belonged. This made itself felt in the design of the new capital, Baghdad, which was given a circular form like the Parthian capital Ctesiphon, Darabjird and Firozabad. A mosque 100 m. square with wooden columns supporting a flat roof was built in the centre of the city, and the caliph's palace, 200 m. square, was built in contact with its *qibla* side, so that the caliph could go directly from his palace into the *maqsura* of the mosque, a screened-off area which included the mihrab and the pulpit. This was the scheme first adopted at Damascus and then at Basra, Kufah, Wasit, Merv and other places. About this time was built the earliest example of a building entirely constructed with free-standing, pointed-arched arcades of 38 arches supporting tunnel vaults: the Cistern of Er Ramle, the only Abbasid monument in Palestine, dated 172 H. (789) by an inscription of Harun ar-Rashid.

In 827 Abdallah ibn Tahir, the Abbasid governor of Egypt, doubled the size of the mosque of 'Amr by the addition to the west of its exact area in the same shape. It follows that no part of the present structure lying to the right of a line drawn through its centre can possibly be older than 827. It then measured about 109 × 120 m., as does the present building. It is known (from excavations) that there were seven arcades on the southeast and northwest sides and four on the southwest side. On the northeast the arcades ran perpendicular to the court. The only decoration that has survived is that carved on the wooden friezes and the tie beams of a few windows. It consists of late acanthus ornament, derived from the Hellenistic art of Syria, and shows that the Abbasid art of Iraq, which is found 50 years later in the mosque of Ibn Tulun, had not yet reached Egypt.

Like the mosque of 'Amr, the Great mosque of Kairouan was founded in the early days of Islam, but no part of the present structure (except the minaret) is earlier than the 9th century, for the whole mosque was rebuilt by the Aghlabid Ziyadat Allah in 836. The sanctuary consists of 16 arcades of 7 arches, each running at right angles to the *qibla* wall but without reaching it, for a transverse arcade runs at a distance of 6 m. from it, and it is against this arcade that the 16 arcades stop. The side aisles are about 3.30 m. in width as against 5.40 m. for the central aisle, which must have measured 6.60 m. before its width was reduced by two arcades built in contact with it, without any bond or liaison of any sort. This modification was the work of Ibrahim II in 862–863, who also built the dome in front of the mihrab and lined the latter with beautifully carved marble panels, expressly imported from Iraq.

The most famous work of the Abbasid caliphs was the foundation of Samarra on the river Tigris, about 70 mi. north of Baghdad, in 836. The palace stands on the edge of the plateau which is about 17 m. above the alluvial valley. It is built partly of kiln-baked, partly of sun-baked, bricks and the decoration consisted of dadoes, generally of molded stucco, except in the throne-room group where they are of marble slabs. The scale of the whole layout is immense.

This palace was followed by the two great mosques of Samarra and Abu Dulaf. The former, as rebuilt in 852, is the largest mosque in Islam, for its outer walls, 2.65 m. thick of kiln-baked bricks with half-round buttresses at intervals of 15–16 m., form an immense rectangle 240 m. deep and 156 m. wide, in the favourite Abbasid proportion of 3:2. The area is nearly 38,000 sq.m. The flat roof rested directly on octagonal piers of brick with marble colonettes at the four corners, making a support roughly 2 m. square. There were no arches. The mosque proper was surrounded by an outer enclosure or *Ziyada*, measuring 376 × 444 m., and in this enclosure on the northeast side rose the minaret, the famous Malwiya, a tower with a spiral ramp about 2.30 m. wide which rises 6.10 m. for each complete turn. The total height to the top platform is 50 m. Between 860 and 861 another immense mosque was built at Abu Dulaf to the north of Samarra. It is 135 m, wide and 213 m. deep. Here the outer walls are of mud brick 1.65 m. thick, with half-round buttresses, but the flat roof rested on arcades of burnt brick at right angles to the *qibla* wall. The minaret is a miniature of the Malwiya.

In Egypt Ahmed ibn Tulun, a Turk born at Samarra, who had been appointed governor in 864, shortly after declared himself independent and decided to build a mosque in Egypt, of which the scheme of the outer walls and windows is Egyptian, being based on the exterior of the mosque of 'Amr of 827. The decoration, however, is directly derived from Samarra. The mosque proper forms a great rectangle 122 m. wide and 140 m. deep; it is surrounded on three sides by open courts or *Ziyadas* about 19 m. wide, the whole forming a rectangle 162 m, square (or 300 Nilometric cubits, the unit of measurement used for setting out the mosque). The *sahn* (central court) is roughly 92 m. square, with five rows of pointed-arched arcades on the *qibla* side and two rows on the other three sides. The door soffits are of wood decorated with Samarra ornament, and the borders and soffits of the arches are decorated with stucco ornament. There are 128 windows filled with stucco grilles of geometrical design of which, unfortunately, only about four are original.

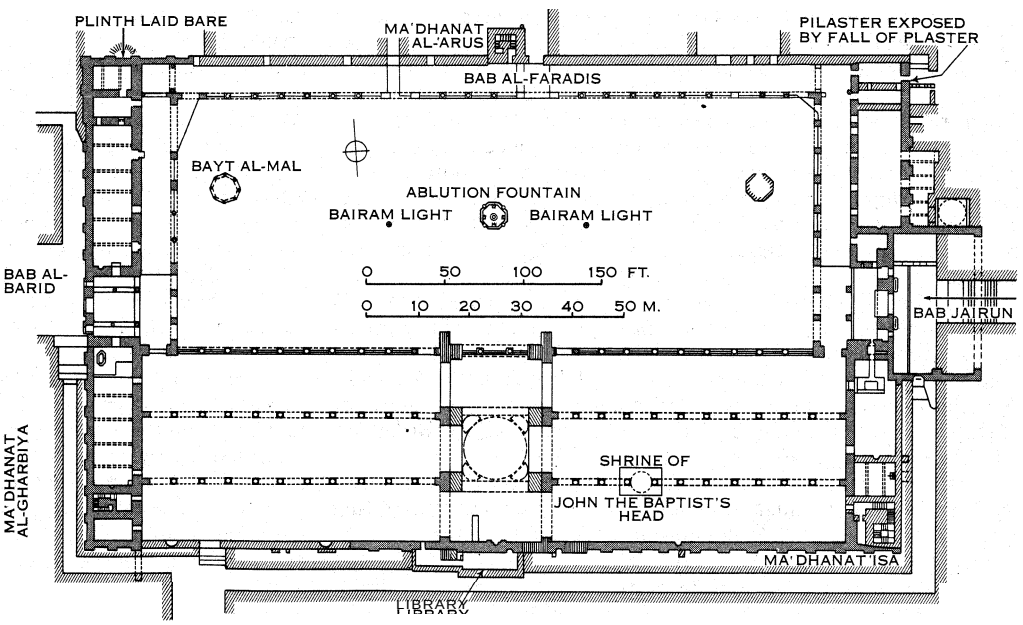


FIG. 2.—PLAN OF THE GREAT MOSQUE. DAMASCUS

PERSIA

Only two mosques dating before the middle of the 11th century have survived—the little Tarik Khana at Damghan and the mosque at Nayin. The former consists of vaulted arcades on round piers running toward the *qibla* wall, the latter of arcades parallel to it, with stucco ornament derived from that of Samarra. But under the Seljuks in the last years of the 11th century, a new feature appears at Isfahan, a large dome 15 m. in diameter in front of the mihrab, covering nine bays of the sanctuary (3 × 3) and consequently opening into it on three of its sides by three arches. An inscription states that it is the work of Malik Shah (1072–92). This type is also found later at Gulpaigan, Ardistan

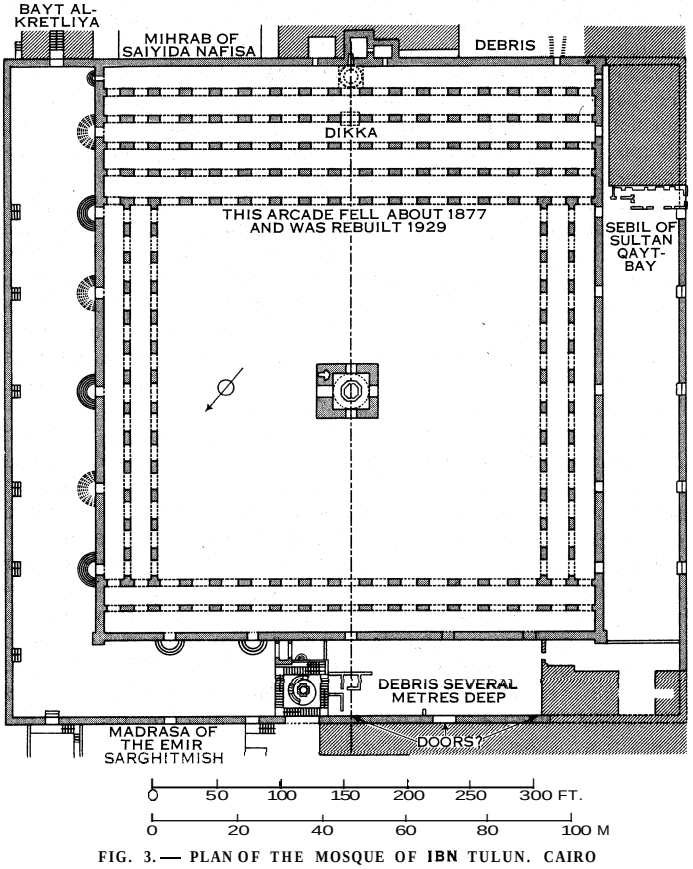


FIG. 3.— PLAN OF THE MOSQUE OF IBN TULUN. CAIRO

(1158) and elsewhere. In the latter, part of an arcade on round piers with 4th-century stucco ornament has survived, proving that this great domed bay was an insertion into an earlier mosque.

The 12th and 13th centuries witnessed the development of fai'ence decoration. Dadoes were composed of star tiles in golden-brown lustre on a white background, and splendid calligraphic borders framed the mihrabs; *e.g.,* the famous mihrab of 1226 from the Maydan mosque at Kashan, once in the Preece collection but later moved to Berlin. But the 13th century also witnessed the greatest disaster that has ever befallen Persia—the Mongol inroads.

This Mongol terror caused an enormous migration of architects and craftsmen, not only to Asia Minor (where the inscriptions on the monuments of Konia and Divigri bear witness to it), but also to Cairo, which became the refuge of Islam from the Mongols. Maqrizi says that "numbers of Orientals came to Egypt and built themselves homes on the banks of the Khalig and the Birkat al-Fil." (Khitat, I, p. 364–365.)

Persian mosques generally have a monumental entrance, consisting of a deep rectangular recess covered by a semidome resting on stalactites; *e.g.,* the Great mosque at Veramin (1324) and the Masjid-i-Jum'a of Shah Abbas at Isfahan. It seems probable that such portals are a development of the side bays of the caliph's palace (Bab al-'Amma) at Samarra, where this feature is seen in its simplest form—a rectangular entrance bay covered by a semi-dome on two squinches. During the Timurid period fai'ence tiles and fai'ence mosaic came more and more into use, and even greater surfaces were covered than had ever been before; *e.g.,* the mosque of Gawhar Shad at Meshed in Khurasan, one of the finest examples of polychrome fai'ence mosaic ever executed, and similarly the remains of the Musalla at Herat.

The Safavid period (1502–1736), of which one of the greatest rulers was Shah Abbas (1587–1628), was marked by his remarkable town planning at Isfahan; nothing of the sort had been attempted since the foundation of Baghdad and Samarra. The scheme included the Great Maidan, or square, surrounded by vaulted bazaars, with the portal of his mosque opening in the centre of the south side, the Ala-Qapu palace on the western side and the avenue over two miles long, known as the Chahar Bagh, with its plane trees and its famous bridge.

Many gilt domes date from this period; *e.g.,* the dome over the shrine of Imam Riza at Meshed. Sir John Chardin, who was in Isfahan in 1673 after an earthquake, saw the copper plates being made for the new dome: they measured 16 × 10 in. and he says that there were ten crowns worth of gold on each and that 3,000 had been ordered. Other examples exist at An Najaf and Kerbela (both due to Nadir Shah), Kazimain (due to Agha Mohammed Khan Kajar), Qum and Samarra (Fath Ali Shah).

Many truly monumental caravansaries were built during this period. Fine work was still being executed at the beginning of the 18th century, for example, the Madrasa of Shah Sultan Husayn at Isfahan (1700–10), but the disaster of the Afghan invasion hastened the decadence which was .complete by the end of the century.

Persian minarets vary slightly in form—a tall, slightly tapering cylindrical shaft, of which the earliest example is the Minar-i Ali at Isfahan, built by Malik Shah (1072–92), with a little covered balcony near the top for the *muadhdhin,* or the man who makes the call to prayer.

Persia was certainly one of the great creative centres of architectural development. For the science and skill shown in the construction of vaults, domes and pendentives, Persian architects must ever command respect and admiration, and in the field of polychrome decoration on the grand scale their achievements remain unrivaled.

TURKEY

Turkish architecture began when a branch of the Seljuk ruling family of Persia established itself in Asia Minor at the end of the 11th century. It therefore naturally bore a strong Persian imprint which was mixed in the 13th and 14th centuries with Syrian influences—in fact the mosque of Ala ad-Din at Konia (1220) was actually built by a Syrian architect, Mohammed ibn Khaulan. In material the country had the advantage over Persia, for splendid limestone was available, hence the superb masonry and rich carved ornament of the monuments of Sivas, Divrigi, Konia, Kayseri, Amasya, Mardin, Nigde, etc.; *e.g.,* the Tschifte Minare (1271) and the Gok Madrasa (1271) at Sivas.

To this period also belong two magnificent caravansaries, Sultan Khan (1229) and the Ak Khan (13th century). One of the outstanding features of Turkish architecture is the monumental portal with a stalactite hood, but it is composed in a different manner from the Egyptian type. In addition there is nearly always a semicircular recess below to right and left, a feature never found in Egypt except in the madrasa-mausoleum of Sultan Hasan. The minarets were derived from those of Persia, together with the practice of having a pair flanking the entrance. In addition to Syrian influence, Armenian masons undoubtedly played an important part, and there can be little doubt that the many circular and octagonal mausoleums, domed internally but covered by a cone externally, were influenced by the *kempet* (domes) of Armenian churches. The most pronounced example of Syrian influence is the Great mosque (1375) of Aya Suluk near Ephesus, which is obviously based on the Great mosque at Damascus.

With the conquest of Constantinople in 1453, an important change takes place in Turkish architecture. The supreme architectural qualities of Hagia Sophia had not led the Greeks to build

other churches like it; it represented a line of development which had been, so to speak, frozen at birth. But after the capture of the city, the brilliant architectural instincts of the Turkish architects realized its supremacy over all other Byzantine monuments, and almost every important mosque built by them in their new capital is a variation of its theme. Apparently they wished to obtain a perfectly symmetrical building with one great dome, four semidomes and four small domes between them, and this was achieved in the mosque of Ahmed in 1609. But it is generally agreed that the most successful mosques built by them are those of Suleiman the Magnificent in 1556–66 and of Selim at Adrianople, both designed by the famous architect Sinan (d. 1587). But whereas Hagia Sophia does not create a very good impression externally, below the springing of its piled-up dome and semidomes, the Turkish architects aimed at a good external effect also. The mosques of this period usually have four minarets, or even as many as six (*e.g.*, that of Sultan Ahmed), and the minarets usually have two and sometimes three galleries.

The most unfortunate event for Turkish architecture was the introduction of French and Italian architects and craftsmen by the French ambassador, the Comte de Choiseul Gouffier, in the middle of the 18th century, the result of which can be seen in the Nur-i Osmanie mosque of 1748–5j and later buildings.

EGYPT

In A.D. 969 the Fatimid conquest of Egypt took place, and the foundation of Cairo on unoccupied ground about 2 mi, north of al-Fustât. The mosque of al-Azhar was begun the following year, and although it has been much altered, it is easy to see that the original sanctuary was five aisles deep and the side aisles three; the north side was without a portico. A transept runs from the court to the mihrab, the five arcades stopping short on either side of it. The material used was brick, with stucco for the decoration.

Another great mosque was begun 20 years later and finished by the Fatimid caliph al-Hakim in 1003. It had a monumental entrance in the centre of the northwest side; there were also two important lateral entrances flanked by several lesser ones. The sanctuary had five arcades resting on brick piers cut through the centre by a transept, at the end of which was a dome on squinches and there was a similar dome at each of the back corners of the sanctuary. The outer walls were of stone and the arcades of brick. There was a minaret forming a salient at the two ends of the main facade, as in the Great mosque of Mahdia, the capital of the Fatimids.

Cairo was refortified by Badr al-Gamali in 1087–92, the town having outgrown its original enclosure, and three splendid gates of fine masonry, the Bab an-Nasr, Bab al-Futuh and Bab Zuwayla, and about 400 yd. of the Fatimid wall still exist. Crusading influence is excluded, for they were built ten years before the first crusade left Europe.

One of the glories of Fatimid architecture was its ornamentation, both its decorative Kufic inscriptions and fine arabesque. It witnessed the beginning of Syrian influence, which increased under the Ayyubids and Mamelukes.

The Ayyubid period (1171–1250) was marked by the military architecture of Saladin, who built the mighty citadel and part of the city walls, in which the most noteworthy feature is the bent-entrance (three in the citadel and two in the walls), the object of this device being to break the rush of a storming party. Other features of this period are the introduction of the madrasa, or theological college, the increasing use of hewn stone, the introduction of marble paneling for mihrabs, the development of stucco ornament in the direction of almost excessive fineness, the first use of glass in window grilles and the first steps in the evolution of the so-called stalactite pendentive.

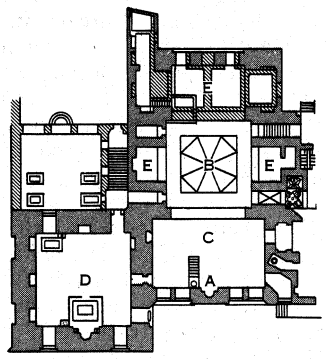


FIG. 4—PLAN OF THE MAUSOLEUM OF QAYT-BAY. CAIRO, SHOWING (A) MIHRAB, (B) COURT, (C) SANCTUARY, (D) TOMB AND (E) HALLS

The Ayyubid dynasty was followed by that of the Bahrite Mamelukes (1250–1382). This period witnessed an important development in the mosque plan, in the mosque of Baybars, where the small dome in front of the mihrab is replaced by a large dome covering nine bays (3 × 3) of the sanctuary. This feature was first introduced at Isfahan by Malik Shah (1072–92) and appeared later on at Ardistan (1158). It first appeared, outside Persia, at Mayyafariqin in 1158, a region which was in close relations with the Egyptian court. This feature occurs again in the mosque of al-Nasir Mohammed in the citadel (1335) and in that of his cupbearer al-Maridani (1340). The Syrian number and arrangement of the doors (3 axial ones) was also adopted. The stalactite portal was also introduced from Syria at this time. .

A Persian architect was employed under al-Nasir Mohammed for the mosque of Qusun, finished in 1330; this must be the explanation of the faience mosaic which now appeared for the first time in Egypt, in the mosques of al-Nasir Mohammed (1335) and Aslam al-Baha'i (1345), and in the mausoleum of Princess Toghai (d. 1349), and then suddenly died out. The period of the Bahrite Mamelukes was also marked by the final development and gradual extinction of stucco ornament, and by the introduction of splendid dadoes of polychrome marble.

The architecture of the Circassian Mamelukes (1382–1517) followed without any break in development. The rich stucco decoration, which had become extinct toward the end of the previous period, was not immediately replaced; at first the stone surfaces were left smooth and marble paneling was the chief enrichment, but when plastic skill in the new material was once acquired elaborate carved surface decoration once more became a regular feature. The stalactite pendentive underwent a change, the niches being set out Syrian fashion on a triangular frame but, unlike Syrian pendentives, each tier is curved in plan instead of cutting across the corner in a straight line and there is a great increase in the number of tiers, seven, eight or nine being quite common. The domes of this period, always of stone, are without rivals for lightness, beauty of outline and richness of decoration; *e.g.*, in the mausoleum of Sultans Barquq, Qayt-Bay, Qani Bay, etc. Fai'ence decoration was employed again at the end of this period, but only in the form of tiles instead of the much more effective fai'ence mosaic of the previous century.

It has been the custom to belittle the Turkish period (1517–1798), but it is probable that the enormous reduction in the amount of money hitherto spent by the rich Mameluke court was a more serious factor than an actual falling off in the quality of the work, and the mosques of Sidi Sariya in the citadel, Malika Safiya and Sinan Pasha at Bulaq justify this opinion.

The houses of Cairo rarely had more than two stories: on the ground floor was the *salamlik*, or men's apartments, and on the first floor the harem, or women's apartments. The chief feature of the façade, above the ground-floor level, was the attractive *mashrabiya* balconies. The following rules are generally observed: (1) the principal rooms face north (the direction of the prevailing wind) and look into the court around which the house is built; (2) the passage leading from the street to the court is built with a right-angled turn to prevent passers-by from seeing into the court; and (3) the entrance to the harem is placed on the far side of the court or in a second court.

The first half of the 19th century witnessed the introduction of the Stambuli style under the dynasty of Mohammed Ali.

WESTERN ISLAM

The Moslem architecture of Spain began with the arrival of Abd er-Rahman, the only member of the Omayyad family to escape the hatred of the Abbasids. He landed in Spain in 755 and by 787 had firmly established his rule and had built a mosque of cut stone at Córdoba. On the south side of the courtyard, which was not surrounded by porticoes until much later, was a sanctuary consisting of 11 aisles formed by 10 arcades of 12 arches each, at

right angles to the qibla wall (there was no transverse arcade at the back as at Kairouan). The central aisle was wider than the rest. The supports were marble columns with many kinds of Corinthian and composite capitals, taken from other buildings. As these supports, with their capitals and bases, only measure about 3.80 m. an upper arcade was added, as in the Aqsa mosque, to obtain the height necessary to support a flat ceiling about 9.30 m. from the floor. The execution of this idea, however, was carried out in a fashion somewhat different from that adopted in Syria, but it resembles the Aqsa mosque in that the aisles are roofed by parallel gable roofs with deep gutters between, which discharge by spouts placed above the piers of the facade on the court. The arches are built with stone voussoirs, alternating with composite voussoirs of four layers of red tiles ground down to a slightly tapering form. This alternation of colours is called *ablaq*. The existing Great mosque of Cbrdoba consists of this original part of 787 to which have been added three enlargements, two to the south toward the river and a third consisting of eight more aisles which, space to the south being lacking, has been added to the whole length of the east side. The second enlargement, due to al-Hakam in 961, is of extraordinary richness, especially the part in front of the new mihrab, where a screen is formed of interlacing arches, supporting three elaborately decorated domes, each set on the square in a different way. The mihrab is decorated with carved marble panels and gold and glass mosaic, said to have been executed by craftsmen sent by the Byzantine emperor.

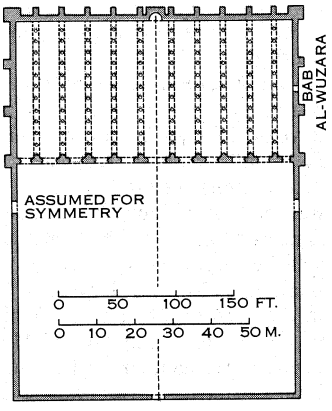


FIG. 5.—PLAN OF THE GREAT MOSQUE, CÓRDOBA, SPAIN

The Reconquista, or recovery of Spain by the Christian kings, began with the battle of Las Navas de Tolosa in 1212. This was a disaster for the Moslems, but the Nasrite kingdom of Granada survived until the end of Moslem Spain in 1492, and produced that famous masterpiece, the beautiful Alhambra (*q.v.*), the work of two kings. To Yusuf I (1334–54) is due the Patio de Comarès, to Mohammed V (1354–92) the Court of Lions and the halls belonging to it.

In North Africa the 12th century is marked by the decoration of the Great mosque of Tlemcen (1135–36), which is of extraordinary richness and beauty, especially the dome setting and the mihrab. A century and a half later came the superb decoration of the Great mosque of Taza.

INDIA

Although India was invaded by Mohammed ibn Qasim in A.D. 712 and again by Mahmud of Ghazni at the beginning of the 11th century, there is not a single example of Islamic architecture until the very end of the 12th century, when Mohammed of Ghor left Qutb-al-Din Aibak behind in India as the first sultan of Delhi. It is to him that the oldest part of the Quwwat al-Islam mosque is due, begun in 1193. This consists of a courtyard, measuring 105 × 142 ft., surrounded by pillared cloisters, short pillars from Hindu temples being superimposed to get the required height, the whole measuring 149 × 214 ft. externally. On the west (qibla) side the close setting of the columns is broken by five octagonal bays, presumably once covered by domes. All this was finished in 1196.

Then two years later a beautiful pointed-arched façade was built in front of the sanctuary, the central arch being wider and higher than the two to right and left. It was set in a rectangular frame which rose above the rest of the façade (a Persian concept known as a pishtaq, or frontispiece) and which consisted of bands of Hindu ornament and Kashki inscriptions. But these five arches are constructed with horizontal courses, for the Hindu masons employed by the conquerors were not acquainted with arcuate construction, and they employed the same technique for the arches when Iltutmish enlarged the mosque in 1229.

It was in the mausoleum of Balban (c. 1280), however, that true arcuated construction made its first appearance. The mosque had three axial entrances and was accompanied by the first minaret in India, the famous Qutb Minar, closely related to those at Ghazni, Afg., and the minaret discovered at Jam (1163–74) in the 20th century.

This mosque, with its three axial entrances, cloistered courtyard and sanctuary with large central arch more or less set the standard type for India (*e.g.*, those at Delhi, Agra, etc.), except that this central arch is sometimes flanked by the massive bases of a pair of minarets (*e.g.*, at Ahmadabad, Dholka, Champanir, etc.). Indian minarets are generally tall, circular or octagonal towers, with several galleries and a domed pavilion at the summit.

Mausoleums form another outstanding feature of Islamic architecture in India. There are three main groups: a domed square; a domed central chamber surrounded by four smaller domes (*e.g.*, mausoleums of Khan Khanan, of Humayun and the Taj Mahal, *q.v.*); and concentric octagons (*e.g.*, mausoleum of Sher Shah), the latter type being almost unknown outside India except for the Qubbat as-Sulaibiya at Samarra.

Unlike the Islamic architecture of Persia and Iraq, the Moslem monuments of India are characterized by their well-finished masonry and finely carved ornament, while the buff or red sandstone so frequently employed adds an attractive touch of colour.

See also ISLAMIC ART; MINARET; MOSQUE.

BIBLIOGRAPHY.—G. L. Bell, *Palace and Mosque at Ukhaidir* (1914); *M.* S. Briggs, *Muhammadan Architecture in Egypt and Palestine* (1922); *K.* A. C. Creswell, *Early Muslim Architecture,* 2 vol. (1932–40), *A Short Account of Early Muslim Architecture* (1957) and *The Muslim Architecture of Egypt,* 2 vol. (1952–59); E. Diez, *Die Kunst der islamischen Volker* (1915) and *Churanische Baudenkmäler* (1918); *A.* Gabriel, "Les Mosquées de Constantinople," in *Syria,* vii, pp. 353–419 (1926), *Monuments turcs d'Anatolie,* 2 vol. (1931–34) and *Voyages archkologiques en Turquie Orientale,* 2 vol. (1940); *A.* Godard, *Âthar-i Iran* (1936–49); C. Gurlitt, *Die Baukunst Konstantinopels,* 2 vol. (1912); R. W. Hamilton, *The Structural History of the Aqsa Mosque* (1949); *E.* E. Herzfeld, *Der Wandschmuck der Bauten von Samarra und seine Ornamentik* (1923); G. Marcais, *L'Architecture musulmane d'occident* (1955); *A.* U. Pope (ed.), *A Survey of Persian Art,* 6 vol. (1938–39); Prisse d'Avennes, *L'Art arabe d'après les monuments du Kaire,* 4 vol. (1877); O. Reuther, *Ocheidir* (1912); *E.* T. Richmond, *Moslem Architecture 623 to 1516* (1926); R. M. Riefstahl, *Turkish Architecture in Southwestern Anatolia* (1931); *F.* Sarre, *Denkmaler persischer Baukunst,* 2 pt. (1901–10); F. Sarre and E. Herzfeld, *Archaologische Reise im Euphrat- und Tigris-Gebiet,* 4 vol. (1911–20); H. Terrasse, *L'Art hispano-mauresque des origines au XIII" siècle* (1932); *M.* de Vogiie, *Le Temple de Jérusalem* (1864). (K. A. C. C.)

ISLAMIC ART, the art of the followers of Mohammed, combined the influences of many regional cultures, extending from western Europe through the far east from the 7th century onward, into a unique style that attained its fullest development during the period between the 10th and 16th centuries. Islamic art is essentially an art of ornament.

Islamic History.—At the death of the prophet Mohammed in 632, his conquering Bedouin hosts already stood on the frontiers of the highly civilized empires of Byzantium and Persia. During the previous four centuries these empires had passed through great vicissitudes and only feeble remnants survived of the tradition of ancient Hellas. In Byzantium, Christianity prevailed; court, civil service and army, however, were intermixed with descendants of the barbarian tribes which had come during the migration of the nations, and in the Semitic provinces the Monophysite spirit rose up against the idolatry of the Greeks. In Persia, on the other hand, there ruled the Sassanids, whose power rested upon their hosts of cavalry from the interior of Persia, and who cultivated, side by side with the Zoroastrian religion of their fathers, ancient oriental traditions only faintly touched by Hellenistic influences.

When, on the death of the fourth elected caliph 'Ali in 661, the early communism of Islam came to an end, the whole of Tripoli, Egypt, Syria, Mesopotamia, Armenia, Georgia and Persia were already under the sway of Islam, which was soon extended to the rest of North Africa and Spain, Turkestan and the lower Indus valley. Until the middle of the 10th century all these lands were

BY COURTESY OF (1, 3, 5, 6, 7, 10) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM. (4) THE TRUSTEES OF THE BRITISH MUSEUM; PHOTOGRAPHS, (2, 8, 9, 11) F. BRUCKMANN

1. Top of a carved stone sarcophagus, from the tomb of Bairam Quli Khan at Faizabad, near Bukhara, Turkistan. Dated 942 (A.D. 1534). 2. Persian or Syrian inlaid candlestick with handles, 14th cent. Hamburg Museum fur Volkerkunde. 3. Horn or "oliphant" (ivory), carved with interlaced ornament; probably Mesopotamian, 10th–12th cent. The metal mounts are of later date. 4. Bowl with *graffito* designs, "Amol" pottery, 10th–12th cent. 5. Pottery dish, Persian, 17th cent. 6. Bottle, siliceous glazed earthenware, Turkish, 16th cent. 7. Stone and glass window, in black and white. 8. Albaretlo, Syria, 14th cent.; thick faience. Ht. 25.5 cm. 9. Bronze duck, perhaps an incense burner, Persia or Turkistan, 7th–8th cent. Bobrinsky collection, St. Petersburg (1912). 10. Enamel glass mosque lamp. 11. Helmet, iron, Mongolian, middle of 16th cent. (Moscow)

ruled by the Arabs; but even under the first dynasty of the Omayyads (661–750) the Christian Syrians and Copts began to gain a considerable influence in intellectual life, followed by the Persians under the Abbasid dynasty (750–945), and the Ostrogoths under the Omayyad caliphs of Spain (independent after 755). The Arabs themselves owned few traditions of culture equal to the needs of a universal empire. With the decay of their empire, the Abbasid caliphs were forced to maintain their power with the help of mercenaries from the nomadic Turkish tribes of the north. From the middle of the 9th century onward these Turkish mercenaries began to create lieutenancies enjoying an even greater degree of independence, with the result that after 945 the caliphs found themselves reduced to a position resembling that of the popes.

In the middle of the 11th century western Asia was overrun by new hordes of Turkish nomads, who founded the Seljuk empire, which, however, soon disintegrated into a number of small states. In the first quarter of the 13th century the Mongols and their kindred peoples of horsemen from central Asia pushed as far as Syria, Asia Minor and Hungary. Other Turkish tribes followed, notably the hosts of the great conqueror Timur (Tamerlane, *c.* 1400) in Turkistan. In 1300 the Ottomans founded the Ottoman empire, and in 1502 the Kizilbash, of the Persian Shi'ah sect, founded the Persian empire under rulers of the Safawid house; these two empires survived until the 20th century.

In 1526, in India, which had previously lain under the domination of a series of Afghan and Turkish dynasties, descendants of Tamerlane founded the Mogul empire, which was ultimately destroyed by England in 1803. In Africa, on the other hand, the leadership soon fell to the nomadic Berber tribes, which formed, in addition to a number of small states, the orthodox kingdom of the Almoravides (1061–1147) and that of the Almohades (1147–1269) in the far west, and, after the loss of Spain in 1492, the kingdoms of the Marinids, Sadites and sherifs of Sijilmasa. Egypt was ruled from 969 to 1171 by the Shi'ite anticaliphs of the Fatimid dynasty — Berbers likewise — and before and after that period by mercenaries (mostly of Turkish race), including the Ayyubids (1174–1250), who were Kurds, and the Mamelukes (1250–1517), who were overthrown by the Ottoman Sultan Selim I. *See* also CALIPHATE.

Origins and Nature **of** Islamic Art. — In a world enclosed between desert and steppe and ruled by nomadic races, Islamic art inevitably followed an entirely different path from that of the west. Western classical art developed among settled tillers of the soil and in towns; it is intellectual. Characteristic of it is the clear structural consistency of architecture, which is carried on into architectural ornament. Naturalistic sculpture and relief, the portrayed figure, are preferred. The art of the nomads, on the other hand, proceeds from the tent and the loom, and for that reason the tectonics of Islamic architecture are limited to the primary forms, though they are frequently resolved into delightful shapes. Wall surfaces are adorned with purely geometrical decoration resembling rugs over the framework of a Kirghiz tent.

Islamic decorative art is based on pure ornament, script, arabesque and intertwined bands. As in early Irish, Scandinavian and Romanesque art, representations of human beings and animals are combined with fillet and arabesque ornament, and in plastic art they appear only in low relief. Only in painting do they acquire an independent life under antique Sassanian and eastern Asiatic influences, but even so they are partly in the nature of calligraphy, against the background of an equally conventional, tapestrylike landscape.

Except in the most recent period, naturalism never existed. Added to this, the Arabian world had a dislike of figural art. already perceptible in eastern Christianity. Figural representations were absolutely prohibited in the early period of Islam and under the Berber dynasties of Africa and the Mamelukes of Egypt and Syria, though under the Omayyads and Abbasids and most of the Shi'ite and Turkish dynasties it was only excluded from public buildings. *See* also BYZANTINE ART; ROMANESQUE ART.

Plastic Art. — Plastic art on the larger scale therefore seldom fell under outside influences. Thus the Seljuks brought with them from eastern Turkestan a plastic tradition akin to the Buddhist art of central Asia; this tradition is represented by the few extant statues and reliefs of lions, double eagles, dragons, angels, etc., from the city walls of Konia and Baghdad, and by a few stucco plaques depicting scenes of court life. Apart from these, human and animal figures in low relief are found scattered here and there among the decorative carving on rafters and beams dating throughout the period from the 11th to the 14th century. Under the Mogul emperors in the 16th and 17th centuries Indian influence appeared in the elephant statues of Fatehpur-Sikri and Delhi. Sassanian influence appeared in the 19th century in the rock reliefs of Fath 'Ali Shah of Persia. Other plastic art, however, was entirely restricted to small-scale works, chiefly figures of lions, elephants and birds in glazed stoneware or bronze, strongly conventionalized as the nature of the material required, and used as water vessels or smoking appliances. A madonna with Mongolian dress and appearance, made of fai'ence, is an exception.

Painting. — Figure painting was much more important. It is true that it was excluded from public, political and religious edifices.

In the private apartments. however — bathrooms and harems especially — painting was tolerated by the clergy, and found its expression in frescoes, illustrated erotic and edifying books, and household vessels, goblets, bottles, etc., adorned with figures. Even the caliphs decorated the private apartments in their palaces in this way. Thus between 712 and 715 the Omayyad al-Walid had the bathrooms in his desert castle of Qusair 'Amra painted throughout with frescoes in the later antique style, depicting birth and death, the three ages of life, hunters and hunting animals, musicians and dancing girls, women bathing, the caliph on the throne, the emperors overthrown by Islam and so on. The latter group betrays the influence of Sassanian art, which dominated the harem frescoes reconstructed out of scanty remnants in the Abbasid residence at Samarra (836–876). There are found dancing girls in every possible pose, naked and in flowing robes, with diadems and long braided hair, with floating veils, bowls and wine jars; huntresses and horsewomen, priests and warriors, and animals of every kind, in a heraldic style on medallions composed of intertwining tendrils and bands in endless repetition, symmetrical and hieratic.

In the Alhambra (*q.v.*) at Granada (13th–14th cent.) the last Moors of Spain were represented as noble knights and troubadours in roof paintings of an almost Gothic style. In the frescaes and faïence tiling of the castles of Isfahan and Ashraf, displaying exquisite calligraphy, and betraying strong eastern Asiatic influence, the amorous and oenophilous sentiment of the courtly youth of the Safawid era were represented. In India, the Mogul rulers of the 16th and 17th centuries had their harem apartments painted throughout with frescoes, though these mere discarded about 1700 by the orthodox emperor Aurangzeb; but wall paintings, some with Buddhist subjects, have been preserved in the bedroom of Akbar's soon abandoned residence at Fatehpur-Sikri, and from a few contemporary miniatures are known the semi-European paintings that Jahangir caused to be executed at Agra. *See* also PERSIAN ART, PAINTING AND CALLIGRAPHY.

Ornament. — Ornament is the centre of Islamic art. It supplanted all the other possibilities offered by different individual technics. Utilizing them all, dependent on none, it is a self-contained world of form, which embraces indifferently the walls of mosques and castles, the backgrounds of figure paintings, the details of sculpture, glasses, pots and vases, furniture and bronze implements, arms and jewelry, bookbindings and calligraphy, a vast storehouse of forms, turning every technique, every material to its own uses in the most perfect taste.

The motifs from which this ornament grew came from the later antique, the ancient east and the barbarian migrations. In the earliest monuments, particularly the great frieze in relief at Mshatta, the prevailing feature, as in Byzantine and Romanesque art, was the spiral tendril springing from the vine, its spaces filled in with vine leaves and branches of grapes, and diversified with all

kinds of animals and large rosettes. In the frescoes and in the third style of the stucco wall facings in the Abbasid residence at Samarra the same motif is found, though already again greatly conventionalized.

Beside it, however, is encountered a new type of ornament undoubtedly traceable to the wood carving of the nomad tribes of the north. consisting of very denatured palm leaves, whose contours soon became an independent style, a complex of free curves. Under the Turks and the Arab dynasties that took their artistic notions from them (10th to 16th century), this developed into a purely abstract art of decoration, carried to the furthest possible extent; its leading motifs are the fillet, the arabesque and the palm leaf.

The fillet is the most important and is derived from the northern nomadic art. Plain or twisted, with herringbone or circular patterns, it divides every area into border and central field, angle and centre medallions, friezes, etc. It curves into circles and wavy lines, imitates the shapes of architectural vaults, piles up tendrilwise in vaulted arcades and forms complicated trellis patterns. This developed into the twined pattern of stars and rosettes favoured during the Mameluke period, which presents designs that, immensely numerous though they are, are always mathematically accurate. The intervening spaces are filled with polygons of every shape, stars, garlands, rosettes, often plain or in simple patterns that secure their whole effect through colour contrast, and frequently are decorated with rich arabesques diversified with palm-leaf motifs.

The early twining vine leaf, the palm leaf. the tree of life of the ancient east, are combined in an inextricable dramatic unity, enriched since the Mongol period with completed palm leaves and even with distortions of these into diabolical masks, houses, etc., and Chinese cloud strata and shreds. Thus western Asia, especially Persia. was dominated by the arabesque, in delicate spirals, often of the shape of snail shells, with little rolled-up and not uncommonly pinnate leaves, and rosettes, and palm leaves radiating outward. It served also as a background for decorative figures of phoenixes and Chinese dragons, hunting animals and birds, musicians and dancing girls, but most of all for ornamental inscriptions.

The clumsy early Arabic script, the Kufic, with its numerous vertical and oblique strokes, produced an extraordinarily monumental effect, and for that reason, it continued to be employed as a decorative writing, and developed into a new form, used with special frequency in Persia — the floral Kufic, in which the top of the characters blossom into floral tendrils. This was also combined with the trellis ornament, a notable example being the stuccowork in the Alhambra at Granada.

The later cursive naskhi, with its wealth of curves and twists, also proved a highly decorative script, the final letters of words being generally crossed with the long strokes of the initial letters like an ornament. They were also frequently used to provide a delicate background to the heavier characters of the Kufic. The shikasta, and the animal figures which were artfully formed from the characters of some sentences (generally from the first sura of the Koran) were confined, however, to the Persian book-designer's art.

After the 16th century Islamic ornament began to decay. As early as the 13th century niches framed by arches and pillars, vases with bouquets of flowers, hanging lamps, cypresses, etc., had appeared sporadically; these now came into favour as decorative motifs, and their seminaturalism drove out the wealth of abstract ornament.

Architectural Ornament. — Since tectonic arrangement in architecture was confined to the broad lines, a wide field was presented for ornament. In the Omayyad period preference was given to the glittering glass mosaic and deep-shadowed pierced stone filigree work, both common in Byzantium. With the victory of the sun-dried brick under the Abbasids, these were superseded by stucco facing sometimes molded in the flat, sometimes likewise cut in high relief, as in the third style of Samarra and in wonderful inscriptions in floral Kufic from Persia, all originally richly painted.

Later, in the Turkish and Mongolian periods, stucco gave way to the cheaper substitute for the more costly mosaic, in freestone or brick, but most often in fai'ence tiling. The less important parts of the rough core of the wall, often quite carelessly put together, were overlaid with a particoloured mosaic of glazed bricks of varied shapes, making all kinds of twined patterns and formalized Kufic words endlessly repeated; while the major portions were covered with mosaics of tiles cut skillfully to the exact shapes of the prevalent patterns, in harmonious colour schemes, particularly blue, or in combinations of fai'ence ornament on a stucco ground (in relief) or friezes of inscriptions in incised stucco in the intervals of fai'ence mosaic. Admirable also are the script friezes of glazed tiles with dark blue characters on a ground of golden-brown arabesques.

With the decay of ornament after the 16th century, this type of mosaic was generally supplanted by square faience tiles with the decoration simply painted on them. Apart from one or two magnificent portions of buildings, Syria, Egypt and the west were content with coloured stuccowork and mosaics of particoloured stone plaques, generally white and red or white and black. For plan and tectonics *see* ISLAMIC ARCHITECTURE. *See* also ORNAMENT, ARCHITECTURAL.

Furniture. — Another reason for this rich wall decoration lies in the almost complete absence of furniture, in our sense of the term, in Islamic places of worship and dwelling houses. This, like the custom of sitting on the floor, was due to the nomadic habit. Household crockery was kept in stuccoed recesses in the walls, or on wooden shelves and in cupboards built into the walls; of the latter there is at Berlin a fine example from Aleppo, with biblical paintings in the Persian style.

Furniture, in our sense, was represented in private houses by small, low, round or oblong tables, and in India also by beds (charpoy). Persons of consequence used the takht, but sat on it in the same posture as on the floor; chairs came into use in the 17th century only in the highest circles. In the mosques the Koran was placed on a desk (kursi) like a campstool, and was often kept in a small circular cabinet; the pulpit (minbar) was a domed box at the top of a staircase, reached through a doorway that could be closed.

A feature of most of these objects is the way in which they are decorated with tasteful tarsia work of small boards, richly carved and inlaid with mother-of-pearl, ivory, etc. This was necessary owing to the wood available and the danger of warping. The harem doors were worked in like fashion, often with rich bronze ornamentation, and the balcony railings (musharabiya), made of small curved wooden pales. (*See* also WOOD CARVING.)

The remaining objects in the house comprised rugs and cushions, jewel cases and boxes, table utensils, lamps, smoking equipment, open charcoal pans (as stoves) and warming pans, candlesticks, etc., in bronze, fai'ence, glass, ivory and other materials. For rugs and woven fabrics, *see* EMBROIDERY; TEXTILES.

Ceramics. — The Islamic ceramic art built upon ancient oriental traditions, enriched them for its own religious purposes with a new and highly effective technique, and pursued its development under growing influences from eastern Asia.

The use of the coloured glazed brick was inherited from Babylon, as was the unglazed earthenware in the barbotin style (in which the pattern is made by applying bands of clay) with the tree of life and naked goddess (Astarte) motifs, enriched with Hellenistic and Sassanian elements, laurel and acanthus leaves, stubs of palm leaves, and later wreathed medallions centred with animal figures, griffins, eagles and the like. Examples are to be seen in the pottery of Samarra, though this is almost entirely in tiny shards. Echoes of this barbotin technique appear in the ware of Mosul down to the 14th century, and in the Gabri ware of Persia, in the sgraffito manner, often with lively painting, until *c.* 1200.

Contemporaneously, in Samarra, appeared the first lustreware. Early Islam was puritanical enough to proscribe gold — like silk — as a worldly luxury, and for that reason, in later times, fai'ence painted with a gold lustre changing to green, brown and violet was used as a substitute; in the earliest examples the forms of the magnificent golden and silver vessels of the Sassanian epoch

can still be plainly traced. This style rose high in favour, particularly in the Seljuk and Mongol periods, but disappeared at the beginning of the 17th century.

The Abbasid caliphs also imported porcelain, from China (Sung dynasty), and had its white, yellow and green overflow glazing and its stippled, fish and other designs imitated in earthenware. With the Seljuks came a new wave of far eastern influence, the chief centre of the industry under their rule being Rhagae, the forerunner of Teheran.

Minai ware consisted of bowls, beakers, tankards and bottles with spirited painting and gilding on a white ground, often with rich figure compositions in bands. There are also vessels of similar types as well as some akin to the bronzes, in animal and human form; their design is left white, generally on a ground of violet lustre, and shows the classical arabesque and palm-leaf motifs, sphinxes and birds with crowned women's heads, peacocks, elephants, scenes of court life and war, and, above all, horsemen with their characteristic pigtails and their garments adorned with arabesques. After the destruction of Rhagae by the Mongols, Sultanabad and Veramin became the centres of the ceramic industry in the 13th and 14th centuries. Favourite types were not only *minai* and lustreware, but also faïence in green and dark blue tones, in many cases with molded ornamentation, and tiles richly decorated in lustre. From the 16th century onward, Chinese white porcelain with blue and gray designs was imported in large quantities and became a regular type. Its decoration was copied and freely developed, but porcelain itself could not be successfully manufactured, and a kind of semifaïence, closely resembling it, was made instead.

Persian pottery formed the basis of that of Syria, Egypt, Spain and Asia Minor. In the Arab civilization, figure motifs disappeared early, and bands of script or arabesque, arranged radially or in rings, became the prevalent form. In Spain, under Christian rule, this art developed still further, and absorbed Gothic motifs; the 14th and 15th century wares of Malaga (whence the name majolica) and of Paterna and Manises, two suburbs of Valencia, exercised a very strong influence on the majolica ware of the early Italian renaissance.

On the other hand, in the Ottoman pottery of Kutaiah and Isnik (Damascus and Rhodos ware), which flourished from the 15th century onward, relatively naturalistic tulips, carnations, roses, lilies, cypresses, etc., and also figure subjects, were preferred for purposes of decoration, cobalt blue. turquoise, green and manganese violet being used as colours, generally on a white ground. *See* also POTTERY AND PORCELAIN.

Glassware and Crystalware. — Unlike pottery, glassmaking was inherited from Hellenic antiquity, and was centred in Syria and Egypt.

The Fatimid period produced narrow-necked bottles, tankards and beakers, and scent bottles ornamented with externally applied bosses, threads and bands, or with spiral tendrils and animal figures molded into the glass. In addition, imitations were made (Hedwig glasses) of rock crystal vessels with ornament consisting of figures and circular tendrils, of Sassanian origin. Many of these came early into the possession of religious or noble houses in Europe, and have thus been preserved. The most marvelous work, however, was produced at Aleppo in Syria, under the Ayyubid and Mameluke dominations. Bottles, beakers, goblets and above all hanging lamps for mosques, were covered with bands of arabesque and script and with medallions in enamel colours (white, red, blue and yellow) and gold; the subjects included figures of horsemen and others, and the coats of arms of the court offices. The celebrated "Luck of Edenhall" was a goblet of this type. Modern Persian glass originated in the industry promoted by Shah 'Abbas the Great (c. 1600). See GLASS.

Metalwork. — Here again oriental traditions, particularly those of the Sassanian empire and the far east, predominated. Most of the work was in bronze, iron being still used almost only for weapons. The use of gold and silver also was limited, because it was forbidden by the Koran; and although the prohibition was often ignored, the great value of such objects led to their early destruction and melting down. Islamic jewelry of the early period is therefore of extreme rarity, being represented only by a few buckles, bracelets, etc., of the Fatimid and Mongol periods, and such pieces as the Gerona silver chest (akin to the similar ivory coffers) in Spain and the Berlin silver tankard of the 13th century, with its embossed reliefs of Sassanian animal friezes. *See* JEWELLERY.

Bronzes. — Such animals in the Sassanian style, lions, dragons, sphinxes, peacocks, doves, cocks and the like, were also cast in bronze in three dimensions, and served, like their ceramic counterparts, as basins, braziers, etc. They were particularly sought after in the later Abbasid, Fatimid and Seljuk periods, and from Egypt they became the prototypes of similar European forms. It was the Seljuks, apparently, who introduced the round bronze mirror, the reverse of which shows in low relief either two sphinxes face to face — in the manner of the *minai* pottery — surrounded by a twined pattern, or two friezes with the astrological symbols of the 7 chief heavenly bodies (sun, moon and the 5 nearest planets) and the 12 signs of the zodiac, surrounded by a band of script; this goes back ultimately to Chinese origins.

Early mugs, etc., were ornamented with animals in low relief, but engraving quickly supplanted this. Under the later Seljuks (particularly the Ortoqid Atabegs of Mosul) and the Mamelukes, engraving became almost the only form of decoration, but only to serve as a basis for the yet richer technique of inlaying: small silver plates and wires, themselves delicately engraved, were hammered into the ribs and surfaces, which were hollowed out and undercut at the edges.

In place of this an Ortoqid bowl in the provincial museum at Innsbruck has the spaces filled in with cellular enamel. This was a method of evading the prohibition of precious metals, just as gold lustre was in pottery. The ornament consisted of friezes and medallions in lattice and arabesque work, the interstices being filled with figures of warriors, hunters, musicians, animals and astrological symbols. These were superseded later by Mameluke coats of arms and inscriptions. In the 15th century the technique was imported from Syria to Venice, where productions of the same kind, *alla damaschina* or *all' azzimina* were made right into the 16th century by Islamic masters, and were in great demand. In the east the process is still common, but both technically and artistically it has decayed.

In the 15th century, however, there was a renascence of pure metal engraving, but the design — inscriptions and arabesques in the Timurid and Safawid styles — was not cut into the material, but left free in the manner of a relief, the background being etched in black.

Decoration was applied to bowls, basins, mugs, vases, mortars, braziers, warming pans, candlesticks, smoking utensils, inkstands, jewel cases, Koran holders, mosque lamps and *kursis*. These are generally in the simplest possible forms — spherical, cylindrical, prismatic — and are developed by cutting off corners, adding projections, narrowing and channeling the walls, and by reduplication; the subjects include motifs of vegetation and animal life — the former mainly in the necks and feet of vessels, the latter for handles and ears, feet and sometimes small spouts. See also METALWORK, DECORATIVE.

Weapons. — Ancient Islamic weapons of any artistic value are comparatively rare: most of the extant pieces date from the 17th or 18th or even early 19th century, while the period from the 14th to the 16th is represented by a fair number of fine examples. Islamic swords were famous even in antiquity for their wonderful blades of Damascus and Toledo steel. This high standard was attained partly by a laborious process of repeatedly welding together pieces of iron of different qualities, but ultimately it was due to the peculiar process used for smelting the Indian raw material — a method whose results have been surpassed only by those of the modern Besserner process. The earlier blades are all straight; curved sabres and daggers did not become common until after 1500.

The blades were ornamented with inlaid work of gold and silver threads, arabesques, blessings and — on the celebrated Mongol blades — also phoenixes and dragons in the Chinese manner; at a later period the inlay was confined to the part near the hilt, the

remainder being adorned with engraved reliefs. For the handle and guards, gold and cellular enamel were used, as on the magnificent Boabdil swords named after the last Moorish king in Spain (15th century), with their hooked guards, and many Ottoman and Persian daggers and sabres of the 17th and 18th centuries. Nephrite, ivory and silver plating with jeweled ornament were also used, especially for daggers.

Scabbards had ornaments to match the hilts, and were covered with riielloed silver plating, leather, snakeskin or rayskin. Battle-axes and maces are also found, though these were often mere symbols of command and high position. The former display not only inlay, but also in many cases engraved relief and even filigree work. The heads of the maces were often made of rock crystal, but more frequently were cast solid, in a smooth pear shape, with grooves or bosses, richly inlaid. Shields were round with a boss in the centre: in Egypt under the Mamelukes they were of inlaid iron, elsewhere generally of leather, with painted lacquer surface.

The armour, of Sassanian origin, consisted of a mail shirt, arm-pieces and greaves, a round breastplate, and a pointed helmet consisting of several spangles riveted together. Not until a late period did a coat of four plates (char-aina), and even a cuirass in the Spanish manner, become common. From the 15th century onward the helmet was made in one piece, though there were in addition a number of movable parts such as nosepieces, cheek-pieces, neckpieces, etc. The decoration, however — grooves or medallions between radiating ribs on a broad frontlet — betrays the original construction. The earlier pieces (15th century) were broad and protuberant, and came so low down over the forehead that eye notches were necessary, the reason for this shape being that the turban was worn under the helmet; the later examples fitted closely, and were pointed or hemispherical with spikes attached, nosepieces and crests.

The usual ornamentation in the early helmets, most of which are ascribed to western Turkistan, consists of silver-wire inlay; later, in Persia, it is generally iron engraving, sometimes combined with inlaid work; and in the grooved Ottoman storm helmets, black etching. An offshoot of the last named is the Zischagge, often richly worked, which was used in the 17th century in Hungary, Poland and even Germany.

Bookbinding and Lacquering. — Koran manuscripts, and also rich miniature books were all bound in leather, the edges being protected by a flap. A very old binding from Egypt shows inlaid work, but apart from this the usual decoration up to the 15th century consisted of stamping with beaded edges, medallions in the centre and in the corners triangular ornaments of unobtrusive script, plait and palm-leaf patterns. From the 16th century onward, however, this decoration was transferred to the inner side of the cover, in finely-detailed filigree work against a brightly-coloured background.

On the outside it was replaced by opulent stamped gilding which had indeed a similar composition but was formed of arabesques and bands of clouds, and even of decorative figure groups; sometimes also the outside was covered in the Chinese manner with lacquerwork, which in the early period showed occasional dragons and phoenixes, and later flowers and romantic and genre scenes. From the end of the 18th century this technique was in high favour, and was applied not only to bookbindings, but also to writing cases, jewel cases, toilet accessories, and even shields and bows. See also BOOKBINDING; LACQUER.

Development and Influence. — When the great civilizations of Egypt and Babylon ceased to exist, the culture of Hellas had conquered the orient with Alexander's victorious progress. Islam was only one factor in the recovery of the east brought about by the Aramaic, Coptic, Persian and Arab stocks, parallel to which proceeded the migration of the nomads of central Asia and eastern Europe and the Germanic nations whom they pushed before them. This migration took its rise from the frontiers of China, and in the later thrusts of the Turks and Mongols it also overran the area of the Arabian civilization; and beside and behind it came the peaceful influence of the far east. Thus in its early period Islamic art continued the assimilation of Hellenistic and ancient oriental motifs begun by the later Persians, and from the Abbasid era it fell almost wholly under the tradition of the Sassanian empire.

With the rise of the Turkish dynasties the nomad character became increasingly marked, and from the Seljuk period onward the influence of eastern Asia grew in strength, particularly from the Mongol to the Safawid period. Meanwhile Islam fused all these influences into a completely individual abstract style, which reached its zenith, artistically and technically, between the 10th and 16th centuries.

Thereafter decadence began, veiled in the 17th century by extravagance of external splendour, but betrayed by a tendency toward some degree of naturalism and an increase of European influence, and leading to complete decay by the middle of the 19th century. During its greatest period, however. the influence of the Islamic culture extended through India as far as Java, to China, to the Sudan and to the whole of Russia.

The European culture of the middle ages and the Renaissance was very largely derived from it. Islamic brocades and carpets, ivories (coffers and olifant horns), 'glasses and aguamaniles, etc., found their way from Spain, Sicily and Fatimid Egypt into the ecclesiastical and princely treasure houses of Europe; in the period from the Crusades to the conquest of Granada the borrowings consisted mainly of Mameluke weapons and glass, *azzimina* bronzes, Toledo blades and majolica ware from Spain, albarellos, etc., and bookbindings.

In the east the Tatars brought their culture and art, especially weapons and clothes, to the Russians. Further, through the Turkish wars various Islamic utensils and objets #art — stuffs, costumes, rugs (Polish rugs), sabres, helmets, etc.—became naturalized in Hungary and Poland, and even in Austria, Saxony, Bavaria and Prussia.

BIBLIOGRAPHY.—Saladin-Migeon, *Manuel d'Art Musulman,* 2nd ed. (1927); F. Sarre and F. R. Martin, *Meisterwerke muh. Kunst in München 1910* (1912); E. Diez, *Die Kunst der islamischen Völker* (1915); E. Kiihnel, *Islamische Kleinkunst* (1925); S. Lane-Poole, *The Art of the Saracens in Egypt* (1888); G. Schmoranz, *Altorientalische Glasgefasse* (1898); H. Wallis, *The Godman Collection* (1901); F. Sarre and E. Mittwoch, *Metall* in F. Sarre Collection (1906); *The Burlington Fine Arts Club Exhibition of the Fayence of Persia and the Near East* (1908); F. R. Martin, *Altere Kupferarbeiten aus dem Orient* (1912); H. Rivière, *La céramique dans l'art musulman* (1913); R. Meyer-Riefstahl, *The Parish-Watson Collection of Muhammedan Potteries* (1922); F. Sarre, *Islamische Bucheinbande* (1924); F. Sarre, *Die Keramik von Samarra* (1925); E. Herzfeld, *Die Malereien won Samarra* (1927). (H. GOE.)

ISLAMIC INSTITUTIONS. Of all the institutions of Islam the caliphate is the oldest, the most fundamental and in essence the most enduring. For its history see CALIPHATE; the present subject is its origin and nature. Muhammad ruled over his people as a divinely inspired and guided prophet. He led the public prayers; he acted as judge; he controlled the army. On his death a leader was put in his place of similar authority, though without the divine prophetic guidance. He was called the "successor" (khalifah, caliph) of the Prophet, later also the *amīr-al-mu'minīn,* commander of the faithful, and was elected by the Muslims, just as the Arab tribes had always elected their chiefs. He was thus an absolute ruler but was democratically elected. For the Sunnites it has been a matter of agreement (see ISLAMIC LAW) from the earliest times that the Muslim community must appoint such a leader (see IMAM). The Shi'ites, on the other hand, hold that the appointment lies with God, and that God always has appointed, though his appointment may not always have been known and accepted. Their position may be called a legitimist one.

Some few heretical sects have held that the necessity of a leader was based on reason, not on the agreement of the community. But, for all, the rule of the leader thus appointed is absolute, and all authority is delegated from him and, in theory, can be resumed by him at any time.

But Abū Bakr, the first caliph, nominated his successor, 'Umar, and that nomination was accepted and confirmed by the people. So a second precedent was fixed, which was again carried a step farther, when Mu'āwiyah I, the first Umayyad caliph, nominated his son, Yazid I, as his successor and caused an oath of allegiance

to be taken to him. The hereditary principle was thus introduced, though some relics of the form of election persisted. The Ottoman claim was based on an asserted nomination by the last 'Abbāsid, who died in exile in Egypt in 1538, of the Ottoman sultan, Salim I., as his successor. Such a nomination in itself was a perfectly legal act, but in this case had a fatal flaw. It was an absolute condition, laid down in tradition, that the caliph must be of the tribe of Quraish, that of the Prophet.

The duties of the caliph were to enforce legal decisions and maintain the divinely revealed ordinances; guard the frontiers and equip armies; receive the alms; put down highwaymen; maintain the Friday services and the festivals; decide disputes and receive evidence bearing on legal claims; marry minors, male and female, who have no guardians; divide booty. He had to be a free, male, adult Muslim; have administrative ability; be an effective governor and do justice to the wronged. So long as he fulfilled these conditions he was to be absolutely obeyed. The caliph, therefore, was the highest executive officer of a system assumed to be definite and fixed. To depose him a *fatwā* (see MUFTI) would be required—in Turkey from the Shaykh-ul-Islām—that he had violated some essential of the Muslim faith, and no longer fulfilled the conditions of a caliph.

The Diwans.—But it was impossible for the caliph personally to administer the affairs of the empire, and by degrees government bureaus (*dīwāns;* see DIWAN) were created to regulate and administer the system of taxation and the revenues of the state. The sources of revenue were (i.) the poor-rate (zakcit), a tithe paid by every Muslim; (ii.) the fifth of all booty; (iii.) the poll-tax (*jizya*) on non-Muslims; and (iv.) the land-tax (*kharāj*) also on non-Muslims. The non-Muslims must retain their lands, cultivate them and pay the land-tax and the poll-tax and give contributions in kind to support the local Muslim garrisons which were massed in great camp-cities at strategic points. The first patriarchal period of conquest, unearned wealth and the simple life passed rapidly into the genuinely Arab empire of the Umayyads, with whom came an immediate development of organization in the state. The seclusion of the caliph in Umayyad times increased still further when the administration of the state passed by delegation into other hands, and the caliph himself became a sacrosanct figurehead, as in the case of the later 'Abbāsids; when theories of semi-divine nature and of theocratic rule appeared, as in the case of the Fatimites; and finally when all the elaborate court ritual of Byzantium was inherited by the Ottoman sultans.

Under the 'Abbāsids the semi-independent provinces became fully independent, or at most acknowledged the caliph as a spiritual head and paid a nominal tribute. His name might stand on the coinage and prayers be offered for him in the Friday service, the two signs of sovereignty to this day in Islam. With this crumbling of the empire went a more elaborate organization; bureaus took the place of principles and of the energy of individual rulers.

The Vizierate.—Abu 'l-Abbās, the first 'Abbāsid caliph, was the first to appoint a vizier (wazir, "helper," so Aaron is *wazir* to Moses in the Qur'ān), a confidential minister to advise him and come between him and the people. The vizier sometimes became as important as the caliph, for with a weak ruler his vizier became absolute, with a strong ruler his vizier remained subordinate. Until the time of Rāḍī (934–940) the vizierate thus fluctuated in importance. In that caliphate the vizier lost all authority, and in his place came the *amir* al-umarci—equivalent to the major *domus* of the Franks—the head of the Turkish bodyguard, in terror of whom the caliph now stood. When in 945 the Būyids captured Baghdad and the caliph became a purely spiritual sovereign, they took the title "vizier" for their own chief minister, and the caliphs retained only a secretary. Under the Seljuks, however, they regained their viziers and some real authority.

Under the early 'Abbāsids the four most important ministers were the chief cadi, the chief of police or head of the life guards, the minister of finance and the postmaster, who was the head of the system of information and espionage which covered the empire. But at different times the different bureaux varied greatly. Under Mutawakkil we find the bureau of taxes and finance; bureau of the crown estates; bureau of state book-keeping; bureau of war, *i.e.* of hired troops; bureau which kept reckoning and control of the pensions of the clients and slaves of the ruling family; bureau of the post system; bureau of expenditures.

As the chief of police, mentioned above, was rather the head of the caliph's bodyguard, there was also a police system after our ideas, but more thoroughgoing. The *muhtasib* had charge in the broadest sense of public order and morals in the streets, and had oversight as to weights, measures and adulterations; but had no right to interfere privately or enter houses save in the clearest and most necessary cases. He had a summary jurisdiction in all minor cases where no trial was necessary; but where witnesses and oafhs entered the case must go to the cadi. Slaves and beasts of burden were under his guardianship; he prevented public scandals, such as the sale of wine; he regulated the public conduct of Jews and Christians. In the interest of public morals he had to find suitable husbands for widows and see that they did not marry before the legal time; questions of paternity also he had to investigate.

It is impossible in Islam to separate logically from the mass of institutions those which we should call religious, as Islam on all sides is for the Muslim equally religious. But perhaps the following may practically be separated under that rubric. Islam, runs a tradition, is built on five things: testimony that there is no god save Allah, and that Muhammad is the apostle of Allah; prayer; the poor-rate; pilgrimage; fasting. For these see ISLAM.

The law and usage of religious foundations in perpetuity (*waqf*, mortmain) became as important in Islam as monastic endowments in mediaeval Europe, and such foundations tended similarly to absorb the greater part of the national wealth. A pious foundation could he erected in such a way that either so much from its funds would be paid yearly in perpetuity to the descendants of the erector, or those descendants would be employed as officials of the foundation.

The Imam.—When it became impossible for the caliph to lead the people personally in prayer in the mosque, he delegated that part of his duties to another, hence called imām (*q.v.*). Naturally, then, the appointment of the imām would lie with the supreme ruler. This holds of the daily prayers in the principal mosque (al-masjid *al-jāmi'*) supported by the ruler where the Friday service is held, but in the separate smaller mosques built by each community the community chooses its own imām. The imām appoints the muadhdhin, the announcer of the hour of prayer from the minaret, and both have a claim on the state treasury.

Another office exercised when possible by the caliph, but very frequently delegated to some high dignitary, such as the heir to the caliphate or a prince, was the leadership of the pilgrimage caravan to Mecca and back. Sometimes this official, called *amīr-al-ḥajj*, was appointed imām as well. He then led all the pilgrimage ceremonies at Mecca.

The Cadi.—Islamic law (*q.v.*) is treated separately. Here, again, as judging is a duty of the caliph, a cadi is the delegate, or, when appointed by a vizier or governor, a delegate of his delegate. He examines into disputes brought before him and enforces his judgments, he names administrators of the estates of minors, the insane, etc.; he supervises the waqf property of mosques and schools in his district and inspects highways and public buildings; he watches over the execution of wills; he inflicts the due legal penalties for apostasy, neglect of religious duties, refusal to pay taxes, theft, adultery, outrages, murder; he can inflict the penalties of imprisonment, fine, corporal punishment, death; if there is no imām, he can perform his duty, as in fact can anyone who has the requisite knowledge.

The Army.—For the existence of an army in Islam, there are two grounds, the holy war (*jihdd, q.v.*) against unbelievers without the state and the suppression of rebellion within. Under Umar, every able-bodied male Muslim was theoretically a fighting man, part of the national militia. This army was divided into corps situated in the conquered lands, as armies of occupation, where they eventually came to form military colonies in great camp-cities. The occupied countries had to support them, and they were bound to render military service at any time. But as the ideal of Umar broke down before facts the use of mercenary

and slave troops finally increased; although there has always continued in Muslim armies acting against unbelievers a proportion of volunteers not paid a fixed wage but subsidized by the state from the poor-rate and alms funds. The generals were appointed by the caliph, and had either unlimited authority to act as his representatives, concluding peace, acting as cadi and imām, distributing booty; or were restricted within limits, *e.g.* to simple leading of the troops and carrying on military operations. As war by a Muslim power is essentially sacred war, the regulations of *jihād* must be considered here. Unbelievers must first be invited to embrace Islam and, if they follow a sacred book and are not idol-worshippers, are given a choice between (a) becoming Muslims; or (b) submitting to the Muslims and entering on a treaty with them of protection and tribute; or *(c)* fighting. If they accept Islam, their lives, families and property are secure, and they form henceforth part of the Muslim community. If they submit and enter on treaty relations, they pay a poll-tax, for which their personal safety is assured, and assume a definitely inferior status, having no technical citizenship in the state, only the condition of protected clients (dhimmis). If they elect to fight, the door of repentance is open, even when the armies are face to face. But after defeat their lives are forfeit, their families are liable to slavery, and all their goods to seizure. Apostates must be put to death. Four-fifths of the booty after a battle goes to the conquering army.

Education.— The glory of Muslim education was its university system, which fed the higher learning and did not serve every-day needs. Its primary system was very poor, almost non-existent; and technical education has never been recognized in Islam. Primary teachers were despised as ignorant and foolish. Their pupils were the young only; they taught the rudiments of reading, Qur'ān, catechism, prayer, writing and arithmetic, but very little of the latter. Technical education was given by the gilds through their apprentice system, teaching mechanical arts and crafts. All Muslim university education, like all Muslim science, revolved round theology. There were, apparently, only two outstanding exceptions to this rule, the academy of Ma'mūn (813–833) at Baghdad, and the hall of wisdom of the Fatimites at Cairo (1004–1171); both of these are explained by their environment. From the earliest times, independent scholars instructed classes in mosques —the common places of meeting for the community—and gave their pupils personal certificates. Their subjects were the reading and interpretation of the Qur'ān; the body of traditions from the Prophet; the thence deduced system of theology; the canon law. But the interpretation of the Qur'ān involved grammatical and lexicographical studies of early Arabic, and hence of the early Arabic literature. Theology came to involve metaphysical and logical studies. Canon law required arithmetic and mensuration, practical astronomy, etc. But these last were strictly ancillary; the object of the instruction was primarily to give knowledge of value for the life of the next world, and, secondarily, to turn out theologians and lawyers. Medicine was in Jewish and Christian hands; engineering, architecture, etc., with their mathematical bases, were crafts. Gradually, educational institutions came to be equipped with scholarships of money or in kind for the students. The first instance of this is generally ascribed to Nishapur (Naisābūr) in 1066; but it soon became general in the system and afforded a means of control and centralization. A final, and most important, characteristic was the wide journeying of the students "in search of knowledge." Scholars thus kept in touch with one another all over the Muslim world, and intellectual unity was maintained.

The Sayyids.—To the democratic equality of Islam, in which the slave of to-day may be the prime minister of to-morrow, there is one outstanding exception. The descendants of the Prophet and of his relatives (the family of Hāshim) formed and form a special class. held in social reverence, and guarded from contamination and injury. These are the sayyids (lords), and genealogical registers of them are carefully preserved. They are of all degrees of wealth and poverty, but are guarded legally from *mésalliances* with persons of ignoble origin or equivocal occupation. Their influence is very great, and in some parts of the Muslim world they enjoy the standing and reverence of saints.

BIBLIOGRAPHY.—A. von Kremer, Culturgeschickte *des* Orients (1877), trans. by S. Khuda Bukhsh (1920, 1927); Māwardī's *Ahkām*, trans. by E. Fagnan (Les statuts gouvernementaux, 1915); McG. de Slane's trans. of Ibn Khaldūn, *Prolégomènes;* C. Snouck Hurgronje, Mekka (1889); D. B. Macdonald, Development of Muslim Theology, etc. (1903); M. Gaudefroy-Demombynes, Les institutions musulmanes (1921); A. Merz, Die Renaissance des *Islams* (1922). (D. B. M.)

ISLAMIC LAW. Law (Shari'ah) in Islam has a wider application than any western secular law, since it claims to regulate all the aspects of life—duty to God, to one's neighbour, to one's self. It is really a system of duties, ethical, legal, religious, and governs not only the private life of the pious Muslim, but also fixes the laws of marriage, divorce and inheritance, as well as the criminal law. Its historical development began with Muhammad sitting as judge in Medina; his decisions followed, at one time, the usages of the Arab and Jewish tribes of Medina; at another, his own personal judgment. At his death he left behind the legislative enactments embodied in the Qur'Bn, and the memory of his legal decisions. These were collected among the traditions (hadith), which recorded his sayings and doings, manners and customs, and his answers to questions on religious life and faith, and his decisions in legal disputes.

The first collecting of traditions was for private purposes, and the first publication dealing with them was legal, viz. the *Muwaṭṭa'* of Malik ibn Anas (d. 795), a corpus *juris* based partly on traditions. Thereafter came collections of two different rypes, the earlier, arranged according to the companions of Muhammad, on whose authority the traditions were transmitted, *e.g.,* the Musnad of Ahmad ibn Hanbal; the other, called *Muṣannaf* (classified), containing traditions arranged in chapters according to their subject matter. That of Bukhārī is the most famous, and is arranged to give a traditional basis for a complete system of canon law; another is that of Muslim ibn al-Ḥajjāj, who paid less attention to legal aspects and more to minute accuracy.

Another element which came into the development was Roman law, which the Muslim jurist found at work in the conquered Roman provinces and in law courts. Many principles of Muslim law can be traced to the Roman codes, and it was plainly influenced by the liberty involved in the *Responsa prudentium* of Roman lawyers, and by the broad conception of the law of nature in the Edict of the Praetor.

During the Umayyad dynasty, the public life of the state was no longer so religious as it had been while Medina was still the capital, and though law was still needed, it had to be opportunist. Its development went on, but became speculative. The study of tradition was now private, and its students were more and more the personally pious, no longer living in contact with reality; they regarded any system of government which did not simply reproduce the patriarchal form of Medina, as a thing with which no religious man could have aught to do.

The rise of the 'Abbāsids brought a change, in that they had promised a return to the old religious attitudes. But in substance they were much as the Umayyads, and though the state was outwardly on a pious footing, and the religious sentiment of the people was respected, the old, absolute religious law was not restored. It was made possible for more theologians and lawyers to work with the state, but an irreconcilable party still remained, and the situation was fixed as it is to this day.

Yet the 'Abbāsids did, in their way, encourage legal studies, and under them processes and results, long pursued in private, became public. Almost within the first century of their dynasty the four legal schools, or rites, were formed and the principles established which survive to this day.

ISLAMIC LAW SCHOOLS

The first school to take definite form was the Hanifite, founded by Abii Hanifa (d. 767), who left behind him a definite system. He used few traditions, and preferred to go back to the Qur'ān, and extract from it by reasoning the rulings which fitted his ideas. The 'Abbāsids adopted his school, and the Ottoman Turks also later, and it may be said to hold now a leadership among the four legal rites.

Malik ibn Anas, the founder of the Mālikite school, used traditions much more generally than did Abii Hanifa, but two of his principles marked a distinct advance and showed that he was no mere traditionalist. For one, he laid down the conception of public advantage (*istiṣlāḥ*); when a rule founded on even a valid analogy would work a general injury, it was to be set aside; justice must not be overcome by logic. And, for the other, he laid stress on the conception of the agreement (ijma'), an idea which was to have indefinite importance in the future. When the surviving companions of the Prophet, after his death, agreed upon any point as belonging to their store of tradition and experience, their agreement was accepted as final.

The third school was founded by ash-Shāfi'ī (d. 820), who laid great stress on tradition, but gave to the principle of agreement *(ijma')* its full rights. The agreement of the Muslim peoples was to be the voice of God. "My people," said a tradition from Muhammad, "will never agree in an error." So, over traditions and over the Qur'ān itself, the agreement tacitly or explicitly ruled and rules. It stamps as authoritative that which the other principles lay down. He also emphasized the principle of analogy.

The four bases thus laid down by ash-Shāfi'ī—Qur'ān; traditions; analogy; agreement—have come to be accepted by all existing schools. This applies to all spheres of life, ethical, social, theological, legal, and it should never be forgotten that the Qur'ān is only one of the sources for Muslim faith and conduct.

The fourth, the Hanbalite school, was founded by the scholars of Aḥmad ibn Hanbal after his death in 885. It minimizes agreement and analogy and is literal in its interpretations.

All these schools of law administer a scheme of duties, law which for centuries has had only a partial connection with the real legal systems of the Muslim peoples. Among the Wahhābis and Ibāḍites alone is it the whole of law. Else here, since the Umayyad period, its courts have been in great part pushed aside by others, and its scheme has come to be regarded as an expression of impossible theory.

For as Islam spread, it came to regions, climates, customs, where the Arabian usages no longer held. Not only were the prescripts of Medina ill adapted to the new conditions; the new people had legal usages of their own to which they clung and which nothing could make them abandon. So, as in religion the faiths of the conquered peoples were thinly veneered with Muslim phrases, in law there grew up a customary code (*'ādāt*) for each country, differing from every other, which often completely obscured and annulled the prescriptions of the shari'ah. The one was an ideal system, studied and praised by the pious learned; the other was the actual working of law in the courts.

There also arose a new and specific statute law. emanating from the sovereign, and sometimes codified as in the Turkish statute law (*qawānīn*) derived from various European codes. Thus there has grown up in almost every Muslim country at least two systems of courts, the one administering the shari'ah, and taking cognisance of private and family affairs, such as marriage, divorce. inheritance, its officials also giving rulings on purely personal religious questions, such as details of the ritual law, the law of oaths and vows, etc.; the other, the true law courts of the land, administering codes based on local custom and decrees.

A rift almost as important entered the legal life of the Muslim lands on another side. Non-Muslim communities, settled in Muslim territory, have been uniformly permitted to administer and judge themselves according to their own customs and laws. Accordingly, to various ecclesiastical organizations, Christian and Jewish, was given over the administration of these non-Muslim sections of the community, their bishops and rabbis becoming their responsible heads and the links of contact with the Muslim rulers.

In accordance with the same principle, the European merchant, living and trading in the East, was put first by usage and finally by treaty under the jurisdiction and control of his own consul. Thus there grew up the extraterritorial law of the capitulations and conventions, by which the sanctity of the person and household of an ambassador is extended to every European.

There may be said, then, in short, to be three elements in the legal life of a Muslim state: the shari'ah, the sacred and fixed law of Islam; the civil law, based on the usages of the different peoples, Muslim and non-Muslim, and on statutes going back to the will of rulers; the international law of the capitulations, with a contractual sanction of its own.

In modern times, frequent demands have been made by liberal Muslim thinkers that the principle of agreement (*ijmā'*) should be so extended as to render possible changes in the shari'ah, so as to bring it into harmony with modern conditions; but the orthodox legists have steadily resisted any such change. In 1926 Turkey adopted the Swiss civil code and the Italian penal code, thereby abolishing the sacred law of Islam altogether.

ISLAMISM: see PAN-ISLAMISM.

ISLAND, any area of land smaller than a continent and entirely surrounded by water. Islands may occur in oceans, seas, lakes or rivers. A group of islands is called an archipelago.

Islands may be classified as either continental or oceanic. Oceanic islands are those which rise to the surface from the floors of the ocean basins. Continental islands are simply unsubmerged parts of the continental shelf (*q.v.*) that are entirely surrounded by water. Many of the larger islands of the world are of the continental type. Greenland (840,000 sq.mi.), the largest island,' is composed of the same materials as the adjacent North American continent, from which it is separated by a shallow and narrow sea. Likewise the world's second largest island, New Guinea (319,000 sq.mi.), is part of the Australian continental platform and is separated from it only by the very shallow and narrow Torres strait. A slight warping of the sea bottom in the vicinity of Torres strait would be sufficient to join New Guinea to Australia; conversely, a slight rise in sea level may submerge a hilly coast and leave the hilltops remaining as small islands just off shore (examples being those off the coast near Boston, Mass., and the islands off the Maine coast).

The islands which rise from the floors of the ocean basins are volcanic. Lava accumulates to enormous thickness until it finally protrudes above the ocean surface. The piles of lava which form Hawaii rise to as high as 32,000 ft. above the ocean floor.

Many of the world's archipelagoes are arranged in island arcs, and they constitute some of the most active volcanic and earthquake areas of the world. Examples are the Leeward and Windward Islands at the eastern end of the Caribbean; the Aleutians; the Japanese archipelago; and the Philippines. Physical geographers believe that these are the areas of continental growth.

Island life exhibits features of special interest. The sea is a barrier to some forms of life but acts as a carrier of others, which, once established in their new home, frequently develop new features in their isolated surroundings. A long-established sea barrier results in marked differences between the animal life and vegetation even of adjacent islands, and from these differences may be deduced the origin of an island. Further, any detailed map of the biological regions of the globe illustrates the importance of islands in the determination of the boundaries of animal-life and vegetational types. For example, to the west of a line (Wallace's line) running between Bali and Lombok and between Borneo and Celebes the islands are biologically Asian, but to the east of the line, notwithstanding the narrowness of the Lombok strait, the vegetation and animal life are Australian. Oceanic islands are usually colonized by only a few animal forms, chiefly sea birds and insects. They are often clothed with abundant vegetation, the seeds of which have been carried by air and water currents, birds, etc., but the variety of plants is by no means so great as that on the mainland. (W. C. C.)

ISLAY is the southernmost island of the Inner Hebrides, Argyll, Scot., 16 mi. W. of Kintyre and ¾ mi. S.W. of Jura, from which it is separated by the Sound of Islay. Pop. (1951) 4,267. Its maximum breadth is 15 mi. and the maximum length 25 mi. The sea lochs Gruinart and Indaal cut into it so deeply as almost to convert the western portion into a separate island. It is rich and productive and has been called the "Queen of the Hebrides." The surface generally is regular, the highest summit being Beinn Bheigeir (1,609 ft.), but the shore is rugged. There are fresh-water lochs and rivers, which provide good trout and salmon fishing. Islay was the ancient seat of the "lord of the

Isles," the first to adopt that title being John Macdonald of Isle of Islay (d. *c.* 1386); but the Macdonalds were ultimately ousted by their rivals, the Campbells, about 1616. Islay house, ancient seat of the Campbells of Islay, is at the head of Loch Indaal. Much business is done in stock raising, dairy farming and cheese-making; oats, potatoes and various green crops are raised. The chief difficulty in the way of reclamation is the great area of peat (60 sq.mi.). The island has several distilleries, producing large quantities of whisky. Local limestone is used extensively as fertilizer, but deposits of lead, iron, slate and marble are no longer worked. Bowmore is the chief town and administrative centre, and Port Ellen, the principal port, is a holiday and golfing resort. The U.S. troops and seamen who were lost in the "Tuscania" and "Otranto" in 1918 are buried on the island, and there is a memorial tower on the Mull of Oa, 8 mi. from Port Ellen. Port Askaig is the ferry station for Feolin on Jura. There are five lighthouses on the island. In addition to a daily steamer service there is also a daily plane service connecting Glenegedale airport, Islay, with Renfrew (Glasgow airport).

ISLES OF THE BLEST or **FORTUNATE ISLANDS** (Gr. αἱ τῶν μακάρων νῆσοι; Lat., Fortunatae *insulae*), placed in Greek mythology in the Western ocean, and peopled, not by the dead, but by mortals upon whom the gods had conferred immortality. Like the Phaeacian land in Homer (Od. viii.) or the Celtic Avalon and St. Brendan's island, the Isles of the Blest have perpetual summer and abundance. No reference is made to them by Homer, who speaks instead of the Elysian Plain (Od. iv. and ix.), but they are mentioned by Hesiod (Works and Days, 168) and Pindar (*Ol.* ii.). By mediaeval map-makers, Madeira and the Canaries are sometimes named *Fortunatae insulae*. (See ATLANTIS.)

ISLINGTON (*Gislandun*=Gisla's dun, or hill), a northern metropolitan borough of London, Eng., bounded east by Stoke Newington and Hackney, south by Shoreditch and Finsbury, and west by St. Pancras, and extending north to the boundary of the county of London. Pop. (1951) 235,632. Area 4.8 sq.mi. The borough includes Holloway, Highbury, Barnsbury and Canonbury, whose names preserve those of ancient manors, and in Canonbury, which belonged in the 13th century to the priory of St. Bartholomew, Smithfield, parts of the old manor house, including Canonbury tower, remain. The fields and places of entertainment in "merrie Islington" were places of resort for Londoners in the 17th century and later. At Copenhagen Fields a great meeting of labourers was held in 1834 and to this site the Metropolitan Cattle market (covering about 33 ac.) was moved from Smithfield in 1855. The market square (about 15 ac.) became the site of the Caledonian market, a big general market with more than 2,000 stall holders which was held every Tuesday and Friday until the outbreak of World War II; in 1951 this market moved to Bermondsey. The Royal Agricultural hall, Archway hospital, Pentonville and Holloway prisons and the Arsenal football stadium are in the borough. New River Head is the termination of the artificial channel by which Sir Hugh Myddelton (1561–1631) brought water to London from the upper Lea valley. Islington's population includes metal, textile and transport workers and printers. The borough returns three members to parliament.

ISLY, the name of a small river on the Moroccan-Algerian frontier, a sub-tributary of the Tafna, famous as the scene of the greatest victory of the French army in the Algerian wars. The intervention of Morocco on the side of Abd-el-Kader led at once to the bombardment of Tangier by the French fleet under the prince de Joinville, and the advance of the French army of Gen. Bugeaud (1844). The enemy, 45,000 strong, was found to be encamped on the Isly river near Kudiat-el-Khodra, Bugeaud had a force of 6,500 infantry and 1,500 cavalry, with a few pieces of artillery. In his own words, the formation adopted was "a boar's head." On Aug. 14 the "boar's head" crossed the river about 9 mi. to the northwest of Kudiat and advanced upon the Moorish camp; it was immediately attacked on all sides by great masses of cavalry, but the volleys of the steady French infantry broke the force of every charge, and at an apt moment the French cavalry in two bodies, each of the strength of a brigade, broke out and charged. One brigade stormed the Moorish camp (near Kudiat) in the face of artillery fire, the other sustained a desperate conflict on the right wing with a large body of Moorish horse which had not charged, and only the arrival of infantry put an end to the resistance in this quarter. A general rally of the Moorish forces was followed by another action in which they endeavoured to retake the camp. Bugeaud's forces, which had originally faced south when crossing the river, had now changed direction until they faced almost west. Near Kudiat-el-Khodra the Moors had rallied in considerable force, and prepared to retake their camp. The French, however, continued to attack in perfect combination, and the Moors were defeated; peace proposals quickly followed.

ISMAIL I (1487–1524), shah of Iran from 1501 to 1524 and founder of the Safawid dynasty, was born on July 17, 1487, probably at Ardabil. Through his father, Sheikh Haidar, he was descended from the greatly revered Sheikh Safi al-Din of Ardabil, who had founded an order of Sufis there in the early 14th century. Sheikh Haidar, who was a fanatical Shi'ite, fell in battle against the Sunnis of Shirvan when Ismail was only one year old. After many hazardous adventures, in the course of which his two elder brothers perished, Ismail succeeded, with the support of seven Turkmen Shi'ite tribes, in establishing his authority in northwestern Iran and was crowned in Tabriz in July 1501. In a series of battles he gained control over the greater part of Iran in the next few years. He thereupon attacked the Sunni Uzbeks who had occupied part of northeastern Iran and defeated them near Merv in 1510. Although many of his subjects had at the outset been Sunnis, he converted the majority to Shi'ism, which became the state religion and served to bind the nation together.

When the Ottoman Turkish sultan Selim I savagely suppressed a revolt of his Shi'ite subjects in Anatolia and persecuted the survivors, Ismail marched to their assistance but his forces, which consisted only of tribal levies, were severely defeated in a hard-fought battle at Chaldiran in northwestern Iran (1514). Against Selim's well-trained janizaries and artillery Ismail had neither regular troops nor cannon. Selim marched on and occupied Tabriz, but a mutiny of his troops compelled him to withdraw to Turkey. Ismail recovered from this reverse sufficiently to prevent any further inroads by either Turks or Uzbeks, and when he died, at Ardabil in 1524, he left Iran a united nation strong enough to protect itself. His dynasty endured till 1736.

The Venetian traveler Giovanni Angiolello, who was in Persia in 1510, described Shah Ismail as "fair, handsome and very pleasing; not very tall, but of a light and well-framed figure. . . . He is as brave as a gamecock, and stronger than any of his lords."

See Ghulam Sarwar, ***History of Shah Ismail Safawi (1939).***

(L. Lo.)

ISMAIL (IZMAIL), a port and fishing centre of Bessarabia, Ukrainian Soviet Socialist Republic, U.S.S.R., on the left bank of the Kiliya (Chilia) branch of the Danube. Pop. (1956 est.) 43,000, including Rumanians, Russians, Ukrainians, Bulgars, Turks, Jews and gypsies. There are flour mills and trade in cereals, woods and hides. As a Turkish fort and capital of a sanjak, Ismail long enjoyed peace and prosperity. It was occupied by Russia in 1770, 1790 and 1812 and transferred to Rumania in 1856, to Russia in 1878 and to Rumania in 1918. Rumania ceded it to the U.S.S.R. in 1940 but recaptured it in 1941 and held it until 1944 when it was retaken by the Soviet Union.

ISMAIL HADJI MAULVI-MOHAMMED (1781–1831), Indian Moslem reformer, was born at Pholah near Delhi. In co-operation with Syed Ahmed he attempted to free Indian Mohammedanism from the influence of the native early Indian faiths. The two men traveled extensively for many years and visited Mecca. In the Wahhabite movement they found much that was akin to their own views and on returning to India preached the new doctrine of a pure Islam. The official Moslem leaders objected, and the dispute led to the reformers' being interdicted by the British government in 1827. The party then moved to Punjab where they made Peshawar the capital of the theocratic community which they wished to establish (1829). Ismail Hadji fell in battle against the Sikhs amid the Pakhli mountains (1831). Some of his adherents are still found in the mountains of the northwest frontier.

Ismail's book Taqouaiyat el Iman was published in Hindustani

and translated in the *Journal* of *the Royal Asiatic Society,* xiii, 1852.

ISMAILIA (AL ISMA'ILIYAH), a town in the Canal governorate of Egypt, located at the Isthmus of Suez where the Sweetwater canal from the Nile meets the Suez canal at Lake Timsah. It lies on the northwestern shore of the lake, a salt lagoon through which the Suez canal passes, and is 93 mi. N.E. of Cairo by rail, 48 mi. from Port Said and 52 mi. from Port Tewfik. Pop (1957) 94.572. The town was established in 1863 by the former Suez Canal company and named after the khedive Ismail. It shows French influence, being laid out on a gridiron plan, with squares, gardens and tree-lined boulevards. The company built for its employees houses. schools and a 200-bed hospital and provided recreational facilities. The central position of the town favoured the establishment there of the Central Movement office, which regulates the daily movement of shipping in the canal. Ismailia was the scene of the first scientific attack upon malaria, which later practically disappeared The town became a headquarters for the Allied forces during 1916 and has retained its military connections. On the other side of the lake are the so-called quarries of Hyenas, from which building material for the town was obtained. (A. B M.)

ISMAIL PASHA (1830–1895), hereditary viceroy of Egypt under Turkish suzerainty, was the second son of the vali Ibrahim Pasha (q *v.*). Born in Cairo on Dec. 31, 1830, he was educated in Paris and on reaching manhood undertook various diplomatic missions in Europe for the viceroy Mohammed Said Pasha, whom he succeeded in 1863. Ambitious to increase his prestige he obtained from the Ottoman sultan in 1867 the hereditary title of khedive. an honorific borne by his successors until 1914.

Beyond his frontiers Ismail pursued an expansionist policy. In 1865 he negotiated with the sultan the cession to Egypt of the ports of Sawakin (Sudan) and Massawa (Eritrea). He modernized the Egyptian army with Remington rifles and Krupp artillery and enlisted a corps of American officers who established a general staff, explored the Sudan and in 1877 prepared a notable map of Africa. In 1870–75 he extended Egyptian authority down the Red sea coast, planting garrisons at Harar and Berbera. but his attempt to occupy Kismayu in 1875 was prevented by Britain. In 1869 he commissioned Sir Samuel Baker to annex parts of Uganda: in 1874 Darfur was added to the Egyptian dominions. Ismail's territorial ambitions were thwarted in Equatoria where Baker's successor, Col. (later Gen.) C. G. Gordon, withdrew the Egyptian outposts from most of Uganda in 1876 and in Ethiopia where two Egyptian armies were disastrously defeated in 1875–76.

Ismail's westernizing domestic policy greatly benefited Egypt. Primary education was expanded in the provinces. The legal disabilities suffered by Egyptians under the capitulations were lessened by the institution in 1876 of mixed courts. An astute landlord of his vast estates and an enthusiastic town planner, he created the modern Cairo and in 1869 granted Alexandria a municipality. The summoning of a legislative assembly in 1867 marked the first approach toward constitutional government. His most spectacular achievements lay in the development of communications. He extended the railways. nationalized the postal service in 1865 and in the Sudan introduced telegraphs in 1866 and a short railway in 1875. In 1869 he presided over the opening of the Suez canal with lavish ceremonies.

His projects were often brilliantly conceived but they were compromised by his financial prodigality. By 1876 the Egyptian public debt exceeded £100,000,000. Pressed by Ismail's creditors the powers intervened and set up a dual control with a commission of the public debt. Ismail's resistance to the resulting encroachments upon his independence, culminating in his dismissal of the European commissioners. led to his deposition by the sultan at the instance of the powers on June 26. 1879.

Ismail died in exile at Istanbul on March 21, 1895. *See* also EGYPT: *History.*

See P. Crabitès, *Ismail, the Maligned Khedive* (1933); *G* Douin, *Histoire du règne du Khtdive Ismaïl,* 3 vol. (1933–41; unfinished) (R. L. HL.)

ISMAY, HASTINGS LIONEL ISMAY, 1ST BARON (1887–), British soldier who served in World War II as chief of staff to the minister of defense, was born at Naini Tal, India, on June 21, 1887, the younger son of Sir Stanley Ismay. Educated at Charterhouse and at Sandhurst, he was commissioned in 1905 and joined the 21st cavalry (Frontier force), Indian army, in 1907. Service on the North-West Frontier of India (1908) and in Somaliland (1914–20) was followed by appointments as assistant secretary (1926–30) and secretary (1938–40) of the Committee of Imperial Defense, and as chief of staff to the minister of defense (1940–46). He was promoted general in 1944 and created 1st baron in 1947.

In 1947 he returned to India as chief of staff to the last viceroy, Earl Mountbatten, and four years later became secretary of state for commonwealth relations (1951–52). Lord Ismay became secretary-general of the North Atlantic Treaty organization in 1952 and on vacating that appointment in 1957 retired from public life. His *Memoivs* were published in 1960. (C. N. B.)

ISMAY, THOMAS HENRY (1837–1899), English shipowner and founder of the Oceanic Steam Navigation company, which became famous as the White Star line, was born at Maryport. Cumberland, on Jan. 7, 1837. In 1867 he took over the White Star line of Australian clippers and in 1869 established, with William Imrie, the Oceanic Steam Navigation company. The firm having determined to enter the Atlantic trade, the first "Oceanic" (3,707 tons) was ordered from Harland and Wolff, of Belfast, Ire. The launching in 1870 marked a turning point in the development of the North Atlantic passenger liner; among the innovations introduced was the siting of passenger accommodations amidships. In 1892 Ismay retired from partnership in the firm of Ismay, Imrie and company, though he retained the chairmanship of the White Star line. He died near Birkenhead, Cheshire, on Nov. 23, 1899.

The White Star line continued until 1934, when it merged with the Cunard line to form Cunard White Star, Ltd. The assets of Cunard White Star were taken over by the Cunard Steam-Ship Co., Ltd. in 1950.

ISMET INÖNÜ (1884–), Turkish statesman, was born in Smyrna of a Turkish family of Malatya. Educated in the military schools, he became in 1903 an artillery lieutenant and in 1906 a captain on the general staff. After the Young Turks revolution of 1908, he was sent several times on military expeditions to Yemen. During World War I he served on the Syrian front and was in command of an army corps when peace was declared. At the time of the occupation of Constantinople by the Allies he escaped to Angora, disguised as a common soldier, and was appointed by the great national assembly to be chief of staff during the military operations of the nationalists against the caliphate army and Armenia. Later, as commander in chief of the Turkish western front, he insisted on the formation of a regular army in place of the irregular nationalist forces. In the meantime the irregular forces were unwilling to submit, and the Greek army had taken the offensive. At Inonii he defeated the Greeks, checked their offensive, subdued the irregular forces and succeeded in completing the organization of a regular army. He remained in command of the western front until after the battle of the Sakaria and the fall of Smyrna, in which events he was the right-hand man of Mustafa Kemal. In 1922 he signed the armistice concluded at Mudania with the Allies and secured the evacuation of Eastern Thrace. In 1923, as minister of foreign affairs, he signed the treaty of Lausanne; and during the autumn, at the time of the declaration of the republic, he became prime minister. After a rest because of failing health, he became prime minister a second time, toward the end of 1924. The abolition of the caliphate and the closing of religious schools and monasteries were brought about during Ismet's almost uninterrupted tenure of office. After Dec. 1934, when. in accordance with the new Turkish law, he adopted a surname, he became known as Ismet Inonii. Upon the death of Mustafa Kemal Atatiirk he was unanimously elected president of Turkey (Nov. 11, 1938). On March 8, 1943, he was unanimously re-elected by parliament for a second four-year term. From Dec. 4 to 6 of the same year he conferred with F. D. Roosevelt and Winston Churchill in Cairo on the improvement of the relations between Turkey and the United Nations.

In 1946 he was criticized by the opposition parties which won 69 electoral seats; and at the general election of 1950 the Republican People's party—of which, as president, he held (somewhat unwillingly) the leadership—was overwhelmingly defeated. Celâl Bayar, the opposition leader, was elected president.

As a statesman Ismet Inönü was cool and cautious. During his presidency he led his country successfully through a period of unprecedented difficulty and danger. He knew that the Turkish people wished him to keep them out of the war; and in spite of Turkey's treaty obligations he succeeded in doing so without forfeiting the support of her allies in the postwar world. After the war, realizing that Turkey's novitiate as a democratic state was over, he set aside the one-party system which had existed since 1923 and established full representative government with free elections.

ISMID (IZMIT, ISNIKMID, KOCAELI; anc. NICOMEDIA), a town of Turkey, near the head of the Gulf of Ismid, Sea of Marmara. Pop. (1960) 73,705. Ancient Nicomedia was built in 264 B.C. by Nicomedes I of Bithynia and became one of the chief towns in that part of Asia Minor. Diocletian made it the chief city of the east. It is in an agricultural district, producing cocoons and tobacco, and there are large forests of oak, beech and fir. The town is connected by railway with Haidar-Pasha, the western terminus, and with Ankara, Konya and Izmir. It contains a fine 16th-century mosque built by the architect Sinān. As the seat of a Greek metropolitan and an Armenian archbishop, Ismid retains some of its ancient dignity. The head of the gulf is silting up, and the port Darinje is almost 4 mi. from Ismid. The *il* of Kocaeli had a population of 254,263 in 1955.

ISNA (ESNA), a town of upper Egypt in Qina province, lies on the west bank of the Nile, 36 mi. S. of Luxor. Pop. (1957) 22,128 (mun.), mostly Copts. The town manufactures pottery and cottons and has large grain and livestock markets. Some trade is carried on with Kharga oasis, 110 mi. W.

Just below the town is the Isna barrage (1908), built to improve the irrigation of upper Egypt. The barrage, of granite and sandstone with 150 sluices, was reconstructed in 1948 and raises the upstream water level by 15 ft. (A. B. M.)

Esna takes its name from the ancient Egyptian Ta-Senet, but in Ptolemaic times it was called Latopolis, because*the fish *Lates niloticus* was worshiped there. The ruins lie buried beneath the modern town, and only the pronaos of the temple has been cleared. Dedicated to Khnum, the ram-headed creator god, the temple took from about 180 B.C. to A.D. 250 to build. It is in Ptolemaic style, though the decoration is largely Roman. Always a Coptic centre, there is a Christian church in the desert, within ½ mi. of the modern town. The Coptic population suffered severely under Diocletian's persecution of A.D. 303. (M. V. S. W.)

ISNEG (APAYAO), a Malayan-type people living in the mountains of northwest Luzon, Philippines. Isneg is the usual anthropological name, while Apayao is the district name, and also that of the subprovince of Mountain province within which nearly all of them live. The Isneg number today approximately 11,500, and are short in stature and rather darkly pigmented, probably through minor mixture with Negrito groups adjacent to them. They have a distinctive language, with several dialect areas. The main body of Isneg lives on the Abulug or Apayao river system which drains most of their territory; but a group called the southern Isneg lives on the Matalag river system in the south of the subprovince. The Isneg economy is based on natural rainfall ("dry") cultivation of rice, maize and tropical roots in shifting gardens, supplemented by hunting, fishing, keeping livestock, and trading tobacco and other products to the lowlands. Settlements are of hamlet size, scattered along the streams which drain the dense rain forests of the region. Each group of adjacent hamlets is crisscrossed by marriage and kinship ties. The region was noted for its headhunting, with warrior bravery and head trophies the principal basis by which males (if they survived) gained status, so that apart from a hamlet's immediate circle of friendly kinsmen all others tended to be enemies. The Isneg built substantial wood houses with high pitched roofs, but also had huts in their rotating fields: they also had distinctive dress and customs generally. Spanish missionaries worked up the rivers in the 17th and 18th centuries. but their converts were generally transferred to the lowlands; pacification was achieved by U.S.-Filipino constabulary forces in 1908–13.

See M. Vanoverbergh, The *Isneg*, Publications of the Catholic Anthropological Conference, vol. 3 (1932); F. M. and M. Keesing, *Taming* Philippine Headhunters (1934). (F. M. KG)

ISOBAR, a line on a map or thermodynamic chart, connecting points having the same pressure. Isobars for intervals of two to five millibars of pressure are important features of weather maps because of the relationship between pressure distribution, winds and weather. See METEOROLOGY. (H. R. B.)

ISOCRATES (436–338 B.C.), a famous writer and educationalist at Athens, who by the artistic form of his prose set a model which influenced many later writers. His father, Theodorus, was an Athenian citizen of the deme (township) Erchia; he owned a flute factory and was rich enough to perform expensive services to the state and to give his sons a good education. Isocrates' teachers are said to have included well-known sophists, but the details are uncertain. He must have been familiar with Socrates, although he does not appear to have been a member of the Socratic circle. Both sophistic and Socratic influences can be seen in his works. The family property was lost during the Peloponnesian War and, after the restoration of democracy in 403 B.C., Isocrates found it necessary to follow a profession. Physical infirmities prevented him from speaking in public and taking an active part in political life. For about ten years he wrote legal speeches for clients. It was an activity he despised and one to which he makes no allusion in his later works. About 392 B.C. he founded his famous school. It was highly successful and for over 50 years attracted pupils from all parts of the Greek world. He died soon after the defeat of Athens by Philip II of Macedonia at the battle of Chaeronea in 338 B.C.

Speeches.—Isocrates' extant works consist of 21 speeches (logoi) and nine letters. "Speech" is a convenient rendering of logos, but it is misleading. Only the six early forensic works are real speeches. It has been suggested that even these were rhetorical exercises, but most scholars believe that they were written by Isocrates, before he started his career as a teacher, for clients to deliver in the law courts. The rest are purely literary. Many by an artistic fiction are given the form of real speeches, but little attempt is made to keep up the illusion consistently. Some take the form of a hortatory address, others of a prose encomium. These literary speeches were presumably circulated as pamphlets among the Greek-speaking public. Isocrates seems also to have intended them to be recited by others to audiences. What are clearly instructions to reciters are to be found in the introductory part of the Antidosis. The literary speeches, the dating of which can in most cases only be approximate, may be roughly divided into two groups according to their subject matter:

Political Speeches.—Panegyricus (c. 380 B.C.) and Philippus (346 B.C.) deal with Greek unity and war against Persia. On the Peace (c. 356 B.C.) and Areopagiticus (c. 355 B.C.) give advice on Athenian foreign and home policy, respectively. In *Plataicus* (c. 373 B.C.) a Plataean citizen urges the Athenians to restore Plataea after its destruction by Thebes. Archidamus (c. 366 B.C.) is supposedly delivered by Archidamus III of Sparta, who comments on conditions of peace offered by Thebes.

Speeches on Education, Ethics and Literary Criticism.—Isocrates' views on education are given mainly in Against the Sophists (c. 390 B.C.) and Antidosis (354–353 B.C.). To *Demonicus* (c. 370 B.C.?), regarded by some as spurious, contains moral precepts. To Nicocles and Nicocles (both c. 370 B.C.) outline the duties of a monarch and his subjects, respectively. *Busiris* (c. 390 B.C.), Helen (date uncertain, perhaps 390–380 B.C.) and Evagoras (c. 365 B.C.) are ostensibly encomia, a genre of rhetorical literature then in vogue, but their main purpose is to advertise Isocrates' literary views. Panathenaicus (c. 339 B.C.), a long, rambling work of Isocrates' extreme old age, is partly an encomium of Athens, partly an exposition of his theories on writing and teaching.

Letters.—The letters, which are addressed to kings and rulers, serve the same purpose as the speeches: they advertise Isocrates'

views on current affairs. They may have been actually sent to the individuals in question, but most of them at any rate were intended for a wider public. There seems to be little essential difference between the letters and the speeches except that the former are shorter and less elaborately composed. All were written in Isocrates' old age. Their authenticity has often been questioned, but most of them at least are now considered genuine.

Political Views.—The dominant theme in Isocrates' political writings is the policy of unifying Greece against Asia. A war against Persia, he claimed, would give the Greeks a common cause and put an end to their disastrous internal dissensions. In his most famous work, the *Panegyricus,* published about 380 B.C., he urged Athens and Sparta to forget their quarrels and jointly lead Greece against the common enemy. His pleading was ineffectual, and in his subsequent efforts to find a champion of the Greek cause he turned first to Dionysius I of Syracuse, then to Archidamus III of Sparta and finally to Philip II of Macedonia. From his third letter written shortly before his death it appears that even after the battle of Chaeronea he continued to hope that Philip would lead a united Greece against Persia. There seems no reason to doubt the authenticity of this letter. Two works concern Athenian politics. In the speech *On the Peace (c.* 356 B.C.) Isocrates urged Athens to abandon its imperialistic ambitions and to recognize the right of Greek states to independence. In the *Areopagiticus (c.* 355 B.C.) he deplored the degenerate Athenian democracy of his own day and advocated a return to the restricted democracy of Solon and Cleisthenes. His political writing had little influence on the conduct of affairs; he himself complains bitterly that the Athenians preferred to listen to the platform oratory of the active politicians.

Educational System.—Isocrates' educational writings are interesting and revealing. *Against the Sophists* was written at the beginning of his teaching career. Only the first part, in which he disparages other intellectual and educational systems by comparing them with his own, is extant. His own views are more fully expressed in the *Antidosis,* written, according to his own statement, when he was 82 years old. He dissociated himself from contemporary rhetoricians whose methods, he claimed, had no educational value. Their purpose was a purely practical one; they concentrated on legal oratory, which Isocrates despised, and treated rhetoric as a technique consisting of rules and precepts which could be imparted by a competent teacher to any diligent student. His own system, which he preferred to call "philosophy," was far broader and more humane. He held that speech composition should be regarded as a creative process allowing full scope for individual talent.

On the details of his educational methods there is little information, but an essential part must have been the composition of speeches modeled on his own. He insisted that students must avoid narrow, petty or specialized themes and choose those of universal interest and importance. These must be expressed in a pleasing form which had attractions analogous to those of poetry. For mathematics and the speculative sciences he had little regard and he derided the conflicting results produced by the researches of the scientists and philosophers. Scientific knowledge *(episteme)* he contended was beyond the powers of human knowledge; the most man could do was to learn by practical experience. He preached a high standard of morality, but morality he conceived in terms of an enlightened self-interest *(pleonexia)*; those gained the true advantage who were righteous toward gods and men, in public and private life.

His pupils included sons of illustrious Greek families, men who became prominent in public life as orators and statesmen, and well-known historians, such as Ephorus and Theopompus. His success was remarkable, but he had many critics. Plato's Academy was founded shortly after Isocrates' school, and rivalry between the two establishments was inevitable. Covert attacks on Plato are found in Isocrates' works, particularly in the introductory part of the *Helen.* Plato's commentary on Isocrates comes mainly in the *Phaedrus,* but the allusions are veiled and scholars differ in interpreting them. Their general tenor, however, seems clear. Plato was willing to allow that artistically and morally Isocrates' humanism was on a higher level than the mere technique of other rhetoricians, but he considered his system unworthy of serious consideration because it was not founded on scientific method.

Conclusion.—Isocrates was not an original thinker. Nearly all his views, whether on politics or education, are adaptations of those already expressed by others. His greatest achievement was the artistic form he gave to his writings. The speeches written before his powers declined show infinite care both in structure and style. His method was to prepare a skeleton outline and build up the speech section by section, taking pains to avoid an abrupt transition from one subject to another. His style is an elaborate instrument of expression. Avoidance of hiatus and harsh collocatians of syllables produces a smooth, harmonious flow of language. This is enhanced by a subtle use of rhythm which defies analysis. It suggests a fondness for certain clausulae but never so obtrusively as to reveal a fixed metrical scheme. He avoided the more extravagant ornaments which gave Gorgias' prose a meretricious appeal, *e.g.,* unusual words, startling metaphors, jingling assonance, but in building up his periods he indulged freely in balanced clauses and antithesis. With much reading the balanced periods become monotonous. He himself seems to have been aware of this. In his advice to reciters of his works he warns them to read only so much as will not weary listeners. His influence on subsequent prose writers, notably Cicero, was considerable.

BIBLIOGRAPHY.—The text was ed. by G. E. Benseler, 2 vol., and ed. rev. by F. Blass, "Teubner Series" (1889–1891); by E. Drerup, with copious notes, unfinished, vol. i (1906); ed. with trans. by G. Norlin and L. Van Hook, "Loeb Series," 3 vol. (1928–1945); and by G. Mathieu and E. Brémond, "Budé Series," 3 vol. (1928–1942; vol. iii, 2nd ed., 1950). *See* also F. Blass, *Die attische Beredsamkeit,* vol. ii, 2nd ed. (1892); R. C. Jebb, *The Attic Orators From Antiphon to Isaeus,* vol. ii, 2nd ed. (1893); K. Miinscher, *Isokrates* in Pauly-Wissowa, *Real-Encyclopadie der classischen Altertumswissenschaft,* vol. ix (2) (1916); E. Mikkola, *Isokrates. Seine Anschauungen im Lichte seiner Schriften* (1954). For a favourable account of Isocrates as an educationalist and political thinker *see* W. Jaeger, *Paideia,* trans. by Gilbert Highet, vol iii (1944), and for his political views, G. Mathieu, *Les Idées Politiques d'Isocrate* (1925). *Index: S.* Preuss (1904).

(H. L. H.-W.)

ISOGAMY, term applied in biology to conditions in which the sexual cells (gametes, *q.v.*) are alike, in contradistinction to heterogamy (*q.v.*) or anisogamy, where the gametes are differentiated into male elements (spermatozoa or spermatozoids) and female elements (ova). Isogamy occurs in some of the lower Algae and certain Protozoa, but it would seem that in most cases, if not in all, the gametes do not behave alike, so that they are functionally anisogamous. *See* ALGAE; FERTILIZATION; PROTOZOA; REPRODUCTION.

ISOLA DEL LIRI, a town of Lazio, Frosinone province, Italy. situated between two arms of the Liri river. waterfalls of the Liri and Fibreno furnish power for paper and textile mills. Pop. (1957 est.) 12,948 (commune). The 12th-century church of S. Domenico, about 1 mi. N., probably marks the site of the villa of Cicero.

ISOMERISM. In the period when chemical analysis was first introduced, the belief was generally held that the properties of each pure substance depended solely upon its chemical composition. Two samples of matter, which had the same properties, and so were composed either of the same substance or else of mixtures of the same substances in the same proportions, were therefore supposed to be identical in composition. Conversely, any difference that could be detected in the properties of two substances under the same conditions was held to be due to some difference in composition.

The fundamental postulate that the properties of a pure substance are uniquely determined by its chemical composition was subsequently found, however, to be subject to certain well-defined types of exceptions. These may be classified under the three headings as: (1) polymorphism, where the difference of properties exists only in the solid state and is considered therefore to be caused by a different arrangement of identical molecules or ions in a crystal; (2) polymerism, where the molecules are of identical percentage composition but of different molecular weight; and (3) isomerism, where the molecules are of identical percentage composition and molecular weight but are considered to differ in their internal structure or configuration. (It should be noted

that modern usage has somewhat altered the historical definition of the word "polymerism," given here. See POLYMERIZATION. The slight change in meaning thus introduced is, however, of no importance to the present article.) Although these three types of exception were grouped together at one time under the general term "isomerism," the distinctions outlined above are now commonly made, and the word "isomerism" is now restricted to the type (3). The present article will deal only with isomerism in this restricted sense. (For discussions of polymorphism, see CHEMISTRY: Physical Chemistry; for one of polymerism, see POLYMERIZATION.)

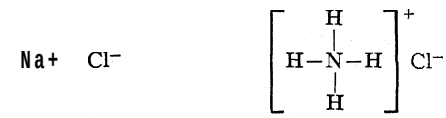
Structural Isomerism. — The field of isomerism is subdivided into two main divisions. structural isomerism and stereoisomerism. Two (or more) substances are said to be structural isomers of each other, or to be structurally isomeric, if they have the same chemical composition and molecular weight, but differ in structure; on the other hand, they are said to be stereoisomers of each other, or to be stereoisomeric, if they have the same composition, molecular weight, and structure, but differ in configuration. In order that the significance of this distinction may be made clear, the technical meanings assigned by chemists to the words "structure" and "configuration" must be discussed. The present section, however, will deal only with the concept of structure, since that of configuration is not required for an understanding of structural isomerism. (For the definition of configuration see the section below on Stereoisomerism and the more detailed article on STEREOCHEMISTRY.)

The structure of a substance (or, more precisely, of its molecules) is given by a detailed statement of the way in which each atom is linked by valence bonds to each of the other atoms of the molecule (see VALENCE). This statement may take any of several equivalent forms. One such form is based upon the use of purely verbal descriptions. Thus, the structure of the hydrogen molecule, H_2, may be expressed by the statement that the two univalent hydrogen atoms are joined to each other by a single covalent bond; the structure of the ethylene molecule, C_2H_4, may be expressed by the statement that each of the two quadrivalent carbon atoms is joined to the other by two covalent bonds, and also to two univalent hydrogen atoms by single covalent bonds; and so on. A verbal scheme of this sort. however, becomes too unwieldy for the description of the structure of a molecule of any complexity, and so a second, much more convenient, method of representation has been generally adopted. When this method is employed, any given structure is represented by a diagram, in which each atom is symbolized by the usual chemical symbol of the element in question, and in which each covalent bond is symbolized by a (usually straight) line drawn between the letters representing the appropriate atoms. Thus, the structures of the molecules of hydrogen and of ethylene, which were described verbally above, can be expressed by the diagrams I and II, re-

I II

spectively. Such symbols as these are usually referred to as the structures of the respective substances, although, in a strict sense, they are merely graphical representations of the structures of the corresponding molecules. (The more modern electronic structures, in which each line is replaced by a pair of dots, differ from the foregoing in no respect which is important to the present discussion. Such modes of description will therefore be ignored here. However, see VALENCE.)

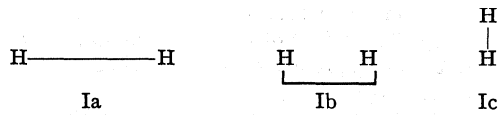
In the graphical scheme outlined above, no symbol for the representation of an ionic bond was mentioned. Actually, at the present time, the following convention seems to be generally adopted. If two or more parts of a molecule are not joined to each other in any way by covalent bonds, but instead are held together by only ionic linkages, then each of the parts (*i.e.*, ions) is represented separately by its corresponding symbol, and the various symbols are merely placed close together. The existence of the electrostatic attractive forces is shown by the presence of appropriate plus or minus signs, as superscripts, to indicate the charges on the ions. Thus, the structure III can be written for the molecule of sodium chloride, which exists in the gaseous but not in the solid state or in aqueous solution (see MOLECULE, CHEMICAL). If any ion contains more than a very few atoms, its



III IV

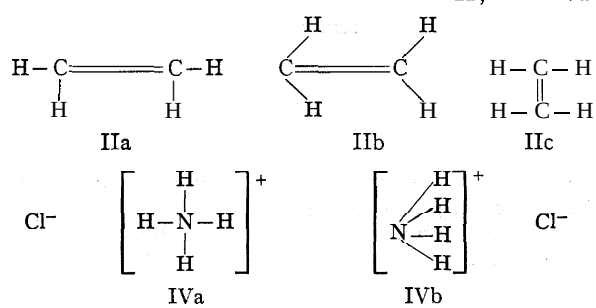
structure is often surrounded by square brackets for the sake of clarity. Thus. the structure of the molecule of ammonium chloride (if such a molecule be capable of existence at all, see MOLECULE, CHEMICAL) may be given as IV.

Significance of *Structural* Diagrams. — As has been explained, the function of a structure is to specify the pairs of atoms which are joined by valence bonds, and to state the number and type of the bonds which connect each of these pairs. Consequently, the exact geometrical properties of any diagram that may be written on paper are of no structural significance. In particular, the lengths of the lines which represent the covalent bonds, the angles between pairs of lines, and the relative positions on the page of the letters which represent the atoms must be ignored. The diagrams Ia, Ib and Ic, for example, represent exactly the



Ia Ib Ic

same structure that I does; in the same manner, IIa, IIb and IIc are to be considered identical with II; and IVa and



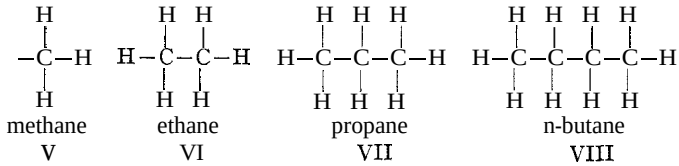
IIa IIb IIc

IVa IVb

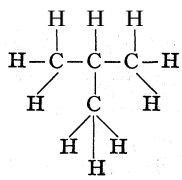
IVb are to be considered identical with IV. This fact is extremely important, since it greatly restricts the number of nonequivalent structures that can be written for a molecule containing a specified number of atoms of specified kinds. It must be constantly borne in mind, in fact, that diagrams which look entirely different superficially may actually represent the same structure. (The situation may be described in mathematical language by the statement that the chemical structures, as defined here, are topological diagrams and have no nontopological significance. See TOPOLOGY, GENERAL.)

The *Number* of Isomers. — A fundamental postulate of the structural theory of chemistry is that two molecules which differ in structure must correspond to different substances with different chemical and physical properties. A corollary of this fundamental postulate is that the number of theoretically possible structural isomers which have a given molecular formula (*i.e.*, which have a given chemical composition and molecular weight, see MOLECULE, CHEMICAL) must be equal to the number of nonequivalent structures permitted by the rules of valence. The general procedure of calculating isomer numbers can be illustrated with a few examples. For the molecular formula CH_3, only the single structure V can be drawn if carbon and hydrogen are, as usual, considered to be quadrivalent and univalent, respectively. Similarly, for the formulae C_2H_6 and C_3H_8, only the single structures VI and VII, respectively, are possible. In agreement with expectation, only a single substance exists for each of these formulae. On the other hand, for the formula C_4H_{10}, the two nonequivalent

structures VIII and IX can be drawn, and, accordingly, two isomeric substances exist; these are known as normal butane and isobutane, respectively. Moreover, for the molecular formula C_2H_4, only the single structure X is possible, but, for the formula C_3H_6, the two structures XI and XII, and, for the formula C_4H_8,

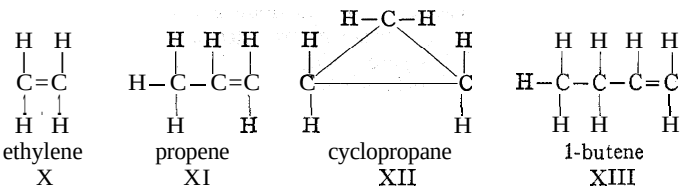


methane V; ethane VI; propane VII; n-butane VIII

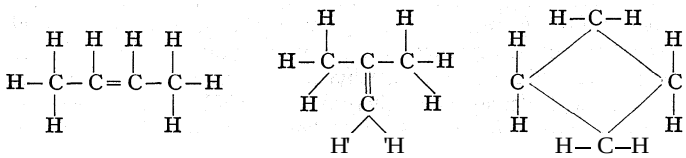


isobutane IX

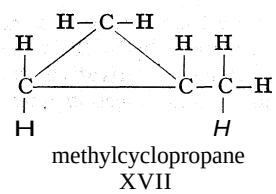
the five structures XIII–XVII, can be drawn. Again, the number of nonequivalent structures in each case is exactly equal to the number of existing structural isomers. This procedure, which can be extended in an obvious manner, and with uniformly satisfactory results, to all further types of molecular formula (however, see below), forms the basis of structural chemistry. Its success provides an important part of the experimental justification of the structural theory.



ethylene X; propene XI; cyclopropane XII; 1-butene XIII



2-butene XIV; isobutene XV; cyclobutane XVI

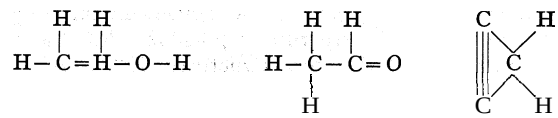


methylcyclopropane XVII

Anomalous Isomer Numbers.—The equality of the number of structures and of isomers corresponding to each molecular formula is subject to several different types of exceptions. The ideal situation would be that exactly one substance exist for each structure which can be drawn, and that, conversely, exactly one structure be associated with each substance which exists. Four types of exceptions to this ideal can be visualized, however, and examples of each type have been encountered: first, many structures which can be written correspond to no known substance at all; second, some structures must be associated with two or more different substances; third, some substances cannot be described by any structure of the usual type; and fourth, some apparently single substances behave as if they possess two or more distinct structures. If the prediction of the numbers of isomers is to be considered an essential function of the structural theory, these exceptions must be examined in order that their extent and significance may be evaluated.

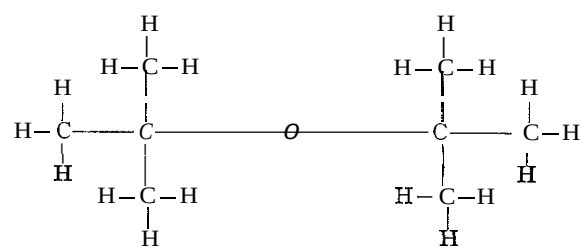
(1) The fact that many structures can be written for which no corresponding substances are known is often merely the result of the fact that no chemist has as yet been sufficiently interested, or had sufficient time, to prepare samples of all the theoretically possible isomers. Even relatively simple molecular formulae may permit enormous numbers of structures; for example, it has been calculated that the formula $C_{20}H_{42}$ permits 366,319 structures and the formula $C_{40}H_{82}$ permits 62,491,178,805,831 of them! (Of course, such large numbers as especially the second of these are experimentally meaningless, since, even if a sample of each of the substances were available, there would be no way of proving that no two of them were identical. Only about twenty different substances that have the formula $C_{20}H_{42}$ and about five with the formula $C_{40}H_{82}$ are known.) The most complicated molecular formula for which all possible structural isomers have been prepared seems to be C_9H_{20}, with altogether 35 nonequivalent structures. For other formulae, incomplete sets of more than 100 known isomers are not uncommon, however. The essential point to be brought out here is that, in those cases in which a serious attempt has been made to prepare all the possible isomers, and in which the factors discussed below do not make success impossible, the theoretical isomer numbers have usually been confirmed experimentally.

In some instances, however, attempts to prepare substances with certain structures have been unsuccessful in spite of repeated and varied attempts. For example, all attempts to prepare vinyl alcohol, XVIII, have led instead to the isomeric acetaldehyde XIX. Apparently, therefore, a substance with the structure



XVIII; XIX; XX

XVIII is incapable of existence or, at any rate, of isolation, because it undergoes a rapid and spontaneous transformation into a different, isomeric substance. This phenomenon is discussed in the article TAUTOMERISM. In other instances, certain structures which can be written on paper correspond to molecules which would be so highly strained that they could not be expected to exist. A simple example of this is represented by the structure XX (of the unknown cyclopropyne); further examples are discussed in the article on STEREOCHEMISTRY: Strain Theory. Finally, certain structures correspond to substances for which no methods of preparation are known at present. In such instances, however, the substances might be capable of existence if only suitable methods of preparation could be devised. Thus, for about 50 years all attempts to make tertiary-butyl ether XXI led instead to



XXI

entirely different (and nonisomeric) substances, as a result of the failure of the chemical reactions to follow the desired courses; nevertheless, this substance was finally prepared in 1941. There is no obvious reason why the situation may not be similar with many other, as yet unknown, substances.

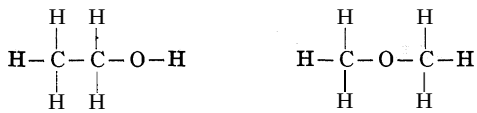
(2) The existence of structures which must be assigned to two or more different substances has made necessary a fundamental extension and broadening of the structural theory. The nature of the developments arising from this cause is discussed briefly in the section on Stereoisomerism below, and in greater detail in the article on STEREOCHEMISTRY.

(3) Some substances exist for which no structure of the usual type can be written. In nearly all instances, however, such substances have been brought successfully into the structural scheme

by suitable extensions of the theory. For example, it is now recognized that carbon. although it is quadrivalent in most of its compounds. is occasionally trivalent, and that many other elements also have greater or less tendencies to display variable valence. A large number of substances. to which structures could not be assigned if each element were considered always to have the same valence, can therefore be taken care of without difficulty. These variations in valence are fairly well understood, so that chemists usually know in advance when they are to be expected (see FREE RADICALS). New types of linkage which were not envisaged originally, such as the so-called hydrogen bond (see VALENCE), have been discovered; these frequently make possible the assignment of definite structures to otherwise anomalous substances. Finally, the theory of resonance (see RESONANCE. THEORY OF) has served to clear up most of the remaining difficulties by introducing a more generalized concept of structure. Although many substances still exist to which no structures have as yet been definitely assigned, there are now no longer many which seem to lie completely outside the structural scheme. (However, see the boron hydrides discussed in the article on BORON.)

(4) The existence of apparently single substances which act as if they have two or more structures has given rise to the concept of tautomerism (*q.v.*).

Assignment of Structures to Isomers.—The structural theory would be of relatively little practical value if it permitted only the calculation of the number of isomers and not the assignment of a definite structure to each of the isomers in those instances in which more than one structure is possible. For the formula C_2H_6O, for example, the two str'uctures XXII and XXIII



XXII XXIII

can be drawn, and the two substances, ethyl alcohol and methyl ether, are known. It is gratifying that the number of structures is equal to the number of isomers, but the chemist would still like to know which structure is to be associated with each isomer. The experimental methods for the determination of structure are varied, and only a few of the salient features of some of the most important methods can be mentioned here.

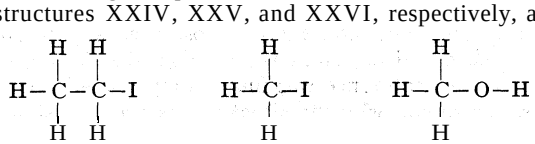
One of the most commonly applied methods for the determination of structure makes use of the chemical reactions of the substances in question. The assignment of structures to the isomeric ethyl alcohol and methyl ether, for example, can be made in the following way. The action of hydrogen iodide upon ethyl alcohol leads to ethyl iodide, C_2H_5I, and water, H_2O:

$$\underset{\text{ethyl alcohol}}{C_2H_6O} + HI \longrightarrow \underset{\text{ethyl iodide}}{C_2H_5I} + \underset{\text{water}}{Hz0}$$

whereas the action of the same reagent upon methyl ether leads to methyl iodide. CH_3I, and methyl alcohol, CH_4O:

$$\underset{\text{methyl ether}}{C_2H_6O} + HI \longrightarrow \underset{\text{methyl iodide}}{CH_3I} + \underset{\text{methyl alcohol}}{CH_4O}$$

For the three organic products of the two reactions, only the single structures XXIV, XXV, and XXVI, respectively, are pos-



ethyl iodide XXIV methyl iodide XXV methyl alcohol XXVI

sible. Comparison of these structures with XXII and XXIII shows that ethyl iodide XXIV is more closely related to XXII than to XXIII, and that methyl iodide XXV and methyl alcohol XXVI are more closely related to XXIII than to XXII. Consequently, the inference is drawn that ethyl alcohol has the structure XXII, since it leads to ethyl iodide, whereas methyl ether has the structure XXIII, since it leads to methyl iodide and methyl alcohol. In other words, the assumption is made that the courses of the chemical reactions are such that the least possible structural changes are produced. Although numerous exceptions to this rule of minimum structural change are now recognized (see MOLECULAR REARRANGEMENTS), it nevertheless forms at least part of the basis of most determinations of structure.

A second method for the determination of structure, which likewise involves the rule of minimum structural change, is based upon the study of the reactions by which the substances can be made. Thus, ethyl alcohol results from the action of dilute aqueous sodium hydroxide upon ethyl iodide:

$$\underset{\text{ethyl iodide}}{C_2H_5I} + \underset{\text{sodium hydroxide}}{NaOH} \longrightarrow \underset{\text{ethyl alcohol}}{C_2H_6O} + NaI$$

whereas methyl ether results from the action of concentrated sulfuric acid upon methyl alcohol:

$$\underset{\text{methyl alcohol}}{2CH_4O} + \underset{\text{sulfuric acid}}{H_2SO_4} \longrightarrow C_2H_6O + \underset{\text{methyl ether}}{H_2SO_4 \cdot H_2O}$$

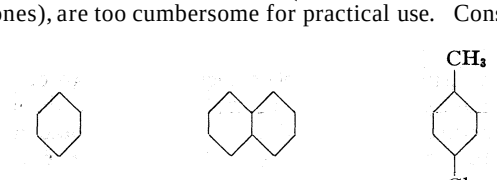
Since the structures of ethyl iodide and of methyl alcohol have been shown (see above) to be XXIV and XXVI. respectively, the principle of minimum structural change again leads to the conclusion that ethyl alcohol must have the structure XXII and methyl ether must have the structure XXIII.

A third method, which makes no explicit use of the principle of minimum structural change. is based upon a comparison of the reactions of substances of unknown structure with those of other substances of known structure. Thus, ethyl alcohol and methyl alcohol resemble each other closely in their chemical properties, whereas methyl ether behaves quite differently toward most reagents. In particular, the two alcohols react with metallic sodium to give alkoxides, and with acid chlorides to give esters (see ALCOHOL), whereas methyl ether is inert toward each of these reagents (see ETHER). Consequently, the structures of ethyl alcohol and of methyl alcohol may be presumed to be similar to each other. Since that of methyl alcohol is necessarily XXVI, that of ethyl alcohol must therefore be XXII. Moreover, the remaining structure, XXIII, must belong to the remaining substance, methyl ether. The assignment of structures is thus the same as by the preceding methods.

Still a further procedure for the assignment of structures to isomers is somewhat more fundamental, but much less commonly used, than the ones just described This method makes direct use of the numbers of isomeric derivatives that can be prepared from each of the isomeric substances in question It has found its greatest use in the determination of the orientation of substituents in benzene, and it is discussed elsewhere (see CHEMISTRY. Organic Chemistry).

Numerous further methods for the determination of structure are based upon the study of physical properties of various kinds. Mention may be made here of refractivities, molecular volumes, parachors, spectra, dipole moments. magnetic susceptibilities and nuclear magnetic resonance spectra. The diffraction of X rays by crystals and that of electrons by gaseous substances has also been used in a number of instances for the establishment of structure. For further discussion of these methods, the reader is referred to the individual articles dealing with them.

Abbreviated Forms of Structures.—The detailed structures such as XXIV, XXV and XXVI (as well as most of the preceding ones), are too cumbersome for practical use. Consequently,



XXVII XXVIII XXIX

abbreviated forms have been adopted for the purpose of convenience in writing and printing. Thus, XXIV becomes $CH_3–CH_2I$ or, more simply still, C_2H_5I; XXV becomes CH_3I; and XXVI

becomes CH_3OH. Even the rather complicated structure XXI can be expressed simply as $(CH_3)_3C–O–C(CH_3)_3$ or as $[(CH_3)_3C]_2O$. In the aromatic series, the structure of benzene (*q.v.*) is written as a simple hexagon, as in XXVII, that of naphthalene (*q.v.*) is written as in XXVIII, and so on; hydrogen atoms attached directly to the carbon atoms of the aromatic rings are usually not indicated explicitly, although other, heavier atoms and groups are always specified, as in the symbol XXIX for p-chlorotoluene. (The phenyl and naphthyl radicals, however, are frequently indicated by their formulae, C_6H_5 and $C_{10}H_7$, respectively.) Benzene is also frequently represented by the so-called Kebulé structure XXX or by the conventionalized diagram XXXI. Other aromatic hydrocarbons can be depicted similarly.

XXX

XXXI

Stereoisomerism. — When the structural theory was first developed, the natural assumption was made by most chemists that two substances with not only the same chemical composition and molecular weight but also the same structure would necessarily have to be identical. Nevertheless, examples were soon encountered in which this assumption appeared to be contrary to the facts. One of the first examples of this further type of isomerism to be carefully studied was that exhibited by tartaric and racemic acids. These substances must be assigned the same structure, $HO_2C–CHOH–CHOH–CO_2H$, and yet they differ in a number of their characteristic properties. In particular, they melt at different temperatures and have different densities, solubilities and crystalline forms. Moreover, tartaric acid is dextrorotatory (*i.e.*, its solutions rotate the plane of polarization of plane polarized light to the right, see STEREOCHEMISTRY), whereas racemic acid is optically inactive (*i.e.*, its solutions have no effect upon the plane of polarization). In a relatively short time, many further examples of the existence of a greater number of isomers than can be accounted for by the structural theory came to light. The extent to which these anomalous isomers differ in properties varies greatly from case to case. Sometimes, as with the dextro- and laevo-rotatory lactic acids (*q.v.*), $CH_3–CHOH–CO_2H$, they are identical in nearly all their properties except in their effects upon polarized light and their reactions with other optically active substances; on the other hand, as with the above tartaric and racemic acids, they may differ noticeably in nearly all their properties; and finally, as with maleic and fumaric acids (*q.v.*), $HO_2C–CH=CH–CO_2H$, they may both be optically inactive.

The detailed discussion of this further type of isomerism is given in the article on STEREOCHEMISTRY. Here, only a few of the most important features will be pointed out. The first fact that has to be established is, of course, that the substances under discussion are actually isomers of one another, in the restricted sense in which the word is used in the present article, and not either polymorphic or polymeric forms. Polymorphism is easily shown not to explain the observations, since the differences in chemical and physical properties and in optical activity are found to persist in solution and in the liquid and gaseous states. Polymerism also is shown to be not involved, since the substances have the same molecular weight. The conclusion can be drawn therefore that the substances are truly isomeric, and that, although they possess the same structure, their individual molecules are not identical. Such isomers are said to be stereoisomers, and their molecules are said to differ in configuration.

The only suggestion regarding the significance of configuration which has received serious attention is that it refers to the arrangement of the atoms in space. That the difference betaeen the dextro- and the laevo-rotatory lactic acids might be explained in some such manner was proposed in 1873 by J. Wislicenus; more complete theories, upon which all subsequent work in stereochemistry has been based, were brought forward the following year by two independent investigators, J. H. van't Hoff and J. A. Le Bel. For a description of their ideas and a further discussion of stereoisomerism, the reader is referred to the article on STEREOCHEMISTRY. (G. W. WD.)

ISOMORPHISM, in crystallography (*q.v.*) and mineralogy, the similarity of crystalline form in substances which are chemically related. Isomorphism is also used in mathematics as applied to groups to denote the correspondence between their operations. In biology, isomorphism refers to similarity between two groups of organisms of different ancestry due to convergent evolution, as exhibited, for example, in the body form of fishes and whales (*see* also MORPHOLOGY; EVOLUTION).

ISOPERIMETRY, a word originally used in geometry to refer to figures of equal perimeter; *e.g.*, a circle and an ellipse may have equal perimeters (circumferences) although not equal areas. One of the simplest of the problems arising in the study is to determine, from all plane figures having the same perimeter, the one that shall have the greatest area. This figure is the circle. Considered more generally, given any number of geometric figures, all defined in the same way, determine the form of the one possessing a maximum (or minimum) amount of a certain property; *e.g.*, of all the triangles having a given area (figures defined as plane, three-sided and of a given area), the one having the least perimeter is equilateral.

For the general definition and treatment consult works on the calculus of variations, where the theory is extended to include solid as well as plane figures.

ISOPRENE, a mobile volatile liquid, which is of interest chiefly because it can be made by the thermal decomposition of rubber and other terpenes and because it polymerizes readily to form rubberlike substances.

Isoprene has the chemical formula C_5H_8; the specific gravity is 0.69; and the boiling point is 34° C. See TERPENES and POLYMERIZATION.

ISOPTERA, an order of insects (*q.v.*), comprising the termites (*q.v.*) or so-called white ants of the tropics. See also SOCIAL INSECTS.

ISOPYCNIC, an adjective used in physics to mean constant density. In oceanography, isopycnic surfaces are considered in certain dynamic computations as the surfaces along which water particles actually move instead of along level surfaces, although the isopycnic surfaces are in most cases very nearly horizontal. The concept is similar to that of the movement of air on isentropic surfaces extensively used for computations and forecasting in meteorology. (H. R. B.)

ISOSTASY is a principle in earth science whereby one understands why continents stand nearly 3 mi. above the floor of the deep ocean, and why a major chain of mountains or an extensive plateau stands so high above the general continental surface. According to the principle, the solid rock underlying the deep ocean for a few tens of miles below sea level is heavier, volume for volume, than the average rock underlying a continent to the same depth, and still heavier than the average rock underlying a mountain chain or high plateau The continents may be said to float on the earth's body, the needed upward pressure being supplied by the downward pressure of the heavy rocks under the ocean, aided by the weight of the water, muds and oozes of the sea floor. Also the weight of each broad mountain chain and plateau is approximately balanced by the weight of the somewhat heavier rock of the continent from which such high land rises. Thus the greater reliefs are almost perfectly compensated by corresponding variations of average density of the materials extending for several tens of miles below the surface.

Investigation shows that the balancing pressure is transmitted below in a weak layer of considerable thickness. To emphasize this weakness (largely caused by high temperature) the layer has been given the technical name asthenosphere. Since the continents and mountain chains are not flattening under their own weights, considerable strength must be ascribed to their rocks above the asthenosphere. Because such volcanic islands as Hawaii and St. Helena, representing enormous loads piled on the ocean floor, now show no sign of sinking, it seems clear that the solid rock under the deep-sea oozes is also strong. In both continental and oceanic regions many relatively narrow downwarps and upwarps of the rocky surface are not compensated and yet appear to

be stable elements in the earth's topography. All around our planet, therefore, there is a strong surface layer of rock; this bears the technical name lithosphere.

The interface between asthenosphere and lithosphere is not level but is characterized by waviness. corresponding to the chemical composition and temperature (which control density) of the lithospheric rocks. To deduce the best reference spheroid for the figure of the earth, needed for accurate mapping, the geodesists have proved that the isostatic principle must be recognized; to allow for its influence they assume, for convenience in calculation, that the locus of compensation is a level passing through the lowest point at the bottom of the lithosphere. With that assumption these workers, using measured deflections of the plumb line and also measurements of the force of gravity at many stations on continents and islands and in submarines traversing the Atlantic, Pacific and Indian oceans, have greatly improved their conception of the earth's figure. (See GEODESY.)

By their own independent methods the seismologists have shown that the lithosphere under the oceans is decidedly denser than the average continental rock, and that the mountain chains are buoyed up by roots of rocky matter still lighter than the average rock of the continents.

In 1889 C. E. Dutton. a geologist, coined the name isostasy from the Greek *isostasios* ("in equipoise"; compare isos, "equal" and statikos, "stable"). He adopted the idea for two chief reasons: (1) the fact that the floor of each wide and thick mass of sedimentary rock laid on the lithosphere sinks by an amount not much smaller than the thickness of the mass; and (2) the fact that, when prolonged erosion removes a thick layer of rock from a broad mountain chain or plateau. the denuded area rises by a large fraction of the thickness of the vanished rock. From these facts he deduced the weakness of the asthenosphere and its ability to transmit the pressures caused by widespread loadings and unloadings of the lithosphere. The new name also meant for him that the major terrestrial reliefs are almost perfectly compensated by the horizontal variation of average density of the lithospheric rocks, allowance being made for the weight of the ocean water.

The isostatic principle is further illustrated by the basining of the lithosphere under the aeight of the extensive icecaps that covered northwestern Europe and northern North America during the Pleistocene epoch, and by the recoil of the downwarped lithosphere since the loads mere removed by melting.

The displacement of matter because of surface loading or unloading is called technically isostatic adjustment. The great viscosity of the earth's materials makes this a slow process. Recoil in the glaciated tract of Europe still continues, though the icecap began to melt away 40.000 years ago and 7,000 years ago had only about 1% of its original weight. Time lag in adjustment for any transfer of surface load and the strength of the lithosphere are two manifest causes for some imperfection of isostatic balancing. Some investigators believe that a small degree of strength characterizing the asthenosphere itself is a third cause.

(R. A. D.)

ISOSTERE, a line of constant specific volume, used particularly in charting the oceans for dynamic computations of currents. In oceanography the specific volume is usually expressed in cubic metres occupied by a metric ton (1,000 kg.) of water.

ISOTHERM, a line on a map or thermodynamic chart connecting points having the same temperature. See THERMODYNAMICS; METEOROLOGY; WEATHER FORECASTING.

ISOTOPE. An isotope is one of two or more species of the same chemical element that have different atomic weights. Most of the elements, in the form in which they are found in the earth's crust and atmosphere, are mixtures of several isotopes. These mixtures are in almost unvarying proportions. For example, natural tin has ten isotopes, ranging in atomic weight from 112 to 124, but all specimens that have been examined have the average atomic weight 118.70. In other words, ordinary tin is nature's standardized blend of ten varieties of tin atoms, no two of which have the same nuclear mass, although they are identical in all other respects.

The term isotopes was coined by F. Soddy in 1913 from the Greek *isos,* "equal," and *topos,* "place," to indicate substances occupying the same place in the periodic table of the elements; *i.e.*, having exactly the same chemical properties, but distinguishable from each other in some other way, such as mode of radioactive decay. With time the basic distinguishing feature of isotopes has been assigned to their respective atomic weights. Since chemical properties are determined by the positive charge on the nucleus (the atomic number) and by the consequent number of extranuclear electrons. this nuclear charge must be the same for isotopes. The differences in atomic masses of isotopes must therefore arise from differences in the masses of the nuclei involved. Present-day usage tends to restrict the word isotopes to atoms having nuclei with masses differing by approximately whole numbers on the atomic weight scale. The general term for an atom characterized by the constitution of its nucleus is nuclide, although isotope has often been used loosely in the past for this purpose. An example of the correct usage lies in the following sentences: "The element chlorine has two isotopes with masses 35 and 37. These two isotopes are examples of nuclides with a mass difference of two."

This article will concentrate on the properties of isotopes related to the stricter interpretation of the name. For further information on atomic and nuclear structure and related topics. see MASS SPECTROSCOPY; NUCLEUS; RADIOACTIVITY, ARTIFICIAL; and RADIOACTIVITY, NATURAL.

Discovery of Isotopes.—Previous to the first decade of the 20th century it was generally assumed that the mass of a standard number of atoms of a chemical element (the atomic weight) was a fundamental characteristic of the element. It was furthermore usually assumed that all the atoms of an element were the same and, in particular, had the same mass. The fundamental importance attached to the mass in characterizing an element is illustrated by the periodic classifications of the elements, such as that of D. I. Mendeleyev, which were made by ordering the elements, with a few minor exceptions, according to their atomic weights.

The first evidence that two substances having the same chemical properties did not have to be physically identical came from the study of the radioactivity of the heavy elements. B. B. Boltwood in 1906 and, considerably more conclusively, H. N. McCoy and W. H. Ross in 1907 showed that ionium (a radioactive product of the disintegration of uranium) and radiothorium (a disintegration product of thorium) once mixed with thorium could not be separated from it by any chemical means. The two substances had radioactive properties quite different from those of thorium and could be shown to have atomic weights differing by several units from that of thorium. It was to cover situations such as this that Soddy devised the name isotopes.

Soon after the acceptance of these ideas as applied to the heavy chemical elements, there came indications that isotopy might exist in the main group of naturally occurring stable elements. J. J. Thomson, during a 1913 investigation of the behaviour of positively charged ions in electric and magnetic fields, found that whereas many substances, when ionized, did behave as if they were made up of identical molecules, the rare gas neon appeared to have a species in about 10% abundance that was 10% heavier than the main constituent. His student F. W. Aston first attempted to confirm this result by trying to change the atomic weight of neon by repeated partial diffusion of the gas through clay pipes. His results, although positive (see below), were not definite enough to establish the idea of isotopy in light elements. Aston then went back to Thornson's methods and developed one of the first mass spectrographs (see MASS SPECTROSCOPY). With this he was able to show conclusively in 1919 that neon had two major constituents, one of mass close to 20 and the other with mass close to 22. The relative abundances were such as to explain the observed average atomic weight of 20.183.

The success with the element neon was followed by the discovery that chlorine had two isotopes (masses close to 35 and 37). Thereafter all the naturally occurring elements were examined and most of them were found to consist of more than one isotope.

Isotopes and Nuclear Structure.—With the discovery of isotopes. it became evident that all chemical elements that had atomic weights that were not close to integers consisted of mixtures of isotopes, each of which individually had a weight close to an integer. This finding has been confirmed and today it is well established that there are no isotopes with masses deviating from whole numbers by more than 0.1 atomic mass unit.

Modern ideas of nuclear structure picture the atomic nucleus as consisting of protons (*i.e.,* nuclei of normal hydrogen atoms) and neutrons. These two particles have nearly the same mass, close to unity on the atomic weight scale. This explains the integral masses observed for isotopes. The integer closest to the exact mass is known as the mass number (A) of the nucleus and is the sum of the number of protons (Z) and the number of neutrons (N) in the nucleus. The number of protons determines the positive charge and therefore the chemical properties of the atom.

Nuclei that have the same mass number are called isobars or isobaric nuclei; those that have the same number of protons, but varying numbers of neutrons, are isotopes; nuclei that have the same number of neutrons are known as isotones. The nuclear constitution of an atom is usually indicated by giving the chemical symbol (which determines the number of protons in the nucleus) with a superscript indicating the mass number and therefore, by difference, the neutron content of the nucleus. The superscript may be placed either before or after the chemical symbol. Thus Cl^{35} and Cl^{37} are the two stable isotopes of chlorine. The nuclei each have 17 protons. In the first isotope there are 18 neutrons. in the second 20 neuttons. The isotopes of hydrogen, H^1, $H^2 \equiv D^2$, $H^3 \equiv T^3$, have been given special names. protium, deuterium and tritium, respectively.

Finally we can define a class of nuclides which have the same number of neutrons and protons, and therefore the same mass number, but in which the nuclei are not in the same energetic state. Such nuclides are knoan as nuclear isomers (see below).

Isotopes of an element differ among themselves. (1) in any properties that depend on the mass; and (2) since the nuclear constitution is different, in all specifically nuclear properties. Thus they can be classified into stable isotopes and isotopes whose nuclei disintegrate spontaneously. The disintegration properties of radioactive isotopes, such as half life (time for half the isotope to disappear by decay) and modes of decay, are discussed under RADIOACTIVITY. ARTIFICIAL and RADIOACTIVITY, NATURAL. The stable isotopes are found as the constituents of the naturally occurring elements. They may also be produced by nuclear transformations. Although some radioactive isotopes exist in nature (see below), most have to be prepared by artificially induced nuclear transformations.

Just as the nuclear stability varies from one isotope to another, so do other nuclear properties such as the nuclear radius, spin, magnetic moment and electrical quadrupole moment. Likewise the nuclear reaction probability often is very different in one isotope than in another. Thus, U^{235} undergoes nuclear fission when bombarded with slow neutrons; U^{238} does not. Similarly. only one of the eight isotopes of cadmium. Cd^{113}, has an extremely large probability of absorbing slow neutrons; the other isotopes are relatively inert. The stability toward spontaneous disintegration of the nucleus and, to a certain extent, nuclear reaction probabilities of isotopes are related to their energetic stability. According to the Einstein relation between mass and energy, the energy content of a system is determined by the mass—the lower the mass, the more stable the system. Although the exact masses of isotopes are close to whole numbers, the deviations are real and significant. In all known cases the mass is lower than that of the same number of separate neutrons and hydrogen atoms. Thus all known atoms are stable with respect to complete decomposition into neutrons and hydrogen atoms.

The detailed variations in mass of nuclides are conventionally measured in terms of the packing fraction. $f_{A,Z}$, of a nuclide of atomic number Z and mass number A. The packing fraction is related to the exact mass, $M(A,Z)$, of the atom by the relation

$$M(A,Z) = A(1 + f_{A,Z})$$

Packing fractions of nuclides (except for hydrogen and deuterium) lie between $+10 \times 10^{-4}$ and -10×10^{-4}. In the case of the stable isotopes of a given element, the packing fractions of the even-mass-numbered isotopes usually form a smooth curve as a function of A, with a minimum (and therefore increased stability) for the isotope of close-to-average mass number. (See NUCLEUS for more data on energetic relations among nuclides and MASS SPECTROSCOPY for the methods of determining packing fractions.)

Variation in the Isotopic Composition of the Elements.—For most elements the relative amounts of the different isotopes in the natural mixture are very constant, irrespective of the source of the sample. In several cases the isotopic composition of elements in extraterrestrial sources such as meteorites has also been found to be the same as that of the same element on the earth's surface. However, elements that can be produced as a result of the fe nuclear transformations (spontaneous or induced) occurring continually on the earth have been found to have varying isotopic content. Thus, the isotopic composition of lead depends on how much thorium or uranium has been nearby during geological time, and for how long (see RADIOACTIVITY, NATURAL). Likewise, since all the helium present today on the earth is the result of nuclear transformations, the relative amounts of He^3 and He^4 are not the same in the atmosphere as they are in helium from gas wells.

Smaller differences in the isotopic composition of the lighter elements arise from the effect of mass on the rates and equilibriums of naturally occurring chemical and physical processes (see below). Thus the deuterium content of hydrogen from the water of the Dead sea is higher than that of hydrogen from most other sources. Even an element as heavy as sulfur has been shown to have an S^{34}–to–S^{32} ratio varying by up to 7%.

Isotopic Composition of Elements.—In spite of such small variations in the constitution of the light elements and the variation in the composition of some others from special sources, the isotopic composition of the great majority of the chemical elements is very constant. The table indicates the isotopic composition of the elements as they occur naturally, giving for each element the mass numbers of the isotopes and the percentage of the atoms of the normal element that consist of that particular isotope. Unless indicated, all the isotopes listed are stable.

It is seen by examination of the table that there. are stable representatives of all mass numbers between 1 and 209 inclusive, except for mass numbers 5 and 8. There are no stable isotopes of any element with these mass numbers. Elements of even atomic number have many more stable isotopes than those of odd atomic number. These latter never have more than two, almost always of odd mass number, whereas the even-atomic-numbered elements. except beryllium, have at least two isotopes and tin (Z = 50) has ten.

The 83 naturally occurring chemical elements are made up principally of 287 isotopes. 271 of which are stable. The other 16 are radioactive with half lives comparable to the age of the earth ($\sim 4.5 \times 10^9$ years) or longer. All the stable isotopes that are known occur in the chemical elements as we know them and in amounts that represent significant fractions (greater than 3×10^{-5}, except for He3) of their respective elements.

An important theoretical interest in the isotopic composition of the elements arises from this being one of the few quantitative evidences available of the process by which all nuclei were originally formed. The relative cosmical abundances of nuclides differing in proton content (Z) have obviously been badly distorted by chemical and physical processes occurring during geological time. Compared with this, the isotopic composition of the elements is very constant. Any theory of the formation of complex nuclei must consider regularities such as the preponderance of neutron-rich isotopes in the heavy elements, the frequent preponderance of light isotopes among the light elements and the generally low abundances of odd-mass-numbered isotopes of even-numbered elements.

Relationship of Chemical Atomic Weights to the Existence of Isotopes.—The chemical atomic weight of an element

is defined as the weight of a standard number of atoms of the element on a scale where the weight of the same number of oxygen atoms is 16.0000. (If this standard number of atoms is taken as Avogadro's number—$[6.0228 \pm .0011] \times 10^{23}$ atoms—the actual weight in grams is the gram atomic weight.) These weights are of great practical value in chemical analysis. As mentioned above. because of the existence of the phenomenon of isotopy, they have lost their fundamental interpretation as accurate measures of the masses of individual atoms. Thus there is no chlorine atom that has a mass on the atomic weight scale of 35.457 (the listed chemical atomic weight of chlorine); instead normal chlorine consists of atoms that have a mass of either 34 96905 or 36 96733.

Because of the existence of three different isotopes of oxygen, the chemical and physical atomic weight scales differ slightly. The physical scale is based on a mass of 16.0000 for the isotope O^{16}; the chemical scale is based on a system in which the normal mixture of oxygen isotopes is assigned a mass 16.0000. Since the heavier isotopes of oxygen are rather rare, the two scales are not far different: one unit on the chemical scale is equivalent to 1.000275 ± 0.000005 units on the physical scale.

The same high precision of modern mass spectrographs that makes possible mass determinations of isotopes suitable for nuclear energy determinations also gives rise to the most accurate method of measuring the chemical atomic weight of a normal element. The chemical atomic weight is just the mass on the physical scale of the separate isotopes of the element averaged by weighting according to the abundance of the isotopes and then converted by the above factor relating the physical and chemical mass scales.

The existence of isotopes and the known or expected small fractionation of isotopes in chemical and physical processes (see below) set limits to the accuracy to which atomic weights have meaning. unless the exact isotopic composition is specified. It was pointed out by H. C. Urey and L. J. Greiff in 1935 that this limit had probably already been reached in the case of several light elements whose atomic weights were being quoted to a thousandth of an atomic weight unit. Even the standard element oxygen could be expected to show a variation in atomic weight in the fourth decimal place as a result of variations in isotopic composition.

Naturally Occurring Radioactive Isotopes.— Radioactivity occurring in nature arises from several sources. Thus there are the long-lived radioactive species (half lives greater than a few hundred million years) that have survived since the formation of the elements. The naturally occurring isotopes of thorium and uranium are of this type. Likewise potassium, rubidium and several other elements are slightly radioactive because of the presence of long-lived radioactive isotopes (see table). Next there are the shorter-lived radioactive isotopes that are present because their disappearance by decay is balanced by continual replenishment from some source. Thus some of the isotopes of thallium, lead, bismuth, thorium and uranium and all the isotopes of the other elements between bismuth and uranium aye radioactive and present in small amounts because they are being continually produced in the radioactive decay of very long-lived parents (isotopes of uranium and thorium). The most famous example of this type is an isotope of radium (Ra^{226}) which is present in uranium ores to the extent of 3.4×10^{-7} g. per gram of uranium.

Cosmic radiation incident on the earth's atmosphere is another such producer of slight amounts of radioactive isotopes. This, for example. is the source of the minute amounts of a radioactive isotope of carbon, C^{14}, that is present in all living tissue to the extent of about 12 disintegrations per minute per gram of carbon. The half life of this carbon isotope is 5,570 years. W. F. Libby developed the radiocarbon method of age determination of archaeological and geological specimens, useful in the range from 1,000 to 30,000 years, from the presence of this cosmic-ray-produced C^{14}.

These and other less important sources make most matter very slightly radioactive. In addition to these natural sources, the use of nuclear energy is producing, as by-products, radioactive isotopes which may become significant supplements to the natural radioactivity of the surface of the earth. Thus the explosion of megaton nuclear weapons had scattered sufficient radioactive debris all over the world that by 1957 all humans had absorbed detectable amounts of the radioactive nuclides Cs^{137} and Sr^{90}.

Radioactive Isotopes.— Radioactive as well as stable isotopes of all the elements have been prepared. By the late 1950s there was information on more than 1,100 radioactive nuclides, and the list was still expanding (see NUCLEUS for a chart of nuclear properties of the nuclides). Most of the radioactive nuclides are prepared by artificially induced nuclear transformations (see RADIOACTIVITY, ARTIFICIAL). The elements technetium ($Z=43$) and promethium ($Z=61$) and all the elements with atomic number greater than that of bismuth ($Z=83$) have only radioactive isotopes. In the case of xenon, besides the 9 stable isotopes, there are 20 known radioactive species with half lives ranging from about 1 second to about 35 days. Six of these are nuclear isomers. At the other extreme, hydrogen has only three known isotopes, two stable and one radioactive.

Effect of Isotopic Substitution on Physical Properties of Substances.— The rather belated discovery of isotopes as well as the difficulty of separation is of course a reflection of the smallness of the effectof mass on most physical and chemical properties. For example, the electronic energy states of atoms or molecules depend on the nuclear mass through the reduced mass, μ, of the electron-nucleus system; μ is defined by

$$\mu = \frac{m_e m_n}{m_e + m_n} \approx m_e\left(1 - \frac{1}{1837A}\right),$$

where m_e and m_n are the electronic and nuclear masses and A is the mass number of the nucleus', It is seen that such effects are of the order of 5×10^{-4} for hydrogen and correspondingly smaller for heavier atoms. In the case of hydrogen, however, the shift in electronic energy levels in going from protium to deuterium is easily detected spectroscopically, and was in fact the mode of discovery of deuterium by Urey, F. G. Brickwedde and G. M. Murphy in 1931.

The other consequence of the presence of isotopes on the optical spectra of atoms arises from the interaction of the magnetic field of the nucleus, if it has one, on the electrons of the atomic system. The result is a splitting of a spectral line into several components (called the hyperfine structure). The number of components and the separations depend upon the spin and magnetic moment of the nucleus and on the nature of the electronic state. Since this phenomenon depends on nuclear properties it varies from isotope to isotope It is most important for heavy elements, but even there it is difficult to measure. Analysis of hyperfine structure is an important method of determining nuclear spins and magnetic moments.

Molecular spectra are much more affected than are atomic spectra by the presence of isotopes, for these spectra reflect in part the vibrational and rotational energies of molecules. The quanta of vibrational and rotational energies are directly dependent upon the masses of the atoms involved and therefore upon the presence of isotopes. It was by examination of molecular spectra that several isotopes (for example, C^{13}, N^{15}, O^{17}, O^{18} and Si^{30}) were discovered.

The presence of isotopes affects physical properties other than spectroscopic. There is, of course, the direct effect of mass on the density of a substance. Because densities can often be measured extremely precisely, a density determination has been used in special cases to establish isotopic composition.

Another direct effect of mass on physical properties is the effect on the rate of diffusion of gaseous atoms and molecules. It has long been known that the rate of effusion of a gas through a hole of size smaller than the distance between the gas molecules varies inversely as the square root of the mass. It was by taking advantage of this property that F. W. Aston first achieved a partial separation of the neon isotopes, and basically similar processes are used today (see below).

In general, other physical properties of substances are significantly affected by the presence of isotopes only at low temperatures and in the case of molecules of low molecular weight.

Isotopic Composition of the Elements as They Occur Naturally

Chemical element	Atomic number (Z)	Chemical symbol	Mass number (A)	Isotopic composition (per cent of atoms)
Hydrogen*	1	H	1	99.986
		D	2	0.014
Helium†	2	He	3	0.00013
			4	100.
Lithium*	3	Li	6	7.42
			7	92.59
Beryllium	4	Be	9	100.
Boron*	5	B	10	18.7
			11	81.3
Carbon*	6	C	12	98.89
			13	1.11
Nitrogen*	7	N	14	99.63
			15	0.37
Oxygen*	8	O	16	99.759
			17	0.037
			18	0.204
Fluorine	9	F	19	100.
Neon*	10	Ne	20	90.92
			21	0.257
			22	8.82
Sodium	11	Na	23	100.
Magnesium	12	Mg	24	78.60
			25	10.11
			26	11.29
Aluminum	13	Al	27	100.
Silicon*	14	Si	28	92.17
			29	4.71
			30	3.12
Phosphorus	15	P	31	100.
Sulfur*	16	S	32	95.018
			33	0.750
			34	4.215
			36	0.017
Chlorine	17	Cl	35	75.53
			37	24.47
Argon†	18	Ar	36	0.337
			38	0.063
			40	99.600
Potassium*	19	K	39	93.08
			40‡	0.0119
			41	6.91
Calcium	20	Ca	40	96.97
			42	0.64
			43	0.145
			44	2.06
			46	0.0033
			48	0.185
Scandium	21	Sc	45	100.
Titanium	22	Ti	46	7.99
			47	7.32
			48	73.99
			49	5.46
			50	5.25
Vanadium	23	V	50‡	0.25
			51	99.75
Chromium	24	Cr	50	4.31
			52	83.76
			53	9.55
			54	2.38
Manganese	25	Mn	55	100.
Iron	26	Fe	54	5.84
			56	91.68
			57	2.17
			58	0.31
Cobalt	27	Co	59	100.
Nickel	28	Ni	58	67.76
			60	26.16
			61	1.25
			62	3.66
			64	1.16
Copper	29	Cu	63	69.1
			65	30.9
Zinc	30	Zn	64	48.89
			66	27.81
			67	4.11
			68	18.56
			70	0.62
Gallium	31	Ga	69	60.2
			71	39.8
Germanium	32	Ge	70	20.55
			72	27.37
			73	7.67
			74	36.74
			76	7.67
Arsenic	33	As	75	100.
Selenium	34	Se	74	0.87
			76	9.02
			77	7.58
			78	23.52
			80	49.82
			82	9.19
Bromine	35	Br	79	50.52
			81	49.48
Krypton	36	Kr	78	0.354
			80	2.27
			82	11.56
			83	11.55
			84	56.90
			86	17.37
Rubidium	37	Rb	85	72.15
			87‡	27.85
Strontium	38	Sr	84	0.56
			86	9.86
			87	7.02
			88	82.56
Yttrium	39	Y	89	100.
Zirconium	40	Zr	90	51.46
			91	11.23
			92	17.11
			94	17.40
			96	2.80
Niobium	41	Nb	93	100.
Molybdenum	42	Mo	92	15.86
			94	9.12
			95	15.70
			96	16.50
			97	9.45
			98	23.75
			100	9.62
Technetium	43	Tc	...	...
Ruthenium	44	Ru	96	5.57
			98	1.91
			99	12.7
			100	12.7
			101	17.0
			102	31.5
			104	18.5
Rhodium	45	Rh	103	100.
Palladium	46	Pd	102	0.96
			104	10.97
			105	22.2
			106	27.3
			108	26.7
			110	11.8
Silver	47	Ag	107	51.35
			109	48.65
Cadmium	48	Cd	106	1.22
			108	0.88
			110	12.39
			111	12.75
			112	24.07
			113	12.26
			114	28.86
			116	7.58
Indium	49	In	113	4.23
			115‡	95.77
Tin	50	Sn	112	0.95
			114	0.65
			115	0.34
			116	14.24
			117	7.57
			118	24.01
			119	8.58
			120	32.97
			122	4.71
			124	5.98
Antimony	51	Sb	121	57.25
			123	42.75
Tellurium	52	Te	120	0.089
			122	2.46
			123	0.87
			124	4.61
			125	6.99
			126	18.71
			128	31.79
			130	34.49
Iodine	53	I	127	100.
Xenon	54	Xe	124	0.096
			126	0.090
			128	1.919
			129	26.44
			130	4.08
			131	21.18
			132	26.89
			134	10.44
			136	8.87
Cesium	55	Cs	133	100.
Barium	56	Ba	130	0.101
			132	0.097
			134	2.42
			135	6.59
			136	7.81
			137	11.32
			138	71.66
Lanthanum	57	La	138‡	0.089
			139	99.911
Cerium	58	Ce	136	0.193
			138	0.250
			140	88.48
			142‡	11.07
Praseodymium	59	Pr	141	100.
Neodymium	60	Nd	142	27.13
			143	12.20
			144‡	23.87
			145	8.29
			146	17.18
			148	5.72
			150	5.60
Promethium	61	Pm	...	...
Samarium	62	Sm	144	3.16
			147‡	15.07
			148	11.27
			149	13.82
			150	7.47
			152	26.63
			154	22.53
Europium	63	Eu	151	47.77
			153	52.23
Gadolinium	64	Gd	152	0.20
			154	2.15
			155	14.7
			156	20.47
			157	15.68
			158	24.9
			160	21.9
Terbium	65	Tb	159	100.
Dysprosium	66	Dy	156	0.0524
			158	0.0902
			160	2.294
			161	18.88
			162	25.53
			163	24.97
			164	28.18
Holmium	67	Ho	165	100.
Erbium	68	Er	162	0.136
			164	1.56
			166	33.41
			167	22.94
			168	27.07
			170	14.88
Thulium	69	Tm	169	100.
Ytterbium	70	Yb	168	0.140
			170	3.03
			171	14.31
			172	21.82
			173	16.13
			174	31.84
			176	12.73
Lutetium	71	Lu	175	97.40
			176‡	2.60
Hafnium	72	Hf	174	0.163
			176	5.21
			177	18.56
			178	27.1
			179	13.75
			180	35.22
Tantalum	73	Ta	180	0.0123
			181	99.9877
Tungsten	74	W	180	0.135
			182	26.4
			183	14.4
			184	30.6
			186	28.4
Rhenium	75	Re	185	37.07
			187‡	62.93
Osmium	76	Os	184	0.018
			186	1.59
			187	1.64
			188	13.3
			189	16.1
			190	26.4
			192	41.0
Iridium	77	Ir	191	38.5
			193	61.5
Platinum	78	Pt	190‡	0.0127
			192‡	0.78
			194	32.9
			195	33.8
			196	25.2
			198	7.19
Gold	79	Au	197	100.
Mercury	80	Hg	196	0.146
			198	10.02
			199	16.84
			200	23.13
			201	13.22
			202	29.80
			204	6.85
Thallium	81	Tl	203	29.50
			205	70.50
Lead†	82	Pb	204	1.40
			206	25.1
			207	21.7
			208	52.3
Bismuth	83	Bi	209	100.
Thorium	90	Th	232‡	100.
Uranium	92	U	234‡	0.0056
			235‡	0.720
			238‡	99.276

*Isotopic composition varies slightly with source.
†Isotopic composition varies considerably with source.
‡Isotope radioactive.
Source: This table has been taken almost entirely from D. Strominger, J. M. Hollander and G. T. Seaborg, "Table of Isotopes," *Rev. Mod. Phys.*, 30:585, no. 2, part ii of 2 parts (April 1958).

Accurate measurements, however, are continually detecting small differences in physical properties of substances related by isotopic substitution. For example, deuterium melts at 18.65° K. and boils at 23.6" K.; the corresponding temperatures for hydrogen are 13.95° K. and 20.38° K. Heavy water (D_2O) has a melting point 3.8" higher and a boiling point 1.4° higher than ordinary water.

Regarding the incompletely understood phenomenon of superconductivity at low temperatures. it is of interest that the temperature at which certain metals transform to the supertonducting state is affected by the isotopic composition of the metal.

Effect **of** Isotopic Substitution on Chemical Properties.— It has usually been assumed that isotopes and substances differing only in the presence of different isotopes have the same chemistry. However, accurate studies, particularly with deuterium, have indicated that the chemistry of isotopes is identical only in the limit of large masses and high temperatures. Whenever quantum mechanical effects are important, and in general they are most important for light masses and low temperatures, the masses of the atoms involved can be expected to affect the situation and, thus, the result to be sensitive to the isotope involved. This can be illustrated by the folloaing example: The forces between atoms are derived from the electric and electronic structures of the atoms. As indicated in the discussion on electronic states of atoms, these are essentially indistinguishable for different isotopes of the same element. The actual motion of the atoms produced by these forces, however, is affected by the atomic mass. In a given potential, the frequency of vibration and, therefore, the quantum of vibrational energy will vary inversely as the square root of the mass of the system. This affects not only the vibrational spectrum (see above) but also means that the zero point energy, the lowest energy state of the system, will be lower for heavier isotopes.

In this way it is quite easy to calculate quantitatively that the energy needed to dissociate the gaseous D_2 molecules into atoms at absolute zero will be 1.81 k. cal./mole ($\sim 2\%$) higher than that needed to dissociate the H_2 molecule. With elements heavier than hydrogen this effect becomes successively smaller. It remains always true, however, that, because of the lower zero point energy, more energy is required to break a chemical bond involving a heavier isotope than to break a bond involving a lighter one.

Using quantum mechanics to estimate the effects of mass, equilibrium constants can be calculated by statistical methods for so-called exchange reactions. These are chemical reactions in which the reactants and products differ only in the exchange of isotopes. For example, the reaction

$$CO_2^{16} + 2H_2O^{18} \rightleftarrows CO_2^{18} + 2H_2O^{16}$$

has an equilibrium constant given by

$$K = \frac{P_{(CO_2^{18})} \times P_{(H_2O^{16})}}{P_{(CO_2^{16})} \times P_{(H_2O^{18})}}$$

where $P_{(CO^{18})}$ designates the pressure exerted by CO_2^{18} at equilibrium, $P_{(H_2O^{16})}$ that of H_2O^{16}, etc.

The value of the equilibrium constant was calculated to be 1.128 at 0° C. and 1.110 at 25° C. by Urey and Greiff in 1935. It is seen that carbon dioxide in equilibrium with water will contain oxygen with slightly higher O^{18} content than does the water. It is also seen that at higher temperatures the oxygen in the carbon dioxide and in the water tend toward more equal isotopic compositions.

Predictions such as the above have been verified experimentally. Likewise it has been demonstrated that the rates of chemical reaction are affected measurably by isotopic substitutions. In general, the effects are greatest for the lightest elements and decrease with increasing temperature. Thus chemical reaction rates involving deuterium compounds may be up to several times slower than those involving the corresponding hydrogen compounds. This effect has been extensively used to investigate the mechanism of reactions that may involve transfer of hydrogen atoms. In view of the measurable effects of isotopes on both chemical equilibriums and the rates of chemical reactions, it is not surprising that the isotopic composition of the lighter elements in nature shows a definite variation from source to source.

Separation of Isotopes.— This term is generally taken to mean the production of an element with an isotopic composition significantly different from that of the natural element. In the extreme, such a process produces a relatively pure isotope. For most purposes, however, such as chemical or biological tagging experiments, complete separation is not necessary.

It has been mentioned that Aston first attempted to confirm Thomson's discovery of isotopes in neon by trying to separate them. He allowed part of a sample of normal neon to diffuse at low pressure through clay pipes, and repeated the process many times on the fractions obtained. He reported in 1913 that in this way he had been able to change the atomic weight of neon by almost 0.5%. Subsequent attempts by many persons using many different methods on different elements did not produce significantly greater separations. Finally, G. Hertz, in 1932, used the same basic methods as had Aston originally, but arranged the diffusing units in a cascade (see below). He produced neon with the heavier isotope, Ne^{22}, more than twice as abundant as the lighter one, Ne^{20}. In normal neon. Ne^{22} has an abundance of only 10%. Since these pioneer achievements, isotope separations by various methods have become increasingly common. Today small samples of almost any element with distorted isotopic abundances are available for research purposes. A few isotopes; *e.g.*, *D*. U^{235}, are separated on a large scale as a part of nuclear energy programs.

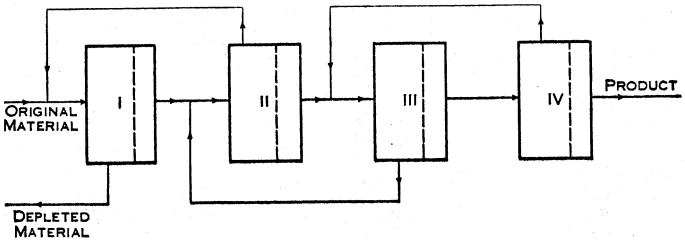
In almost all the methods used for separating isotopes there is involved the repetition of a basic step many times to achieve the desired extent of separation. A process is judged by two factors that have different relative importance in different situations. One is the separation factor per stage (f). This is defined as the ratio of the relative concentration of a given isotope after the basic step in the concentrated fraction to that in the stripped fraction. The latter is ordinarily indistinguishable from the original concentration entering the unit. Thus if the normal isotopic composition of an element is n_1 and n_2, and if, after one stage of the process, it becomes n_1' and n_2', then

$$f = \frac{(n_1'/n_2')}{(n_1/n_2)}$$

The second important factor is the amount of material processed per stage. In general, processes operating with good separation factors produce only small amounts of material and vice versa.

In order to achieve desired over-all separations with processes of low separation factors, many repetitions of the basic stage are necessary. For example, to get 90% U^{235} starting with normal uranium and a process with a separation factor of 1.0043 (a high one for a diffusion process), 1,660 stages are necessary.

Such large numbers of stages can be used only if they are arranged in a manner not to waste material. Such an arrangement is the cascade used by Hertz in 1932 and thereafter in most of the large-scale separation methods. A cascade arrangement of four stages is illustrated in the drawing. The boxes I, II, III and IV represent units. Into one of them (*e.g.*, III) goes a certain amount of feed material from the left. As a result of the operation of the unit, a small fraction of this feed material comes out of the unit toward the right, concentrated in the isotope in question. It forms the feed material for unit IV. The great majority of the feed material for unit III is slightly depleted in the isotope and is returned to become part of the feed material for the unit II. As a result of the operation of the cascade, the material coming out at the right from unit IV is concentrated in one isotope; the



CASCADE ARRANGEMENT OF FOUR STAGES FOR SEPARATING ISOTOPES

material being rejected by unit I is depleted in the isotope. The theory of such cascades is similar to that of multiplate-distillation columns and countercurrent solvent extractions.

Historically, of course, a unit in which a gas was diffused through small pores of a solid was the first type used in such a cascade (Hertz). Diffusion units are also used in the large-scale production of U^{235} in the United States. The gas employed is uranium hexafluoride. Diffusion processes, in spite of low separation factors, can be designed to handle large amounts of material and are susceptible to engineering for continuous automatic operation.

At the other extreme of separation factors is the electromagnetic separation process, which can produce small amounts of very enriched isotopes in one step. These units are simple mass spectrographs designed to collect the mass-analyzed beams instead of merely recording their presence. Large numbers of such units (called calutrons) were used in the United States in World War II together with the diffusion process to produce the U^{235} for nuclear bombs. In general, large-scale operations appear to be more economical with the diffusion process. On the other hand, the electromagnetic process is more versatile. In the 1950s it was used both in the United States and Europe to produce milligram quantities of almost any element with a distorted isotopic composition.

For the isotopes of hydrogen (deuterium and tritium) electrolysis of water solutions proved an effective way of separating isotopes. The liquid remaining after most of the water of, for example. an NaOH solution has been electrolyzed is concentrated in the heavier isotope. This water can be distilled away from the NaOH and made into a fresh NaOH solution and the process repeated. The separation factors in such a process depend upon the electrodes used and can be as high as seven. This, of course. is much higher than is ever encountered with other elements. The electrolytic process was used in Norway from the middle 1930s for the production of ton quantities of heavy water (D_2O). Libby used electrolytic concentration in his measurements of the tritium content of rains.

The chemical exchange method is another that often uses multistage cascades to increase the effect of a small separation factor per stage. Thus Urey made use of the exchange reaction

$$HC^{13}N(\text{gas}) + NaC^{12}N(\text{solution}) \rightleftarrows HC^{12}N(\text{gas}) + NaC^{13}N(\text{solution})$$

which has an equilibrium constant a little less than unity in a process that produces carbon with more than 20% C^{13} (instead of the normal 1.1%). Similar schemes were devised by Grey and co-workers to produce nitrogen and sulfur samples enriched in N^{15} and S^{34}. During World War II catalysts were found that would achieve equilibrium in the exchange reaction

$$H_2(\text{gas}) + D_2O(\text{gas}) \rightleftarrows D_2(\text{gas}) + H_2O(\text{gas}).$$

The reaction has an equilibrium constant of about three. This exchange reaction process as well as the straight separation of D_2O from H_2O by distillation are much more economical in most places than the electrolytic process. They have been used to produce the ton quantities of D_2O needed for nuclear reactors (see below).

In addition to the methods described, which have been used in relatively large-scale separations, isotope separations have been achieved using centrifugation and thermal diffusion (diffusion of gases in the presence of a thermal gradient).

Uses of Isotopes. — The uses of isotopes can be divided roughly into two categories. In one. application is made of some particular nuclear property of the isotope — either its radiations upon decomposition or some nuclear reaction probability. Since such uses do not depend upon the principle of isotopy, they will not be discussed in detail here.

The other class of application of isotopes depends on the fact that, to a very good approximation in most cases, all isotopes of an element have the same chemical properties. This makes it possible to label or tag an element by distorting its isotopic composition. The distortion is accomplished by the addition either of a radioactive isotope or of one of the stable isotopes of the element. The behaviour of this element can then be followed either by measurement of the radioactivity or by analysis with a mass spectrometer. The isotope added is often referred to as a tracer or indicator. The use of labeled atoms in this manner was introduced by G. von Hevesy and F. A. Paneth in 1913. They used a radioactive isotope of .lead (radium D or Pb^{210}) to study the solubility of lead salts. Since then, with the availability of radioactive or stable isotopes as tracers for almost all the elements, the use of labeled elements for many chemical, biological and industrial purposes has become widespread.

A type of investigation made possible by the availability of isotopes is that of exchange reactions (see above). In these there is no change in either the type or number of chemical species involved. Studies on the equilibriums and rates of such reactions are important not only for the separation of isotopes but also as a means of understanding chemical reactions in general and as a prelude to other applications of isotopes.

Isotopes have found extensive application in chemical analysis. An example is the isotope dilution method, used in many variations with both stable and radioactive isotopes. All the variations have in common the feature that the chemical separation procedures used do not have to be quantitative in order to provide quantitative answers. Thus to analyze for an element *A* in a mixture, a known amount of a tracer for *A* is added at the start. A chemical separation of A is carried out, yielding A in a chemically pure form. The fraction of the added tracer recovered measures the efficiency of the process. This, together with the absolute amount of *A* recovered, as measured either by weighing or by other conventional means, determines the total amount of *A* present in the original mixture.

A second analytical application, often called activation analysis, involves nuclear reactions and actually analyzes for particular isotopes. If these are present in a normal element the result is an analysis for the element. Thus the production of a radioactive isotope of an element upon exposure of a sample to slow neutrons measures the amount of isotope of one lower mass number present in the sample. The method can be calibrated by exposing a known amount of the element to the same neutrons and measuring the production of the radioactivity involved.

A third analytical application of isotopes and particularly of radioactive ones arises from the sensitivity of detection instruments used in isotopic analysis. An activity of 100 disintegrations per minute (easily measured) of an isotope with a one-day half life corresponds to about 200,000 atoms. Several of the transuranium elements have been discovered through their radioactive properties and the complete experiments involved less than 100 atoms. More generally, the behaviour of elements at very low concentrations can be studied using radioactive isotopes. Also, starting with larger amounts of radioactivity, the occurrence of very improbable reactions can be detected.

Specific applications of the above and other techniques of tracer application are too numerous to cover in detail here. It is true, however, that isotopes, both stable and radioactive, play an indispensable role in research on the problem of photosynthesis. Another area that might be singled out is the study of the animal metabolism of different types of food. It was established through the use of tracers that there is a continual exchange between almost all injected substances and those present in the animal body. Even portions of bones and teeth are accessible to exchange with injected calcium and fluorine.

In medicine the principal applications of isotopes involve the radioactive ones. The use of radium in the treatment of cancer has a long history. Later other radionuclides became available in sufficient quantity and were also used for the same purpose. Probably the outstanding example of the application in medicine of a radioactive isotope is the use of 8.0-day I^{131} in the diagnosis and treatment of thyroid ailments.

The industrial applications of isotopes were just beginning in the 1950s. An accomplished development was the use of gamma-emitting radioactive isotopes such as radium or Co^{60} instead of an X-ray machine for the radiography of metal castings. Such sources have the advantage of compactness and ruggedness which often make them preferable to electric machines. The convenience of

radioactive isotopes in furnishing high-energy radiations in a small space has found application in several other situations. Thus the ionization of air produced by these radiations is used to prevent the accumulation of undesirable static electric charges. Similarly the scattering of these radiations by thin films, being a sensitive function of the thickness of the film, is used widely in thickness gauges.

Isotopes of Importance in Nuclear Energy Programs.—The development of nuclear energy for both weapons and power has often depended upon the characteristics of individual isotopes rather: than that of the natural mixture occurring in elements. Thus U^{235} is the only isotope in natural uranium (in fact the only naturally occurring nuclide) that can support a chain reaction. In concentrated form (*i.e.*, separated from its diluent U^{238}) it can support a fast neutron chain reaction and therefore can be used for nuclear explosives. In its ordinary dilution it can be used to support a slow neutron (thermal) chain reaction. The extra neutrons in a chain-reacting pile can then be used either to make plutonium (Pu^{239}) from U^{238} or U^{233} from Th^{232}. Both Pu^{239} and U^{233} have fissionability characteristics comparable with that of U^{235} and so are usable either in weapons or as the basis for controlled release of nuclear energy.

In addition to these heavy nuclides, there are several isotopes of the light elements that are of importance in nuclear energy developments. They are useful either as moderators (to slow down neutrons) in uranium chain-reacting piles or as direct sources of nuclear energy. In the former category helium and carbon (in the form of graphite), and hydrogen, deuterium and oxygen (in the forms of light and heavy water) had already been used, and Be^9 and F^{19} were additional possible moderators in the 1950s. In the second category, the large-scale conversion of D^2 into He^4 was first accomplished by the U.S. in Nov. 1952 in a hydrogen bomb explosion on a Pacific atoll. In the late 1950s, the controlled release of such thermonuclear energy had not been achieved.

Nuclear Isomers.—Nuclear isomers are nuclei which have the same charge (Z) and mass number (A) but represent different energy states. Atoms differing because of the presence of nuclear isomers as their nuclei are isobaric isotopes. One of two nuclear isomers must be unstable with respect to de-excitation. Although the existence of any excited state is in a sense an example of nuclear isomerism, the term is ordinarily applied only to cases where the excited state has a measurable half life for decomposition (greater than about 10^{-10} seconds). Such nuclei are called metastable and are usually designated by an asterisk (*) or an ^{m} after the mass number. Thus Br^{80*} and Br^{80} represent a pair of nuclear isomers. Br^{80*} decays to Br^{80} with a 4.5-hour half life. See also NUCLEUS: Metastable Nuclei.

The first case of nuclear isomerism was discovered by O. Hahn in 1921. He found two nuclear species having distinctive radioactive properties that had to be assigned the nuclear constitution expressed by Pa^{234}. In the late 1950s there were more than 160 pairs of nuclear isomers known, as well as a few cases of triple isomerism. Since nuclear isomers have the same charge and differ in mass by less than a few thousandths of a mass unit (isotopes differ from each other by at least one mass unit), it is unlikely that atoms differing only in the presence of nuclear isomers as their nuclei will have detectable differences in chemical or physical properties.

BIBLIOGRAPHY.—F. W. Aston, Mass Spectra and Isotopes, 2nd ed. (1942); D. Strominger, J. M. Hollander and G. T. Seaborg, "Table of Isotopes," Rev. *Mod. Phys.*, 30:585, no. 2, pt. ii of 2 pt. (April 1958); H. D. Smyth, Atomic Energy for Military *Purposes* (1945); Samuel Glasstone, Sourcebook on Atomic Energy (1950). (A. L. TH.)

ISRAEL, MANASSEH BEN (1604–1657), Jewish theologian and founder of the modern Jewish community in England, was born in Portugal, probably in Lisbon. His father, Joseph ben Israel, was a marrano (Jews or Moors on the Spanish peninsula who professed Christianity to avoid persecution). The family later moved to Amsterdam, where Manasseh studied for the rabbinate under Isaac Uziel. Two years after the death of his master, Manasseh was chosen to succeed him as rabbi and teacher though not yet 19 years of age. He acquired a reputation for his scholarship and theological argument, was one of the two principal teachers of Benedictus de Spinoza (*q.v.*) and numbered among his friends Isaac Vossius and Hugo Grotius. In 1627 he established the first Hebrew print shop in Amsterdam. He wrote prolifically and many of his works were widely read.

Manasseh was convinced of an imminent return of the Jews to the Holy Land, according to Messianic promise, but believed this depended first on a rescattering of the Jews into all countries. He was therefore interested in securing the readmission of Jews into England, where a ban on Jewish residence had existed since the edict of Edward I in 1290. Toward this end he wrote *Esperança de Israel* (1650; Eng. tr. *Hope of Israel*), which came to the notice of Oliver Cromwell and secured for Manasseh permission to visit England. There he pleaded his cause and eventually gained consent to end the debarment of Jews from living freely in England. In response to contemporary criticism, Manasseh wrote *Vindiciae Judaeorum* (Vindication of the Jews, 1656). After thus successfully concluding his mission in England, Manasseh returned to the Netherlands. He died in Middleburg, en route home, Nov. 20, 1657. A portrait etched by Rembrandt is extant.

ISRAEL, the name of the Jewish people as a religious community (I Chron. ii, 7); of the ancestor of the Hebrews, Jacob (Gen. xxxii, 28); of the northern tribes distinguished from Judah (II Sam. ii, 10); of the undivided kingdom (Gen. xlvii, 27); and of the Jewish people personified as God's servant (Is. xliv, 1, 21). The Hebrew term means "let El (God) persevere, persist." Found on the pillar of Merneptah, pharaoh of the Exodus. See HEBREW LANGUAGE; JACOB; JEWS; JUDAISM; PALESTINE.

ISRAEL, a country of Asia, situated on the eastern end of the Mediterranean sea. After nearly 2,000 years of statelessness and dispersion, and half a century after the first Zionist congress at Basel, Switz., the Jewish people on May 14, 1948, asserted their independence, fought for it and won it. It was the climax of perhaps the most tragic decade in the history of the Jewish people. In continental Europe, out of a Jewish population of 9,500,000, about 5,750,000 had been killed by the Germans; about 2,000,000 remained in the Soviet Union; world Jewry was reduced from 16,750,000 in 1939 to approximately 11,000,000 in 1946; about 5,000,000 of these were in the United States.

History.—On Nov. 13, 1945, it was announced that the British and U.S. governments had agreed to set up a joint committee of inquiry, charged with making recommendations on the future of Palestine, on the conditions of Jewish refugees in Europe and the possibilities of Jewish immigration into Palestine. On March 29, 1946, the Anglo-American committee recommended: (1) immediate immigration of 100,000 Jews; (2) repeal of Palestine legislation which restricted the transfer of land to Jews; (3) that Palestine should be neither a Jewish nor an Arab state but that the mandate should be transformed into a trusteeship of the United Nations with a progressive measure of autonomy for both peoples. As the U.S. government declined to share the resulting military and financial responsibilities, the British government did not implement the proposals; and—having failed to obtain agreement with the Jews and Arabs for its own plans for administration of the country, and faced with both Jewish and Arab revolt—referred the problem of Palestine to the United Nations.

A special assembly of the UN was held at Flushing Meadow, N.Y., and on May 15, 1947, a UN special committee on Palestine was set up to submit recommendations to the second regular assembly. The committee unanimously agreed that the British mandate should be terminated and that the independence of Palestine should be achieved without delay, but was divided in opinion about the future government. The majority recommended partition into a Jewish state and an Arab state, which should, however, be linked in an economic union; and Jerusalem and an area around it, including Bethlehem, should be an international enclave, under a trusteeship of the United Nations, and demilitarized. The minority recommended that Palestine be a single federal state, Jews and Arabs enjoying autonomy in their respective areas, and that Jerusalem be the capital. On Nov. 29, 1947, the assembly adopted the majority recommendations by 33 votes to 13 with 10 abstentions—the U.S. and U.S.S.R. being

among the states voting for the partition and Great Britain abstaining. The assembly also appointed a five-member commission to supervise the implementation of the plan and, in consultation with Jewish and Arab democratic parties, to elect provisional councils of government. The mandate was to come to an end in six months and the British forces were to leave the country by Aug. 1948.

The Arabs rejected the plan, and disorders immediately broke out in all parts of the country. Great Britain declared that it would not implement the decision by force. At the same time, it would be responsible for law and order until the administration left, and it was not willing to allow the United Nations commission to go to Palestine until immediately before the end of the mandate, which was fixed for May 15, 1948. For nearly six months there was utter confusion. Guerrilla warfare was waged between Arabs and Jews, and there were terrorist incidents by Arabs and Jews against the British forces. Arab bands from neighbouring countries, some from regular forces, infiltrated into the northern and eastern areas of Palestine, attacked Jewish villages and tried to blockade the road from Jaffa to Jerusalem and prevent supplies from being taken to the Jewish population. The Jews, though greatly outnumbered, had the better of the fierce fighting. They took Haifa on April 22 and Jaffa on May 13. The bulk of the Arabs in the areas allotted to the Jewish state took flight to the neighbouring Arab states.

Gen. Sir Alan Gordon Cunningham, the last high commissioner for Palestine, left on May 14, 1948, and on the same day the Jewish National council and the General Zionist council at Tel Aviv proclaimed establishment of a Jewish state, to be called Israel, of which it would be the provisional government. David Ben-Gurion was appointed prime minister, and on May 16 Chaim Weizmann was elected president of the provisional council. Straightway the U.S. government recognized the council as the de *facto* authority of the state, and de jure recognition by the U.S.S.R. followed on May 17. The five neighbouring Arab states —Egypt, Trans-Jordan (later renamed Hashemite Kingdom of Jordan), Iraq, Syria and Lebanon—announced that their armed forces would enter Palestine with the object of restoring order. The United Nations on May 20 appointed Count Folke Bernadotte as mediator, to bring about a settlement between Israel and the Arab states, while the consular commission in Jerusalem continued its efforts for a local truce. The Arab forces occupied the areas in the south and east, which were not yet controlled by the Jews, and tried to blockade Jewish Jerusalem. The Arab legion of Trans-Jordan, despite a desperate defense by the Jews, obtained the surrender of the small Jewish quarter of the old city. The Jews, however, had won control of the section of the main road to Jerusalem in the Judaean hills and beat off all Arab attacks on their scattered settlements.

Count Bernadotte obtained a cease-fire of four weeks from June 11 and put forward proposals for settlement, which were rejected by both sides. The Arabs refused a prolongation of the cease-fire, and hostilities broke out again in July. The Jews gained lightning successes in nearly all sectors; they occupied Ramleh and Lydda and the surrounding central plain, captured Nazareth and western Galilee (which had been allotted to the Arabs) and advanced their positions in the south. A second cease-fire was accepted on July 18. Count Bernadotte, assassinated in Jerusalem on Sept. 17 by Jewish terrorists, was succeeded as mediator by Ralph Bunche of the United Nations secretariat. Despite the orders of the United Nations, the truce was not observed faithfully by either side; and by the end of 1948 the Jews had occupied all the Negev up to the former Egyptian frontier, except a strip of coast between Gaza and Rafa, which remained in Egyptian possession.

The mediator secured separate armistice agreements between Israel and most of the Arab states (Egypt, Feb. 24, 1949; Lebanon, March 23; Trans-Jordan, April 3; Syria, July 20); and the Iraqi government withdrew its troops and transferred the areas occupied by them to Jordan. It was broadly agreed to fix a temporary frontier where the line had been at the beginning of the negotiations. Certain border areas were demilitarized; and the Jews secured adjustments in the western sector (so that the railway from Tel Aviv to Haifa was in their hands) and established a well-guarded corridor to Jerusalem. In Dec. 1948 the United Nations assembly had appointed a three-member conciliation commission to promote a final settlement and to arrange an international regime for Jerusalem; but all its efforts were frustrated. By the armistice agreements mixed commissions composed of Arabs and Jews, with a chairman from the United Nations staff, were established to deal with complaints of violation. Israel was admitted to the United Nations on May 11, 1949.

The provisional council of Israel, which had enacted an ordinance on the form of government, organized elections in Jan. 1949, for a constituent assembly (knesset) of 120 members, elected by proportional representation, with the whole country treated as one constituency. Of the 12 parties represented, the largest were two wings of Labour, divided on matters of foreign policy and the internal program: the Mapai (Israel Workers), which won 46 seats; and Mapam (United Workers), which won 19. The leader of Mapai, David Ben-Gurion, formed a coalition government with the United Religious front and smaller centre parties.

The draft constitution was not discussed It was decided to pass an interim organic law defining the legislative, executive and judicial powers and to let the rest of the constitution grow gradually. The knesset became a single-chamber parliament. The state was a republic. The president had the limited powers of a French president and appointed the prime minister after consultation with leaders of the parliamentary parties; the other members of the executive council (cabinet) were appointed on the prime minister's advice. The courts were independent of the executive, applying the law of mandated Palestine subject to new legislation. Besides the civil courts, religious tribunals for Jews. Moslems and Christians had jurisdiction in personal status. Arabs had equal political rights, and in 1956 eight Arabs were members of the knesset. Nazareth, a predominantly Arab town, had an Arab municipality and magistrate.

Chaim Weizmann, the first president (elected in Feb. 1949), died in Nov. 1952. The next president was Itzhak Ben-Zvi. a Mapai member of the knesset who had formerly been president of the Jewish National council in mandated Palestine. A second assembly had been elected in 1951, when the General Zionists, a bourgeois party. gained at the expense of the extreme parties both of the left (Mapam) and of the right (Herut). Ben-Gurion's second coalition government was at first composed of the same elements as his former one; but after a year the General Zionists were brought into it. In Dec. 1953 Ben-Gurion retired into private life in a collective settlement in the Negev—he returned as minister of defense in March 1955—but the coalition was maintained under Moshe Sharett, a member of Mapai, who had been foreign minister and combined that office with the prime minister's. The third general election was held in July 1955 and resulted in a swing back to the extremist parties, Herut and two divisions of the former Mapam, at the expense particularly of the General Zionists. Ben-Gurion formed a new coalition of the three labour groups with one of the religious parties and the Progressives. In 1956 Sharett was forced to retire as foreign minister and was replaced by Golda Myerson (Meyer), then minister of labour. The principal enactments of the assembly included the Law of Return, which gave every Jew the right of immigration in accordance with the policy of "gathering the exiles"; the Education law, which instituted free compulsory elementary education for all citizens, Arabs as well as Jews, between 5 and 13; the Law of National Service, which required Jewish men to give $2\frac{1}{2}$ years and women to give 2 years of service, partly in agricultural work, partly in military training; and the Law of Nationality, which conferred Israeli citizenship on the widest possible basis.

The question of Jerusalem remained unsettled. From 1948 the city was divided into two completely separated sections, Jewish and Arab. Israel moved the knesset and most of the government offices (previously in Tel Aviv) to Jerusalem in Dec. 1949. The government declared itself willing to have the holy places put under the protection of a UN commissioner but opposed international

administration of the city. The kingdom of Jordan was equally opposed to an international regime for Jerusalem.

In 1950 the United States, Great Britain and France issued a tripartite declaration that they would maintain a balance of arms between Israel and the Arab states and would check any aggression by either side attempting to change the frontiers fixed by the armistice agreements. From 1952 relations deteriorated, and frequent incidents on the Jordanian and Syrian borders disturbed the peace and were submitted by one side or the other to the Security council. Israel's plan for the use of the waters of the Jordan by a canal from Lake Hule (Huleh) to irrigate the Negev provoked violent Syrian resistance, and the Soviet veto at the council prevented action. An attempt of the U.S. president's emissary to get agreement on a comprehensive irrigation project for the benefit of Jordan, Syria and Israel was frustrated. Then in 1955 the supply by the Soviet Union of jet aircraft and heavy armament to Egypt increased the tension, and serious raids were multiplied. The secretary-general of the UN in April 1956 obtained an unconditional cease-fire between Israel and Egypt and the Arab states. Very soon, however, raids by Egyptian commandos *(fedayeen)* were resumed. and, following Col. Gamal Abdel Kasser's nationalization of the Suez canal, the parliamentary elections in Jordan (which reflected Egyptian influence) and Arab threats of invasion. Israel mobilized its forces and on Oct. 29 invaded Sinai. In five days its army had taken Gaza. Rafa and El Arish and occupied most of the peninsula east of the Suez canal.

The objects of the operation were to wipe out Egyptian raider bases, to open sea communication through the Gulf of Aqaba (Akaba) with Elath, and to put pressure on Egypt to negotiate peace. On Nov. 8 Ben-Gurion stated, under pressure of the UN, U.S. and the Soviet Union, that Israel would withdraw its forces from Egyptian territory when satisfactory arrangements were made with the UN international force. The withdrawal was completed by March 8, 1957.

In Map 1960 fugitive Nazi war criminal Karl Adolf Eichmann, once head of Hitler's extermination camps and reportedly responsible for the deaths of 6,000,000 Jews, was kidnapped in Argentina by Israeli agents and smuggled to Israel. There, after a lengthy trial, he was convicted of mass murder and sentenced to death. Hanged on May 31,1962, Eichmann became the first person ever executed by the state of Israel.

Territory and Population. — The area of Israel, as defined by the armistice agreement, was 7,993 sq.mi.—including all mandated Palestine west of the Jordan, except the plateaus of Judaea and Samaria (which were annexed by Jordan) and the Gaza strip (which was occupied by the Egyptians). The largely unpopulated Negev, with a narrow strip at its southeastern corner on the Guli of Aqaba, comprised more than half the territory. The population of Israel in 1961 was 2,173,923, including about 200,000 Arabs. There had been a Jewish immigration of about 850,000 in the years 1948–56, mainly from central and eastern Europe till 1950, and from the communities in oriental or Moslem countries, particularly Yemen, Iraq and North Africa, thereafter. (Oriental Jews constituted two-fifths of the population in 1955.) The government tackled the problem of settling the newcomers with material help from the Jewish Agency ior Palestine, representing Zionists of all countries. In the early period homes could be found ior them in evacuated Arab quarters of towns and villages (about 700,000 Arabs had fled during the fighting), and building became a principal industry. New towns were developed: the population of Beersheba, for instance, rose from 2,000 to 97,445, and by 1956 there were more than 400 new agricultural settlements, in addition to the 300 existing in 1948. The government's budget for settlement was provided partly by the Jewish agency, partly by international loans and partly by private investment. Tel Aviv-Jaffa (pop. 386,612) and Haifa (182,007) are the largest towns.

Economy and Finance. — A sustained effort was made to enable Israel to produce more of its requirements in food, and there was considerable industrial development. The mineral wealth oi the Negev was exploited, as also were the minerals in solution in the Dead sea. In the 1950s the principal industries were building, textiles, metals, diamond cutting and chemicals. Electric power for irrigation and industry was provided by the Palestine Electric corporation, the nationalization of which was carried out in 1954. The oil pipeline from Iraq to Haifa was put out of operation by the Arab stoppage of the oil flow, so that the oil refinery in Haifa had greatly to reduce its activity. Oil was struck in 1955 near Ascalon and by the end of 1956 provided about one-tenth of Israel's needs. An oil pipeline was laid from Elath to Beersheba in 1957 and the railway from Beersheba to Lydda was opened in 1956. Though exports steadily increased, the adverse balance of trade was still great. It was met by iour sources: reparations in kind paid by the German Federal Republic, to the value of more than $800,000,000 over a period of ten years from 1952; contributions from the free Jewish communities in all parts of the world; loans irom foreign countries, particularly the Independence loan floated by Israel in the United States; and the U.S. government's grant-in-aid. Jewish-owned sterling balances in the United Kingdom from Palestine were exhausted by 1952. The government, however, encouraged foreign investment by tax and customs concessions. There was, moreover, a steady development of the merchant marine and fishing; and, in addition to the ports of Haifa and Tel Aviv, the construction of a harbour at Elath on the Guli of Aqaba was undertaken. The government balanced its budget, including the heavy charge for defense. Revenue is derived principally from income tax, customs and excise, land and luxury taxes.

The unit oi currency is the Israel pound, divided into 1,000 prutas. Originally it was equivalent to the pound sterling, but the inevitable inflation brought a steep decline in the exchange rate, and in 1953 the government carried through a devaluation and fixed the rate at IL. 5 to the pound sterling, for most purposes, or IL. 1.80 to the U.S. dollar. The deflation policy successfully held the exchange rate. A new central bank was formed for the issue of notes.

The cost-of-living index, which mounted steeply during World War II, was by 1949 nearly four times what it had been in 1939; subsequently it again doubled itself. In 1949 the government introduced strict rationing and price control, but from 1952 controls were greatly reduced. Wages were maintained at a high rate by the General Labour federation, which comprised most of the workers. A great part of the agricultural settlement is organized through collective and co-operative villages *(kibbutzim* and *moshavim)*. Road transport services, building enterprise and cultural activities are in the form of co-operative societies. The federation conducts health and other social services, but the government passed a national insurance law for old-age and also widows' and maternity benefits.

Education and Culture. — Eight years after the establishment of the state, free elementary education was being given for more than 300,000 children. There were also many secondary schools maintained by municipalities and voluntary bodies, as well as teachers' training colleges and five institutes of higher education, namely, the Hebrew university of Jerusalem, the religious Bar-Ilan university near Tel Aviv, the Haifa Institute of Technology, the Tel Aviv University college and the Weizmann Institute of Science for Fundamental Research. All the institutes were rapidly expanding, and at the Hebrew university in the year 1956–57 the number of undergraduate and postgraduate students had risen from 1,000 in 1949 to 4,000. Faculties of medicine, law, agriculture and the social sciences had been added to those of the humanities and of science.

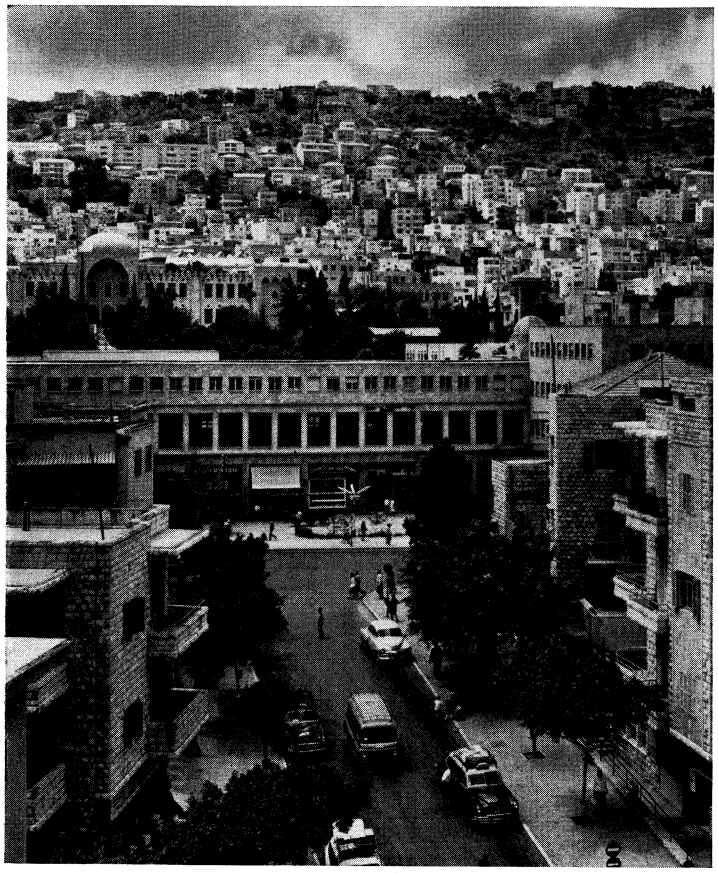
The army is an important educational instrument aimed at the integration of immigrants. In addition there is a large development of adult education by civil bodies, and resident colleges are established for intensive Hebrew education of the immigrant intellectuals. Hebrew is the language of the schools and of the-university, of the government offices and of the courts. There is a remarkable output of Hebrew literature and periodicals

Sre also JEWS; PALESTINE; ZIONISM.

BIBLIOGRAPHY — *Reports* of the Anglo-American Committee of Inquiry on Palestine (1945), of the UN Special Committee on Palestine (1947) and of the UN Economic Survey Mission for the Middle East (1949); J Garcia-Granados, *Birth of Israel* (New York, Toronto, 1948); A Koestler, *Promise and Fulfilment: Palestine 1917–1949* (London, New York, 1949); J G Macdonald, My *Mission in Israel* (New York, London, 1951); H Sacher, *Israel The Establishment of a State* (New York, London, Toronto, 1952); N Bentwich, *Israel* (London, 1952); J Parkes, *End of an Exile: Israel, the Jews and the Gentile World* (New York, London, 1954); and the Israel government annual (No B.)

ISRAELI, ISAAC BEN SOLOMON *(c.* 850–950), Jewish physician and philosopher, was born in Egypt and became court physician at Kairouan (Kairwan). His medical works were translated by Constantine the African (1087) and include a *Book on the Fevers* much esteemed in the middle ages. His extant philosophical writings are: a *Book of Definitions and Descriptions* (Hebrew trans by Nisim ben Solomon; Latin version by Gerard of Cremona, ed. by J. T Muckle in *Archives d'histoire doctrinale et littéraire du moyen âge,* vol. xii–xiii, Paris, 1938), mainly based on al-Kindi; a *Book on the Elements* (Hebrew trans. by Abraham ha-Levi bar Hisdai; Latin version by Gerard of Cremona); a *Treatise* on *Spirit and Soul,* probably part of an exegetical work in which Israeli sought to adduce scriptural support for his philosophical doctrines; the *Book of Substances;* and a treatise designated in Hebrew as *Chapter on the Elements.* The latter two works (ed. by S. M. Stern and by *A.* Altmann, *Journal* of *Jewish Studies,* vol. vii, no. 1–2, London, 1956) are based on a pseudo-Aristotelian source otherwise lost which offers an important variant of Neoplatonism. Israeli's doctrine had a pronounced influence on the 13th-century Jewish mystics in Gerona. Ibn Gabirol too seems to be indebted to it.

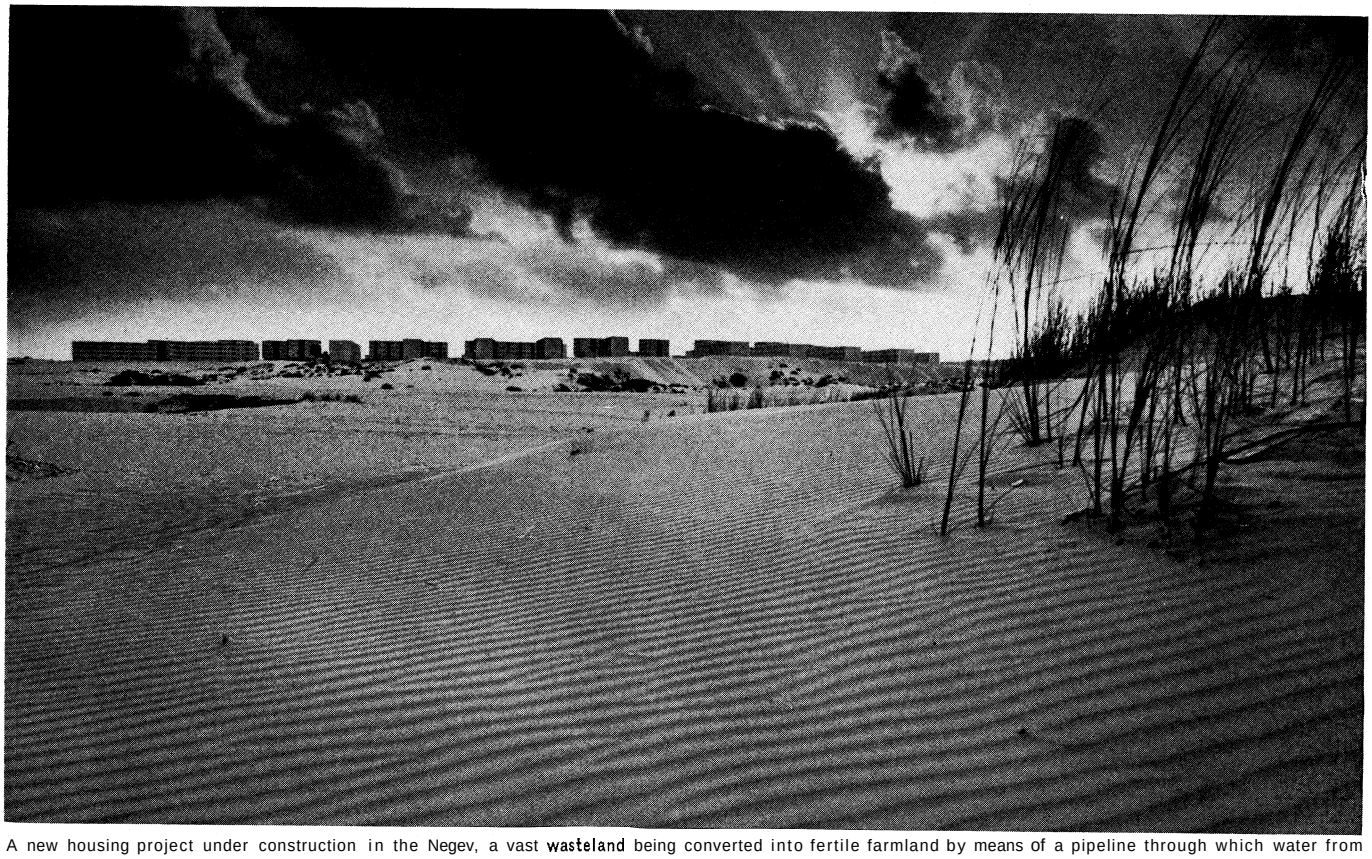
For medical and philosophical treatises extant in Latin see *Opera omnia Isaci* (Lyons, 1515). *See* also J Guttmann, *Die philosophischen Lehren drs Isaak ben Salomon Israeli* (Munster, 1911). (A. AN.)



View of Hadar-Hacarmel, Haifa, with Mt. Carmel in the background. The domed building on the left is part of the Technion (Israel Institute of Technology)

Modern apartment buildings on Arlosoroff street in Zafon, a new residential quarter in Tel Aviv-Jaffa

Nuclear science building at the Weizmann Institute of Science, Rehovot, south of Tel Aviv-Jaffa



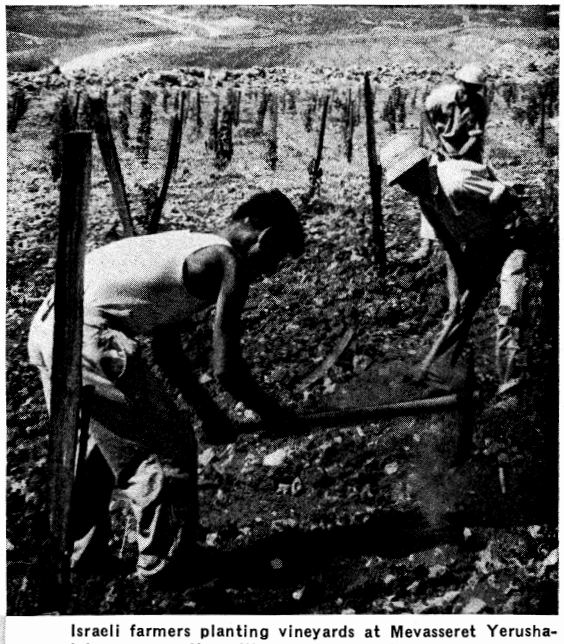
A new housing project under construction in the Negev, a vast wasteland being converted into fertile farmland by means of a pipeline through which water from the Jordan river will be diverted

MODERN ISRAEL

PHOTOGRAPHS 4 L GOLDMAN—RAPHO GUILLUMETTE

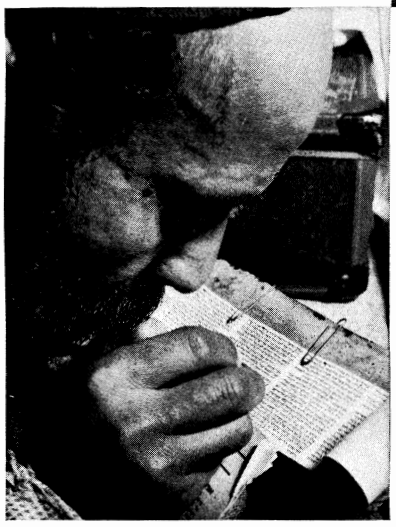
ISRAEL

Fishermen of Tiberias hanging their nets to dry along the shore of the Sea of Galilee (Lake Kinneret)

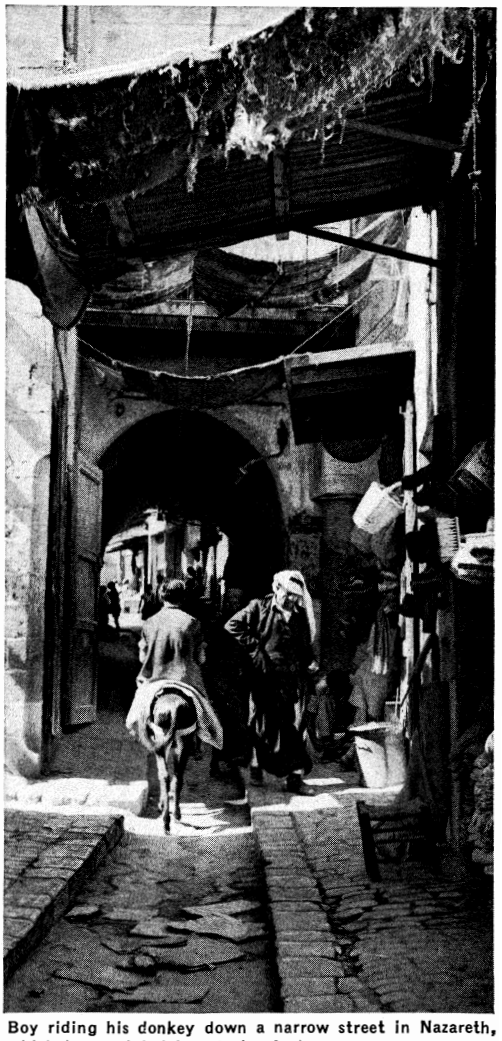


Israeli farmers planting vineyards at Mevasseret Yerushalaim, co-operative village near Jerusalem

Bedouin girl of the desert of the Negev



Orthodox Jew writing prayers for phylacteries, small boxes worn by Jews during prayer



Boy riding his donkey down a narrow street in Nazareth, which is populated largely by Arabs

Jewish youths, members of the ultraorthodox Jewish community in Jerusalem

VIEWS OF ISRAEL AND ITS PEOPLE

PHOTOGRAPHS. (TOP LEFT) PATELLANI—PIX FROM PUBLIX. (TOP RIGHT) RUBINGEE— PIX FROM PUBLIX, (CENTRE LEFT) A. L. GOLDMAN— RAPHO GUILLUMETTE, (CENTRE) W. BRAUN—P.I.P., (BOTTOM LEFT) ERICH HARTMANN—MAGNUM (BOTTOM RIGHT) © ENCYCLOPEDIA BRITANNICA

ISRAELS, JOZEF (1824–1911), Dutch painter and etcher, leader of The Hague school of peasant genre painting which flourished in the Netherlands during 1870–90, was born at Groningen of Jewish parents on Jan. 27, 1824. He began his studies in Amsterdam, but admiration for Ary Scheffer led him to Paris (1845–47), where he worked under F. E. Picot. Horace Vernet and H. Delaroche. He first tried to establish himself as a painter of portraits and of conventional history pictures, but had achieved little success nhen in 185j ill-health compelled him to quit Amsterdam for the fishing village of Zandvoort, near Haarlem. The change of residence revolutionized Israels' art and henceforward he became the painter of Dutch fisherfolk and peasants. In 1871 he moved to The Hague. often working in nearby Scheveningen. He died at The Hague on Aug. 12. 1911. Israels' style was one of sentimental naturalism and he preferred pathetic themes like "The Shipwrecked Mariner" (1861, National gallery, London). (A. Bs.)

ISSACHAR, Jacob's ninth son. his fifth by Leah, is the eponymous ancestor of one of the northern tribes of Israel having affinities with the northern group of tribes rather than with the Joseph clans on their southern border. Issachar played but an insignificant part in Israelite history. The name hardly occurs in later times, and the references to the premonarchic period suggest an attitude of submissiveness to their Canaanite neighbours (cf. Gen. xlix, 14 et seq., and the fact that the Canaanite cities of the Plain of Esdraelon retained their independence comparatively late), though Issachar is mentioned in Jud. v, 15 as taking a part in the war against Sisera.

ISSERLES, MOSES BEN ISRAEL (c. 1525–1572), known as REMA, was born at Cracow and died there in 1572. He wrote commentaries as the *Zohar,* the "Bible of the Kabbalists," but is best known as the critic and expander of the Shulhan Aruch of Joseph Qaro (Caro) (*q.v.*). His chief halakhic (legal) works were Durke Moshe and *Mappah.* Qaro, a Sephardic (Spanish) Jew, in his code neglected Ashkenazic (German) customs. These deficiencies Isserles supplied. and the notes of Rema are now included in all editions of Qaro's code.

ISSUS, BATTLE OF (Oct. 333 B.C.). Topographically, the region in which the battle of Issus was fought is an interesting one. The field itself lies a few miles north of Myriandrus, at or near Alexandria (Alexandretta). It is surrounded by mountainous country and is approached by three passes: northwest of Issus, the Cilician Gates over the Taurus range; northeast, the Amanic Gates leading to the Euphrates; and south, the Syrian Gates leading into Syria and toward Sochi where Darius had assembled his army. Toward this last-mentioned pass Alexander marched, and either the Amanic Gates were unknown to him or, what is more probable, he never expected that Darius. whose main strength lay in cavalry, would desert the plains. The unexpected, however, happened, and Darius, rejecting the advice of his generals, marched on the Amanic Gates which lay to the rear of Alexander. If tactically this was a bad move, strategically it was a sound one, for by advancing through this pass Darius compelled Alexander to relinquish the initiative and fight a battle to regain command of his communications. On hearing what Darius had done, Alexander at once assembled his generals, pointing out to them the danger they were in, and then countermarched to meet the Persians.

As the Greeks debouched onto the coastal plain, Alexander deployed his army, the right wing resting on the foothills and the left on the seashore; the front of the army was about 1½ mi. from flank to flank. The Persians, who considerably outnumbered Alexander, were drawn up on both banks of the river Pinarus (Deli), their main force of cavalry being on their right. Alexander, noticing this, reinforced his left wing with the Thessalian cavalry and secured his right by a crochet of light infantry In front of his left wing he placed the Cretan archers and the Thracians; the Greek mercenaries he held in reserve.

The Battle. — The battle opened by a skirmish on the right flank, the Persians on the foothills being driven back. This done, Alexander first rested his men. then led them forward at a slow pace, and on nearing the Pinarus advanced his right wing at a run in order to close, and so lessen the time taken in crossing the arrow zone. Darius had established his headquarters in the centre of his line of battle. and toward him Alexander charged, throwing the Persians back in confusion. Then the unexpected happened. The phalanx, disordered while crossing the Pinarus, fell back, whereupon Alexander wheeled his right wing around to the left and charged in flank the Greek mercenaries who were driving back the phalanx Once he had extricated his centre, the pursuit of the defeated Persians was taken up. The traditional losses are 110,000 Persians killed and 450 Macedonians.

Tactics. — The main tactical interest in this battle is that though Alexander developed his attack from his normal order of battle he was in no way tied down by it but adapted it to the ground and the probable actions of the enemy. He did not advance to the attack until he had secured both his flanks, neither did he direct his decisive attack against the Persian cavalry, the most formidable troops confronting him, but against the enemy's command — that is. against Darius himself. Thus, he first decided on his objective; second, he secured his advance; and, third, only then did he launch his attack, which was carried out at top speed, and so simultaneously developed security and offensive power. The blow was an overwhelming one, yet in the elation of success Alexander did not lose his head, for directly he saw that his phalanx was in danger he wheeled his cavalry around to assist his infantry. By so doing he abandoned his goal in order to secure his base of action which was vital to him.

Lessons. — The main lessons of this battle are: correct distribution of troops to ground; concentration against the decisive point; and the maintenance of tactical direction. If the'phalanx had been destroyed while Alexander was pursuing Darius, the whole of the Macedonian army would in all probability have been overwhelmed by the Persian right wing. (See GRANICUS, BATTLE OF THE: Bibliography.) (J. F. C. F.)

ISSYK-KUL, also called Tuz-kul ("Salt lake") because of its brackish waters, and by the Kalmucks, Temurtu-nor ("Iron lake"); a lake in the Issyk-Kul *oblast,* Kirghizia Soviet Socialist Republic (*q.v.*), U.S.S.R., lying in a deep basin, apparently of tectonic origin, 5,400 ft. above sea level. It extends from 76° 10′ E to 78° 2′ E. and has a length of 113 mi. from west-southwest to east-northeast and a breadth of 36 mi.; its area is 2,394 sq.mi. The lake is at an altitude of 5,279 ft. and has a maximum depth of 2,303 ft. The name is Kirghiz for "warm lake" because of the fact that though ice may form occasionally, the surface of the lake is never completely frozen over. Issyk-kul lies between two westward running spurs of the Tien-shan, the Kunghei Ala-tau range to the north, which rises 15,653 ft., and the snow-clad Terskei Ala-tau range, which skirts the south of the lake at a distance of 5 to 13 mi. and rises to 17,323 ft. The passes over the Terskei lie at great altitudes, the Barskoun (12,316 ft.), the Dzhukuchak (10,190 ft.) and the Kerakyr (12,536 ft.). The Dzhukuchak, linking northward with Przhevalsk (Karakol), the eastern stage for steamer communication with the west of the lake, from which a comparatively easy route leads to the railhead at Tokmak, is most used, since it links south with the Ak-su oasis by the Bedel pass (14,055 ft.). Another route from Ak-su, involving a steep climb of 11,817 ft. over the Muzart pass in China, on the east of Khantengri, leads to the Tekes river.

The narrow plain which fringes the lake extends inland for 46 mi. to the east and then rises to the Santash pass, 1.922 ft. above the level of the lake (7,201 ft. above sea level), which forms a link between the Terskei Ala-tau and the Kunghei Ala-tau. A route from the east of the lake crosses this pass to Kulja in Sinkiang. There is an abundance of blossom, especially at the eastern end of the lake where beekeeping is profitable, more than 800 tons of honey being exported per annum. There are few trees, except in the valleys of the streams entering the lakes. Numerous small streams reach the lake from the mountain slopes, the two chief being the Tyup and Dzhirgalan from the east. The Chu river rises in several streams to the west of the lake and approaches the western extremity very closely in a curve which it takes before flowing northwest to lose itself in the desert; it is incorrectly shown on some maps as draining from Issyk-kul. **A**

marsh extends between the bend of the Chu and the lake, and a tiny stream drains from this marsh into Issyk-kul. Issyk-kul probably at one time drained through the Baum gorge at the northwest extremity of the lake, through which the route now goes to Tokmak and the Russian settlements on the fertile loess strip extending to Frunze. The present level of the lake is lower than in former times, and sandy marshes overgrown with reeds, the haunts of the wild boar and the tiger, have spread on the sites formerly occupied by the lake. Fish, especially carp, abound in the lake; its waters are too salty to provide drinking water. The soils on the shore of the lake are sandy, but in a few places there are fertile clayey patches. The nomad herdsmen pasture their flocks in the Issyk-kul valley in winter and on the high meadows in summer.

Along the narrow route by the southern shores of the lake passed the tribes driven westward by the Huns, notably the Indo-Scythian Yue-chi (*q.v.*) and the blue-eyed and fair-haired Uzuns, or Ussuns, from central Asia at the end of the 2nd century B.C. The former passed farther west, but' the latter settled in the valley and built the town of Chi-gu near the Tyup river, which still existed in the jth century. The rude stone images of the Uzuns are sometimes washed up from the lake and are of a type distinct from those of the Kalmucks or Kirghiz; a huge copper cauldron of the Czuns was washed ashore in 1842. The Uzuns disappear from history after the 5th century, but the fair-haired, blue-eyed, straight-nosed element sometimes met with among the Kirghiz of the Issyk-kul region indicates that they were probably absorbed by these tribes. The valley is at present occupied by the On (right or east) section of the Kara-Kirghiz, with Russian settlements at the eastern end of the lake. Hsuan Tsang (q v.), the Chinese Buddhist pilgrim. passed south of Issyk-kul in the 7th century and has left a description of the region. In the early 14th century Nestorian Christians founded a monastery on the northern shores of the lake, indicated on the Catalan map of 1374. The famous Russian explorer Nikolai Prjevalsky (*q.v.*) died at Karakol (now Przhevalsk) in 1888. The region was annexed to Russia in 1864.

ISTANBUL (formerly CONSTANTINOPLE), the largest city and seaport of the Turkish republic and the capital of Turkey until 1923.

The old walled city of Istanbul is situated on the western (European) shore of the Bosporus, a strait about 18.6 mi long linking the Black sea with the Sea of Marmara (Marmora). Guarding the Marmara end of the strait, it strategically occupies a triangular promontory, washed on the north by the Golden Horn (Halic), a narrow inlet, about 4.5 mi. deep, which forms an excellent harbour. A broad valley, through which there once flowed a small stream, the Lycus. divides the promontory from west to southeast into two masses of elevated ground: a long ridge overlooking the Golden Horn and an isolated hill in the southwest The ridge consists of six eminences, so that, all together, there are seven hills upon which Constantinople, like Rome, is said to be enthroned The first hill has the Seraglio palace. Hagia Sophia and the Hippodrome; the second the column of Constantine and the Nuruosmaniye mosque: the third the university and the mosque of Sultan Suleiman; the fourth the mosque of Mehmed II Fatih: the fifth the mosque of Sultan Selim; the sixth, which is the highest (250 ft.), the Edirne or Adrianople gate and Mihrimah mosque; the seventh, called in the middle ages Xerolophos ("dry hill"), is occupied by the quarter of Alti Mermer.

The Golden Horn, which is spanned by the Ataturk and the Karakoy-Eninonu bridges, divides old Istanbul, which contains the greater part of the city's archaeological heritage, from the quarters of Galata, once a separate walled city, and Beyoglu (formerly Pera). Facing Istanbul on the Asiatic side are Uskudar (ancient Chrysopolis) and Kadikoy (ancient Chalcedon). "Greater Istanbul." as it may be called, embraces not only these localities but an almost uninterrupted, though narrow, ribbon of settlements on both sides of the Bosporus and, for a considerable distance, on both the European and Asiatic shores of the Sea of Marmara. The inhabited areas stretch from old Istanbul to Kucukcekmece, about 18 mi. to the southwest and. on the opposite shore, from Uskudar to Pendik, a distance of about 16 mi. Close to the Asiatic shore of the Sea of Marmara, about 10 mi. from Istanbul, lie the Kizil Adalar or Princes Islands (*q.v.*), a cluster of four big and five small islands, used as a summer resort. Suburban developments have rapidly expanded, especially after World War II. The area enclosed by the municipal boundaries is 98 sq.mi., of which only approximately 9 sq.mi. are occupied by the old city.

Climate.—By virtue of its situation, Istanbul is influenced both by the climate of the Mediterranean and by that of the Black sea. The climate shows great variation depending on the prevailing wind: the north wind (*poyraz*) is the most frequent, resulting in a generally temperate climate. The south wind (*lodos*) is warm and damp, sometimes causing storms in the Sea of Marmara. In the winter a northwest wind (karayel) often blows from the mainland, bringing snow and short periods of intense cold. In general, fine weather lasts from May until October and often later. The most pleasant season is the autumn. The average annual temperature is 57° F., the average temperature of the coldest month (February) is 41° and of the warmest months (July and August) 73". Istanbul is subject to severe earthquakes which over the centuries have caused great damage to the monuments of the city.

HISTORY

Byzantium was the original name of the city before it was renamed Constantinople. The origin of Byzantium (allegedly so called after its mythical founder Byzas) is to be sought in the context of trading relations between Greece and the Black sea. Greek colonists, largely from the cities of Miletus and Megara, set up trading posts on the shores of the Propontis (Sea of Marmara) from the end of the 8th century B.C. onward. Byzantium nas a Megarian colony. According to tradition, it was founded about 657 B C. against strong resistance on the part of the native Thracian tribes. Byzantium fell under the sway of the Persian empire at about the time of the Scythian expedition of Darius I (512 B C.). Persian domination, temporarily interrupted during the Ionic revolt, continued until 478 B.C. when the city was captured by a Greek fleet Thereafter Byzantium became part of the Athenian confederacy; its growing prosperity is evidenced by the .Athenian tribute lists in which Byzantium figures as one of the most important contributors. In 411 B.C., however. with the decline of Athenian power during the Peloponnesian War (*q.v.*), Byzantium acknowledged Spartan supremacy. The city was recaptured after a siege by Alcibiades (*q.v.*), but after the total defeat of the Athenians, it fell once more under Spartan domination (405 B C.).

In 377 B.C. Byzantium joined the Second Athenian League. In 740 B C it was unsuccessfully besieged by Philip II (*q.v.*), king of Macedonia, whose failure ensured the independence of the city throughout the Hellenistic period. Even after the Roman conquest of the east, Byzantium remained free until its autonomy was taken away by Vespasian (AD. 70–79), although it was later restored. In 196 Byzantium, which had sided with the usurper Pescennius Niger, was captured after a long siege by Septimius Severus. Its walls were razed and its inhabitants massacred For a while it ceased to be a city and was annexed to Perinthus (Heraclea). But Severus soon changed his mind: Byzantium was not only restored but even enlarged, and renamed Antoninia after Severus' son M. Aurelius Antoninus (Caracalla).

The civil war between Constantine and Licinius was decided on the banks of the Bosporus. It was at Chrysopolis that Licinius suffered his final defeat (Sept. 18, 324). Immediately after this, Constantine, who must have been impressed by the strategic advantages of the straits, decided to make Byzantium his new capital. The foundation rites were celebrated on Nov. 8, 324; on May 11, 330, the imperial city, greatly enlarged, was officially inaugurated. It then bore the names of the New Rome and Constantinopolis (from the Greek Konstantinou polis, "Constantine's city").

Practically nothing remains of ancient Byzantium The city occupied the tip of the promontory and was protected by a line of walls (renowned in antiquity as being among the strongest of Greece) which described an arc starting approximately at modern

Sirkeci and ending on the Sea of Marmara east of the Hippodrome. The walls were rebuilt by Severus who carried them forward to the point later occupied by Constantine's forum (Cemberlitas). Severus also built a number of public monuments including the Hippodrome, which he left unfinished, the baths of Zeuxippus (next to the Hippodrome), a theatre and an arena for the exhibition of wild animals, and streets lined with porticoes. (See also BYZANTIUM.)

Constantinople.—The city, as rebuilt by Constantine, covered a much larger area. The walls extended from roughly the quarter of Fener on the Golden Horn to that of Samatya on the Sea of Marmara. Inside this enlarged circuit Constantine erected the buildings appropriate for an imperial capital. In the centre of an elliptical forum was placed a porphyry column (still standing) which supported the radiate statue of the emperor as Apollo Helios. Next to the forum rose the Senate house. The Hippodrome was completed and alongside it was built an imperial palace which remained the residence of the Byzantine emperors until the 12th century; this was known as the Great or Sacred palace. The palace opened onto a square called the Augustaion. Constantine also founded the church of Irene (Peace), which still stands although not in its original form, and the church of the Holy Apostles (now replaced by the Fatih mosque). The city was decorated with a multitude of statues that were removed from the principal towns of the eastern Mediterranean. New settlers were attracted by free distribution of bread and the granting of citizenship rights.

Constantinople experienced a period of rapid growth and building activity under Constantine's immediate successors. By the end of the 4th century Constantine's walls were already too narrow to contain the sprawling city. This factor, combined with the rising danger of barbarian invasion, dictated the erection of a new line of walls, which was done in the reign of Theodosius II by the praetorian prefect Anthemius (413). The walls along the shores of the city were constructed in the same reign by the praetorian prefect Cyrus (439). The area enclosed within the new walls was so large that no further need arose to extend them. The Theodosian walls are still standing.

The peak of medieval Constantinople was reached in the reign of Justinian I (527–565). The population of the city at the beginning of his reign may be estimated at about 500,000. In 532 a large part of the city was burned during the Nika insurrection, a bloody uprising of the Hippodrome factions. This gave Justinian an opportunity to indulge his passion for building. The basilica of Hagia Sophia (St. Sophia), probably built A.D. 360 by Constantius, son of Constantine, and dedicated not to a saint but to Divine Wisdom, was re-erected on a colossal scale (532–537). In addition, Justinian's building activity is represented today by the churches of St. Irene and SS. Sergius and Bacchus (Kucuk Ayasofya Camii) and by two great underground cisterns, that supposedly built by Philoxenus (Binbirdirek) and the Cisterna basilica (Yerebatan Sarayi). But these structures represent only a fraction of the buildings that Justinian put up in Constantinople, and which included upward of 20 churches, among them the famous basilica of the Holy Apostles (originally founded by Constantine), palaces, hospices, administrative buildings, colonnades and harbours.

The subsequent decline of Constantinople dates from the great plague which struck the city in 542 and is said to have killed 300,000 persons. As for the rest of the Byzantine empire so with Constantinople, the late 6th, 7th and 8th centuries were a period of extreme hardship and privation, followed by slow recovery in the 9th century. Building activity in Constantinople followed this curve; it was almost at a standstill during the period of decline, except for necessary works of fortification, then picked up again in the 9th century and continued until the end of the 12th, though on a smaller scale than in the period from Constantine to Justinian.

Throughout the middle ages Constantinople underwent a number of sieges, the mast serious being: by the Persians and Avars in 626, by the Arabs in 674–678 and 717–718, by the Bulgarians in 813 and 913, by the Russians in 860, 941 and 1043, by the Pechenegs in 1090–91. All of these were successfully resisted; it was not until 1204 that Constantinople fell to a foreign foe. For later sieges see below.

In 1082 the Venetians were given special trading privileges and quarters in Constantinople; they were followed by the Pisans, Amalfitans, Genoese and other Italians. Maritime trade. upon which the prosperity of Constantinople depended, was henceforth to be in the hands of westerners. Friction between the native and foreign elements culminated in a terrible massacre of the latter in 1182.

In 1203 the armies of the fourth crusade. deflected from their objective in the Holy Land, appeared before Constantinople ostensibly to restore the legitimate emperor, Isaac II. The city fell, but for a year remained under Byzantine government. On April 13. 1204, the crusaders once more captured the city and this time gave themselves to indiscriminate pillage and massacre. A western emperor, Baldwin of Flanders, was then chosen to rule in Constantinople, while the church fell under the control of the venetians who had been the prime instigators of the crusade. The Byzantines retrenched themselves in Nicaea and in the Epirus. while the remainder of their empire was partitioned by the westerners. The period of Latin rule (1204–61) was the most disastrous in the history of Constantinople: the city was systematically ransacked, all valuables and especially sacred relics were removed to the west, even the bronze statues were melted down for coin.

In 1261 Constantinople was retaken by Michael VIII Palaeologus, Greek emperor of Nicaea. For the next two centuries the shrunken Byzantine empire, threatened both from the west and by the rising power of the Ottoman Turks in Asia Minor, led a precarious existence. Some building was carried out at the end of the 13th and beginning of the 14th century, but thereafter the city was in a state of complete decay, full of ruins and tracts of deserted ground, contrasting with the prosperous condition of Galata across the Golden Horn. which had been granted to the Genoese by Michael VIII. When the Turks crossed into Europe in the mid-14th century the fate of Constantinople was sealed. The inevitable end was retarded by the defeat of the Turks at the hands of Timur (*q.v.;* Tamerlane) in 1402; but in 1422 Sultan Murad II laid siege to Constantinople. This attempt failed, only to be repeated 30 years later. In 1452 Sultan Mehmed (Mohammed) II proceeded to blockade the Bosporus by the erection of a strong fortress at its narrowest point; this fortress, called Rumeli Hisari, still forms one of the principal landmarks of the straits. The siege of the city began in April 1453. The Turks had not only overwhelming numerical superiority but also cannon which breached the ancient walls. The Golden Horn was protected by a chain. but the sultan succeeded in hauling his fleet by land from the Bosporus into the Golden Horn. The final assault was made on May 29 and, in spite of the desperate resistance of the inhabitants aided by the Genoese, the city fell. The last Byzantine emperor, Constantine XI, was killed in battle. For three days the city was abandoned to pillage and massacre, after which order was restored by the sultan.

As an ecclesiastical centre, Constantinople became the seat of a patriarch in 381 (see CONSTANTINOPLE. ECUMENICAL PATRIARCHATE OF). His rank was defined as being next only to that of the bishop of Rome. The patriarch of Constantinople is still the nominal head of the Orthodox Church. A patriarch of the Armenian Church also resides there. Constantinople was the seat of three ecumenical councils, the second (381), fifth (553) and sixth (680–681), as well as of many important local councils. The famous fourth ecumenical council was held in a suburb of Constantinople, at Chalcedon in 451 (see COUNCIL).

Istanbul.— At the time of its capture Constantinople was almost deserted. Mehmed II took measures to repeople it by transferring to it populations from other conquered areas such as the Peloponnese, Salonica and the Greek islands. By c. 1480 the population rose to between 60,000 and 70.000. Hagia Sophia and other Byzantine churches were transformed into mosques. The Greek patriarchate was retained, but moved to the church of St. Mary Pammacaristos (Fethiye Camii), later to find a perma-

nent home in the Fener. The sultan built the Old Seraglio (Eski Saray), now destroyed, on the site occupied at present by the university, and a little later the Seraglio (Topkapi Sarayi) which is still in existence; he also built the Eyup mosque at the head of the Golden Horn and the Fatih mosque on the site of the basilica of the Holy Apostles. The latter mosque was destroyed by the earthquake of 1766 and was subsequently rebuilt. The capital of the Ottoman empire was transferred to Constantinople from Adrianople (Edime) in 1457. The Turkish name Istanbul or Istanbol, attested before 1453, is a corruption of vulgar Greek *Stimboli* (eis tin *polin*); *i.e.*, "in the city."

After Mehmed II Istanbul enjoyed a long period of peaceful growth, interrupted only by earthquakes, fires and pestilences. The sultans and their ministers devoted themselves to the building of mosques, palaces, charitable foundations and fountains, so that the aspect of the city was soon completely transformed. The most brilliant period of Turkish construction coincides with the reign of Suleiman the Magnificent (1520–66).

The next major change in the history of Istanbul occurred at the very beginning of the 19th century with the approaching dismemberment of the Ottoman empire, the liberation movements in the Balkans and the era of internal reforms (tanzimat). The reforms were accompanied by serious disturbances, such as the massacre of the Janissaries in the Hippodrome (1826). With the triumph of the progressive Sultan Mahmud II over the conservative opposition. the westernization of Istanbul started apace. There was an ever-growing influx of European visitors who, since the 1830s. could reach Istanbul by steamship. The first bridge across the Golden Horn was built in 1838. In 1839 Sultan Abdul-Medjid I issued the charter of Gulhane guaranteeing to all his subjects, whatever their religion, the security of their lives and fortune. The process of westernization was further accelerated by the Crimean War (1853–56) and the quartering of British and French troops in Istanbul. The latter part of the 19th and beginning of the 20th century were marked by the introduction of various public services: the European railroad extending to Istanbul was built in 1871; the underground tunnel joining Galata to Pera in 1873; a regular water supply for Istanbul and the settlements on the European side of the Bosporus was brought from Lake Terkos on the Black sea coast (29 mi. distant from the city) by the French company. La Compagnie des Eaux, after 1885; electric lighting was introduced in 1912 and electric streetcars and telephones in 1913 and 1914. An adequate sewage system had to wait until 1925 and later.

In the first quarter of the 20th century Istanbul experienced various disasters marking the death of the Ottoman empire and the birth of modern Turkey. In 1908 the city was occupied by the army of the Young Turks who deposed the hated sultan Abdul-Hamid II. During the Balkan Wars (1912–13) Istanbul was nearly captured by the Bulgarians. Throughout World War I the city was under blockade. After the conclusion of the armistice (1918) it was placed under British, French and Italian occupation which lasted until 1923. The Greek-Turkish war in Asia Minor. as well as the Russian revolution, brought thousands of refugees to Istanbul. With the victory of the Nationalists under Mustafa Kemal Ataturk, the sultanate was abolished and the last sultan, Mehmed VI, fled from Istanbul (1922). After the signing of the Lausanne treaty, Istanbul was evacuated by the Allies (Oct. 2, 1923) and Ankara was chosen as the capital of Turkey (Oct. 13, 1923). On Oct. 29 the Turkish republic was proclaimed. Because of Turkey's neutrality during most of World War II, Istanbul suffered no damage, although a German invasion was feared after the Balkans had been conquered by the Axis. In 1955 Istanbul (as also Izmir) was the scene of severe anti-Greek riots, related to the differences between Greece and Turkey over Cyprus, in which Greek shops and property mere wrecked. The influx of automobiles brought acute traffic problems to Istanbul, especially after World War II. By the early 1960s large tracts of the city had been demolished or cleared to make way for modem highways.

MONUMENTS

Byzantine Monuments. — The most impressive vestige of secular Byzantine architecture in Istanbul is the city walls. The land walls, about 4.5 mi. long, consist of a double line of ramparts, the inner one erected in 413, the outer one in 447, and a moat. The inner wall is about 40 ft. high and 15 ft. thick, and is guarded by towers, about 60 ft. high at intervals of about 180 ft. The outer wall, which is lower, is also provided with towers. The walls were repaired at different periods and bear inscriptions to that effect. The seaward walls consist of a single line. Those along the Sea of Marmara are tolerably well preserved, while those along the Golden Horn have almost disappeared. Near the junction of the land walls with the Marmara walls stands the Golden gate, a triumphal arch flanked by square marble towers, erected *c.* 390.

The Byzantine palaces have almost completely perished. An excavation on the site of the Great palace, carried out by a Scottish expedition starting in 1935, has resulted in the discovery of a peristyle with a magnificent mosaic pavement probably dating from the late 6th century A.D. The only reasonably well-preserved example of Byzantine palace architecture in Istanbul is the so-called Tekfursarayi, attached to the land walls not far from the Golden Horn. It is the shell of a three-story rectangular building, and dates from c. 1300.

Of the famous Hippodrome only its curved end remains as well as three monuments on its longitudinal axis: the granite obelisk of Theodosius I, originally erected at Karnak in Egypt by Thutmosis III (c. 1504–1490 B.C.), the masonry obelisk of Constantine VII (A.D. 913–959). once covered with bronze plaques, and the mutilated Delphic serpent made after the battle of Plataea (479 B.C.). Of the many monumental columns which decorated Constantinople there remain only Constantine's porphyry column near the Nuruosmaniye mosque, the base of the column of Arcadius (395–408) in the Cerrahpasa quarter, the column of Marcian (450–57), known in Turkish as Kiztasi (column of the virgin), in the Fatih quarter, and a perfectly preserved Corinthian column in the grounds of the Seraglio presumably dating from the reign of Claudius II Gothicus (268–270).

Istanbul has a great number of underground Byzantine cisterns. These usually have vaulted roofs supported on columns. The most impressive of these are the Cisterna basilica near Hagia Sophia. which has 336 columns and still contains water, and the cistern of Philoxenus near the Hippodrome, which has 224 columns; the Philoxenus cistern is now dry. There are also four enormous open-air cisterns. one of which is outside the city.

Of the Byzantine churches the most important is Hagia Sophia, rebuilt 532–537, converted into a mosque in 1453 and into a museum in 1935. It is a rectangle 252 ft. long, 234 ft. wide, covered with an immense dome 110 ft. in diameter, rising to a height of 186 ft. The uncovering and cleaning of the mosaics of Hagia Sophia has been carried out by the Byzantine Institute of America, which began this work in 1931. There are about 25 other Byzantine churches in Istanbul, many of which are still used as mosques. The most interesting are: the ruined basilica of St. John of Studius (Imrahor Camii), founded in 463 by the patrician Studius, once the seat of a famous monastery; the octagonal church of SS. Sergius and Bacchus, built by Justinian between 527 and 536; the church of St. Irene, built in its present form by Justinian and used until about 1950 as a military museum; Church of the Saviour Pantocrator (Zeyrek kilise Camii) of the 12th century, with a magnificent inlaid pavement; the Virgin Pammacaristos (Fethiye Camii) of the 11th and 14th centuries, with interesting mosaics; and the Church of St. Saviour in Chora (Kahriye Camii), restored in the 11th century and extensively remodelled in the 14th. Kahriye Camii, now a museum. has a splendid mosaic decoration dating from c. 1320; this too has been cleaned and consolidated by the Byzantine Institute of America. (*See* also BYZANTINE ARCHITECTURE; BYZANTINE ART.)

Turkish Monuments. — The sultans' Seraglio (Topkapi Sarayi) is now a museum. With its gardens it occupies the entire tip of the promontory and is enclosed within a fortified wall. Begun by Mehmed II in 1462, it served as the residence of the sultans until the beginning of the 19th century. The Seraglio consists mostly of small buildings grouped around three courts. The most sig-

nificant buildings are the Faience kiosk (Cinili kosku) built in 1472, the Audience chamber (Arzodasi), the Hirkaiserif, a sanctuary containing relics of the prophet Mohammed, and the elegant Baghdad kiosk (Bagdat Kosku) commemorating the capture of Baghdad in 1638. The Seraglio houses the sultans' treasure and has important collections of manuscripts, china, armour, textiles, etc. After the abandonment of the old Seraglio, the sultans built for themselves palaces along the Bosporus, such as the Beylerbey palace (1865), the lavish Dolmabahce palace (1853). the Ceragan palace built in 1874 and burned in 1910 and the Yildiz palace which was the residence of Abdul Hamid II.

It is to its mosques that Istanbul owes its distinctive skyline. Architecturally. they may be separated into three groups. those built before *c.* 1500 reproducing the archaic formulas that had been applied by the Turks in the mosques of Nicaea (Iznik). Bursa and Adrianople (Edirne) ; the "classical" group which extends into the 17th century and is influenced by Byzantine architecture, especially by Hagia Sophia; later mosques marked by the introduction of western, first baroque and then neoclassical. elements The principal mosques of the first period are Mahmud Pasa Camii (1464), Murad Pasa Camii (1466), Atikalipasa Camii (1497) and. a little later, Sultan Selim Camii (1520). The "classical" period opens with Sultan Beyazid Camii (1501–05). and finds its highest expression in the work of the architect Sinan, viz. Sehzade Camii or Princes' mosque (1544–48), Suleymaniye Camii (1550–57), the masterpiece of Ottoman architecture in Istanbul. Mihrimah Camii and Rustempasa Camii (both middle of the 16th century) the latter famous for its Iznik faience tiles. Ahmed Pasa Camii (1555), Sokollu Mehmed Pasa Camii (1572). and Kilicalipasa Camii at Tophane (1580), a close replica of Hagia Sophia. The classical style is continued in Sultan Ahmed Camii (1616), popularly known as the Blue mosque and having six minarets, more than any other mosque of Istanbul: and Yeni Valide Camii or New mosque (1614–63), at the head of the Eminonu bridge. The most important specimens of the baroque period are Nuruosmaniye Camii (1755) near the Grand bazaar, Laleli Camii or the Tulip mosque (1763) and Fatih Camii (1767–71). Later mosques are of lesser interest.

Other curious examples of Turkish construction are the numerous fountains, the most elaborate being that of Sultan Ahmed III (1728) behind the apse of Hagia Sophia; the mausoleums of the sultans and their relatives, usually attached to mosques, especially those of Mehmed II by the Fatih mosque, Suleiman the Magnificent and his wife Roxelana by the Suleymaniye Camii. Murad III and Selim II by Hagia Sophia and Ahmed I on the Hippodrome; other appendages of mosques such as schools (*medrese*) and hostels for the poor (imaret) ; and bazaars, like the labyrinthine Grand bazaar (Buyuk Carsi) and the Egyptian market (Misir Carsi) at Eminonu. (*See* also ISLAMIC ARCHITECTURE : *Turkey.*)

Museums. — In addition to historical monuments which have been converted into museums. Istanbul possesses an important Archaeological museum containing Greek, Roman and Byzantine antiquities. Its most prized possession is the so-called Alexander sarcophagus of the 4th century B.C. as well as other sarcophagi found at Sidon. A special section of the museum is devoted to oriental antiquities; *e.g.,* Hittite, Assyrian. Babylonian and Egyptian.

POPULATION, ADMINISTRATION AND ECONOMY

Population. — Istanbul has always been a cosmopolitan city. Although census figures are not always reliable, it appears that the population of Istanbul was on the increase until World War I; thereafter it dropped. but has been increasing steadily since 1930. The count of 1876 showed 873,565 persons within the city limits; that of 1927 showed 690,857, of whom 447,851 were Muslim Turks and 243,066 non-Muslims (mostly Greeks, Jews and Armenians), including foreigners. The non-Muslim element has been dwindling; in 1945, out of a total population of 860,558, there were 663,278 Muslims, 147,568 Christians and 49,239 Jews. In 1960 the total population was 1,459,528.

Education. — Istanbul possesses a university founded in 1846 with faculties of letters, science, law, medicine and forestry; it is located in the buildings of the former Seraskerat (mar ministry). There are also a Technical university on the Galata side of the Horn, an Academy of Fine Arts, schools of technology, commerce and economics. Foreign educational institutions include the American Robert college for boys (founded 1863) and the American college for girls (founded 1871). both on the Bosporus; an English high school for boys and-one for girls; and the French-Turkish lycée of Galatasaray (founded 1867).

BY COURTESY OF TURKISH INFORNATION AND TOURIST DEPARTMENT

DOLMABAHCE MOSQUE, BUILT IN 1853, ON THE EUROPEAN SIDE OF THE BOSPORUS, WITH DOLMABAHCE PALACE IN BACKGROUND

Administration. — The municipal prefect of Istanbul is also the governor of the province (il) and is appointed by the president of the republic. The municipality (belediye) is divided into 12 circumscriptions (*kazas*), each governed by a kaymakam: Eminonu. Fatih (in the old city), Eyup. Bakirkoy, Beyoglu, Sisli, Besiktas. Sariyer (on the European side). Beykoz, Uskudar, Kadikoy, Adalar (on the Asiatic side).

Commerce and Communications. — Istanbul is the largest port of Turkey as well as being the industrial centre of the country. Maritime traffic, affected by the international situation, has remained somewhat sluggish owing to restricted intercourse with the Black sea countries. There are shipbuilding yards in the Golden Horn. Goods manufactured in the city include textiles, pottery, leather, cigarettes, liqueurs. flour. cement, glass and soap. Another growing source of revenue is tourism.

Istanbul is the terminus of the

international rail service (the former Orient Express) Paris-Milan-Belgrade-Sofia or Salonica-Istanbul, and the starting point (at Haydarpasa on the Asiatic side) of the Baghdad railway. The city is served by numerous maritime lines. From the airport of Yesilkoy, 17½ mi. W. of the city, there are services to most of the major cities of the world.

Internal communication of the city is served by buses which have now replaced streetcars, and an extensive network of ferries connecting the Galata bridge with the villages of the Bosporus. the Asiatic coast as far as Yalova, the Princes Islands and the Golden Horn.

Istanbul Province. — The *il* of Istanbul lies between longitude 28° and 30° and latitude 40° 45' and 41° 45', covering an area of about 2,080 sq.mi. It is bisected by the Bosporus and includes on the European side the towns of Silivri and Catalca, and on the Asiatic side Sile, Kartal and Yalova. The area has small deposits of metal and lignite. Agriculture is not developed apart from vegetable and fruit growing. The population of the province was 805,707 in 1927 and 1,542,941 in 1955.

See also references under "Istanbul" in the Index volume.

BIBLIOGRAPHY.—E. Mamboury, *Istanbul touristique* (1951); *Guide bleu: Turquie* (1958); G. Ostrogorsky, *History of the Byzantine State* (1956); V. P. Nevskaia, *Byzanz in der klassischen und hellenistischen Epoche* (1955); F. Babinger, *Mehmed der Eroberer und seine Zeit* (1953); A. van Millingen, *Byzantine Constantinople: the Walls of the City and Adjoining Historical Sites* (1899); *Byzantine Churrhes in Constantinople* (1912); R. Janin, *Constantinople byzantine* (1950); *La géographie ecclesiastique de l'empire byzantin*, vol. i, pt. 3, *Constantinople, les églises et les monastères* (1953); A. M. Schneider, *Byzanz: Vorarbeiten zur Topographie und Archaologie der Stadt* (1936); Djelal Essad, *Constantinople: de Byzance à Stamboul* (1909); J. Ebersolt, *Le Grand Palais de Constantinople* (1910); B. Meyer-Plath and A. M. Schneider, *Die Landnzauer von Konstantinopel* (1943); W. R. Lethaby and H. Swainson, *The Church of Sancta Sophia* (1894); T. Whittemore, *The Mosaics of St. Sophia at Istanbul*, vol. i–iv (1933–52); A. M. Schneider and M. Is. Nomidis, *Galata* (1944); Misn (M. Is. Nomidis), *Carte topographique et archéologique de Constantinople* (1938); C. Gurlitt, *Die Baukunst Konstantinopels* (1907); A. Gabriel, "Les mosquees de Constantinople," *Syria*, vol. vii, pp. 353–419 (1926); B. Miller, *Beyond the Sublime Porte* (1931); R. Liddell, *Byzantium and Istanbul* (1956). (C. A. Mo.)

ISTHMUS, a narrow strip of land connecting two larger land areas otherwise separated by the sea. Unquestionably the two most famous are the Isthmus of Panama, connecting North and South America, and the Isthmus of Suez, connecting Africa and Asia. Historically the Isthmus of Corinth was of major importance because it connected what otherwise would be the island of Peloponnese with the rest of the Greek peninsula. Isthmuses are of great importance in plant and animal geography because they offer a path for the migration of land plants and animals between the two great land masses that they connect.

(W. C. C.)

ISTRIA (ISTRA), after 1918 the Italian province of Pola, in the region of Venezia Giulia; area 1,435 sq.mi. In 1947 most of Istria passed to Yugpslavia, where it was divided along ethnic lines between Croatia and Slovenia. It comprises most of the Istrian peninsula (area 1,545 sq.mi.), stretching into the Adriatic between the Gulf of Trieste and the Gulf of Quarnero, and the islands of Cherso, Lussino and others. The coast line extends for 267 mi. and is indented on the west by the bays of Muggia, Capodistria, Pirano, Port Quieto and Pola, and on the east by those of Medolino, Arsa, Fianona and Volosca. A great portion belongs to the Carsic region and is occupied by the so-called Istrian plateau, flanked north and east by mountains (Monte Maggiore [Ucka], 4,580 ft.). It slopes south and west in undulating terraces toward the Adriatic. The Quieto in the west and the Arsa in the east, neither navigable, are the principal streams. The climate is warm and dry. The coasts are exposed to the sirocco from the south-southeast and the bora from the northeast. Wheat, maize, rye. oats, olives, figs and melons are grown. Viticulture is well developed. and the best sorts of wine are produced near Capodistria. Muggia, Isola, Parenzo and Dignano, while well-known red wines are made near Refosco and Terrano. The oil of Istria was already famous in Roman times. Cattle are bred. and lumbering gives beech and oak timber (good for shipbuilding), gallnuts, oak bark and cork. Fishing, recovery of salt from the sea water and shipbuilding are other occupations.

Istria was the ancient Istria or Histria, known to Rome as the, abode of fierce Illyrian pirates. It owed its name to an old belief that the Danube (Ister, in Greek) discharged some of its water by an arm entering the Adriatic in that region. The Istrians, protected by the difficult navigation of their rocky coasts, were subdued by Rome only in 177 B.C. after two wars. Under Augustus the greater part of the peninsula was added to Italy, and the later removal of the capital to Ravenna advantaged Istria. After the fall of the western empire it was pillaged by Longobardi and Goths; it was annexed to the Frankish kingdom by Pepin in 789; and about the middle of the 10th century it fell to the dukes of Carinthia, then successively to the dukes of Meran. the duke of Bavaria and the patriarch of Aquileia and the republic of Venice. Under this rule it remained until 1797, when Austria added it to the northeastern part which had fallen to its share as early as 1374. By the peace of Pressburg. Austria was in 1805 compelled to cede Istria to France. and the department of Istria was formed, but in 1813 Austria regained it and retained it until 1918.

ITACOLUMITE, a variety of porous yellow sandstone or quartzose schist occurring at Itacolumi, in the southern portion of Minas Gerais, Brazil The rock is of interest for two reasons. it is believed to be the source of the abundant diamonds of the district, and it is the best-known example of a flexible sandstone. If a piece 1 ft. in length and about ½ in. thick is supported at its ends, it will gradually bend under its own weight; if it then is turned over, it will bend in the opposite direction. The cause of the flexibility is ascribed to the porous character of the rock and the interlocking of the sand grains. (P. G. H. B.)

ITAGAKI, TAISUKE COUNT (1837–1919), Japanese statesman, was born in Tosa in 1837 He distinguished himself originally as one of the soldier politicians who contributed so much to the overthrow of feudalism and the restoration of the administrative power to the throne. After taking a prominent part in subduing the resistance offered by a section of the shogun's feudatories to those changes, he received cabinet rank in the newly organized system. But in 1873 he resigned his portfolio as a protest against the ministry's resolve to refrain from warlike action against Korea. Itagaki feared that the country was about to pass under the yoke of a bureaucratic government. He became thenceforth a warm advocate of constitutional systems, though at the outset he does not seem to have contemplated anything like a popular assembly in the English sense of the term, his ideas being limited to the enfranchisement of the samurai class. Failing to obtain currency for his radical propaganda, he retired to his native province, and there established a school (the Risshi-sha) for teaching the principles of government by the people, thus earning for himself the epithet of "the Rousseau of Japan." His example found imitators. Not only did pupils flock to Tosa from many quarters, attracted alike by the novelty of Itagaki's doctrines, by his eloquence and by his transparent sincerity, but similar schools sprang up among the former vassals of other fiefs, who saw themselves excluded from the government. In 1875 no fewer than seven of these schools sent deputies to hold a convention in Osaka, and an appeal to force seemed possible.

But the statesmen in power were not less favourable to constitutional institutions than the members of the Aikoku Ko-to (Public Party of Patriots), as Itagaki and his followers called themselves. A conference attended by Kido. Okubo, Inouye, Ito, Itagaki and others entered into an agreement by which they pledged themselves to the principle of a constitutional monarchy and a legislative assembly. Itagaki now accepted office once more. Finding, however, that his colleagues in the administration favoured a much more leisurely rate of progress than he himself advocated, he once more retired into private life (1876) and renewed his liberal propagandism. It is in the nature of such movements to develop violent phases, and the leaders of the Aikokusha (Patriotic association), as the agitators now called themselves, not infrequently showed disregard for the preservation of peace and order. Itagaki made the mistake of memorializing the government at the moment when its very existence was imperilled by the Satsuma rebellion (1877), and this evident disposition to

take advantage of a great public peril went far to alienate the sympathies of the cabinet. Recourse was had to legislation in restraint of free speech and public meeting. But repression served only to provoke opposition.

Throughout 1879 and 1880 Itagaki's followers evinced no little skill in employing the weapons of local association, public meetings and platform tours, and in Nov. 1881 the first genuine political party was formed in Japan under the name of *Jiyū-tō*, with Itagaki for declared leader. A year later the emperor announced that a parliamentary system should be inaugurated in 1891, and Itagaki's task might be said to have been accomplished. Thenceforth he devoted himself to consolidating his party. In the spring of 1882, he was stabbed by a fanatic during the reception given in the public park at Gifu. The words he addressed to his would-be assassin were: "Itagaki may perish, but liberty will survive." Once afterward (1898) he held office as minister of home affairs, and in 1900 he stepped down from the leadership of the *Jiyū-tō* in order that the latter might form the nucleus of the *Seiyū-kai* organized by Count Ito. Itagaki was raised to the nobility with the title of count in 1887. From the year 1900 he retired into private life, devoting himself to the solution of socialistic problems. His countrymen justly ascribe to him the fame of having been the first to organize and lead a political party in Japan. He died in 1919.

True to his liberal principles, he forbade his son to apply for the succession of his title and it lapsed.

ITALIAN FRONT, IN WORLD WAR I. On the outbreak of World War I the Austro-Italian frontier, as delimited after the war of 1866, was about 600 km. in length, four-fifths of it in the mountain zone and a considerable part in the high Alps. To some extent it corresponded with the crest of the mountains, but in several areas it was well to the S. or W. of it, and almost everywhere the summits and the most favourable positions were held by Austria. Commencing at the top of the Stelvio pass, it followed the Alpine ridge to the Tonale, deflected S. to the Adamello group and the lake of Idro, turned E. across the Lago di Garda, S. of Riva, ascended the M. Altissimo of the Baldo group, crossed the Adige S. of Borghetto, turned N.E. along the outer edge of the Asiago plateau, E. along the Cime Portule, Dodici, Undici, crossed the Brenta below Grigno, kept along the ridge of the Cadore mountains, crossed the Cordevole S. of Livinallongo, passed S. of Cortina d'Ampezzo, reaching the Carnia Alps at M. Popera, keeping due E. along the crest to the source of the Pontebba stream, turned S. along Morlasio, M. Canin, M. Maggiore and M. Kolovrat, W. of the Isonzo, followed the Judrio, crossed the Torre below its confluence with the Natisone, passed E. of Palmanova, and reached the sea between the lagoons of Murano and Grado. It formed two salients—that of the Trentino, driven like a wedge into the heart of the Venetian plain, with 12 military roads spreading fanlike from it in all directions, and that of the Friuli extending towards the Isonzo; the former was much more favourable to Austria than the latter was to Italy.

On the Italian side there was a main line of railway from Milan to the Austrian frontier at S. Giorgio di Nogaro, with a line pushing N. from Verona to the Austrian frontier at Borghetto, and another from Mestre N.E. to the frontier at Pontebba, a line parallel to the E. frontier from Udine to Palmanova, and a number of branch lines. On the Austrian side there were the main lines from the Brenner to the frontier, from Leoben to Pontebba and from Graz to Trieste and San Giorgio di Nogaro, an intermediate line along the Pusterthal, another from Klagenfurt to Gorizia and Monfalcone and various branch lines.

As soon as Italy intervened in the war the Italian troops effected a forward push and succeeded in some sectors in securing more favourable positions—the Tonale, M. Baldo, Col Santo, Pasubio, Vallarsa and Valsugana sectors of the Alpine front (see TRENTINO), and crossed the upper Isonzo at Caporetto, occupying the Monte Nero and Plezzo areas. On the middle and lower Isonzo the advance was held up by the defenses of the town of Gorizia (*q.v.*) and the Carso, although the river was eventually crossed at Pieris and other points and Monfalcone occupied. Subsequently, after heavy fighting, the enemy having been able to strengthen the naturally strong Carso positions, the Isonzo line was pushed forward until in Aug. 1916 Gorizia was captured, with a wide area on the Carso to the south of the town. Further progress on the Carso and at various points east of the Isonzo was effected in the autumn of 1916 and the first months of 1917, the Bainsizza plateau northeast of Gorizia being occupied after hard fighting in August.

On the Trentino front the Austrian offensive of May 1916 resulted in the loss by the Italians of several sectors on the Asiago plateau; but thk last mountainous diaphragm was held as well as the Pasubio, and an Italian counter-offensive recaptured most of the lost ground. On the other sectors there were few changes. When the Austrians broke through at Caporetto (*q.v.*) in October 1917 the II. and III. armies fell back on the Piave, the Carnia and Cadore sectors were evacuated and some important positions on the Asiago plateau were also lost. The new front was 200 km. shorter than the old. From the Stelvio to Asiago it was unchanged; in the latter sector it was well to the S. of the old line, and further E. it ran along M. Asolon, M. Grappa (*q.v.*), Col dell'Orso to the Piave S. of Valdobbiadene, and then followed the Piave (*q.v.*) to its mouth. Only slight changes were effected, except in the Grappa and Asiago areas where, after desperate fighting in November and December, the Italians fell back still further, until by the end of the year the new line was definitely stabilized. At the battle of the Piave some positions in the Asiago area were lost and the Austrians crossed the Piave at two points, but the Italians counter-attacked and regained all the lost ground.

There were no further changes until the Italian victory of Vittorio Veneto (*q.v.*), which ended the war on this front (Oct. 23–Nov. 3, 1918).

The strategic outline of the campaign on the Italian front is given *s.v.* WORLD WAR I; see also the references to separate articles above.

(L. V.)

ITALIAN LANGUAGE is the standard language used for official, formal and literary purposes throughout Italy, taught in schools to natives and foreigners. The common everyday speech is either a local Italian dialect different from the standard, or the standard influenced by local usage. The less formal the occasion and the less educated the speaker, the greater are the deviations from standard Italian; many persons cannot speak standard Italian at all. All speech forms called Italian belong to the Romance languages (*q.v.*).

The Dialects.—The number of dialects is very great, and the differences are so profound that many are mutually unintelligible. Thus the word "dialect" here connotes much more radical variations than it normally does in reference to English. The dialects may be divided into six major classes.

1. Gallo-Italian: (a) Piedmontese; (*b*) Ligurian; (*c*) Lombard; (d) Emilian.
2. Venetian: (*a*) Veneziano; (*b*) Trentine; (*c*) Istrian.
3. Tuscan: (*a*) Florentine; (*b*) Western Tuscan; (*c*) Southern Tuscan.
4. Corsican.
5. Central Italian: (a) Northern Latian; (b) Umbrian; (c) Marchigiano; (d) (Modern) Roman.
6. Southern Italian: (a) Southern Latian; (b) Abruzzese; (c) Campanian; (*d*) Calabrian; (*e*) Apulian; (*f*) Sicilian.

Different classifications are possible, as are further subdivisions.

Italian dialects are also spoken in the Swiss canton Ticino and on Corsica, and were spoken on the Adriatic island of Veglia (Krk) and in Dalmatia until the 19th and 15th centuries, respectively. (Some consider the last a separate Romance language.)

Italian in its various forms is spoken natively by about 49,000,000 persons. A considerable number of Italian immigrants to the United States and to Argentina continued to speak Italian, and used the language of their new homeland as a second language, but the succeeding generations became progressively monolingual speakers of English or Spanish. Since the loss of Italy's African colonies at the end of World War II, Italian, once the official language there, though not the mother tongue of the natives, has been on the wane.

The linguistic fragmentation of Italy and the tenacity of the dialects have historic causes. Although Italy was latinized by the conquering Romans, it is certain, though evidence is scanty, that the numerous pre-Latin languages of Italy persisted for some time after the Roman conquest and continued in certain local pronunciations of Latin. Furthermore, not all Italy was occupied by the Romans at the same time, hence it was not all exposed to the same kind of Latin, nor latinized with equal thoroughness. There was no policy of linguistic acculturation in annexed regions. Linguistic decentralization was intensified by the extreme and enduring political dismemberment of the peninsula after the fall of the Roman empire, and enhanced by the rugged geography of the country and the physical difficulties of communication.

The Standard Language. — Classical Latin, after the dissolution of the Roman state and the breakdown of secular education, became the property of a diminishing number of educated persons, largely of the clergy; it became unintelligible to the common man whose vernacular continued to change, as all language does. When it became urgent to employ, for state and private business, a language other than Latin which all could understand, and when literary men wished their works to appeal to a greater listening, if not reading, public, it became necessary to reduce previously unrecorded contemporary dialects to writing. This is a difficult task, even with the methods of modern linguistics, which is aggravated when the effort is deprecated as an attempt to replace a noble tongue by an allegedly vulgar patois.

In *De vulgari eloquentia* "About Popular Speech," written in Latin early in the 14th century, Dante, having skillfully surveyed the languages of Europe and Italy, proposed to establish for all Italians a literary language which should be constructed from all the dialects, preserving a core of common features and discarding extreme local peculiarities. But, contrary to his own theory, Dante himself wrote in his native dialect, Florentine. Thus almost single-handed he made Florentine the literary standard language of Italy, albeit without being fully aware of it. The elevation of a dialect to a literary language because of some prestige accrued to it is the usual phenomenon rather than the procedure Dante suggested. And Florentine acquired the necessary prestige mainly through Dante's own *Divina Commedia*, and later Boccaccio's *Decamerone*, and Petrarch's *Canzoniere*. But Florentine had to compete with other dialects in which meritorious works had been composed, such as the poetry of the Sicilian school, which flourished in Palermo at the court of the German emperor Frederick II (1194–1250) and ended with the Hohenstaufen dynasty. The dialect of the original poems is uncertain, most of the extant manuscripts being from Tuscany and liberally tuscanized. Florentine, however, was aided by the poetry in the *dolce stil nuovo* "sweet new style," produced by a Tuscan school; one of its leaders, Guido Guinizelli, a Bolognese, wrote in Florentine.

Graver obstacles were: the opposition of the learned men who did not wish to see Latin losing ground; the relatively slow spread of Dante's works due to extensive illiteracy and the cost of books before the invention of printing; the seeming needlessness of a national language in the absence of a nation; the cultural climate favouring a renascence of antiquity, which led one humanist of Florence to denounce the *Divina Commedia* as a vulgar piece written in a vulgar tongue, and Italian as a language unfit for poetry. (Petrarch himself was prouder of his Latin than of his Italian works.)

Thus developed the discussions of the *Questione della lingua* "Problem of the Language," which sought to decide whether Latin or Italian should become the national idiom, and, if the latter, which dialect and how "pure" (*i.e.*, free from archaisms, at issue especially from the Renaissance on, and gallicisms, which began to come into Italian and other European languages in the 18th century) it should be. In practice, however, Dante had already decided the quarrel in favour of Florentine. In 1525 the Venetian Pietro Bembo by publishing his *Prose della volgar lingua* fulfilled the two pressing requirements for a standard language (now one that was to be printed in relatively cheap books), an orthographic and a grammatical codification.

Even a standard language, which is by purpose conservative, must not be inhospitable to revision if it is to remain useful. Once adopted, standard Italian was prevented from evolving, and was nearly stifled by its grammarians. It became unwieldy, crammed with formulas and phrases thought beautiful or noble (*cf.* even the modern formal style in letters and officialese), and alienated from reality; it became inadequate over the centuries for the demands of a changing world and new literary trends. Some writers once more had recourse to the uninhibited, lively dialects, and a growing dialect literature in the 18th and 19th centuries threatened to reduce Italian, like classical Latin, to a dead language. It was resuscitated by the Milanese author Alessandro Manzoni (1785–1873), who wrote the second edition of his novel **I** *promessi sposi* "The Betrothed" in standard Italian. But he saw to it, in practice and also in numerous theoretical essays, that the language was reformed and revived, that it was allowed to fill its gaps, and that it would be nurtured by the stream of life it was to reflect and to serve. Manzoni's endeavours were succoured by the awakening nationalism.

Modern standard Italian is still basically the dialect of Florence (minus peculiar localisms like *la hasa* for *la casa, amaθo* for *amato*), but constantly enriched by borrowings from other dialects. Naturally, the dialect of Rome, the capital of the nation after 1870, is particularly influential. Some characterize current standard Italian as *lingua toscana in bocca romana* "Tuscan tongue in Roman mouth." Pronunciation is far from uniform in Italy, but in morphology and syntax all Italians can either speak or learn to speak the same language. Few people speak literary Italian natively, though the Tuscans, for obvious reasons, come nearest to the standard. With rapid improvements in education and communication, and the spread of newspapers, radio and television into remote areas, linguistic standardization of Italy, for better or for worse, should progress apace.

Linguistic History. — It is impossible to set a date for the end of Latin and the beginning of Italian; the development was uninterrupted and boundaries are arbitrary in spoken language. But in written texts a beginning of Italian may be discovered in the midst of Latin. Some writers realized that the spoken and the written idioms were not two kinds of Latin, the "good" written form (as nearly classical as authors could make it) and the "bad" spoken form, but were really different languages. Attempts were then made to write the spoken vernaculars also. The earliest evidence is a set of court records of the 10th century, in which the clerk put down the proceedings in customary subclassical Latin, but inserted the decisive deposition of witnesses verbatim in the language of the speakers, which was Italian (a southern dialect) rather than Latin. From then on, documents and monuments in the *lingua volgare* or *rustica* "vulgar or rustic language," were more frequent, without completely replacing Latin, however, for many centuries, especially in learned works. Galileo (1564–1642) was the first to use Italian for scientific works.

Toward the end and after the fall of the Roman empire, the incursions and occupations by speakers of foreign dialects and the growing number of foreigners in the civilian population and the army, were bound to modify native idioms, although the extent of the linguistic changes was small (much less than the transformation of English after the Norman conquest).

The most important invasions of Italy during the middle ages were those by the Visigoths (5th century, moving from the north to Calabria, but abandoning Italy after the death of their king Alaric), the Ostrogoths (later 5th and early 6th centuries, founding a kingdom with the capital in Ravenna, but after Theodoric's death in 526, overcome by Roman power revived by Justinian), and the Lombards (who remained longest, 568–774, founding a loosely integrated kingdom with the capital in Pavia, which was terminated by the Franks allied with the papacy); these Germanic invaders were followed in southern and central Italy by Arabic-speaking Moslems and by Norman *condottieri* whose sovereignty lasted until the 12th century. None of these significantly changed the Italian language; their only important traces are in lexical borrowings, of which the German, numbering about 1000, are the strongest contingent. This ineffectualness was due in part to the small number of invaders, but mainly to the cultural incompati-

bility of natives and invaders. The Germans were so awed by the superior Roman civilization that they did not even attempt to impose their ways.

Thus the dialects of Italy, including Dante's idiom, underwent little change through foreign influence. And since Italian has changed little since the 13th century, modern Italian diverges least of all the Romance languages from Latin.

Each dialect has its own linguistic history, although all are Romance. in particular Italian, dialects. All Italian dialects together with the other Romance idioms, partook of the common Romance changes *(see* ROMANCE LANGUAGES). Beyond these, the history of standard Italian is fairly simple, the complexities arising mainly from dialect mixture. For a more detailed historic description, Florentine is the obvious choice.

Phonology.— The accented *e* and *o* vowels of late spoken Latin, if open and in free position (*i.e.,* at the end of syllables) were diphthongized: *pĕdem* > *piede, bŏnum* > *buono;* in checked position they remained: *cĕrtum* > *certo, mŏrtem* > *morte;* if close, regardless of position, they remained: *pēsum* > *peso, vocem* > *voce, fīrmum* > *fermo, mūltum* > *molto.* The *a* remained, except in some northwestern dialects where, as in Northern French, *e* appeared in its place: infinitive *-are* > *are,* or *-e(re).* The *i* and *u* (resulting from earlier long **i** and **1,** the short *ĭ* and *ŭ* appearing as *ę* and o, respectively—except in some southern Italian areas) also remain. *filum* > *filo, murum* > *muro.* It is typical of Florentine, though not of other Tuscan dialects, that a following palatal or nasal element, produced *i* and *u* instead of the expected *e* and *o,* respectively: *lingua* > *lingua,* elsewhere *lengua; ungula* > *unghia,* elsewhere *onghia.* Southern dialects are noteworthy for metaphony, that is, the influence of an unstressed upon the preceding stressed vowel: *bonum* > *buono,* but *bonam* > *bona.* Piedmont and Lombardy have, again like French, the so-called umlauts *ü* and o (so transcribed after the German orthography).

The (unstressed) vowels tend to weaken, except for *a,* so that *e* and *i, o* and *u* often merge. Their development depends largely upon their position in the word: pretonic, posttonic, initial, final, intertonic. In southern dialects all final unstressed vowels may fuse into the schwa-sound a (pronounced like the second vowel in English "father").

The most striking phenomena among consonant changes are these: the palatalization and affricatization of stops before *e, i,* or yod, and of yod itself: *certum* [kertum] > *certo* [tšerto] (brackets enclose a phonetic transcription), *cibum* [kibum] > *cibo* [tšibo], *nationem* [natyonem] > *nazione* [natsione] , *gentem* > *gente* [dżente], *gyrum* > *giro* [dżiro], *iurare* > *giurare* [dżurare], *-arium* > *-aio, vinea* > *vigna* [vinya] ; the palatalization of consonant plus *l: plus* > *più, florem* > *fiore, clarum* > *chiaro* [kyaro] ; and the loss of most final consonants. In southern dialects *-nd-* and *-mb-* appear as *-nn-* and *-mm-: quando—quanno, gamba—gamma,* peculiarities often cited as attesting an Oscan substratum. In the north. single voiceless intervocalic consonants appear voiced, and long ones (spelled double; "long stops," a contradiction in terms, are really stops articulated with retarded explosion, *e.g.,* the two t's in English "put to" as opposed to "putting") are shortened. In the northeast *tš* and *dž* appear as *ts* and *dz.* In the south *-ll-* appears as a long cacuminal stop, generally spelled *-dd-* (transcribed *-ḍḍ-*) as in *Turiddu* for *Torello.*

Where standard Italian has forms divergent from the expected ones, dialect borrowings are often the cause. Sometimes doublets with different meanings are retained, such as *stazione* "station" and *stagione* "season." both from *stationem.*

Morphology and Syntax.— Beyond the common Romance developments listed in ROMANCE LANGUAGES, Italian has undergone few radical changes. It may be pointed out that the plural of nouns and adjectives is derived from the Latin nominative case, as in Rumanian but not in other Romance languages. The Latin *ille* "this (one)" and its paradigm become the Italian definite article. The use of subject pronoun is optional; it may convey emphasis.

Vocabulary is, as mentioned, overwhelmingly Latin. In the later middle ages and in the succeeding centuries, Italian borrowed (to the sorrow of the purists) from various European languages, especially French and Spanish during the periods of political and cultural ascendancy of these nations. The number of borrowed words is not great, but the frequency of occurrence rather high because among them are common words: *giardino* "garden," *mangiare* "to eat," *giallo* "yellow," *flotta* "fleet." Arabic words, often coming by way of Spanish, are recognizable by the prefix *al-,* Germanic words by *gu-* from Germanic w- *(cf.* the English doublet "guard" and "ward," the first being a Romance borrowing, the second the native German word) : Italian *guerra*— English "war."

Numerous learned words are later borrowings from Latin especially during the Renaissance (again often leading to doublets: *circulum* > *cerchio,* later borrowing *circolo*), and modern scientific terminology uses many Latin roots.

Modern Italian spelling employs the regular Latin alphabet. But Italian (quite unlike English) orthography is almost phonetic; once the regular equivalences of sound and spelling are mastered, Italian can be read and written correctly: there are no exceptions. Identical spellings for different sounds, as in English *rough, though, through, bough, cough, ought* do not occur in Italian, nor do different spellings for identical sounds as in English *through, zoo, shoe, flew, flue, do.* Placement of the stress may offer some difficulty: it is unpredictable (except where there is a grave accent on the final stressed vowel: *cittd, moltiplicità*). Certain etymological spellings, like *ph, th, y,* have been abolished in favour of *f, t, i (fotografia, teologia, sistema*). Italian grammars often stress the difference in the timbre of open versus close e and *o,* which is not apparent in the spelling; but this distinction is not significant and varies from region to region. The significant opposition of long versus short consonants, however, is regularly indicated *(sera* "evening": *serra* "he tightens"; *fato* "fate": *fatto* "done"; *casa* "house": *cassa* "box"; *capello* "hair": *cappello* "hat"), except where such lengthening occurs in transition from one word to another, as in *a casa* "at home," which is pronounced *accasa.* (In some compositions the double spelling has been standardized, so that *della* stands for *de la* "of the" and *dammi* for *da mi* "give me.") Italian spelling has no devices like the French cedilla or the Spanish tilde; such variations in sound are indicated by letter spellings. The grave accent is used regularly on the final stressed vowel, and occasionally to distinguish a verbal form *dd* "he gives" from a nonverbal *da* "from." The circumflex appears only in older writing as on *foglî,* now *foglii* or *fogli,* plural of *foglio* "sheet."

BIBLIOGRAPHY.—C. Battisti and G. Alessio, *Dizionario etimologico italiano* **(1950** *et seq.*); G. Bertoni, *Profilo linguistico d'Italia* (1940); Robert A Hall, Jr., *Bzbliography of Italian Linguistics* (1941); *C.* **H.** Grandgent, *From Latin to Italian* (1927); *K.* Jaberg and J. Jud, *Sprach- und Sachatlas Italiens und der Südschweiz* (1928–40); *T.* Labande-Jeanroy, *La question de la langue en Italie* **(1927); B.** Migliorini, *Storia della lingua italiana* **(1960)** ; *E.* Monaci, *Crestomaaza italiana dei primi secoli etc.* (1955) ; *E.* Pulgram, *The Tongues of Italy: Prehistory and History* (19j8). (E. PM.)

ITALIAN LITERATURE. One characteristic fact distinguishes Italy's intellectual life in the middle ages: the tenacity with which the Latin tradition remained alive *(see* LATIN LANGUAGE; LATIN LITERATURE). At the end of the 5th century the northern conquerors invaded Italy. The political structure of Rome crumbled to pieces; Goths, Greeks, Lombards and Franks were in turn pre-eminent in Italy. Theodoric the Great, however, who considered himself a lieutenant of the Byzantine emperor, was not averse to learning, and even the Lombard kings, who belonged to a truly barbaric stock, seem to have been compelled by the force of local habits to countenance the existence of lay and ecclesiastical schools. The persistence of lay schools throughout the middle ages is an Italian characteristic. Ecclesiastical schools were founded as a matter of routine; when the Benedictine institutions underwent a period of decadence, Irish monks settled in Italy and helped in reviving religious zeal and interest in learning.

If the original output of Italian scholars during the earlier middle ages was comparatively small, there were nevertheless men of outstanding merit practically in every century. Peter of Pisa was at Charlemagne's court together with Paul the Deacon who hailed from Monte Cassino; Gunzo of Novara migrated to the court of

the Saxon emperors; later Lanfranc of Pavia and Anselm of Aosta rose to important positions in France and in England. No doubt the persistence of the classical tradition among the native population was rendered possible by the relatively small number of barbaric settlers and helped by the sight of countless monuments of Roman greatness; this same persistence greatly hindered the re-elaboration of classical tradition and barbaric legends which gave rise in France to a new literature. Italians were late in the field and they preferred to import French works dealing with the Romans (*Faits* des *Romains*), Alexander the Great (Roman *d'Alixandre*) and Trojan legends (Roman de Troie). Likewise the Italians, whose vernacular dialects must have taken shape very early (there are records of passages in the vulgar tongue as early as the 9th century at Verona and in the south), were slow to realize that Latin, the language they were taught at school (*grammatica*), was no longer their real language; they were shy to break away from tradition: Gunzo of Novara (10th century) justified a grammatical slip he had made in a Latin speech by his habit of speaking the Italian vernacular which was similar to Latin, and yet until the 13th century no Italian dialect seems to have been used in writing, with the exception of some verses in a poem by the Provencal Raimon de Vaqueiras, an inscription at Ferrara and the song of a Tuscan jongleur (*Salva* lo vescovo senato).

The Fashion of French and **Provençal.**—By the end of the 12th and the beginning of the 13th centuries Latin had become unsuitable for the expression of everyday feelings; at the same time the courtly society of feudal castles, as well as the people loitering in the squares, wished for some kind of literary entertainment. In many a castle of northern and central Italy Provencal troubadours were welcome guests; their poems were transcribed in manuscripts which are still extant, and there were many Italians who wrote Provencal poems, such as the Marchese Alberto Malaspina (12th century), Maestro Ferrari of Ferrara, Cigala of Genoa, Zorzi of Venice, Sordello of Mantua, Buvalelli of Bologna, Nicoletto of Turin and others. The same courtly circles that appreciated Provençal lyrics greedily read Arthurian romances, at first in French and later in Italian translations. Carolingian poems, instead, found favour with the less educated people for whose benefit they were recited in the thoroughfares first by French jongleurs, who must have endeavoured to make themselves more easily understood by italianizing their pronunciation, later by Italian imitators. As a result there came into being several works written by Italians in imperfect French during the 13th century. Such were the "chansons de geste," Macaire, the *Entrée* en Espagne written by Nicola of Verona, the Prise de *Pampelune* and some others. Many such works have been lost, among them those which were later rendered into Tuscan *cantari* dealing with epic subjects, but a good number are still extant in prose as well as in verse, such as Le *Régime* du corps by Aldobrandino of Florence or Siena, a chronicle of Venice written in 1267 by Martino da Canale, a treatise on falconry translated by Daniele of Cremona (1251), the travels of Marco Polo written down, possibly from dictation, by Rustichello of Pisa (1298), who had previously lived at the court of Edward I of England and composed many Arthurian romances; the encyclopaedic work Lis Livres dou tresor of Brunetto Latini (just after 1260). Several authors—Canale, Ennachet, Latini (who wrote in France)—were at pains to state that they were using the French language because it was more pleasant than others and more widely understood. But so artificial an attempt must soon have proved a failure, for while it was in progress, there had begun an active effort at translating from Latin and French into the Italian vernaculars and also at writing original works in Tuscan and other Italian dialects.

It was in the course of the 13th century, and especially from 1250 onward, that the new literature largely unfolded and developed itself. This development was simultaneous in the whole peninsula, only there was a difference in the subject matter. In the north, the poems of Giacomino of Verona and Bonvesin of Riva were specially didactic and religious and were intended to be recited to the people. Uguccione of Lodi, Bonvesin, Giacomino, Girardo Patecchio and the others no doubt wrote in their local dialects, occasionally adopting words and forms from other dialects with the intention of thus attaining a higher literary standard, and their genuine forms may at times have been further modified by enterprising copyists who spoke different if neighbouring vernaculars. Some of these religious works may possibly have been connected with the heretical movements in Lombardy at the period.

The Sicilian School.—In the south of Italy French lyrics of the langue *d'oïl* and, even more, of the langue *d'oc* enjoyed favour in courtly circles. One of the most ancient poems of the Sicilian school, a name by which the poets of the court of Frederick II are indicated whether they hail from Sicily or not, is ascribed to John of Brienne, king of Jerusalem; and the emperor Frederick, perhaps himself a poet, certainly encouraged his friends to cultivate the vernacular muse. Modern critics have pointed out French influences in many of these lyrics, and it may be that the famous and much discussed *contrasto* of Cielo Dalcamo, a poet who had probably studied at Salerno, was an attempt at imitating local and French popular or pseudopopular poems. Despite some vigour, zest and coarseness the *contrasto* cannot rank with real popular poetry. The Provençals, however, had provided models which, being the product of social refinement in a feudal environment, must have proved more congenial to Frederick and his courtiers; and the lyrics of the Troubadours were often imitated by Pier della Vigna, Enzo (Frederick's son), Jacopo Mostacci, Jacopo da Lentino (probably the inventor of the sonnet) and the others; among them Giacomino Pugliese and Rinaldo of Aquino occasionally gave signs of genuine feeling. As has been noted, several of the poets of the Sicilian school were not Sicilians, but hailed from southern Italy, as Pier della Vigna and Rinaldo, from Tuscany, as Arrigo Testa, or from Genoa, as Percivalle Doria. Moreover Frederick and his courtiers were ever moving up and down Italy as the political situation required; and all of them endeavoured, when writing, to ennoble the language they used by discarding purely local forms and thus unconsciously worked toward a standard literary language. Later scribes may have emphasized such a tendency by altering Sicilian to Tuscan forms. Followers of the Provençals have been traced in Naples and Rome; and farther north, in central Italy, there were other forces at work besides the influence of the Troubadours.

Religious Poetry of the 13th Century.—The religious revival of the 13th century is connected in central Italy with St. Francis of Assisi (1182–1226). Around him a legend has grown up and from some parts of it we seem to be able to infer that its hero had a strong feeling for nature and a most warm and responsive heart. There is clear evidence of such gifts in his famous Cantico del sole, which despite rhythmical irregularities is considered the finest religious hymn of early Italian literature. The Franciscan movement inspired the composition of many religious lyrics; and when after the saint's death the order was split by dissensions, one of the upholders of strict adherence to the original rule, Jacopone da Todi (d. 1306), wrote poems of outstanding merit. He was a lawyer and had probably tried his hand at poetry before his conversion. A vehement passion must have stirred his heart and maintained a despotic hold over him, the passion of divine love. Under its influence he wished upon himself the severest sufferings and gave vent to his religious intoxication in his poems. There is no indication of deliberate artistic effort in his poems: there is only feeling, a feeling that absorbed him, fascinated him, penetrated him through and through. He was put in prison and chained, but his spirit lifted itself up to God, and that was enough for him. The same feeling that prompted him to pour out in song ecstasies of divine love and to despise himself moved him to reprove those who forsook the heavenly road, whether they were popes, prelates or monks.

To the religious movement in Umbria is also traceable the origin of religious drama. In 1258 an old hermit, Raniero Fasani, leaving the cavern in which he had lived for many years, suddenly appeared at Perugia. Those were difficult times in Italy. The breaking up of the feudal system, the incidence of economic forces connected with the rise of manufacturing industries, the struggles between popes and emperors kept the people in constant agitation and spread abroad paralyzing fears. Fasani represented him-

self as sent by God to disclose mysterious visions and to announce terrible visitations to the world. Under the influence of fear there were formed *compagnie di disciplinanti,* who, for a penance, scourged themselves till they drew blood, and sang *laudi* in dialogue in their confraternities. These *laudi,* closely connected with liturgy, were among the first examples in Italy of drama in the vulgar tongue. Their development, however, was rapid. As early as the end of the same (13th) century came the *Devozioni del Giovedi e Venerdi Santo,* which have some dramatic elements in them, though they are still connected with the liturgical office. There is also the representation *di un monaco che andò al servizio di Dio* ("of a monk who entered the service of God"), in which there is already an approach to the definite form which this kind of literary work assumed in the following centuries.

THE TUSCAN DIALECT

Tuscan Poetry. — In the 13th century Tuscany was peculiarly circumstanced both as regards its literary condition and its political life. The Tuscans spoke a dialect which most closely resembled the mother tongue, Latin — one which afterward became the language of literature almost to the exclusion of all others and which was already regarded at the end of the 13th century as surpassing the others: "Lingua Tusca magis apta est ad literam sive literaturam," writes Antonio da Tempo of Padua, born about 1275. Among the other cities Florence, thanks to geographical and economic causes, acquired a pre-eminent position. From 1266, when the Hohenstaufens were defeated at Benevento, the city was in a position to begin that movement of political reform which in 1282 resulted in the appointment of the *priori delle arti.* This was afterward copied by Siena, by Lucca, by Pistoia and by other Guelph cities in Tuscany. Economic prosperity found expression in the erection of churches and town halls and in their artistic decoration. It was no wonder that literature also rose to unlooked-for perfection. In Tuscany, too, there was some popular love poetry; there were imitators of the Troubadours and the Sicilians. such as Guittone del Viva of Arezzo and Dante of Majano; but literary originality took another line — that of humorous and satirical poetry. Folgore da San Gimignano is humorous when in his sonnets he tells a party of Sienese youths the occupations of every month in the year, or when he teaches a party of Florentine lads the pleasures of every day in the week; and likewise Cene della Chitarra when he parodies Folgore's sonnets. The sonnets of Rustico di Filippo are half fun and half satire; laughing and crying, joking and satire, are all to be found in Cecco Angiolieri of Siena. But another kind of poetry also began in Tuscany. Guittone d'Arezzo, besides imitating the love songs of the Provençals, attempted political poetry, and thus struck an original note. A more fruitful development occurred at Bologna, the seat of an already famous university. The poets of Provence had paid the same kind of homage to their ladies that the noblemen owed to their feudal overlords; at Bologna, where the new tendencies of the scholastic philosophy were much discussed, a poet was born, Guido Guinicelli di Magnano (1230?–75?), who followed at first the lead of Guittone but soon struck out on an original path, ascribing to his lady the power of calling into activity all the good qualities which a-ere dormant in him; as he was gifted with an extraordinary power of dramatic imagination and real feeling, he succeeded despite some philosophical subtleties in composing lyrics of striking beauty which brought about a revolution in Italian poetry and strongly influenced Cavalcanti and Dante.

But before Dante is discussed, certain other facts, not, however, unconnected with his formation, must be noticed. Didactic poetry, which was direct in northern Italy, adopted the device of allegory in Tuscany. Thus Brunetto Latini, whom Dante looked upon with filial affection, wrote the *Tesoretto,* in which the author professes to be lost in a wilderness and to meet with a lady, who is Nature, from whom he receives much instruction. Francesco da Barberino, a learned lawyer, wrote two little allegorical poems — the *Documenti d' amore* and *Del reggimento e costume di donna. A* fourth allegorical work was the *Intelligenza,* attributed to Dino Compagni.

Prose in the 13th Century. — While the production of Italian poetry in the 13th century was abundant and varied, that of prose was scanty, The oldest specimen dates from 1211 and consists of short notices of entries and expenses by Florentine bankers from Siena. In 1253 and 1260 there are some commercial letters. The original compositions in the *langue d'oil* were followed by translations or adaptations from the same. There are translations and adaptations from French originals: some moral narratives takes from religious legends; a romance of Julius Caesar; some short histories of ancient knights; the *Tavola rotortda;* translations of the *Milione* of Marco Polo and of the *Tesoro* of Latini. At the same time there appeared translations from Latin of moral and ascetic works, of histories and of treatises on rhetoric and oratory, several of which were the work of Bono Giamboni. Among the oldest prose writing is a scientific book — the *Composizione del mondo* by Ristoro d'Arezzo, who lived about the middle of the 13th century. This work is a copious treatise on astronomy and geography. Ristoro seems to have been a careful observer of natural phenomena, and consequently many of the things that he relates were the result of personal investigations. There is also another short treatise, *De regimine rectoris,* by Fra Paolino, a Minorite friar of Venice, who was probably bishop of Pozzuoli and who also wrote a Latin chronicle.

The 13th century was very rich in tales. There is a collection called the *Cento novelle antiche* (or *Novellino),* which contains stories drawn from oriental, Greek and Trojan traditions, from ancient and mediaeval history, from the legends of Brittany, Provence and Italy and from the Bible: from the local tradition of Italy as well as from bestiaries and ancient mythology. There were other prose tales inserted by Francesco da Barberino in his work *Del reggimento e costume di donna,* but they are of much less importance than the others. Some attention should be paid to the *Lettere* of Fra Guittone d'Arezzo, the subjects of which are moral, religious and political. During the later middle ages it had become the fashion to ornament Latin orations and letters with all sorts of rhetorical devices, among them rhythmic *clausulae* (*cursus);* and such a practice. which was enforced by a number of rhetorical treatises *(artes dictandi),* Guittone followed when writing Italian, with results that are often extravagant.

The **"Dolce Stil Nuovo."**—Lyric poetry rapidly reached a high standard of perfection in Tuscany at the end of the 13th century. It followed to some extent Guittone's and much more Guinicelli's models, but its achievements were principally due to Cavalcanti. Guido Orlandi, Lapo Gianni, Dino Frescobaldi, Dante. Cino da Pistoia and a few others must all be grouped around Cavalcanti. They were named by Dante "poets of the *dolce stil nuovo.*" The secret of their success was a fresh and sincere inspiration; as Dante expresses it—

> Quando
> Amore spira, noto, ed a quel modo
> Ch' ei detta dentro, vo significando—

that is to say, that these poets express their feelings as love inspires them, in an appropriate and graceful manner, fitting form to matter, and by art fusing one with the other. In Lapo Gianni the new style is not free from some admixture of the old associations of the Siculo-Provencal school. Sometimes, however, he draws freely from his own heart, and then the subtleties and obscurities disappear, and his verse becomes clear, flowing and elegant.

Guido Cavalcanti (*c.* 1250–1300) was a learned man with a high conception of his art. He felt the value of it and adapted his learning to it. His poems may be divided into two classes — those which portray the philosopher and those which are more directly the product of his poetic nature imbued with mysticism and metaphysics. To the first set belongs the famous poem *Donna mi prega,* which in fact is a treatise on the nature of love and was annotated later in a learned way by Marsilio Ficino and others. But there are many of his poems, the *ballate* particularly, in which the truth of the images and the elegance and simplicity of style are admirable and make us feel that we are in quite a new period of art.

Among the followers of the new school was also Cino da Pistoia (1270–1336) of the family of Sigisbuldi. His love poems are so

sweet, so mellow and so musical that they are only surpassed by Dante's. The pains of love are described by him with vigorous touches. It is easy to see that they are not feigned but real. The psychology of love and of sorrow nearly reaches perfection.

DANTE, PETRARCH AND BOCCACCIO

Dante (1265–1321).—As the author of the *Vita nuova,* the greatest of all Italian poets, Dante Alighieri, also belongs to the same lyric school and partly shares Guinicelli's and Cavalcanti's conception of love. In the lyrics of the *Vita nuova* there is a high idealization of love. untouched by anything earthly or human, and the poet seems to have had his eyes constantly fixed on heaven while singing of his lady. Several of the lyrics *(rime)* not included in the *Vita nuova* or the *Convivio* deal, too, with the theme of the "new life"; while other pieces are philosophical and bridge over to the *Convivio (c.* 1307), an unfinished philosophic treatise in which are to be read some of the finest passages of early Italian prose. Dante expressed original views about the literary language of Italy in another unfinished work in Latin *(De vulgari eloquentia, c.* 1305); just as later, probably in 1313, he expounded his political system in the Latin *Monarchia* and in some letters. Toward the end of his life he composed a short treatise *De aqua et terra* and two Latin eclogues of great interest. But the work which made him immortal is of course the *Divina Commedia,* probably written between 1307 and 1321. In 100 cantos Dante describes a vision, during which he visited Hell, Purgatory and Paradise under the guidance of Virgil (symbolizing human reason) and later of Beatrice (human reason illumined by revelation). Many incidents in this pilgrimage, as well as the pilgrimage itself, have an allegorical meaning, and Dante succeeded in expressing his opinion upon the political and social realities of his age and upon all the subjects that principally interested him in the course of an anticipated Last Judgment to which he dared to summon men of past ages and his own time. It was so clear to him that he had a mission to fulfill and a message to deliver that he felt inspired to greater effort by the very daring of his undertaking. And though as a pilgrim through the afterworld he described himself as having risen from human to celestial heights, as a poet he kept faith to the same moral and political ideals for which he had fought and suffered. Even those readers who may be unequal to the effort of making out the grand lines of his majestic structure cannot fail to see and to remember the ineffable charm of some particular passages tender or ghastly, stern or moving.

Dante is often said to have summed up the middle ages for the men who came after him; it should not be overlooked, however, that there is much in his work that seems to herald the age that was to follow. He claimed to have learned his literary style from the classics and from Virgil in particular; and if his was not yet a scholarly return to the classics, the angle from which he looked upon them was no longer completely mediaeval.

Petrarch (1304–1374).—The next step was to be taken by Petrarch (*q.v.*), and it will be easier to grasp its significance if one bears in mind that his principal aim was a rebellion against the philosophy of the schoolmen and against the deductive method in science and philosophy by which every truth could only be derived from what Aristotle and his commentators had said. This rebellion he fostered by holding up Plato, whose works and ideas were only indirectly known to him, in opposition to Aristotle and by summoning to his aid the results of his own introspection. The data of introspection he sought to compare with the records which great writers of antiquity had set down of their own experiences. It was necessary, then, to know exactly what the ancients had written and therefore to discover and to collate as many of the manuscripts of their works as were still traceable. Scholarship and antiquarianism were means to an end and not ends in themselves for Petrarch. He was the first humanist and at the same time the first lyric poet of the modern school. His career was long and eventful. He lived for many years at Avignon, cursing the corruption of the papal court; he travelled through nearly the whole of Europe; he corresponded with emperors and popes; he was considered the first man of letters of his time; he had honours and moderate riches; and he always experienced restlessness, melancholy and incapacity for satisfaction—three characteristics of the modern man. He loved Laura, whoever the lady was, and Laura may have for a time countenanced his courtship but ever remained out of his reach. His life was passed in pining for her, admiring her beauty, sorrowing for her coldness and sometimes rebelling against love; for love of woman and desire for worldly fame hindered, in his view, the spiritual freedom of man and his striving toward Christian perfection. These perpetual alternations of his moods he embroidered upon with faultless technique, whether or not he happened to be prompted by feeling, throughout the *Rime sparse,* as he seems to have called his Italian lyrics when, long after Laura's death (1348), he revised and collected them, including also a few political and occasional poems. A clearer but far less successful expression of his views is to be found in the vision that he called **I** *Trionfi,* clearly imitated from Dante's *Commedia;* but no one can hope to penetrate the world of Petrarch's thought who has not read his *Secretum,* a dialogue between St. Augustine and himself, the treatise *De vita solitaria,* the great body of his Latin epistles, and last but not least his epic poem in Latin, *Africa,* by which he sometimes expected to be remembered by posterity.

Boccaccio **(1313–1375).**—Giovanni Boccaccio had the same enthusiastic love of antiquity and the same worship for the new Italian literature as Petrarch. He supervised the work of Leonzio Pilato (Leon Pilatus), a Greek born in Calabria, who put together a Latin translation of the *Iliad* and the *Odyssey.* Boccaccio's vast classical learning was shown specially in the work *De genealogiis deorum,* in which he enumerates the gods according to genealogical trees constructed on the authority of the many who wrote about the pagan divinities. Boccaccio was also the first historian of women in his *De claris mulieribus* and the first to tell of the vicissitudes of famous men in his *De casibus virorum illustrium.* He continued and perfected former geographical investigations in his interesting book *De montibus, silvis, fontibus, lacubus, fluminibus, stagnis, et paludibus, et de nominibus maris,* for which he made use of Vibius Sequester, but which contained also many new and valuable observations. Of his Italian works his lyrics do not approach the perfection of Petrarch's. His narrative poetry is better. He was the first to use *ottava rima* in a work of some length and written with artistic skill, such as is his *Teseida,* the oldest Italian romantic poem. The *Filostrato* relates the loves of Troiolo and Griseida (Troilus and Cressida). The *Ninfale fiesolano* tells the love story of the nymph Mesola and the shepherd Affrico. The *Amorosa Visione,* a poem in *terza rima,* doubtless owed its origin to the *Divina Commedia.* The *Ameto* is a mixture of prose and poetry and is the first Italian pastoral romance.

The *Filocolo* takes the earliest place among prose romances. In it Boccaccio tells in a laborious style, and in the most prolix way, the loves of Florio and Biancofiore. The *Fiammetta* is another romance, taking its pattern from the loves of Boccaccio and Maria d'Aquino, a supposed natural daughter of King Robert, whom he always called by this name of Fiammetta.

The Italian work which principally made Boccaccio famous was the *Decameron,* a collection of 100 short stories, related by a party of men and women, who had retired to a villa near Florence to escape from the plague in 1348. The short story, so abundant in the preceding centuries, especially in France, now for the first time assumed an artistic shape. The crudeness of the old *fabliaux* gives place to the careful and conscientious work of a mind that has a feeling for what is beautiful, that has studied the classic authors and that strives to imitate them as much as possible. Over and above this, in the *Decameron* Boccaccio is a master in character-sketching and an observer of passions. In this lies his novelty. Much has been written about the sources of the short stories of the *Decameron.* Probably Boccaccio made use both of written and of oral sources.

Unlike Petrarch. Boccaccio felt for Dante something more than love—enthusiasm. He wrote a biography of Dante, of nhich the accuracy has been not altogether successfully challenged in the past, and he gave public lectures on his poem in the church of Santo Stefano di Badia at Florence.

Imitators.—Dante and Boccaccio were not without their imi-

tators. Fazio degli Uberti and Federigo Frezzi imitated the *Divina Commedia,* but only in its external form. The former wrote the *Dittamondo,* a long poem, in which the author supposes that, being taken by the geographer Solinus into different parts of the world, he was told the history of them by his guide. Frezzi, bishop of his native town, Foligno, wrote the *Quadriregio,* a poem of the four kingdoms — Love, Satan, the Vices and the Virtues. The poet has Pallas for a companion.

Ser Giovanni Fiorentino wrote, under the title of *Pecorone,* a collection of tales, which are supposed to have been related by a monk and a nun in the parlour of the monastery of Forli. He closely imitated Boccaccio and drew on Villani's chronicle for his historical tales. Franco Sacchetti also wrote short stories for the most part on subjects taken from Florentine history. His book gives a convincing picture of Florentine society at the end of the 14th century. A third writer of short stories was Giovanni Sercambi of Lucca, who after 1374 wrote a book, in imitation of Boccaccio, about a party of people who were supposed to fly from a plague an3 to go travelling about in different Italian cities, stopping here and there telling stories. A later, but important, name is that of Masuccio Salernitano (Tommaso Guardati), who wrote the *Novellino.*

OTHER 14TH-CENTURY WRITERS

Chroniclers and Ascetic Writers. — At the end of the 13th century we find a chronicle by Dino Compagni. A merchant, he was democratic in feeling and was a supporter of the new ordinances of Giano della Bella. As prior and gonfalonier of justice he always had the public welfare at heart. He belonged to the party of the Bianchi and opposed the claims which Boniface VIII made on Florence. In spite of its title, his *Cronica* is a monographical account of the political crisis in Florence (1300–01), together with its prelude and its aftermath (1280–1312). The narrative is constantly personal. It often rises to the finest dramatic style. It is one of the most important sources for that period of Florentine history, notwithstanding several factual mistakes which are to be found in it. On the contrary, Giovanni Villani, born *c.* 1276, was more of a chronicler than a historian. He relates the events up to 1347. The journeys that he made in Italy and France and the information thus acquired account for the fact that his chronicle, called by him *Istorie fiorentine,* comprises events that occurred all over Europe. What specially distinguishes the work of Villani is that he speaks at length, not only of events in politics and war, but also of the stipends of public officials, of the sums of money used for paying soldiers and for public festivals and of many other things of which the knowledge is very valuable. Matteo, the brother of Giovanni Villani, continued the chronicle up to 1363. It was again continued by Filippo Villani. Gino Capponi, author of the *Commentari dell' acquisto di Pisa* and of the narration of the *Tumulto dei Ciompi,* belonged to both the 14th and the 15th centuries.

Neither Petrarch nor Dante could be classified among the pure ascetics of their time. But many other writers come under this heading. St. Catherine of Siena's mysticism was political. She was a really extraordinary woman, who aspired to bring back the Church of Rome to evangelical virtue and who has left a collection of letters written in a high and lofty tone to all kinds of people, including popes. She joins hands on the one side with Jacopone of Todi, on the other with Savonarola. Hers is the strongest, clearest, most exalted religious utterance that made itself heard in Italy in the 14th century.

Another Sienese, Giovanni Colombini. founder of the order of the Gesuati, preached poverty by precept and example, going back to the religious idea of St. Francis of Assisi. His letters are among the most remarkable in the category of ascetic works in the 14th century. Jacopo Passavanti, in his *Specchio della vera penitenza,* combined instruction with narrative. Domenico Cavalca translated from Latin the *Vite dei santi padri.*

Poetry in the 14th Century. — In direct antithesis to this is a kind of literature which has a strong popular element. Humorous poetry, the poetry of laughter and jest, which as we saw was largely developed in the 13th century, was carried on in the 14th by Bindo Bonichi, Arrigo di Castruccio, Cecco Nuccoli, Andrea Orgagna, Filippo de' Bardi, Adriano de' Rossi, Antonio Pucci and other lesser writers. Antonio Pucci was superior to all of them for the variety of his production. He put into *terza rima* the chronicle of Giovanni Villani (*Centiloquio*) and wrote many historical poems called *serventesi,* many comic poems and not a few epico-popular compositions on various subjects. A little poem of his in seven cantos treats of the war between the Florentines and the Pisans from 1362 to 1365.

Many poets of the 14th century left political works. Fazio deqli Uberti, the author of *Dittamondo,* wrote also a *serventese* to the lords and people of Italy, a poem on Rome, a fierce invective against the emperor Charles IV; and Francesco di Vannozzo, Frate Stoppa and Matteo Frescobaldi deserve mention. From this period also dates that literary phenomenon known under the name of Petrarchism. Petrarchists were already singing of love in Petrarch's manner, but others treated the same subject with more originality, in a manner that might be called semipopular. Such were the *ballate* of Ser Giovanni Fiorentino, of Franco Sacchetti, of Niccolò Soldanieri, of Guido and Bindo Donati.

There cannot have been an entire absence of dramatic literature in Italy in the 14th century, but traces of it are scarce, although we find them again in great abundance in the 15th century. One drama of the 14th century mas, however, unique: the *Ecerinis* written by Albertino Mussato of Padua in 1315. Mussato, a political man and the historian of Henry VII, aimed at strengthening the antagonism against Cangrande della Scala by describing in a Senecan style the evils of the tyrannical government of Ezzelino da Romano.

The revival of learning which Petrarch had fostered as a means to a philosophical, moral and political revolution so fascinated many of his admirers that it became for them an end in itself. Petrarch had affected to look upon his works in Italian as trifles (he called them *nugellae vulgares*): the scholars who took over the literary leadership after him, Coluccio Salutati and partly Luigi Marsili, still admired Dante. Petrarch and Boccaccio's Italian works but always wrote in Latin themselves, and for many decades Latin triumphantly rivalled Italian.

THE RENAISSANCE

In the 15th century a great number of scholars industriously and indefatigably carried on the rediscovery of antiquity. Such were Niccolb Niccoli, Giannozzo Manetti, Palla Strozzi, Leonardo Bruni (Leonardo Aretino), Francesco Filelfo, Poggio Bracciolini, Lorenzo Valla. Manetti spent his time translating from Greek, studying Hebrew and commenting on Aristotle. Palla Strozzi sent into Greece at his own expense to search for ancient books and had the works of Plutarch and Plato bought for him. Poggio Bracciolini went to the Council of Constance and found Cicero's orations buried in a monastery. He copied Quintilian with his own hand, discovered Lucretius, Plautus, Pliny and many other Latin authors. Guarino da Verona went through the east in search of codices. Giovanni Aurispa returned to Venice with many hundreds of manuscripts. These Italians were but handing on the solemn tradition which, although partly latent, was the informing principle of Italian mediaeval history and now at length came out triumphant. This tradition was that same tenacious and sacred memory of Rome. that same worship of its language and institutions, which at one time had retarded the development of Italian literature and now grafted the old Latin branch of ancient classicism on the flourishing stock of Italian life. Men came to have a more just idea of nature: the world was no longer cursed or despised; man was born again; and human reason resumed its rights. Both the individual and society were changed under the influence of new facts.

Characteristics and Development. — First of all there was formed a human individuality, which was wanting in the middle ages. As J. Burckhardt remarked, man became an individual. He began to feel and assert his own personality, which was constantly attaining a fuller realization. As a consequence of this, the idea of fame and the desire for it arose. The mediaeval principle of conduct was turned upside down: men who had hitherto turned

their thoughts exclusively to heavenly things and believed exclusively in the divine right now began to think of beautifying their earthly existence. of making it happy and gay, and returned to a belief in their human rights. This was a great advance, but one which carried with it the seeds of many dangers. The conception of morality became gradually weaker. The *fay ce que vouldras* of Rabelais became the first principle of life. Religious feeling was blunted. Besides this, a great literary danger was hanging over Italy: humanism threatened to submerge the youthful national literature. There were authors who laboured hard to give Latin forms to Italian. Provincial dialects tried to reassert themselves in literature. The great authors of the 14th century were forgotten or despised by many people of the cultured class. In spite of its glorious beginnings, the light went out from Italian literature for almost a century after the death of Boccaccio.

It was Florence that saved literature by reconciling the classical models to modern feeling. At Florence celebrated humanists wrote also in the vulgar tongue and commented on Dante and Petrarch and defended them from their enemies. Leon Battista Alberti. the learned Greek and Latin scholar, wrote in the vernacular; Vespasiano da Bisticci, uhilst constantly absorbed in Greek and Latin manuscripts. produced the *Vite d' uomini illustri,* rivalling the best works of the 14th century in their candour and simplicity; and Andrea da Barberino wrote the beautiful prose of the *Reali di Francia.*

The **Academies.**—As a consequence of the intellectual movement toward the Renaissance, there arose in Italy in the 15th century three academies, those of Florence, of Naples and of Rome. The Florentine academy was iounded by Cosimo I de' Medici. Having heard the praises of Platonic philosophy sung by Gemistus Pletho, who in 1439 was at the council of Florence, he took such a liking for those opinions that he soon made a plan for a literary congress which was specially to discuss them. Marsilio Ficino described the occupations and the entertainments of these academicians: there, he said. the young men learned, by way of pastime, precepts of conduct and the practice of eloquence; there grown men studied the government of the republic and the family; there the aged consoled themselves with the belief in a future world. Such men as Pico della Mirandola, Politian *(see* below) and Alherti were among the members of the academy, besides the Medici. The Roman academy was founded by Giulio Pomponio Leto, with the object of promoting the discovery and the investigation of ancient monuments and books. It was a sort of religion of classicism, mixed with learning and philosophy. Platina (Bartolomeo Sacchi), the celebrated author of the lives of the first hundred popes, belonged to it. At Naples, the academy known as the Pontaniana was instituted. The founder of it was Antonio Beccadelli, surnamed Il Panormita, and after his death he was succeeded by Giovanni Pontano (Jovianus Pontanus) who gave his name to it and became its moving spirit.

Lorenzo de' Medici and **Politian.**—It was with Lorenzo de' Medici (1449–92) that the Florentine influence on the Renaissance gathered momentum. Lorenzo's mind was moulded by classical education: he attended the lectures of the Greek Argyropulos, befriended many Platonists, took pains to collect codices, sculptures, vases, pictures, gems and drawings to ornament the gardens of San Marco and to form the library later named after him. In the halls of his Florentine palace, in his villas at Careggi, Fiesole and Poggio a Caiano, stood wonderful works of art by Antonio Pollaiuolo. Sandro Botticelli. Filippino Lippi and Andrea del Verrocchio. And yet if we read Lorenzo's poems we only see the man of his time, the admirer of Dante and of the old Tuscan poets, who took inspiration from the popular muse and who endowed his poetry with the colours of the most pronounced realism as well as of the loftiest idealism. who passed from the Platonic sonnet to the impassioned triplets of the *Amori di Venere,* from the grandiosity of the *Selve* to *Nencia (see* below, *Pastoral Poetry)* and to *I Beoni,* from the *Canto carnascialesco* to the *Lauda.*

Next to Lorenzo comes Politian (Angelo Ambrogini, 1454–94), who also united, and with greater art. the ancient and the modern, the popular and classical styles. In his *Rispetti* and in his *Ballate* the freshness of imagery and the plasticity of form are inimitable. A great Greek scholar, a forerunner of scientific methods in textual criticism, he wrote Italian verses with polished simplicity and refinement; the purest elegance of the Greek sources pervaded his art in all its varieties, in the idyllic play of *Orfeo* as well as in the enchanting poem called *Stanze per la giostra.*

Savonarola's **Reaction.**—Lorenzo in his livelier mood favoured masquerades and festivals, for which he and his friends composed poems such as the *trionfi* and the *canti carnascialeschi.* It was the moral laxity and the heathen ideals expressed in such poems as these that the Dominican Girolamo Savonarola of Ferrara set himself to reform when he arrived in Florence (1489). He directed his attack against Lorenzo the promoter of classical studies, the patron of pagan literature. rather than against Lorenzo the political tyrant. Animated by mystic zeal, he took the line of a prophet, preaching against the reading of voluptuous works and against the tyranny of the Medici and calling for popular government. His attempt to put himself in opposition to his time, to arrest the course of events. to bring the people back to the faith of the past, the belief that all the social evils came from a Medici and a Borgia, his not seeing the historical reality as it was, his aspiring to found a republic with Jesus Christ for its king—all these things show that Savonarola was more of a fanatic than a thinker. Nor has he any great merit as a writer. He wrote Italian sermons, hymns *(laudi),* ascetic and political treatises, but they are roughly executed and important only because they throw light on the history of his ideas. The religious poems of Girolamo Benivieni are better than his and are drawn from the same inspiration. In these lyrics, sometimes sweet, always warm with religious feeling, Benivieni, and with him Feo Belcari, carry us back to the literature of the 14th century.

The Tridentine Reaction. — The fundamental characteristic of the later Renaissance is that it perfected itself in every kind of art, particularly in uniting the essentially Italian quality of its language with classicism of style. This period lasted from about 1494 to about 1560. In the middle of the 16th century, however, two events exercised a considerable influence upon Italian thought and consequently upon literature and art: the Council of Trent and the rediscovery of Aristotle's *Poetics.* The Council of Trent, having failed to find a compromise with the northern Reformers, set itself to restore discipline within the ranks of the Roman Church by a strict enforcement of authority. It was then realized that the assimilation of classical ideas, symbolized by such popes as Nicholas V, Pius II and Leo X, had imperilled the very existence of the church by its consequent laxity of morals. The Society of Jesus and the *Index librorum prohibitorum* mere the more conspicuous organs by which a deadening discipline was brought to bear on the men of the later Renaissance. At the same time the *Poetzcs* were rediscovered and commented on, and the principle of authority that prevailed in politics and religion was thus introduced in literature as well: only such literary forms were considered legitimate, as could be supposed to have Aristotle's support.

Heroic Poetry. — Italy never had any true epic poetry in its period of literary birth. Still less could it have any in the Renaissance. It had, however, many *cantari,* poems so called because they contained stories that were sung to the people dealing with the heroes of Charlemagne and King Arthur. But the first to introduce elegance and a new life into this style was Luigi Pulci (1432–84) who grew up in the house of the Medici and who wrote the *Morgante Maggiore* at the request of Lucrezia Tornabuoni, mother of Lorenzo the Magnificent. The material of the *Morgante* is almost completely taken from an obscure chivalrous poem of the 15th century (later rediscovered by Pio Rajna). On this foundation Pulci erected a structure of his own, often turning the subject into ridicule, burlesquing the characters, introducing many digressions, now capricious, now scientific, now theological. With a more serious intention Matteo Maria Boiardo (1434–94), count of Scandiano, wrote his *Orlando innamorato,* in which he seems to have aspired to embrace the whole range of Carolingian legends; but he did not complete his task. Here, too, we find a large vein of humour and burlesque. Yet Boiardo is drawn to the world of romance by a profound sympathy for chivalrous manners and feelings—that is to say, for love, courtesy, valour and

generosity. A third romantic poem of the 15th century was the *Mambriano* by a certain Francesco called Il Cieco da Ferrara. He showed the influence of Boiardo, especially in something of the fantastic which he introduced into his work.

It was Boiardo's success that encouraged Lodovico Ariosto (1474–1533) to write his *Orlando furioso*. The world of chivalry interested him mainly as a canvas on which to embroider his beautiful patterns. Under the influence of classicism he rendered the structure of his poem more compact and harmonious; and if his characters lack some of the vigour with which Boiardo had endowed them, they are given a perfection of poise and of artistic delineation such as only a master craftsman could create. He worked for many years with unflagging enthusiasm at the revision of his poem, being fully aware that no poet could ever treat the octave stanza with the same easy grace and dazzling perfection.

Meanwhile there was an attempt at the historical epic. Gian Giorgio Trissino of Vicenza composed a poem called *L'Italia liberata dai Goti*, in which he forced himself to observe all the rules of Aristotle; Trissino's work is poor in invention and without any poetical colouring. Luigi Alamanni's *Girone il Cortese* and *Avarchide*, and Bernardo Tasso's *Amadigi* belong to the same period and to the same school of poetry and are not much more successful. We may mention here Annibal Caro's translation of the *Aeneid*.

Torquato Tasso (1544–95), who was perpetually obsessed by religious scruples and critical uncertainties, well exemplifies the post-Tridentine period. He was only 18 years old when, in 1562, he tried to reconcile the Aristotelian rules with the variety of Ariosto in an epic poem, *Rinaldo*. He later wrote the *Aminta*, a pastoral drama of exquisite grace. But the work to which he had long turned his thoughts was a heroic poem, and that absorbed all his powers. He himself explained what his intkntion was in the three *Discorsi*. written while he was composing the *Gerusalemme:* he intended to choose a great and wonderful subject. not so ancient as to have lost all interest, nor so recent as to prevent the poet from embellishing it with invented circumstances; he meant to treat it rigorously according to the rules of the unity of action observed in Greek and Latin poems, but with a far greater variety and splendour of episodes, so that in this point it should not fall short of the romantic poem; and finally, he decided to write it in a lofty and ornate style. This is what Tasso did in the *Gerusalemme liberata*, the subject of which is the liberation of the sepulchre of Jesus Christ in the 11th century by Godfrey of Bouillon. Tasso possessed an unparalleled gift for melodious verse; he lacked power, and in order to bring in the element of surprise so persistently advocated by the commentators of the *Poetics*, he occasionally had recourse to tiresome antitheses and exaggerated metaphors.

Drama.—As the work of Matteo Boiardo originated from the popular *cantari*, the *sacra rappresentazione* developed from the mediaeval *mistero* ("mystery-play"). Although it belonged to popular poetry, some of its authors were celebrated men of letters. It is enough to notice Lorenzo de' Medici, who wrote *San Giovanni e Paolo*, and Feo Belcari. From the 15th century, some comic and profane elements found their may into the *sacra rappresentazione*. Politian emancipated himself from its biblical conventions in his *Orfeo*, which, although in its exterior form belonging to the sacred representations, yet substantially detaches itself from them in its contents and in the artistic element introduced.

The first to occupy the tragic stage during the 16th century was Giangiorgio Trissino with his *Sofonisba*, following the rules of the art most scrupulously. The *Oreste* and the *Rosmunda* by Giovanni Rucellai were no better, nor was Luigi Alamanni's *Antigone*. Sperone Speroni in his *Canace* and Giraldi Cintio in his *Orbecche* tried to ensure success by barren innovations of technique. Superior to these was the *Torrzsmondo* by Torquato Tasso.

The Italian comedy of the 16th century was almost entirely modelled on the Latin comedy. Only two writers stand out among the many who wrote comedies—Machiaveli *(see* below) and Ariosto. In his *Mandragola* Machiavelli, unlike all the others, composed a comedy of character, creating types which seem to be alive even now. Ariosto was far less original. The notorious Pietro Aretino might also be included in the list of the best writers of comedy.

Pastoral Poetry.—The eclogues of Virgil, Nemesianus and others had enjoyed great favour during the middle ages, particularly during the so-called Carolingian Renaissance. Dante imitated Virgil when composing his eclogues to Giovanni del Virgilio; Albertino Mussato followed in his steps, so did Petrarch and Boccaccio, who also wrote a pastoral novel, the *Ameto*. This artificial conception of a pastoral world. so far removed from rural and real life, pleased Italians no less than it had pleased other Romance peoples. Winsome and gentle shepherdesses appear in the poems of Guido Cavalcanti, Franco Sacchetti and many other poets in Tuscan and other dialects down to Lorenzo de' Medici. who also attempted a more definitely rural form with his *Nencin da Barberino* (if indeed he was the author of this poem). The *Nencia* was imitated by Luigi Pulci (*Beca da Dicomano)*. Boiardo composed eclogues in Italian. but it was left to Jacopo Sannazaro, the author of some piscatory eclogues in Latin, finally to fix the characteristics of pastoral poetry in his immensely popular *Arcadia* (1504). This partly allegorical story mingles prose with verse, forming. in all sections a mosaic of classical reminiscences and ever tinged with a melancholy charm. With Sannazaro the realm of shepherds and nymphs finally became something akin to the golden age, a dream world men would enjoy when seeking refuge from the realities of an age in which the collapse of political independence, wars and violence caused more suffering than men of letters cared to describe realistically.

For the later period Giovanni Battista Guarini (1538–1612) ought to be recorded as the author of a pastoral drama *(Pastor Fido*, 1590) which vied in fame with Tnrquato Tasso's *Aminta* (1573), both works having a lyrical rather than a dramatic character. Giovanni Andrea dell' Anguillara made a celebrated translation of Ovid's *Metamorphoses*.

Lyrical Poetry.—Originality was almost entirely wanting in lyrical poetry, since it seemed as if little better could be done than to copy Petrarch. Still, even in this style there were some vigorous poets. Giovanni della Casa (1503–56) and Pietro Bembo (1470–1547) nere technically refined. Even Michelangelo Buonarroti was at times a Petrarchist, but his poems at least bear the stamp of his original genius. And a good many ladies are to be mentioned with these poets, such as Vittoria Colonna, Veronica Gambara and Gaspara Stampa.

Humorous Poetry **and** Satire.—The 15th century had not been without humorous poetry; Antonio Cammelli, surnamed Pistoia. is specially deserving of notice. Francesco Berni (who also reshaped and tuscanized Boiardo's *Orlando innamorato*) carried this kind of literature to perfection in the 16th century. From him the style has been called "bernesque" poetry. It was art for art's sake that inspired and moved Berni to write, as well as Grazzini *(see* below) and other lesser writers. Bernesque poetry is the clearest reflection of that religious and moral scepticism which was one of the characteristics of Italian social life in the 16th century and which showed itself more or less in all the works of that period. The Berneschi, and especially Berni himself, sometimes assumed a satirical tone. But theirs could not be called true satire. Pure satirists, on the other hand, were Antonio Vinciguerra, a Venetian, and, in his *Satire*, Luigi Alamanni. Ariosto's *Satire* read as chapters of a humorous autobiography.

Historiography.—The Italian historians of the 15th century mostly wrote in Latin and were often readier to consider "eloquence" of style or the interests of their patrons than truthfulness; notable exceptions were Leonardo Bruni, who made good use of the documents to which he had access in his history of Florence, and Lorenzo Valla of Forlì. who gave evidence of his pugnacious temperament in some historical tracts, among which the one disproving the legend about the Donation of Constantine is the most famous. Pontano wrote the history of Naples in elegant Latin, Bernardino Corio that of Milan in far less admirable Italian.

Machiavelli and Guicciardini were the chief originators of the modern science of history. Niccolb Machiavelli (1469–1527) can also be described as the creator of the experimental science of

politics. His principal works are: *Il Principe;* the *Discorsi sulla prima deca di Tito Livio; Dell' arte della guerra;* and *Le Istorie fiorentine.* The *Prince* and the *Discourses* were written while Machiavelli was in an enforced retirement from active political work. They have in common the purpose of expounding the political theories that Machiavelli had been evolving in the course of his career and while reading ancient historians. In addition, the *Prince* has the immediate aim of inciting a "new prince" to found a strong state embracing the whole of Italy, whereas the *Discourses* devote more attention to the preservation of states and put the accent on the republican form of government. The *Art of War* is a technical treatise advocating the institution of a popular militia. Machiavelli was capable of cold reasoning, while at the same time an idealist; and the unquenchable longing for a strong and united Italy, able to resist foreign aggression, underlay his masterly theorizing. He would not allow his political thought to be influenced by ethical or other nonpolitical considerations. The vividness and directness of his style are fascinating.

Francesco Guicciardini (1483–1540), like Machiavelli a historian, a statesman and a student of politics, was less of an idealist and did not share Machiavelli's enthusiasms. His insight into the nature of man was exceptionally sharp, even if so pessimistic as to be depressing; he preferred to base his political conclusions on careful weighing of the particular circumstances of each situation rather than on general theories (*Ricordi politici e civili*). His *Storia d'Italia,* which extends from the death of Lorenzo de' Medici to 1534, is full of political wisdom and is written in an impressive style.

Throughout the 16th century historians were legion, following the tradition set up by Machiavelli and Guicciardini. The Florentine Jacopo Nardi, Benedetto Varchi and Giovanni Battista Adriani, the continuator of Guicciardini, deserve special mention, together with Bernardo Segni, Pierfrancesco Giambullari, Bernardo Davanzati, Paolo Giovio and Camillo Porzio. Pietro Bembo wrote the history of Venice (continued by Paolo Paruta), Angelo di Costanzo that of Naples. Giorgio Vasari (1511–74) rendered a signal service to art historians with his *Vite,* or biographies of artists, and Benvenuto Cellini (1500–71) wrote an autobiography fascinating for its liveliness and sincerity.

Didactic Works and Miscellaneous Prose.—Leonardo da Vinci wrote a treatise on painting, Leon Battista Alberti one on sculpture and architecture. But these two men are mainly important as embodiments of a characteristic of the age of the Renaissance—versatility of genius, power of application along many and varied lines and excellence in different fields.

In the 16th century there were not a few didactic works, including two in verse, *Le Api* by Giovanni Rucellai and *La Coltivazione* by Luigi Alamanni. A much more important book, however, is the *Cortegiano* of Baldesar Castiglione (1478–1529), in which the author imagines a discussion between knights and ladies in the palace of the dukes of Urbino as to what are the gifts required in a perfect courtier, giving a valuable illustration of the intellectual and moral state of the highest Italian society in the first half of the 16th century. Wide fame was also achieved by Giovanni della Casa's *Galateo,* a book giving rules of behaviour in polite society, and by Bembo's *Gli Asolani.* Marcello Adriani translated Plutarch's *Lives* and *Moralia.*

The most important of the writers of short stories of the 16th century were Anton Francesco Grazzini (called Il Lasca) and Matteo Bandello: the former, playful and bizarre; the latter, informative from the point of view of social history. Agnolo Firenzuola was another elegant and pleasing writer of short stories; he also translated the *Golden Ass* of Lucius Apuleius. Giovanni Battista Giraldi's tales had a didactic purpose; much more amusing are Giovanni Francesco Straparola's fairy tales. Annibal Caro translated the *Daphnis and Chloe* of Longus.

Finally, mention must be made of the philosopher Giordano Bruno (*q.v.;* 1548?–1600).

THE SECENTISMO

Spanish oppression and the tyranny of the Counter-Reformation seem to have exhausted Italian creative power which was already worn out by the great output of the Renaissance. From about 1559 began a period of decadence in Italian literature. The suspicious rulers fettered all freedom of thought and word; they tortured Campanella and burned Bruno. In this period the phenomenon known in the history of Italian literature as *secentismo* (comparable to similar phenomena in the English, French and Spanish literatures) manifested itself. Its writers, devoid of sentiment, resorted to exaggeration: the utter poverty of the matter tried to cloak itself under exuberance of form.

Marina.-The foremost of the *secentisti* was Giovanni Battista Marino (1569–1625), whose main work, *L'Adone,* consists of 45,000 lines. His aim was to excite wonder by novelty; hence the most extravagant metaphors, the most forced antitheses are to be found in his book; supreme technical skill, particularly in the sensual passages (Marino's art was decidedly sensuous), goes together with lifelessness. Marino's imitators were innumerable. In general, one may say that most 17th-century poets were infected with "marinism." Some, however, struck a more or less original note; in particular, Gabriello Chiabrera (1552–1638), who made successful experiments in imitating the metres of classical poetry (especially of Pindar) and excelled in his *canzonette* (graceful and musical lyrical poems) described as *"anacreontiche";* Fulvio Testi (1593–1646), whose choice style and patriotic sentiments are sometimes ennobled by inspiration; Francesco Redi (1626–98), whose dithyramb *Bacco in Toscana* is full of gaiety and vitality; Vincenzo da Filicaja (1642–1707), whose sonnets, full of rhetorical emphasis, are chiefly remembered for their patriotic feeling; and Alessandro Guidi (1650–1712).

The **"Arcadia".**—The Academy of Arcadia was set up in 1690 with the avowed purpose of "exterminating" bad taste; foremost among its founders were Giovan Mario Crescimbeni and Giovanni Vincenzo Gravina. The program of the Arcadia was in tune with a generally felt need of the age—that of reacting against the bombastic style of the 17th century. This reaction, however, consisted in imitating the simplicity of the shepherds supposed to have lived in Arcadia in the golden age. Thus a new artifice was obviously replacing the old one: effeminacy and affectation instead of bombast, over-refinement instead of turgidity. G. B. Zappi and Carlo Innocenzo Frugoni (1692–1768) were among the most typical products of this school of poetry; but Paolo Rolli (1687–1765) deserves higher praise for the freshness of his *canzonette,* and his name can be coupled with that of Metastasio in this respect.

Scientific Prose, History and Satire.—It would be wrong to suppose that the foregoing occupied the whole of the 17th-century literary scene. Galileo Galilei (1564–1642), who built the foundations of modern science and led the struggle against the Aristotelians and their narrow-mindedness, earned for himself a great place in literature because of his prose style, which is clear, goes straight to the point and possesses an unconscious artistry without rhetorical ornaments. Tommaso Campanella (1568–1639), the philosopher who sought to unite humanity under a utopistic theocracy based on natural religion, also wrote robust and sincere though rough-hewn poetry. Trajano Boccalini (1556–1613) was the standard-bearer of the fight against Spanish domination and for political independence; his best-known books (*Ragguagli di Parnaso,* 1612–1613; *La Pietra del paragone politico,* 1614) are satirical in character and full of an effective and caustic humour. Paolo Sarpi (1552–1623), the author of the *Storia del Concilio di Trento,* was the most powerful advocate of the liberty of the state against papal interference.

The popularity of satire, too, was a healthy sign of reaction against the prevailing political, social and literary conditions. Prominent in this genre were Benedetto Menzini and, even more, the painter Salvator Rosa (1615–73), who attacked in his seven *satires* the vices and shortcomings of his age; his writings (poems and letters) reveal at once an exuberant personality and a genius that anticipated the artistic outlook of a later age. Alessandro Tassoni (1565–1635) acquired great fame with a mock-heroic poem, *La Secchia rapita,* which is both an epic (partly based on historical fact, partly on imagination) and a personal satire. Other notable writers of heroicomic poems were Francesco Bracciolini

(Lo Scherno degli dei) and Lorenzo Lippi (*Il Malmantile racquistato*).

Every review of 17th-century literature should mention Giambattista Basile (1575?–1632), a prose-writer in Neapolitan dialect, whose collection of tales *(Lo Cunto de li cunti)* proved to be the forefather and often the source, of a large number of the fairy tales written since.

THE 18TH CENTURY

With the end of the Spanish domination, political conditions in Italy began to improve. Reforms were gradually introduced in most parts of the country.

Research.—Giovanni Battista Vico (1668–1744) was a token of the awakening of historical consciousness in Italy. In his *Scienza nuova* he applied himself to the investigation of the laws governing the progress of the human race and ruling over the course of events From the psychological study of man he endeavoured to infer the *comune natura delle nazioni*, that is, the universal laws of history, or the laws by which civilizations rise, flourish and fall.

From the same scientific spirit which animated the philosophical investigation of Vico, there was born a different kind of investigation, that of the sources of Italian civil and literary history. Lodovico Antonio Muratori (1672–1750), after collecting in one entire body *(Rerum italicarum scriptores)* the chronicles, biographies, letters and diaries of Italian history from 500 to 1500 and after discussing the most obscure historical questions in the *Antiquitates italicae medii aevi*, wrote the *Annali d' Italia*, minutely narrating facts drawn from authentic sources. Muratori's associates in his historical researches were Francesco Scipione Maffei of Verona (the tragic dramatist) and Apostolo Zeno of Venice. Girolamo Tiraboschi and Count Giovanni Maria Mazzuchelli of Brescia devoted themselves to literary history. Literary criticism also attracted great attention; Muratori, Vico, Gravina, Maffei and several others, while advocating the imitation of the classics as a cure for literary decadence, well realized that such imitation must needs be cautious, and thus anticipated critical standpoints that were later to come into favour during the age of romanticism.

The new spirit of the times also led men to inquire into the mechanism of economical and social laws. Ferdinando Galiani wrote on currency; Gaetano Filangieri wrote a *Scienza della legislazione*. Cesare Beccaria, in his famous little book *Dei delitti e delle pene*, made a contribution to the reform of the penal system and promoted the abolition of torture. Pietro Giannone defended the freedom and independence of secular states in his *Istoria civile del Regno di Napoli*.

Satire.—Giuseppe Parini (1729–99) seems to embody the literary revival of the 18th century. In his days the nobles and the rich spent their lives in empty pursuits or in shameless self-indulgence, wasting their time and fomenting corruption. It was against these social conditions that Parini's muse was directed. In the *Odi* the satirical note is already heard. But it came out more strongly in the poem *Il Giorno*, in which he pretends that he is teaching a young Milanese patrician all the habits and ways of gallant life; he shows up all its ridiculous frivolities, and with delicate irony unmasks the futilities of aristocratic habits. Dividing the day into four parts, (*Mattino, Mezzogiorno, Vespro, Notte*) he pursues his pupil's occupations and holds them up to ridicule. As a work of art, the *Giorno* is notable for the skill with which its delicate irony is constantly kept up and for the classical elegance of its blank verse. In the *Odi* Parini's moral conscience and high principles add value to the lyrical beauties of each poem.

Gaspare Gozzi's satire was less pungent, but directed toward the same end as Parini's. In his *Osservatore veneto*, something like Addison's *Spectator*, he hit the vices with a delicate touch and inculcated a practical moral with much good sense. Gozzi's prose is very graceful and lively. Another satirical writer was Giuseppe Baretti (1719–89). In a journal called the *Frusta letteraria* he took to lashing without mercy the works which were then being published in Italy. He learned much by travelling; and especially his long stay in England and the friendship of Samuel Johnson contributed to give independence to his criticism.

Melodrama and Comedy.—Drama, too, felt the influence of the times. Apostolo Zeno and Metastasio (the Arcadian name for Pietro Trapassi, 1698–1782) endeavoured to make "melodrama and reason compatible." The latter was particularly successful in depicting human passions in a mild and musical way. Comedy was reformed by Carlo Goldoni (1707–93), the author of about 250 plays, who created the comedy of character for Italy—helped no doubt by Molière's example. Goldoni's characters are acutely, even if optimistically. described: he studied nature but did not plunge into psychological depths. He portrayed the Venetian scene masterfully, writing many of his comedies—perhaps the best, in the Venetian dialect.

Pietro Chiari and Carlo Gozzi also stand out among 18th century playwrights. Two of the many adventurers of the time, G. B. Casti and Lorenzo da Ponte (Mozart's librettist) likewise wrote dramatic works; but the former is chiefly remembered for his long fable, *Gli Animali parlanti*, the latter (who ended his checkered career in the United States) for his *Memorie*.

Patriotism **and** Classicism: **Alfieri.**—The ideas that were making their way into French society in the 18th century and afterward brought about the Revolution of 1789 gave a special direction to Italian literature of the second half of the 18th century. Love of liberty, desire for equality and hatred of tyranny created in Italy a literature which aimed at national objects, seeking to improve the condition of the country by freeing it from the double yoke of political and religious despotism. But all this was associated with another tendency: the Italians who aspired to a political redemption believed that it was inseparable from an intellectual revival. These ideas and aspirations were effectively voiced in Pietro Verri's periodical *Il Caffè*.

Patriotism and classicism were the two principles that inspired the literature which began with Vittorio Alfieri (1749–1803). He worshipped the Greek and Roman idea of popular liberty in arms against the tyrant. He took the subjects of his tragedies mostly from the history of these nations, made continual apostrophes against the despots and made his ancient characters symbolize the ideal world of his mind; he did not trouble himself with the verisimilitude of the characters. But as the style of the "Arcadia" was still flourishing, it was necessary to arm the patriotic muse also against it: if the Arcadians, not excluding Metastasio, diluted their poetry with languishing tenderness, the new writers had to fight their trend, to be concise, strong, bitter, to aim at the sublime as opposed to the lowly and pastoral. The stern example set by Parini and Alfieri's grand manner exercised a potent influence.

Alfieri also wrote a remarkable autobiography which provides an invaluable commentary on his determination to put Italy on the level of other nations as far as tragedy was concerned. Among Alfieri's predecessors in the tragic theatre, Francesco Scipione Maffei (*q.v.*) is the most deserving of notice.

THE 19TH CENTURY

Foscolo **and Monti.**—Ugo Foscolo (1778–1827) was an eager patriot who carried into life the heat of the most unbridled passions and into his art a manner occasionally rhetorical but always inspired by classical models. The *Ultime Lettere di Jacopo Ortis* is the story, in the form of letters, of a young man who is led to suicide by frustrated love at once for a woman and for his fatherland. Many of its pages are moving or inspiring. and the book was extremely popular; but it is marred by lack of development in the plot, psychological incoherence and a somewhat strained style. In the lecture *Dell' origine e dell' ufficio della letteratura* Foscolo for the first time gave evidence of his profound critical insight and may be said to have pointed the way to modern Italian criticism. His poem **I** *Sepolcri* had a great and well deserved success. In less than 300 lines Foscolo succeeded in giving lyrical expression of supreme beauty to a fundamental trait of Italian history which he probably learned indirectly from G. B. Vico, for the Italians have ever sought inspiration in their past, and in this poem past glories are extolled as incentives to, and good omens of, a great future. Two odes, some matchless sonnets and the unfinished poem *Le Grazie* are also a testimony of Foscolo's outstanding poetic merit. He went as an exile to England and died

there. He wrote for English readers some *Essays* on Petrarch and on the texts of the *Decamerone* and of Dante, which are truly remarkable pieces of constructive criticism.

If in Foscolo patriotism and classicism together formed almost one passion, as much cannot be said of Vincenzo Monti (1754–1828), in whom the artist was absolutely predominant. He had no one deep feeling that ruled him: rather the mobility of his feelings was his characteristic. He saw danger to his country in the French Revolution and wrote the *Pellegrino apostolico,* the *Bassvilliana* and the *Feroniade;* Napoleon's victories caused him to write the *Prometeo* and the *Musogonia* in his praise; in his *Fanatismo* and his *Superstizione* he attacked the papacy; afterward he extolled the Austrians. Thus every great event made him change his mind, with a readiness which was due to his absorption in art and literature. It would be unjust to accuse Monti of baseness: nature in giving him only one faculty had made the poet rich and the man poor. Knowing little Greek. he succeeded in making a translation of the *Iliad* which is remarkable for its neoclassical beauty.

Foreign Influences.— A remarkable translation of the *Odyssey* was produced about this time by Ippolito Pindemonte, whose truly preromantic poetic output was deeply influenced by 18th-century English literature. Another of the many writers who drew inspiration from English models (particularly T. Gray and E. Young) was Alessandro Verri *(Le Notti romane).* Filippo Pananti was equally under the spell of English intellectual life, but its impact on his style and mood was far more superficial, although he spent some years in England. His *Poeta di teatro* is a poetic novel written in a jocose vein.

A wider and more lasting appeal was exercised by *Le Poesie* di *Ossian, a* verse translation by Melchior Cesarotti (1730–1808) of the so-called Ossianic poems. Preromantic taste was greatly affected and influenced by those lyrical and epical, mysterious and gloomy fantasies.

The **Purists.**—Cesarotti had also occupied a prominent position in the world of learning at the end of the 18th century; his *Saggio sulla filosofia delle lingue* (1785) was an important pronouncement in the course of the dispute on the Italian language then raging. It was not altogether surprising that precisely when so great a political agitation prevailed the question of the Italian language should be heatedly discussed, for it had raged during the 16th century already, when Bembo, Machiavelli and Castiglione, among others, had discussed it, and it was to occupy later on the minds of Alessandro Manzoni and his friends. For the time being the trend was toward a pedantic classicism in the choice of words and expressions as a reaction against the excessive Gallicism which had been favoured in theory and in practice by some of the 18th century innovators, such as Verri and Beccaria. *Purismo,* as this tendency was called, appeared to its supporters to be a manner of patriotism. Among them may be mentioned Antonio Cesari of Verona (1760–1828), who republished ancient authors and brought out a new edition, with additions, of the *Vocabolario della Crusca.* He wrote a dissertation *Sopra lo stato presente della lingua italiana* and endeavoured to establish the supremacy of Tuscan and of the three great writers Dante, Petrarch and Boccaccio. But patriotism in Italy has always had something municipal in it, and a Lombard school opposed this Tuscan supremacy. At the head of the Lombard school were Vincenzo Monti and his son-in-law Count Giulio Perticari. Monti accordingly issued a *Proposta di alcune correzioni ed aggiunte al vocabolario della Crusca,* in which he attacked the Tuscanism of the *Crusca.* The dispute about language was ranked with the literary and political disputes, and all Italy took part—Basilio Puoti at Naples, Paolo Costa in the Romagna, Marc' Antonio Parenti at Modena, Salvatore Betti at Rome. Giovanni Gherardini in Lombardy, Luigi Fornaciari at Lucca, Vincenzo Nannucci at Florence.

A patriot, a classicist and a purist at the same time was Pietro Giordani (1774–1848); he was almost a compendium of the literary movement of the time. His works were few and comparatively unimportant but his position among his contemporaries was such as to single him out as the last great exponent of *purismo.*

The Romantic Movement.— The French domination in Italy had a twofold effect: it caused people to realize that the ancient and often purely sentimental aspirations toward political unity and independence were within the range of possibilities, for all separate little states and their rulers had been swept away by Napoleon; and it convinced Italians that no reliance could be placed on foreign help if such an aim was to be attained, for the French themselves, who had entered Italy as liberators, had proved oppressive masters. An artificial form of classicism was associated with the Napoleonic pre-eminence so that when Napoleon fell, forces antagonistic to classicism were released. The 18th-century critics had long since denounced some of the exaggerations of the classicists; literary romanticism had won favour in France, and French romantics, if erroneously, considered their tendencies akin to those of the German romantics. Between 1816 and 1818 a battle was fought for romanticism particularly in Milan where a romantic periodical, *Il Conciliatore,* was published. G. Berchet (the patriotic poet and author of *La Lettera semiseria di Grisostomo,* the manifesto of romanticism), the dramatist Silvio Pellico, L. di Breme, Giovita Scalvini, E. Visconti were among its principal contributors; their polemical efforts were silenced when several of their group were arrested by the Austrian police (1820) because of their liberal opinions; among the accused was Silvio Pellico, who was later to write a famous account of his experiences, Le *Mie Prigioni* (1832). It appears from the articles in the *Conciliatore* and from other essays that the new school, though advocating the study of modern works in different languages) a certain independence from classical imitation and the discarding of classical conventions, was on the whole consistent with Italian tradition, a point that was made even clearer by the works of Manzoni, who was hailed as the chief exponent of this school.

Manzoni (1785–1873).—*I Promessi Sposi* (1825–26) is the work that made Alessandro Manzoni immortal. S o doubt he got the idea of writing a historical novel from Sir Walter Scott's successes; but he produced not merely a historical novel but an eminently realistic work of art. His characters are so true to life that they hold the reader's attention throughout the novel: from the greatest to the least they stand before us with the human qualities not of one time more than of another, but of all time. Manzoni's ideal was "a true subject, a moral purpose and a pleasing form as a means of attraction." The 17th-century background of Manzoni's novel is vividly and faithfully described, and the slender but skilfully contrived plot is all merged, so to speak, in its historical surroundings. At the same time the novel is meant to bear out its author's views on life, morality and religion. A keen though kindly sense of humour pervades the whole work, which is written in an admirably modern, fluent and elegant style. As a poet, Manzoni had gleams of genius, especially in the ode *Il Cinque maggio,* written on the death of Napoleon, and in those passages of the *Inni sacri* (five poems in celebration of as many ecclesiastical festivals), where he described human affections. His two tragedies, *Il Conte di Carmagnola* (1820) and *Adelchi* (1822) marked the victory of romanticism over the die-hard classicist school; they rely on strict historical truthfulness and rank high in Italian dramatic literature; but the moral purpose is less ably blended with the underlying artistic conception in these plays than in I *Promessi Sposi,* and this detracts from their dramatic merit. Their three choruses stand out as being particularly successful and moving. Great importance attaches to Manzoni's literary, linguistic, historical and philosophical writings.

Apart from Pellico, G. B. Niccolini (1782–1861) was the only other dramatist of note of the romantic period; but his output, which gradually evolved from a classical to a romantic pattern, was never based on historical research and never rose above the surface of events. Eloquence was his strong point, and this he directed toward the aim of stirring his compatriots to love of liberty.

Leopardi (1798–1837).—The great poet of the age was Giacomo Leopardi, born at Recanati, of a patrician family, bigoted and avaricious. He became so iamiliar with the writings of Greek authors that he afterward used to say that the Greek mode of thought was more clear and living to his mind than the Latin or even the Italian. Solitude, sickness and domestic tyranny, prepared him ior profound melancholy. From this he passed into

complete religious scepticism. His matchless poems (*I Canti*) attain to the highest degree of lyrical beauty and are one of the most agonizing cries in modern literature, uttered with a solemn quietness and conviction that at once elevates and terrifies. Form and content are so perfectly harmonized that. whatever one's opinions, one cannot help being carried away by Leopardi's *ennui* and universal sorrow. But besides being a great poet of nature and of sorrow, he was also an admirable prose writer. In his *Operette* morali — dialogues and discourses marked by a cold and bitter smile at human destinies which freezes the reader — the clearness of style, the simplicity of language and the depth of conception are such that he can be considered one of the most perfect prose writers of Italian literature.

Historiography. — The political preoccupations prevailing at the end of the 18th century were not without effect on historical studies: the purely documentary researches of the previous century gave way to the interpretation of past ages from a modern angle. One of the most interesting historians of the earlier part of the new century was the Neapolitan Carlo Troya. His *Storia d' Italia nel medio evo* (1839) was to express a new conception of life. The Piedmontese Carlo Botta was also prompted to write history by political considerations, but his work was notable for rhetorical eloquence of exposition, not, like Troya's, for penetration and originality. Botta wrote a history of Italy from 1789 to 1814; later on he continued Guicciardini's *Storia* to 1789 and wrote an account of the *Guerra d'indipendenea degli Stati Uniti d'America* (1809).

Close to Botta comes Pietro Colletta, a Seapolitan. He also in his *Storia del reame di Napoli dal 1734 al 1825* strove to defend the independence and liberty of Italy. He had a rapid, brief, nervous style, which made his book attractive reading.

While realism in art gained ground the positive method in criticism kept pace with it. From the manner of Botta and Colletta history returned to its spirit of learned research, as is shoun in the *Archivio storico italiano*, established at Florence by Giampietro Vieusseux. and in such works as Gino Capponi's *Storia della Repubblica Fiorentina,* Manzoni's own remarkable treatise *Sopra alcuni punti della storia longobardica in Italia* and Michele Amari's very fine history of the *Vespro siczliaizo.* (A. Ba.; C. F.; U. L.)

The Risorgimento.—After 1821 the literature of Italy was mainly concerned with political events. The names of romantics and classicists survived. but the representatives of either school were actuated by patriotism. Manzoni's novel created so deep an impression that several writers of little merit followed in his tracks. The novels of Carlo Varese, Giovanni Rosini, Defendente Sacchi. Cesare Cantù and many others are scarcely deserving of record; but other works were written that cannot so lightly be dismissed. Tommaso Grossi (1790–1853), Manzoni's friend, composed a historical novel, *Marco Visconti,* lacking in vigour of characterization and conventional in its description of the middle ages, which enjoyed, however, a large measure of popularity. Massimo Taparelli d'Azeglio (1798–1866), a painter and a statesman as well as an author, had a political object in view in writing his *Ettore Fieramosca,* on a heroic episode of the Renaissance, and his *Niccolò de' Lapi* on the private life of a Florentine family of the middle classes during the siege of 1530. Though it is overcronded with incidents, the first of these two novels is full of zest. Later D'Azeglio entered politics and was several times prime minister; during a period of leisure he composed an excellent book of memoirs, *I Miei Ricordi.* D'Azeglio was a Piedmontese and a monarchist. Yet another author of historical novels, Francesco D. Guerrazzi (1804–73), was born at Leghorn and was a republican and a follower of Mazzini. Writing was, to him, a means of fighting against oppression; he led the Tuscan revolution of 1848 and in the intervals of political activity he brought out several novels, of which the *Assedio di Firenze* is the most notable. His style is frankly rhetorical and his historical accuracy is open to criticism, nevertheless there was such vigour and conviction in his writing as to impress his readers. Garibaldi knew Foscolo's *Sepolcri* by heart and his followers called each other by the names of Guerrazzi's characters. It is among Garibaldians that one finds the last historical novelists. G. C. Xbba wrote *Sulle rive della Bormida,* based on an episode of the French domination in Piedmont, and *Da Quarto al Volturno,* a moving account of Garibaldi's campaign in 1860; and the Friulian Ippolito Nievo, who also was one of the Thousand, nrote *Le Memorie di un ottuagenario,* a cyclic novel that just falls short of being a masterpiece through lack of revision, Nievo having been drowned in 1861 in his 29th year. Giovanni Ruffini, an exile and a friend of Mazzini originally wrote in English his two novels, *Lorenzo Beizoni* and *Il Dottor Antonio.*

The pressure of political events caused many works to be written, most of nhich were of course of ephemeral value, though not a few are of notable importance. Giuseppe Mazzini (1805–72) wrote profusely on art, literature and music; at first he championed romanticism, later he opposed it as laying too great a stress on the individual. but at all periods his style was as vigorous as his convictions were sincere; among his political works may be mentioned *Fede ed avvenire* (1835), *Doveri degli uomini* (1844) and *Ai giovani d'Italia* (1860). Cesare Balbo, the historian, should also be recorded here as the author of the essay *Le Speranze d'Italia,* but more important was Vincenzo Gioberti (1801–52), a Piedmontese priest, a philosopher and a man of wide vision, who left his country and the clergy because of his love of liberty. In 1843 he published his *Primato morale e civile degli Italiani* in which he advocated the moral and historical right of the Italians to independence and the creation of an Italian confederation under the presidency of the pope. This book formed the basis of the political creed of the Italians, other than the followers of Mazzini, who took part in the events of 1848–49. The failure of the revolution caused him to revise his opinions and to advocate the institution of a monarchy under the house of Savoy in his *Rinnovamento civzle d'Italia* (1851).

Patriotic themes were common in the poetry of the period. Besides Manzoni, Leopardi and Niccolini, two exiles, Gabriele Rossetti (the father of Dante Gabriel and Christina) and Pietro Giannone, should be mentioned in this connection. The lyrics of Goffredo Mameli, who died fighting in Rome in 1849 at the age of 21, of Alessandro Poerio and of Luigi Mercantini are little better than impromptu verses, but Mameli's at least are vigorous enough to have survived the generation for which they were written. The work of Giuseppe Giusti (1809–50) had greater literary merit, and his satires, not unlike those of Pierre Béranger, were avidly read; but he seldom gave the full measure of his capacity as in the lyric *Sant' Ambrogio.* However. he was endowed with true Tuscan wit and fluency, and his pointed satire was ably directed against political oppressors and human weaknesses alike. Even livelier and wittier were the poems in Milanese dialect of Carlo Porta (1775–1821), and the sonnets in Roman dialect of G. G. Belli (1791–1863). Belli, however, was not a patriotic poet.

Francesco Dall 'Ongaro (1808–73), Aleardo Aleardi (1812–78) and Giovanni Prati (1814–84) were sentimental romantics and patriots. Prati was, indeed, the standard-bearer of the so-called "second romanticism," a movement that had its heyday between 1850 and 1870 and was characterized by its sentimentality and mannerism. Prati's *Edmengarda* (1841) was acclaimed as a novel and original work of art and Aleardi was held in high repute; but very soon they and the mediocre imitators of Manzoni brought romanticism into disrepute and prepared the way for Carducci's reaction. In other departments of literature there was no outstanding figure. P. Cossa was a successful playwright who composed tragedies on Roman subjects; P. Ferrari of Modena (1822–89) transformed the romantic comedy of Gherardi del Testa into modern drama either illustrating a historical period or stating a social problem.

Carducci and Pascoli.—The great figure of the age was Giosuè Carducci (1835–1907). He lived through the feverish period of 1859–60 and his patriotic enthusiasm was changed to disillusionment by the difficulties in which the new kingdom was involved and the manner in which they nere faced by the politicians. He looked to history for inspiration to the classics as models; and he believed his literary gifts to invest him with a political mission. As a poet-seer endoaed with a forceful personality, much learning and uncompromising sincerity he exercised a kind of literary dictatorship. His poems dating trom 1861 to 1900 and published under various titles are collected in his *Poesie.* A determined op-

ponent of romanticism, he attempted a revival of classical metres in his *Odi Barbare* (1877–89); in these and in the other poems of his maturity *(Rime Nuove,* 1861–87; *Rime e ritmi,* 1898) he expressed with admirable power his vigorous outlook on life and his sense of classical beauty and sang the past and contemporary glories of Italy. He was also a polished writer of prose and a scholarly historian of literature; his literary essays have a permanent value, although philosophical criticism such as that of De Sanctis was distasteful to him.

Francesco de Sanctis (1817–83), who was exiled by the Bourbons of Naples, considered literature the expression of social and moral conditions, and on the basis of a sound philosophical training on the works of Giovanni Vico and Georg Hegel he inaugurated aesthetic criticism. His *Saggi critici* and particularly his masterly *Storia della letteratura italiana* were not fully or generally appreciated in his day, but have since received recognition and formed the starting point of the philosophical revival of the later 19th century.

While Carducci was still alive, Giovanni Pascoli (1855–1912) acquired a great reputation and succeeded him in the chair at Bologna. His art was always impressionistic and fragmentary, his language occasionally childish and laborious; but his lyricism, at first timid and tender and altogether rustic and domestic *(Myricae,* 1891) rose gradually to fuller tones, and his concern for the underprivileged (peasants, orphans and even little birds) shifted to the loftier themes of antiquity, Roman heritage and greater Italy. His original vein still found a touching expression in the best among the *Canti di Castelvecchio* (1903); and the classicism of the *Poemi conviviali* (1904), much subtler and more temperate than literary or political neoclassicism usually is, was rather imbued with melancholy nostalgia than swollen with celebration. He tried his hand, however, in the epic genre with the *Canzoni di* Re *Enzio* and such other feeble imitations of Carducci and d'Annunzio; and in later years he produced—both in rich humanistic Latin and in self-consciously elaborate Italian—ample heroic hymns in honour of the sacred cities of Italy, eternal and modern, Rome and Turin.

(H. O.; C. F.; U. L.)

Beside men of such stature, lesser men, however deserving of notice, almost pale into insignificance: even poets as honest and highminded as the Piedmontese Giuseppe Giacosa (1847–1906), author of two greatly applauded plays *(Partita a scacchi,* 1871; *Come le foglie,* 1900), or as gifted as Arturo Graf, Giovanni Marradi and Guido Mazzoni. Giacomo Zanella (1820–88), a classicist, wrote poetry full of inspiration, though lacking in depth. Cesare Pascarella (1858–1940) wrote in the Roman dialect poems full of verve, wit and human feeling.

In the realm of prose, the forceful style and rugged personality of Alfredo Oriani (1852–1909), a novelist, essayist and historian *(Lo Lotta politica in Italia,* 1892) received less notice than was their due. S. Farina and G. Rovetta were minor if popular novelists.

The Realist **Novel.**—Giovanni Verga (1840–1922) stands out as by far the greatest Italian novelist of his time and as probably one of the greatest Italian novelists of all times; he was a realist, indeed, the master of Italian realism, and his two best novels *(I Malavoglia,* 1881; and *Mastro Don Gesualdo,* 1889), which describe the dismal conditions prevailing in Sicily during the first part of the 19th century, often soar to a poignant intensity of desperate fatality. Verga was also an exceptionally gifted writer of short stories *(Novelle rusticane,* etc.). Although his success was not immediate, it proved lasting and his influence on all further developments of Italian literature was paramount. A friend and a follower of his was Luigi Capuana (1839–1915); and the much younger Federico de Roberto (1866–1927), who wrote a masterly novel *(I Vicerk,* 1894), must also be considered as belonging to the same group.

In order to secure a realistic reproduction of life, all these writers drew their subjects almost invariably from the life of their town or district, thus creating a tradition of "regionalist" novels. The same may be said of the Neapolitan Matilde Serao (1856–1927) and of the Tuscan Renato Fucini (1843–1921). To some extent it could be said of Antonio Fogazzaro (1842–1911), too, although his characters move in a wider circle. Fogazzaro was a deeply religious man and was much influenced by Manzoni and the German romantics. His later tales (*Il Santo,* 1906, well-known because of the criticism which it provoked from the ecclesiastical authorities; *Leila,* 1911) did not equal the mellowness and sentimental seductiveness of previous works *(Piccolo mondo antico,* 1895, generally acknowledged as his masterpiece; *Piccolo mondo moderno,* 1900). This was due partly to the growing disagreement between the writer's unchanging moods and the needs and tastes of a changing time, partly to the stiffening attitude of the Roman Catholic Church toward modernism. Rather vaguely if he is to be judged as a philosopher or theologian, but very intensely insofar as he described emotions. Fogazzaro had striven for an alliance of religion and science, of piety and progress. The condemnation of modernism as a heresy, which became final in the papal encyclical *Pascendi* (1907), laid waste the foundation on which he had built the optimistic world of his fiction, where pride of intelligence went together with the peacefulness of conformism and ascetic seekers after God did not disclaim the charms of earthly love.

Other 19th-Century Authors.—A lasting, though less resounding, fame was won by Emilio de Marchi (1851–1901), whose literary allegiance can be traced back directly to Manzoni; his novels (particularly *Demetrio Pianelli,* 1890) reveal the thoughtful and kind-hearted nature of their author and are not devoid of a sense of humour. An altogether different writer was Edmondo de Amicis (1846–1908), whose *Cuore* (1886) became a classic of children's literature and whose short stories and travel books are mainly remarkable, not indeed for vigour of thought, but because they are truly representative of the mood of the masses in his tirne.

Finally the writers of the "Scapigliatura Milanese" deserve mention. This movement, which had Milan as its centre, was strongly imbued with romanticism—not the "second romanticism" (against which it waged war) but the original article. It affected an attitude of rebellion and a dislike for bourgeois orderly life, taking its cue from French "Bohémiens." The novelist Giuseppe Rovani (1818–74; *I Cento Anni,* 1859–60), Emilio Praga (1839–7j) and the poet and musician Arrigo Boito (1842–1918; he mas Verdi's librettist) were the foremost among the "Scapigliati."

In literary criticism the historical method prevailed. Under the inspiration of such teachers as Alessandro Ancona, A. Bartoli, C. de Leva, Pasquale Villari, D. Comparetti and G. I. Ascoli a great amount of scholarly research was carried out and was expounded in learned monographs: facts were ascertained and obscure points were cleared up in political and literary history. (U. L.)

THE 20TH CENTURY

D'Annunzio (1863–1938).—The literature of the 20th century was marked at its inception by the rising influence of Gabriele D'Annunzio. Nietzsche's theory of the superman and a revived Roman patriotism, unmistakably aiming at imperial conquest, merged visibly in the mature phase of D'Annunzio's imagination and in the immature imitations of his followers. The master's literary quality, on the whole, deteriorated from his culmination, which was reached in the earliest years of the century, to his later efforts; and there is a steep descent in his stage production from the passionate glamour of *Francesca da Rimini* (1902) and the enchanting colour and melody of the tragic pastoral entitled *La Figlia di Iorio* (1904) to the weary overemphasis of such plays as *La Fiaccola sotto il moggio* (1905), *La Nave* (1908), *Fedra* (1909) and *Il Martirio di San Sebastiano* (1911), the latter published first in French and set to music by Claude Debussy. The same is noticeable, although less obviously, in his verse. from the sweeping autobiography of *Laus vitae* (1903) and the exultant nature represented in *Alcyone* (1904), to the nationalistic and militaristic program poetry of a collection like *Le Canzoni della Gesta d'Oltremare* (1912). Even in the narrative genre in which he had given his best during his youth, to mark thereafter his step, there appears to be a difference between the firmness of *Il Piacere* (1889), *Il Fuoco* (1900) and *Le Novelle della Pescara* (1902) on the one hand and the devious glibness of *Forse che sì forse che no* (1910) on the other.

But while the values of his literary work vere weakening, he

was injecting into his poetry the meaning and purpose of his will and applying the incitements of poetry to the decisions of life. This double transmutation of biography into poetry and poetry into biography happened with him far more strikingly than with Byron or any other forerunner. He struck the keynote to Italy's intervention in World War I; and his prominence as an inspirer in word and deed persisted all through the struggle. During the armistice, Sept. 1919, at the head of a small army of irregulars, he occupied Fiume, where he reigned like a prince of the Rensissance until the end of 1920. The seed that had been laid by him came to fruition shortly afterward in the Fascist march on Rome and in Mussolini's conquest of Italy. Oct. 1922.

Croce and Gentile.— More aloof from daily events and from the currents of popular or sectional emotion was Benedetto Croce (1866–1952). He had a high repute as a philosopher. but the main weight of his significance is apparent in the field of the history of letters.

Possibly his treatise of ethics (*Filosofia della pratica,* 1909) is the most consummate of his books, but neither this nor any other of them compares in effectiveness with the *Estetica.* Published first in 1902, it inaugurated the new century like a clarion call to youth. Many of its readers overstressed or perverted outright whatever indications in favour of boundless indicidualistic expressionism and of ultimate dissociation of the aesthetic from the moral values the book contained. In several literary circles the suggestions coming from Croce were interpreted as if agreeing with the teachings of D'Annunzio, and the same was to happen a few years later in the ethico-political field when Croce, keenly interested in the diffusion of Georges Sorel's message and especially of Sorel's *Réflexions sur la violence,* contributed indirectly to the moods of the forthcoming nationalist and Fascist upheavals. He himself, the philosopher, warned by the growing difficulties in applying his aesthetic doctrine to concrete subjects of literary criticism, by the objections of some of his pupils and opponents and, last but not least, by the innate moderation of his mind, tried repeatedly to correct his theory without discarding its primal tenets. Various stages of such alterations were consigned to books or collected essays like *Problemi di estetica* (1910), *Breviario di estetzca* (1913), *Nuovi saggi di estetica* (2nd ed., 1926), and *La Poesia* (1936). They made his aesthetic speculation more comprehensive, but also more vague.

In literary criticism, especially successful when exercised on Italian contemporary literature and on writers of the past most congenial to him *(La Letteratura della nuova Italia; Saggi sulla letteratura italzana del seicento)* as well as in historiography (excellent among other books are *Storia del Regno di Napoli, Storza d'Italia dal 1871 al 1915* and *Storia dEuropa nel secolo XIX),* Croce's inexhaustible vein and tireless diligence provided Italy with a monumental work. Pre-eminent among its features are common sense interspersed with humour, charming even when the final point is less convincing, and the neatness of an almost unlimited humanistic scholarship. Such traits are expressed in a prose as fluent as it is polished, as spontaneous as it is appropriate, never inhibited or stilted: a rare appearance in the pageant of Italian letters.

The closest friend of Croce's youth, Giovanni Gentile (1875–1944), whose remarkable contributions to literary criticism can be seen in such books as *Dante e Manzoni* (1923) and *Filosofia dell' arte* (1931), deduced rigorously from certain principles of neoidealistic philosophy which he had held in common with his elder associate, a theory of the absolute state leading him to fascism. Croce avoided this dead end and reaffirmed steadfastly his allegiance to the liberal faith, never satisfactorily defined in his work either from a philosophical or from a social and economic standpoint, but unquestionably alive with moral fervour. Direct participation or even expression in politics nas obviously forbidden to a nonconformist in the era of Mussolini; Croce's opposition, however, is testified—even if, as a rule by implication and innuendo—in the issues of his bimonthly review *La Critica* (founded 1903).

After World War II Croce played an important part in the definition and re-establishment of democracy in Italy.

Poetry from 1900 to 1920.—With the close of the great cycle of lyric poetry which ran from Parini to D'Annunzio, particular trends become more and more difficult to discern. Many poets still clung to traditional patterns, as did A. S. Novaro, Francesco Pastonchi, Angiolo Orvieto; and pure Grecian grace flowed to the poems of Salvatore di Giacomo (1862–1934; collected *Poesie,* 1907) from the secluded source of his Neapolitan inspiration. In Rome. Trilussa (Carlo Alberto Salustri; 1873–1951) carried on the old tradition of Belli and of Cesare Pascarella by pouring his sceptical wisdom and easy-going maliciousness, sometimes with a political sting, into innumerable fables and sonnets in Roman dialect. In Milan, Ada Negri (1870–1945) gave a touch of spontaneity and of feminine warmth of heart to her verses. Another Neapolitan, Francesco Gaeta (1879–1927), is less easy to define: in some ways he was akin to the "Crepuscolari," although he was endowed with a stronger and more courageous personality than most of them.

The "Crepuscolari" (poets, as it were, of a disenchanted twilight after the dazzling D'Annunzian day) heralded in their mild way the break with poetic tradition which became a more and more marked feature of 20th-century poetry. Although their predilection for choice words and a nonchalantly polished style reveal that they could not wholly escape D'Annunzio's dominant influence, they rebelled against his heroic outlook by striking notes of indolent melancholy and of self-complacent resignation: taking their cue from French and Belgian decadentism they groped for an ideal, failed to find it and were left with the boredom and emptiness of life as their main theme. Fausto Maria Martini (1886–1931), Marino Moretti (1885–), Sergio Corazzini (1887–1907) and Aldo Palazzeschi (1885–) were the most striking representatives of this mood. But Guido Gozzano (1883–1916) won more permanent laurels than any of the "Crepuscolari"; he skilfully blended an attitude of disenchanted naïveté *(La Via del rifugio,* 1907; *I Colloqui,* 1911) with a capacity for cynical introspection, using a style often described as poetically colloquial.

A more acute stage in the spiritual crisis of Italian culture was marked by Futurism, the pseudoliterary and pseudoartistic movement heralded in 1909 by Filippo Tommaso hlarinetti (1876–1944).

The Futurists noisily set out to proclaim the subversion of all aesthetic and intellectual standards, to abolish every intermediary between word and expression (by the use of *"parole* in *libertà"*) and to create an art appropriate to an era of scientific and industrial dynamism; in their view, the inspiration of poetry and the urge of physical violence should be one and the same. As a whole, Futurism (although it can now be seen as the starting point of a feeling of revulsion against the traditional language of Italian poetry) was hardly more than a farce, amusing in parts. Vet Marinetti was a close friend to the young hfussolini, and his joke contained some premonition of a time to come.

Journalism, Criticism and Historiography.— As the line of demarcation between literature and politics was fluid, so was it between the university and the periodical press, between high learning and popularization. Among the intermediaries between scholarship or philosophy and broader audiences, *La Critica* of Benedetto Croce preserved through the decades an undisputed primacy, but a long lineage of smart reviews stretched from the *Leonardo* (Florence, 1903) of Giovanni Papini (*q.v.;* 1881–1956) to the *Voce* (Florence, 1908 and ff.) of his friend Giuseppe Prezzolini (1882–), from the Roman neoclassicist *Ronda* of V. Cardarelli. A. Gargiulo and Riccardo Bacchelli to the *Convegno* in Milan and other more eclectic or more exclusive journals in the 1920s and 1930s. A list of those who achieced reputation mainly through agencies of this sort would make a long catalogue; Enrico Thovez (1869–1926), Ardengo Soffici (1879–), Renato Serra (1884–1913). Scipio Slatnper (1888–1913). Emilio Cecchi (1884–), Adriano Tilgher (1887–1941), Mario Vinciguerra and Francesco Flora can be singled out in so far as they exercised influence also through the medium of relevant books and through strong adherence to particular trends in literary criticism and aesthetics.

Historiography, in all its branches, flourished; whether it mas in care of specialized scholars like Ettore Pais (1856–1939), *Storia*

di Roma nei primi cinque secoli; Gaetano De Sanctis (1870–1957), *Storia dei Romani;* Luigi Salvatorelli, Ernesto Buonaiuti, Piero Martinetti (*Gesú Cristo e il Cristianesimo),* or in the vivid interpretations of Guglielmo Ferrero (*q.v.*; 1871–1942), *Grandezza e decadenza di Roma* (1902–07). In literary history the guidance of Francesco De Sanctis (1817–83) was acknowledged by nearly all. Of those who contributed best to its progress, P. Rajna, E. G. Parodi, A. Gargiulo, G. De Robertis. G. A. Cesareo. Guido Mazzoni, V. Rossi, M. Barbi, C. De Lollis, Arturo Farinelli, G. Bertoni, L. Russo, G. Toffanin, A. Galletti and especially Attilio Momigliano (1883–1952) won a following also among laymen.

In these exchanges between centre and provinces as well as between artists or scientists and the public of various regions and strata. the Italian language found at last the stability and unity, together with the vernacular liveliness, that had been desired for centuries.

At the same time, the standards of learning were high, witness not only the rich production in philosophy and all humanities, but also the many thousands of columns of the *Enciclopedia Italiana,* which was published in 1929 ff., but had been planned earlier.

(G. A. Bo.; U. L.)

The Fascist Era.—The Fascist regime (1922–43) on the whole affected literature unfavourably. Conditions under a dictatorship are such as to thwart uninhibited expression. In the theatre, the works of such well-established playwrights as Luigi Antonelli (1882–1942), Sem Benelli (1877–1949; *La Cena delle beffe,* 1909), Roberto Bracco (1862–1943), Luigi Chiarelli (1877–1949; *La Maschera e il volto,* 1916), *E. L.* Morselli (1882–1921; *Glauco,* 1919), Dario Niccodemi (1878–1934) and Rosso di San Secondo (1887–1956) continued to hold the eye of the public. The main interest, however, remained focused on Luigi Pirandello (1867–1936), who received a Nobel prize in 1934. Pirandello's dramas *(Cosi è se vi pare, 1918; Sei personaggi in cerca d'autore, 1921*; *Enrtco IV, 1922; Questa sera si recita a soggetto,* 1930; etc.) gained international success by the originality of the dry geometric method of their treatment and by the unconventionality of an often paradoxical technique. their characters move on the stage in puppetlike fashion, devoid of human flesh and blood and responsive to a weird string-pulling from behind the scene; yet at the same time they are torn by powerfully felt, though unresolved, conflicts —the conflicts among the different beings that cohabit in the same brain. Drama was the ultimate and most congenial form for the expression of Pirandello's disbelief in the rationality of life and in the coherence of human personality—a disbelief which assumes that we can make of life whatever our creative or destructive imagination wants it to be. But before turning to drama, he had tried his hand and perfected his style on fiction. Here his roots lay in the common terrain of the Sicilian realistic school, of which Giovanni Verga, Luigi Capuana and Federico de Roberto had been the major exponents; but his numerous short stories *(Novelle per un anno, 1922* ff.) were admirable for the uncompromising pessimism of the background from which their sketchy characters emerged rather than for such pity and hope as had inspired his predecessors. Already in his early novel, *Il* Fu *Mattia Pascal* (1904), the fundamental topic of his work—an implacable attack against the hypocrisy of social conventions—is quite amply developed.

In the narrative genre some of the old masters continued to hold their own. Grazia Deledda (1871–1936; her masterpiece. *Elias Portolu,* 1903; Nobel prize, *1926)* portrayed her native Sardinia in an uninterrupted flow of novels in which nobility and even outright beauty of style and sentiment were not obscured by monotony. Alfredo Panzini (1863–1939) wrote many novels and short stories in which an exquisite and altogether literary irony invariably seasoned whatever might taste bitter in a reality rather contemplated as puzzling than apprehended as dreadful. More familiar matter was provided for larger clientèles by Virgilio Brocchi (1876–) and by Salvator Gotta *(1887–*) who, together with Delfino Cinelli *(1889–*). Bruno Cicognani *(1879–*), Umberto Fracchia (1889–1930), Enrico Pea (1881–1958), Antonio Baldini *(1889–*), Emilio Cecchi *(1884–*). Bruno Barilli (1880–1952) and Corrado Alvaro (1895–1956), took the places that had belonged to Luciano Zuccoli (1879–1929) or to Matilde Serao in the previous generation. Similarly Ugo Ojetti (1871–1946), an elegant chronicler and supple portraitist *(Cose viste,* 1923 ff.), largely occupied the place that had been held for several decades by Ferdinando Martini (1841–1928). Massimo Bontempelli *(1884–*) exercised his talents in surrealistic compositions. Giuseppe Antonio Borgese (1882–1952) gained greater fame for his works of literary criticism and aesthetics than for his novel, *Rubè (1921).* a picture of the moral and intellectual disintegration out of which fascism was soon to grow. The output of Giovanni Papini (1881–1956) embraces the fields of philosophy and literary criticism, of autobiograpy *(Un Uomo finito, 1912)* and religion, and is as plentiful as it is uneven, though his earlier works stand out for polemical brilliance and zest; a "Crepuscolare" turned Futurist, he became later a mystic.

Next to these already well-known writers, there were some who made their mark during the Fascist era. Italo Svevo (pen name of Ettore Schmitz, 1861–1928), perhaps the most impressive of them, won literary fame late in life *(La Coscienza di Zeno,* 1923); though it is usual to link his name with those of Joyce and Proust or with German romanticism, his own brand of searching psychological analysis defies classification. Of the younger generation, Riccardo Bacchelli *(1891–*), a poet and later a playwright as well as a successful novelist, owes his renown to *Il Diavolo al Pontelungo* (1927) and, even more, to *Il Mulino del Po* (1938–40); both these powerful and well-contrived novels follow in the wake of the best Italian narrative tradition. It was the fate of Ignazio Silone (pen name of Secondo Tranquilli, 1900–) to acquire a wide international repute before his best novels *(Fontamara, 1933*; *Pane e vino,* 1937) were known to his compatriots; for Silone was a political exile, and his books handled convincingly the theme of the anti-Fascist struggle; when they appeared in Italy after World War II, however, the public was already out of tune with their style and mood.

The "Hermetic" Movement.—Poetry in the Fascist period underwent an interesting process of involution which extended the break from a centuries-old tradition, partly under the stress of political conditions in Italy, but even more under the influence of French symbolism. This process amounted to a new and indeed revolutionary use of words and to an attempt at isolating, so to speak, their "lyric potentiality" and at discarding all accessory or decorative elements. Obscurity inevitably resulted, so that the new manner came to be called *ermetismo,* because the meaning of the words was hermetically sealed and because the poet aimed at isolating himself, with uncompromising integrity, within the solitary sphere of his inner self. Fragmentariness, aridity and an attitude of utter indifference were the main features of this movement, which disregarded the appeal of popularity. Its herald was Arturo Onofri (1885–1928), and its best exponents were Giuseppe Ungaretti *(1888–*), in whose brief sketches each word is charged with an extraordinary significance and intensity of emotions, and Giuseppe Montale *(1896–* ; *Ossi di Seppia, 1925, Le Occasioni,* 1939), who took the visible aspects of the external world as "occasions" for a corrosive and cynical symbolizing of his sorrowful outlook on life. Dino Campana *(1885–1932),* Salvatore Quasimodo (1908–) and Leonardo Sinisgalli (1908–) may be mentioned among the rest of the "hermetic" poets. Umberto Saba *(1883–*) preserved a more immediate human appeal and a greater touch with everyday realities.

World War II and Its Aftermath.—Toward the middle of the 20th century. the outlines of the literary scene become too dim to be seen in detail, and the individual voices were too deeply submerged by the din of the crowd to be discerned and evaluated clearly.

"Hermetic" poetry lingered on during World War II. (Mario Luzi, 1914– ; Alfonso Gatto, 1909– ; and many others); but with the subsequent violent changes in the political climate it evolved so much in the direction of articulacy as to become unrecognizable, the first steps in this direction being taken by Ungaretti himself (*Il Dolore,* 1947).

Italian poetry after the war, while still in the throes of the spiritual crisis that characterized most of the first half of the cen-

tury, and still groping for new ways of expression, seemed likely to exchange the gloomy mood of the Fascist period for a brighter and more vigorous attitude.

In the field of narrative literature Italy displayed remarkable vitality and maturity during the 1940s. Having felt sooner and more intensely than other nations the crisis that led to the war, Italy was braced at the end of the conflict for the task of expressing artistically its painful experiences in the previous eventful years, its feeling of rebirth and its new mood of alertness and of undefined but marked expectation. Already in 1941 two novels, Cesare Pavese's *Paesi tuoi* and Elio Vittorini's *Conversazione in Sicilia,* were obviously promising a new stage in literary development.

From these two works and from certain aspects of American narrative literature (as exemplified by William Faulkner, Ernest Hemingway, or John Steinbeck) Italian postwar neorealism took its cue. This neorealism had its roots in the Italian realistic tradition of the late 19th century; but it differed from the latter inasmuch as the reality that was its theme was not a historical reality, but a lyrically interpreted one, evoked at once with lucidity and with the detachment of dreams and given an almost magic hue. The treatment moreover was strongly analytic, or rather psychoanalytic, and the style was colloquial and unpretentious, thus carrying on in the field of prose the reaction to a classical and rhetorical tradition already noticed in regard to poetry. While poetry, however, remained exclusive and pleased only the initiate, prose affected a simplicity of style which gave it a wider appeal. Trends parallel to literary neorealism were also apparent in painting and in the cinema.

Elio Vittorini (1908–), a restless artist forever experimenting in new techniques. was perhaps the most promising of the younger writers (*Uomini* e *no,* 1945); the premature death of Cesare Pavese (1908–50) robbed Italy of a novelist who had already proved his exceptional gifts in such novels as *Prima che il gallo canti* (1949) and *La Luna e i falò* (1950) where balance and control were coupled with a clear insight into the conscience of man. Next to these two masters of neorealism, Vasco Pratolini (1913–) proved himself to be in the forefront of postwar narrative literature; his *Cronache di poveri amanti* (1947) was a novel full of vitality and rich with the teeming life of the Florentine working classes. Many drew their materials from war experiences, as Giuseppe Berto (*Il Cielo è rosso,* 1947), or from a reelaboration of prewar experiences, as Carlo Levi (1902–) nhose *Cristo si è fermato a Eboli* (1945) not only shows a moving sincerity but also sketches a social, moral and, above all. poetical portrait of a people and of a district. Of the older generation, Aldo Palazzeschi, already mentioned as a "Crepuscolare" (he was later a Futurist before temperamentally pursuing his further vagaries from style to style). eclipsed the lustre of his earlier novel, *Le Sorelle Materassi* (1934), with an uneven but even more pleasing novel, I *Fratelli Cuccoli* (1948). Finally, Alberto Moravia (Alberto Pincherle, 1907–) achieved an international repute with his consummate art as a storyteller; his gifts, already apparent in his first novel *(Gli Indifferenti,* 1929), were refined by experience in his later production, throbbing with curiosity for the processes of the human mind. His cold and detached way of exciting indignation, while pretending to refrain from passing judgment, was such as to mask the occasional weaknesses of his plots. In *Agostzno* (1946), *La Romana* (1947), *La Disubbidienza* (1948) and *Amore Coniugale* (1949) his psychological analysis was convincing but limited to certain problems or situations; in *Il Conformista* (1951) he seemed to have deepened and widened his field of observation.

By the middle of the 20th century the very standard-bearers of neorealism seemed gradually to move away from it, Vittorini in his later and more lyrically inclined novels *(e.g., Le Donne di Messina,* 1947), Pavese in his last and posthumous works *(Saggi,* 1952; *Il Mestiere di vivere,* 1952).

There is no doubt. however, that neorealism was a lively movement, truly representative of the temper and of the spiritual needs of the nation in the postwar period.

BIBLIOGRAPHY.—Extremely valuable information, criticism and bibliography for all centuries of Italian literary history are to be iound in *Storia letteraria d'Italia,* 13 vol., 3rd rev. (Milan, 1936–47), the most comprehensive publication of its kind, and in *Storia dei generi letterari,* 20 vol. (Milan, 1904–47). More succinct, but useful, literary histories are. V. Rossi, 3 vol., 15th ed (Milan, 1946); F. Flora, 5 vol. (Milan, 1948); N. Sapegno, 3 vol. (Florence, 1947); A Momigliano, 3 vol. (Messina. 1934); and A D'Ancona and 0. Bacci, 6 vol. (Florence, 1926–29) U. Renda and P. Operti, *Dizionario storiro della letteratura italiana,* 3rd rev. (Milan, 1952) is a repertory of biographies and bibliographies The collection *La Letteratura italiana: storia e testi,* 83 vol. (Milan-Kaples, 1951–), was planned to comprise 75 volumes containing texts, the remainder dealing with literary history. For a bibliographical repertory of 20th-century publications *see* G. Prezzolini, *Repertorio bibliografico della storia e della critica della letteratura italiana dal 1902 al 1932,* 2 vol. (Rome, 1937–39), and *dal 1933 al 1942,* 2 vol. (New York, 1946–48).

Works in English include: for the early period, A. Gaspary, *History of Early Italian Literature to the Death of Dante,* Eng. trans. (London, 1901): and for the *Renaissance,* J. A. Symonds, *Renaissance in Italy,* 7 vol., 3rd ed. (London, 1926). (U. L.)

ITALIAN **WARS.** The war which broke out in 1848 had for its theatre the northern provinces of Italy and was due to the inhabitants' endeavouring to gain their national unity. To expel the Austrians who were in possession of Lombardy and Venetia was the principal aim of the inhabitants. For a discussion of the political events of this period *see* ITALY: *History.*

THE FIRST WAR

March 1848.—News of the outbreak of the revolution in Vienna in March 1848, together with the revolt of the Hungarians, was the signal for the Italian patriots to rise in Milan four days later (March 17) against the Austrians. Radetsky, the military governor, decided after severe street fighting to retire into the citadel. Seeing that his force was too small to cope with the rising, he evacuated the citadel. On the 23rd he was at Lodi. There he heard of the intended march of the Sardinians on Milan and of the fact that Venice had fallen. The Austrian position was grave, and the only available reinforcements, those in Tirol, were being hurried to Italy. King Charles Albert, who assumed command of the Sardinians, crossed the Ticino at Pavia and Buffalora, intending to pursue the enemy, thought to be in flight. By the first week in April he was at Cremona with 70,000 men. Charles Albert marched to Pastrengo, intending to bar Radetsky's retreat to Tirol. After the action at Goito, April 8. the king crossed the Mincio, while Radetsky retreated to a position west of Verona. The Sardinian attack failed on May 6 at St. Lucia, but Radetsky refrained from following the enemy till reinforcements arrived. Nugent, with part of the expected reinforcements moved from Gorizia to Verona. Evading battle with the papal forces under Durando and Ferrari, he joined Radetsky on May 23.

The Austrian leader assumed the offensive, threatening the Sardinian right and rear and intending to relieve Peschiera. He entered Mantua on May 28. Encountering strong resistance, after the fall of Peschiera, Radetsky attacked Durando with 30,000 men and forced him to surrender with 18,000 men on June 11. Restoring order in the Brenta valley, Radetsky, reinforced, returned to Verona with 60.000. Charles Albert, with 75,000 men, occupied the hilly country around Custozza and the Rivoli plateau. After foul' days fighting, the Sardinians were driven across the Mincio and in full retreat. Charles Albert tried in vain to obtain an armistice. Radetsky, moving by parallel roads, defeated the hostile right at Crema and Lodi and reoccupied Milan on August 4. The Sardinians having crossed the Ticino, an armistice was concluded on August 9.

The Second Campaign. — By the beginning of 1849 Charles Albert was again forced to take up arms in March, entrusting command to Chrzanowski a former Polish general. His forces amounted to seven divisions, three being thrown forward to the Ticino at Galiate, Tregate and Vigevano, with two others at Novara and Ollegio, while another stood under Ramorino, south of the Po opposite Pavia. Radetsky intended to concentrate at Pavia, interposing between the two Sardinian forces north and south of the Po, and then to march against the principal force. He evacuated Milan on March 17, feigning to retire toward Piacenza. Two days later he wheeled to his right and made for Pavia so as to cross the frontier as soon as the armistice expired. Firmly believing the Austrians were retreating, Chrzanowski gave

orders to cross the Ticino at Magenta on March 20.

Radetsky crossed the Ticino and destroyed the bridge at Mezzano Corte, whereby Ramorino was cut off from Chrzanowski's main army. Hearing of Radetsky's advance, Charles Albert decided to meet him at Vigevano. Radetsky sent three corps to Mortara, outflanking the enemy's right with one and with another guarding his own right flank at Vigevano, Mortara fell. the Sardinians retreating to Novara. Next day Radetsky advanced toward Yespolate, with an outflanking detachment on Robbio. The five Sardinian divisions were drawn up at Novara, ready to receive battle that day. Radetsky, believing he was faced by a rear guard, changed his plan of a massed advance on Kovara to a left wheel toward Vercelli, with but one corps going to Novara.

The following morning the Austrian 2nd corps encountered the whole hostile army at Novara and for hours was in the greatest danger. The 3rd corps, coming up, saved the situation in the afternoon and mas, in its turn, followed by the 4th, which threatened the enemy's right. The reserve corps arriving, Radetsky ordered a general advance. the Sardinians falling back in disorder on Novara. An armistice mas arranged that night, Charles Albert abdicating in favour of his son, Victor Emmanuel, and Radetsky giving up the advance on Turin.

THE SECOND WAR

Austria's Ultimatum. — War began on April 26, 1859. Sardinia had rejected the Austrian ultimatum to disarm, dispatched on the 19th, and Gyulai ordered the frontier to be crossed the following day. Having crossed the Ticino at Pavia and Bereguardo, Gyulai reached Valenza on May 3, when a report coming from Vienna, stating the French mere already in Turin in great strength, stopped his advance. He now decided to move on Turin and attack the French columns debouching from Suza. On May 8 the Austrians reached the Sesia at Vercelli. but reports announcing the advance of strong hostile forces on Piacenza forced Gyulai to retire to the Lomellino, with his headquarters at Mortara. A bridge was constructed at the confluence of the Po and Ticino to facilitate a retirement to the south if necessary. The French were already on Sardinian soil and were rapidly joining their allies. Some had come across the Alps by Mont Cenis and Mont Genevre, while the rest had arrived by sea, disembarking at Genoa. Napoleon, assuming command, continued undecided whether to advance to Piacenza, south of the Po, or to move via Magenta on Milan. The first encounter took place at Montebello on May 20, when Stadion was sent to ascertain the strength of the enemy at Voghera. After a brisk fight with Forey's division. the Austrians fell back but were not pursued. This confirmed Gyulai in the belief that the French would march on Piacenza, while Napoleon imagined the Austrians intended a big offensive south of the Po.

He now gave orders to move north by a long flank march on Magenta. as proposed by Jomini. The Sardinians started on May 25, reaching Vercelli on the 29th, while the French made for Casale-Valenza, their right being protected by a division at Voghera and Valenza. Gyulai soon heard of the Sardinian march but mistook it for a feint to divert his attention from the Po.

An action occurred on May 30 at Palestro, which the Sardinians were to hold, to facilitate the French crossing of the Sesia at Vercelli. Fighting was resumed the next day, when the French 3rd corps participated in repulsing the enemy. The French main army was approaching Kovara on June 1, while the Sardinians, with the remaining French forces, were around Palestro-Vercelli, the river Agogna being between them; the Austrians might have attacked them, knowing how widely they were spread out, but Gyulai decided to retreat across the Ticino, which he did next day. His idea was to retreat to the Mincio, but Kuhn, his chief of staff, protested against so hurried a retirement.

Meanwhile, the allies approached the Ticino, seizing the crossings at San Martino and Turbigo. The 2nd French corps. together with the 2nd guard division, crossed the river and occupied Robeccheto early on June 3. The allies now stood as follows: the 1st corps at Lumelogno and the 4th corps at Novara; guards with the 3rd corps at Novara; Sardinians at Galiate. A detachment guarded the extreme right flank at Mortara. The French general headquarters, being badly served by the cavalry, ascertained only early on June 4 that Gyulai had crossed the Ticino the previous evening.

Napoleon intended to attack the Austrian right flank with the 2nd corps and Sardinians, while advancing with the main body, consisting of the 3rd and 4th corps with the guards, against the bridges of San Martino, and to force his way across. Gyulai, on his part, wished to give battle on June 5, holding the enemy with his right, the jth and 6th corps, at Magenta, and to strike the enemy debouching from San Martino with his remaining five corps. Events turned out differently. MacMahon's detachment advanced in two columns early on June 4, but, on approaching Buffalora at midday, met with an obstinate resistance, which held up his advance. The Austrians had 12,000 men posted there, 8,000 at Magenta, 12,000 to defend the bridges and 27,000 at Abbiategrasso. A second move was made at about 4 P.M., when the Austrians were driven back to Magenta.

Meantime, Napoleon, having in hand but a small force at San Martino, awaited MacMahon's advance, which would open the road for his own troops. Hearing firing from the direction of MacMahon's force, Napoleon sent a division of the guards to storm the bridges and support MacMahon toward Buffalora. A desperate struggle ensued, Mellinet's guards encountering 18,000 Austrians, who were trying to wreck the bridges. Urgent messages were sent to the 3rd and 4th corps to forward reinforcements. The French across the Ticino were now able to hold their own for the time being, and it was fortunate for them that MacMahon shortly afterward renewed his effort to press forward, the Austrians gradually giving way before him. Hearing that Magenta had been captured by the enemy, Gyulai gave orders to retreat late that night in the direction of Cremona-Piacenza. The French feared an attack on June 5, and rightly so, as the Austrians could have collected 110.000 men for a renewed battle, but hearing of the retreat of the enemy, they entered Milan on June 7. Next day they drove back the Austrian rear guard at Milegnano, the enemy retreating to the Mincio, which was crossed on June 16. That day the emperor Francis Joseph took command of the army, having Baron Hess as his chief of staff.

Contact with the enemy was lost at the crossing of the Chiese June 1j, but little skill being shown by the allied cavalry, the Austrians assembling in full security behind the Mincio. By the 21st the allies were over the Chiese, with headquarters at Montechiaro, numbering 107,000 French, with 48,000 Sardinians. No fighting was expected west of the Mincio. isolated hostile horsemen alone being visible. A balloon detachment made an ascent at Castiglione June 23, but no enemy was to be seen.

The Austrians decided to take the offensive and crossed the Mincio on June 23 over 12 bridges. By the evening they stood on the line Pozzolengo-Solferino-Pvledole. The 2nd corps was left at Mantua against the hostile jth corps, which was known to be moving south of the Po. A division from the 2nd corps was sent to Marcaria. Neither opponent expected a battle on the 24th. The Austrians believed the enemy would be encountered in two or three days time. while the allies did not expect them this side of the Mincio, which they had to cross on the 24th. The Austrians had every chance of success, had they utilized the 2nd corps at Mantua against the French flank and rear. Lack of initiative and excessive centralization prevailed in their army. The battlefield can be divided into two parts: the hilly (northern) part around San Martino-Solferino; the (southern) plain between Guidizzolo-Medole. The allies stood as follows: the Sardinians on the left at Lonato; the centre: the 1st and 2nd corps and guards, Castiglione-h'lontechiaro; the right: the 3rd and 4th corps, Medole-Castelcoffredo. The Austrians advanced in close formation. The 8th corps. Pozzolengo; the jth, Solferino; the 1st, Cavriana; the 3rd, Guidizzolo; the 4th, Volta; the 9th, Robecco-Medole; the 11th, Cereta. Their plan was to hold the allies by incessant attacks, while making for Carpendolo from the south against the allied right. Their march forward was to begin at 9 A.M. on the 24th.

Firing between the outposts began at 5 A.M. east of Castiglione, and gradually the 1st and 2nd French corps were involved in fighting around Solferino. To the south the 4th corps was also

shortly engaged in a fierce encounter at Medole. The 3rd, delayed by crossing the Chiese, nas hurrying forward but, on approaching Castel Goffredo, heard rumours of a hostile movement from the south, which did not take place. The 2nd corps, being held up at Casa Morino, asked in vain for help from the 4th. and the latter, in turn, pressed the 3rd to assist it. In the north the Austrian 8th corps was hotly engaged from daybreak and held up the Sardinians after seizing San Martino by incessant attacks throughout the day. By 11 A.M. the Austrians were desperately defending Solferino, and, to ease the situation, the Austrian emperor ordered the and army to advance on Castiglione, instead of Carpendole. But all attempts were made in vain against the French 3rd and 4th corps which were attacking in their turn. At 2 P.M. Solferino was captured, thanks to the assistance of the guards. The 2nd army, receiving a second order from Francis Joseph, made a fresh effort, but at 3 P.M, the 1st army having begun to fall back, the battle was practically lost, and the Austrians began their retreat to the Mincio. On the extreme right the 8th corps repulsed every Sardinian attack, falling back only when informed of the 2nd army's retreat. There nas no pursuit. The Austrians fell back on Verona. An armistice was concluded at Villafranca on July 8, Austria ceding Lombardy, while Napoleon received Savoy and Nice from Sardinia.

Venetia.—Seven years had elapsed since the war of 1859, but the Italians still cherished hopes of annexing Venetia, which. nith the exception of Rome. was the remaining Italian state not incorporated in the kingdom. Foreseeing that the Schleswig-Holstein disputes between Austria and Prussia would certainly end in hostilities. Italy signed a treaty of alliance nith Prussia on April 8, 1866. It was stipulated that they were to demand Yenetia from Austria. support by force of arms the reforms for a German confederation and not sign peace separately.

Austria was forced by her political circumstances to assemble two armies. one on her northern frontiers, against Prussia, and a much smaller one against Italy. She relied, to make up for her numerical inferiority, on her small but highly trained forces and on her strong defensive position in the quadrilateral. By an agreement with Prussia: Italy was to invade Venetia. mobilizing her forces for that purpose, in the middle of April 1866 and concentrate them in two groups.

The Austrians under the Archduke Albert, with General John as chief of staff. disposed of but 75,000 well trained troops. He took up a central position between Montagnana and Lonino within reach of either Rovigo or Verona, as he learned the enemy would advance in two separate armies from two directions: one from the Mincio, the other from south of the Po. On June 20 orders were issued to advance to Verona, the archduke intending to attack the Italian king. Garibaldi, meanwhile, was advancing into Tirol. On the 23rd the archduke, having completed his concentration between Verona-Pastrengo, sent his troops into the hills, his plan being to take the offensive the next day, striking the Italians when they would be advancing toward the Adige. The Italians, not expecting serious resistance, advanced with little precaution.

When at Villafranca the Italians were checked by artillery and cavalry, and 20,000 remained inactive all day. Meanwhile, they fell in with the main hostile forces on the heights of Peschiera-Custozza. The Austrians, in their turn, began the attack along the whole line. Battle raged all day with varying success till about 5 P.M., when the Italians were forced to retire to the Mincio. A fortnight later the archduke and the bulk of the army were transported to defend Vienna against the Prussians, and when hostilities closed in Austria the archduke was sent with 1 j5,000 men to Isonzo. No further fighting took place, however, and peace was signed October 3, Austria losing Venetia, though the Italian navy sustained a crushing defeat at Lissa on July 20 when attacked by Tegetthof. Only in 1870. however, did Rome once again become the capital of Italy, the French being obliged to withdraw their garrison from the Eternal City after the French empire had fallen. (A. SMI.)

ITALIC DIALECTS comprise a well-defined subdivision of the Indo-European languages spoken in Italy in ancient times, of which only one. Latin, survived, as Italian: through postclassical and medieval times into modern. In addition to the non-Indo-European Etruscan, there were also spoken in ancient Italy other Indo-European languages, *e.g.,* Messapic, to which the term Italic is not applied; this distinction must be borne in mind. By Italic, then, is understood that subdivision of the western group of Indo-European languages spoken in ancient Italy, which, as tested by the accepted criteria of agreement and of regular, but not uniform, development in vocabulary, syntax, accidence, word formation, and treatment of a common stock of speech sounds, makes a coherent group of dialects. This group is distinguished, by the same criteria, from other western Indo-European subdivisions.

This Italic subdivision: however, falls into two smaller classes: Osco-Umbrian and Latin-Faliscan. The agreements between these two classes are so numerous and so striking that it is necessary to regard them as together forming a single group. The argument that they are separate Indo-European subdivisions need not be pressed further than to say that the speakers of the two classes entered Italy in successive waves. The argument that Osco-Umbrian is in some features closer to Greek than to Latin is unconvincing.

Italic as a whole shows remarkable agreements with Keltic and, in less degree, with Germanic. Perhaps the most striking features that separate Osco-Umbrian from Latin are the substitution of p for I. Eu. q^u where Latin has qu or c (before u or a consonant) and *u* (initial and intervocalic), and the substitution of b for I. Eu. g^u where Latin has *gu* (after *n*), g (before u or a consonant) (c by assimilation); *e.g.*, 0. *púd,* pod, U. *puŕ-e,* Latin quod, I. Eu. $*q^uod$; O. *kumbened, conuēnit,* U. *benust, uenerit,* L. *uenio,* Gothic *qiman* "come," Skt. *gácchati* "he goes," I. Eu. $*g^uem$; U. *umen* (older **omben*), L. *unguen,* I. Eu. $*oŋg^uen$.

Keltic also falls into two subdivisions, similarly distinguished by their treatment of q^u (see J. Whatmough, "Development of I. Eu. labiovelars," Melanges Pedersen [*Acta Jutlandica,* IX, i] 1937, especially pp. 47–48), thus Ir. cia "why," W. *pwy* "who" (cognate with O. pod, L. *quod* above). There are also other important points of agreement between Keltic and Italic.

Of all the ancient languages of Italy, only one, namely Latin, is fully documented and therefore fully known. It remains here only to say something about the geographical distribution of the dialects, the dates between which they are recorded, the nature of the documents in which they are preserved and the varieties of alphabet in which those documents are recorded. Apart from Latin, which also has epigraphic as well as literary evidence, the other dialects are known only in inscriptions, some from a certain number of glosses, *i.e.,* definitions of dialect words, preserved in ancient writers. The evidence of ancient names, local. divine and personal, is by comparison unimportant, but (like the glosses) usually confirms the other evidence (or is confirmed by it) and occasionally, especially in the more scantily recorded dialects, contributes a few items of information that would otherwise be totally unknown.

Latin was originally the language only of Rome and its immediate vicinity. Its neighbour and congener Faliscan was properly the dialect of Falerii in southern Etruria and of a tract of surrounding territory as far south as Capena. It is probable that these dialects mere introduced into Italy by an early wave (not later than the beginnings of the Early Iron Age) of Indo-European speaking tribes, nho, coming down from the north, crossed the eastern Alps and then the Apennines to reach the west coast of Italy, where they were subsequently isolated by the Etruscans. In fact, traces of kindred speech have been detected among Alpine dialects, of which Venetic shons some features curiously reminiscent of Latin, e g., medial b and d from Indo-European *bh,* dh; ks and kt preserved; genitive singular *i* or o stems; dative-ablative plural *-os* [*-bos*].

(*See* the Harvard dissertation of M. S. Beeler, "The Phonology of Venetic.")

A group of Raetic inscriptions discovered in 1936 and 1937 in the Val Camonica (north of the Lago d'Iseo) reveals striking similarities with Faliscan. *e.g., sanquuos,* genitive singular of a u stem; cf. Faliscan *zenatuo(s)*; *tito,* dative singular, as in Faliscan *titoi,*

tito.

(See J. Whatmough, *Classical Philology,* vol. xxxv, pp. 186–188, 1940.)

The Osco-Umbrian dialects are believed to have entered Italy at a later date. Umbrian is wedged between Etruscan and Picene, and the southernmost extension of Oscan to the toe of Italy and across the Straits of Messina dates from *c.* 300 B.C. The following may be distinguished: (1) southern Oscan, represented chiefly by the Tabula Bantina (Apulia), but also by fragmentary remains in Lucania and in the country of the Bruttii; (2) central Oscan in Campania and among the Samnite tribes (Hirpini, Samnium, Frentani), which is the main source of information about Oscan, especially as it appears in the numerous inscriptions of Campania, so that "Oscan" unqualified usually means the central Oscan of Campania, though the language of the Tabula Bantina is not essentially different and contributes much to knowledge of the dialects; (3) northern Oscan, represented by inscriptions of the Paeligni, Marrucini and Vestini, which, because of their peculiar features and limited sources, are usually spoken of specifically.

A pair of Volscian inscriptions (Velitrae, Antium) represent the dialect of the Volsci who lived in southern Latium. Records of a number of minor dialects (of the Marsi, Aequi, Hernici, Praenestini and Sabini) in central Italy are commonly grouped together as Latinian, though actuzlly they all belong (except Praenestine) with the Osco-Umbrian group. Volscian shows strong similarities of development to those of Umbrian. All the pre-Latin dialects of regions of Italy other than those here enumerated belong to other linguistic Indo-European groupings (Greek, Keltic, Illyrian and Ligurian), the non-Indo-European Etruscan of the west coast alone excepted.

Knowledge of a dialect cannot be claimed without primary records of that dialect; in the case of ancient dialects, this is tantamount to saying without written records of it. All varieties of writing in articulate documents of ancient Italy (a few Phoenician and late Semitic inscriptions excepted, and of course the non-native texts on exotic objects brought in by trade) stem from some variety of Greek alphabet. So far as the dialects described in this article are concerned, the alphabets in which they are preserved to us stem without exception (not even Latin) from a proto-Etruscan or Chalcid-Etruscan alphabet, which is a variety of western Greek alphabet (like the old Attic alphabet). This form of writing cannot have been introduced into Italy much before *c.* 800 B.C. The oldest dialect or Latin inscription (that of the Praenestine fibula) is dated *c.* 600 B.C. But neither dialect nor Latin inscriptions are numerous before the middle of the 3rd century B.C. There are no Oscan inscriptions of later date than the Pompeian graffiti which were written shortly before the eruption of Vesuvius overwhelmed Pompeii in A.D. 79. Since, however, Oscan has left some clear marks of its influence on southern Italian dialects, it probably was not extinct at so early a date. Official documents in Oscan cease at dates which vary with the advance of Roman control (at Capua in 211 B.C., for example; at Pompeii in go B.C., when Sulla captured the city; and indeed everywhere after the Social War of 90–89 B.C.).

With the help of such fixed points as these, the relative chronological order of inscriptions may be determined, within broad limits, on epigraphic grounds.

Both the Oscan and the Umbrian, like the Etruscan and the oldest Latin, alphabets have the letters facing to the left (ꟻ b) and also have a right-to-left direction of writing. The Latin alphabet is in use in the later inscriptions, and in some of the southern Oscan inscriptions the Tarentine-Ionic variety of Greek alphabet is used. For details *see* C. D. Buck, Grammar *of Oscan and* Umbrian, pp. 22–24.

See also ETRUSCAN LANGUAGE; LATIN LANGUAGE; OSCAN; UMBRIAN LANGUAGE.

BIBLIOGRAPHY.—On the archaeology and dialects of ancient Italy: J. Whatmough, *The Foundations of Roman Italy* (1937).

On the dialects: R. von Planta, *Grammatik der oskisch-umbrischen Dialekte* (1892–97); *R.* S. Conway, *The Italic Dialects* (1897); *C.* D. Buck, *Grammar of Oscan and Umbrian* (1904); *A.* von Blumenthal, *Die iguvinischen Tafeln* (1931); *G.* Devoto, *Tabulae Iguvinae* (1937); E. Stolte, *Der faliskische Dialekt* (1926); *R.* S. Conway, J. Whatmough and S. E. Johnson, *The Prae-Italic Dialects of Italy,* 3 vols. (1934); E. Vetter, *Handbuch der italischen Dialekte* (1953); G. Bottiglioni, *Manuale dei dialetti italici* (1954); *M.* S. Beeler, *The Venetic Language* (1949); J. Whatmough, *Orbis,* vol. iv, pp. 323–348 (1955).

Reviews or notices of relevant new publications appear in the periodicals *Language, Classical Philology, American Journal of Philology* and in *L'année philologique, Bibliographie linguistique, Glotta, Indogermanisches Jahrbuch, Bulletin de la Socitte de Linguistique de Paris* and *Indogermanische Forschungen.* (J. WH.)

ITALO-CELTIC: *see* ITALIC DIALECTS.

ITALO-TURKISH WAR. Following the diplomatic discussions which took place between Rome and Constantinople during the summer of 1911, an ultimatum from Italy was delivered to the Porte on Sept. 28, demanding Turkey's consent to a military occupation of Tripolitania and Cyrenaica. A period of 24 hours was set by the ultimatum, and as the Turkish reply did not meet the Italian demands a state of war was declared as from 2.30 P.M. on Sept. 29.

Italian Naval Activity.—Military action was slow to succeed the formal declaration of war, and it was not till Oct. 11 that the first transports reached Tripoli. Meanwhile the Italian navy had been busy. On Sept. 28 a squadron appeared off Tripoli, and notice was given that if the town were not surrendered it would be bombarded. The obsolete fortifications were bombarded for two hours on Oct. 3, after the Turkish authorities had declined to surrender the town. By next day, the Turkish garrison, acting upon order received from Constantinople, had retired into the sandy plains, and on Oct. 5, a force of 1,600 sailors was disembarked. Meanwhile hostilities had been begun elsewhere. On Sept. 29 and 30 Italian destroyers under the command of the duke of the Abruzzi sank the Turkish torpedo-boats off Prevesa in Epirus and on Oct. 1 Admiral Aubry left Augusta to go in search of the Turkish fleet, which the declaration of war had found at Beirut. But the orders given him were suddenly countermanded, and instead of steaming to the Aegean in order to intercept the Turks, he was sent to Tobruk, which was occupied by a detachment of sailors on Oct. 4. The renunciation of the attempt to cut off the Turkish fleet was inspired by political reasons.

Italian Expeditionary Force.—A week elapsed between the landing of the sailors at Tripoli and the arrival of the expeditionary force, and it was not till Oct. 20 that all the equipment had been put on shore. The force consisted of some 9,000 rifles with a few field and mountain batteries and two squadrons of cavalry. There was very little transport, for it had not been anticipated that the Turks would retreat towards the interior and receive support from the native tribesmen. That Neshat Bey, the Turkish commander in Tripoli, did receive this support was largely due to two men—Ferhat Bey, deputy for Tripoli, and Suleiman el Baruni, a Berber from Fessato, who was deputy for the Jebel region. Meanwhile Homs, Derna and Benghazi had been occupied. There was some resistance at each place, especially at Benghazi, but the first fighting of any importance was a sudden attack on Oct. 23 upon the Italian lines at Shara Shat in the Tripoli oasis, backed by a rising behind the lines. Two companies of Bersaglieri were cut to pieces, and the rest of the regiment were hard put to it to hold their own. Further attacks led to a withdrawal of the line, and to the clearing of the oasis behind the trenches. Large reinforcements were sent from Italy, and by the fourth week in November General Caneva, who was in command of the expedition, had about 25,000 rifles and 16 batteries. He took the offensive, and in two actions cleared the oasis and sent the Turks and their tribesmen allies packing. Turkish headquarters were established at Aziziya, some 30m. south of Tripoli.

Political Aspect.—At the beginning of November the Italian Government had considered the possibility of extending the theatre of war, on the sea at least, hoping to induce Turkey to give up the struggle. Austro-Hungary intervened, backed by Germany, invoking Article VII. of the Triple Alliance. Italy's action being limited in this way, it was necessary to solve the problem directly, but the task was more difficult than it need have been owing to the limitations laid upon General Caneva by the Italian Government. General Caneva's orders appear to have

been that he must not risk reverses or suffer heavy loss. In the circumstances, an expedition in pursuit of the Turks, and their mobile allies seemed hardly practical. In any event, months went by without any action of importance in Tripolitania. In Cyrenaica there was one fight near Benghazi, when a force of Arabs who had come near the town were attacked and severely punished. Derna was closely beset throughout the winter, and Enver Bey, who had succeeded in reaching Cyrenaica towards the end of the year, organized a formidable resistance, securing relative unity among the tribesmen, and a willingness to co-operate with the Turks, which had never before existed.

Italian Offensive Renewed. — In April, the long spell of inaction in the western province came to an end, and from that time onward the resistance of the Turks and Arabs was gradually broken by a series of operations at various points. In April Italian warships appeared off the entrance to the Dardanelles. They were fired on by the Turkish forts and their answer drew a fresh and very energetic protest from Vienna. The northern Aegean was left alone by the Italians henceforth, but in May the island of Rhodes and 12 small islands of the Sporades (subsequently famous as the Dodecanese) were occupied by Italy. During the summer there were a number of successful actions in Tripolitania, and peace negotiations were begun at Ouchy in August. Progress was very slow, and it was not until Oct. 15, when two important victories had been won by the Italians, at Derna and Sidi Bilal (near Zanzur) that the Treaty of Ouchy mas signed.

Conclusions. — The conduct of the Tripoli campaign was prejudiced, first, by the failure of the Italian Government to judge the situation correctly, and secondly, by the limitations which were laid upon the military command. It was not possible at once to launch a desert expedition, and the difficulties of an advance to the Jebel, through country largely waterless, may be said to justify the adoption of a less ambitious plan. What is difficult to understand is the practical veto upon action of any kind, which immobilized large forces from December till April and delayed the carrying out of the policy which eventually put an end to hostilities. the policy of extending the area of operations and striking a blow whenever the chance offered.

The operations of the summer changed the situation, but Italian prestige was not wholly restored by the later successes, or by the subsequent actions against the tribesmen who did not lay down their arms when the treaty was signed. The policy of the Government bore heavily upon the army, which came in for much unfair criticism and increased the difficulties of those who undertook the administration of the country after the peace. The troubles which were to come with the outbreak of World War I may be traced in part at least to the hesitations and uncertainties of the six months following the landing.

BIBLIOGRAPHY.—Sir T. Barclay, The *Turco-Italian* War (1912); G. von Gravenitz, Gesckichte des Italienischen-Turkischen Krzeges (1912–14); F. MacCullagh, Italian Warfare in Tripoli (1912); W. K. McClure, Italy in North Africa (1913); Enver Pasha, *Um Tripolis* (1918). (W. K. McC.)

ITALY (ITALIA), the name applied both in ancient and in modern times to the great peninsula that projects from the mass of central Europe far to the south into the Mediterranean sea, where the island of Sicily may be considered as a continuation of the continental promontory. The portion of the Mediterranean commonly termed the Tyrrhenian sea forms its limit on the west and south, and the Adriatic on the east; while to the north, where it joins the main continent of Europe, it is separated from the adjacent regions by the mighty barrier of the Alps, which sweeps round in a vast semicircle from the head of the Adriatic to the shores of Nice and Monaco.

The land thus circumscribed extends between the parallels of 46° 40' and 36° 38′ N. lat. and between 6° 30' and 18° 30' E. long. Its greatest length in a straight line along the mainland is from northwest to southeast, in which direction it measures 708 mi. in a direct line from the frontier near Courmayeur to Cape Santa Maria di Leuca south of Otranto, but the great mountain peninsula of Calabria extends about 2° farther south to Cape Spartivento in lat. 37° 55′. Its breadth is, because of its configuration, very irregular. The northern part measured from the Alps at Monte Viso to the mouth of the Po is about 270 mi. wide, while the maximum breadth from the Mont Cenis to Duino is far greater. Peninsular Italy, which forms the largest portion of the country, nowhere exceeds 150 mi. in breadth and does not generally measure more than 100 mi. across.

Italy's southern extremity, Calabria, forms a peninsula, being united to the mass of Basilicata or Lucania by an isthmus only 35 mi. in width, while that between the gulfs of Sant'Eufemia and Squillace, which connects the two portions of the region, does not exceed 20 mi. The area of the republic of Italy is 116,294 sq.mi., or, excluding Sicily and Sardinia, 97,068 sq.mi.

Land Frontiers. — Italy's northern land frontier is formed by the Alps, which divide it from France, Switzerland and Austria. In the east the treaty of Paris (1947) fixed an ethnic boundary between Italy and Yugoslavia; the southern end of this boundary was along zones A and B of the former Free Territory of Trieste. Zone A was later incorporated into Italy.

The French Frontier. — The French frontier starts from the Ligurian coast at Ponte San Luigi about 3 mi. W. of Ventimiglia at the mouth of the Roya river; keeps to the west of the Roya for about 9 mi, then crosses it southeast of Breil and, since 1947, runs northeastnard to Monte Marguareis, thus taking the small communes of Briga and Tenda into France. From hiarguareis the frontier goes west along the watershed to Cima di Collalunga, where it joins the main Alpine watershed and follows it in a general northerly direction to the Mont Blanc mass and Mont Dolent at its eastern end. The most important alteration made in this frontier by the treaty of 1947 was that which included Briga and Tenda and several electric power stations, particularly that at San Dalmazzo, in France. Between Tenda and Collalunga France acquired a stretch of wild mountain country by the moving of the frontier on to the main watershed.

In the Mont Thabor-Chaberton area north of Briançon the treaty eliminated certain small Italian salients into French territory, which were said by the French to constitute a threat to Briançon. A little farther north an alteration on the Mont Cenis plateau gave France the hlont Cenis lake and with it the control of the water supply to the big Italian power station of Venaus. One small rectification on the col of the Little St. Bernard pass transferred the hospice to France in order to give the French better strategic control over the approach from the Valle d'Aosta. The important road and railway from Cuneo through the Tenda pass to Ventimiglia run partly through French territory; the main railway line from Turin into France enters France by the Mont Cenis tunnel under the Col Fréjus. All of this frontier lies among the mountains (many of them more than 10,000 ft. high). Though there are a number of high passes, there are only four, apart from the Tenda pass, crossed by roads; viz., the Little St. Bernard, the Mont Cenis to Lanslebourg, the pass by Claviere to Briançon and that between the Cottian and Maritime Alps by Argentera.

The Swiss Frontier. — The Swiss frontier runs from Mont Dolent to Piz Lat close to the Resia pass in an east-west direction. East of the Great St. Bernard the frontier follows the line of the crests including the hfatterhorn and Monte Rosa. From Pizzo d'Andolla the line runs northeastaard, leaving the whole of the Simplon pass in Switzerland. From Punta di Valrossa west of the St. Gotthard pass the frontier describes a great V southward. Switzerland thus includes the top end of Lago Maggiore and most of Lago di Lugano and comes within 3 mi. of the town of Como before the frontier runs northward again to Pizzo Tambo near the Splugen pass. From the Splbgen the frontier goes southward to the western end of the Bernina Alps along their crests, southward again to Tirano and then northward to Campo di Corno, leaving the whole Bernina pass in Switzerland. From there it runs mainly northward, crossing the Stelvio pass at right angles, to Piz Lat and the Resia pass. This frontier is crossed by the railway lines to the Simplon, St. Gotthard and Bernina passes and by many international roads.

The Austrian Frontier. — The Austrian frontier, fixed by the treaty of St. Germain (1919), runs along the high Alps to the east and west of the Brenner pass. Starting from the Resia pass

the frontier runs along the crest of the Venoste (Otztal) and Stubai Alps to the Brenner and then along the Aurine (Zillertal) Alps to the Vetta d'Italia, the most northern point of Italy; from the Vetta it runs south along the Pusteria Alps to the Carnic Alps, which it follows in an easterly direction to Monte Forno, its junction with the Italo-Yugoslav frontier, leaving Tarvisio and the Predil pass inside Italy.

The Yugoslav Frontier.—The frontier fixed by the treaty of Paris follows the northern part of the line proposed by the French as one which would conform to the ruling of the Council of Foreign Ministers of France, Great Britain. the Cnited States and the U.S.S.R. to fix a frontier which would be in the main an ethnic line leaving a minimum population under alien rule. But the calculations of the French were based on the inclusion of Trieste and its immediate surroundings in Italy; the creation of the Free Territory of Trieste destroyed the balance and left a large number of Italians in the coastal towns of Istria under Yugoslav rule and practically no Yugoslavs in Italy.

The northern part of the frontier lies west of the Isonzo river which it crosses at Salcano about 2 mi. N. of Gorizia; it then skirts Gorizia closely, leaving the town in Italy but the springs which provide its water supply in Yugoslavia. From Gorizia the line runs southward to a point about 1¼ mi. N.E. of the village of San Giovanni, where the frontiers of Italy, Yugoslavia and the Free Territory of Trieste meet. The Italo-Trieste frontier runs southward from this point into the Adriatic just west of Duino.

PHYSIOGRAPHY

While the Alps thus constitute the northern boundary the configuration and internal geography of Italy are determined almost entirely by the great chain of the Apennines, which branches off from the Maritime Alps between Nice and Genoa and, after stretching in an unbroken line from the Gulf of Genoa to the Adriatic, turns southward and continues throughout central and southern Italy, of which it forms, as it were, the backbone, until it ends in the southernmost extremity of Calabria at Cape Spartivento. The great spur or promontory projecting toward the east to Brindisi and Otranto has no direct connection with the central chain.

One result of the manner in which the Apennines traverse Italy from the Mediterranean to the Adriatic is the marked division between northern Italy, including the region north of the Apennines and extending thence to the foot of the Alps, and the central and southern parts of the peninsula.

Northern Italy.—By far the larger portion of northern Italy is occupied by the basin of the Po, which comprises the whole of the broad plain extending from the foot of the Apennines to that of the Alps, together with the valleys and slopes on both sides of it. From its source in Monte Viso to its mouth on the Adriatic—a distance of more than 280 mi. in a direct line—the Po receives all the waters that flow from the Apennines northward and all those that descend from the Alps toward the south, including the Mincio (the outlet of the Lago di Garda). The next river east of the Mincio is the Adige which, after pursuing a parallel course with the Po for a considerable distance, enters the Adriatic by a separate mouth. Farther to the north and northeast the various rivers of the Veneto flow directly into the Gulf of Venice.

The geography of northern Italy is best described by following the course of the Po. The river starts as a mountain torrent descending from the north flank of Monte Viso, from a point more than 6,000 ft. above the sea. After less than 20 mi. it enters the plain at Saluzzo, between which place and Turin (30 mi.) it receives three considerable tributaries—the Chisone on its left bank and the Varaita and Maira on the right or south. A few miles below Valenza it is joined by the Tanaro, which brings the waters of several minor rivers.

More Important are the rivers that descend from the main chain of the Graian and Pennine Alps and join the Po on its left bank. Of these the Dora Riparia, which flows into the Po just below Turin, rises in Mont Genèvre and flons past Susa at the foot of the Mont Cenis. Next comes the Stura, which rises in the glaciers of Roccamelone; the Orca, flowing through the Val di Locana; and the Dora Baltea, which has its source in the glaciers of Mont Blanc and thence descends through the Valle d'Aosta for about 70 mi. till it enters the plain at Ivrea and, after another 20 mi., joins the Po below Chivasso. (See SAINT BERNARD PASSES.) About 25 mi. farther on. the Po receives the Sesia, which rises at the southern foot of Monte Rosa and enters the Po 14 mi. below Vercelli. A little above this confluence, at Casale Monferrato, the navigable portion of the river begins (337 mi. to the mouth, minimum width 650 ft., minimum depth 6 ft. with many shallows and sandbanks). About 16 mi. E. of Vercelli it is joined by the Ticino, a large and rapid river, which flows out of Lago Maggiore (*q* v.). The next great tributary, the Adda, flows out of Lago di Como at Lecco, and thence traverses the plain for 70 mi. till it enters the Po between Piacenza and Cremona. It receives the waters of the Brembo, descending from the Val Brembana, and the Serio from the Val Seriana above Bergamo. The Oglio rises in Monte Tonale above Edolo and descends through the Val Camonica to Lovere, where it expands into the Lago d'Iseo (*q.v.*). From Iseo's southwestern end, the Oglio has a long and winding course through the plain, reaching the Po above Borgoforte. In this lower part it receives the smaller streams of the Mella, which flows by Brescia, and the Chiese. from the small Lago d'Idro, which lies between Lago d'Iseo and Lago di Garda.

The last great tributary of the Po is the Mincio, which flows from the Lago di Garda (*q.v.*) and has a course of about 40 mi. from Peschiera sul Garda. at Garda's southeastern angle, till it joins the Po. About 12 mi. above the confluence it passes under the walls of Mantua (*q.v.*) and expands into a broad lakelike reach so as to encircle that city entirely.

The Adige, joined by the Isarco below Bolzano, enters the great plain at Verona, following a course from north to south nearly parallel to the rivers last described. But below Legnago it turns eastward and runs parallel to the Po for about 40 mi., entering the Adriatic by an independent mouth about 8 mi. from the northern outlet of the greater stream. The two rivers have, however, been joined by artificial cuts and canals, thus permitting free circulation between them.

The Po itself, which is there a very large stream with an average width of 400 to 600 yd., divides into two arms, known as the Po della Maestra and Po di Goro, at Santa Maria di Ariano, and these arms are subdivided into several other branches, forming a delta more than 20 mi. in width from north to south. The point of bifurcation, at present about 25 mi, from the sea, was formerly much farther inland, more than 10 mi. W. of Ferrara, where a small arm of the river, still called the Po di Ferrara, branches from the main stream. Before 1154 this channel was the main stream, and the two small branches into which it subdivides, called the Po di Volano and Po di Primaro, were in early times the two main outlets of the rive:. The southernmost of these, the Po di Primaro, flows into the Reno and enters the Adriatic about 12 mi. N. of Ravenna, so that, if these two arms are included, the delta of the Po extends for about 36 mi. from south to north. The main exit of the river in 1950 was the Po della Pila. The whole course of the river, including its windings, is estimated at 420 mi.

In the first 21 mi. of its course, down to Revello (west of Saluzzo), the Po descends no less than 5,250 ft., a fall of 47.3:1,000. From the confluence of the Ticino its fall is about 0.3:1,000; from the beginning of the delta below Ferrara, 0.08:1,000. At Turin it has an average width of 400 to 415 ft., a mean depth of 3½ to 5½ ft. and a velocity of 1 to 3 ft. per second. The mean depth from the confluence of the Ticino (altitude 217 ft.) downward is 6 ft to 1 j ft.

The total length of the embankments exceeds 600 mi. Its confinement between these high banks and the great amount of sedimentary matter which the river brings down with it have gradually raised its bed so that in its lower course it is often above the level of the surrounding country. A result is the rapid growth of the delta (1300–1600, 127 ac.; 1823–93, 174 ac.). The Po della Maestra advances 282 ft. annually, the Po delle Tolle 262 ft., the Po della Gnocca 111½ ft., and the Po di Goro 259 ft. The low ground between the lower Po and the lower Adige and the sea is known as Polesine.

Besides the delta of the Po and the large marshy tracts which it forms, there exist on both sides of it extensive lagoons of salt water, generally separated from the Adriatic by narrow strips of sand or embankments, partly natural and partly artificial, but having openings which admit the inflow and outflow of the sea water and serve as ports for communication with the mainland. The best known and the most extensive of these lagoons is that in which Venice is situated, which extends from Lido di Iesolo in the north to Foce del Brenta in the south. a distance of more than 40 mi.; but they were formerly muck more extensive and afforded a continuous means of internal navigation by what were called the "Seven seas," from Ravenna to Altino, a few miles north of Torcello. That city, like Ravenna, originally stood in the midst of a lagoon; and the coast east of it to near Monfalcone, where it meets the mountains, is occupied by similar expanses of water, which are, however, gradually becoming converted into dry land.

The tract adjoining this long line of lagoons is, like the basin of the Po, a broad expanse of perfectly level alluvial plain, extending from the Adige eastward to the Carnic Alps where they approach close to the Adriatic between Aquileia and Trieste and northward to the foot of the main chain of the Alps which there sweeps round in a semicircle from the neighbourhood of Vicenza to that of Aquileia. The space thus included was known in ancient times as Venetia, a narne applied in the middle ages to the well-known city; the eastern portion of it became known in the middle ages as Frioul or Friuli, a district which is of special interest for the form of Romance language still spoken in it.

Returning to the south of the Po, the tributaries of that river on its right bank below the Tanaro which flow from the Ligurian Apennines generally dwindle in summer into insignificant streams. The principal are: (1) the Scrivia, a small but rapid stream flowing from the Apennines at the back of Genoa; (2) the Trebbia, a much larger river which rises near Torriglia within 20 mi. of Genoa, flows by Bobbio and joins the Po a few miles above Piacenza; (3) the Nure, a few miles east of the preceding; (4) the Taro, a more considerable stream; (5) the Parma, flowing by the city of the same name; (6) the Enza; (7) the Secchia, which flows by Modena; (8) the Panaro, a few miles to the east of that city; (9) the Reno, which flows by Bologna, but instead of holding its course till it discharges its waters into the Po, as it did in Roman times, is turned aside by an artificial channel into the Po di Primaro. The other small streams east of this have their outlet in like manner into the Po di Primaro, or by artificial mouths into the Adriatic between Ravenna and Rimini. The Marecchia river, which enters the sea immediately north of Rimini, may be considered as the natural limit of northern Italy. (See RUBICON.) The Savio is the only other stream of any importance that has always flowed directly into the Adriatic from that side of the Tuscan Apennines.

The narrow strip of coastland between the Maritime Alps, the Apennines and the sea (called in ancient times, as now, Liguria [*q.v.*]) is throughout its extent, from Nice to Genoa on the one side and from Genoa to Spezia on the other, almost wholly mountainous. The steep slopes facing south enjoy so fine a climate as to render them favourable to the growth of fruit trees, especially the olive, which is cultivated in terraces to a considerable height up the face of the mountains, while the openings of the valleys are generally occupied by towns or villages, some of which are favourite resorts.

Because of the proximity of the mountains to the sea the rivers in this part of Italy are generally mere torrents. The largest descend from the Maritime Alps between Nice and Albenga: the Roya, which rises in the Col di Tenda and descends to Ventimiglia; the Taggia, between San Remo and Oneglia; and the Centa, which enters the sea at Albenga. The Lavagna, which enters the sea at Chiavari, is the only stream of any importance between Genoa and the Gulf of Spezia. But immediately east of this bay (a remarkable instance of a deep landlocked gulf with no river flowing into it) is the Magra, a large stream that descends from Pontremoli down the valley known as the Lunigiana, and brings with it the waters of the Vara. The Magra (Macra), in ancient times the boundary between Liguria and Etruria, may be considered as constituting on that side the limit of northern Italy.

The Apennines (*q.v.*), as has already been mentioned, traverse the whole breadth of Italy there, cutting off the peninsula proper from the broader mass of northern Italy by a continuous barrier of considerable breadth, though far lower than the Alps. The Ligurian Apennines are a continuation of the Maritime Alps. From the neighbourhood of Savona to that of Genoa they do not rise to more than 3,000 to 4,000 ft. and are traversed by passes of less than 2,000 ft. As they extend toward the east they increase in height; Monte Bue rises to 5,915 ft., while Monte Cimone (7,096 ft.) is the highest point in the northern Apennines.

Between Tuscany and the Emilian provinces a continuous ridge runs from the mountains at the head of the Val di Mugello (due north of Florence) to the point where they are traversed by the Furlo pass or Cola di Furlo. through which runs the Candigliano, a tributary of the Metauro (Metaurus). The highest point in this part of the range is Monte Falterona, above the sources of the Arno, which attains 5,426 ft. Throughout this part of Italy the lower slopes of the Apennines are generally covered with extensive forests of chestnut, oak and beech, while the upper slopes afford good pasture.

Central Italy. — The geography of central Italy is almost wholly determined by the Apennines, which extend in a direction roughly north-northwest to south-southeast almost precisely parallel to that of the coast of the Adriatic from Rimini to Pescara. The line of the highest summits and of the watershed is about 30 mi. to 40 mi. from the Adriatic, while about double that distance separates it from the Tyrrhenian sea on the west. In this part of the range almost all the highest points of the Apennines are found. From the group called the Alpi della Luna (4,770 ft.) near the sources of the Tiber, they continue in Monte Nerone (5,007 ft.), Monte Catria (5,584 ft.) and Monte Maggio to Monte Pennino (5,151 ft.) near Nocera and thence to the Monti Sibillini (7,657 ft.) near the source of the Nera. Proceeding southward there are Monte Vettore (8,064 ft.), Pizzo di Sevo (7,946) and the two great mountain masses of Monte Corno, commonly called the Gran Sasso d'Italia, the most lofty of all the Apennines, attaining to a height of 9,583 ft., and Monte della Maiella, whose highest summit rises to 9,170 ft. Farther south no very lofty summits are found till the group of Monti del Matese (6,725 ft.) in Samnium, which according to the division adopted here belongs to southern Italy, is reached. Besides the central masses there are two other lofty peaks, outliers from the main range and separated from it by valleys of considerable extent. These are Monte Termini110 (7,278 ft.) near Leonessa and Monte Velino (8,192 ft.) near Lago Fucino, both of which are covered with snow from November to May. But the Apennines of central Italy, instead of presenting, as do the Alps and the northern Apennines, a definite central ridge with transverse valleys leading down from it on both sides, in reality constitute a mountain mass of considerable breadth, composed of a number of minor ranges and groups of mountains, which preserve a generally parallel direction and are separated by upland valleys, some of them of considerable extent and considerable elevation above the sea. Such is the now-drained basin of Lago Fucino (*q.v.*), while the upper valley of the Aterno, in which Aquila is situated, is 2,380 ft. above the sea. The valley of the Gizio (*see* SULMONA) connects with the upper valley of the Sangro by a plain called Piano delle Cinquemiglia at a height of 4,298 ft. Nor do the highest summits form a continuous ridge of great altitude for any considerable distance; they are rather a series of groups separated by much lower areas forming natural passes across the range and broken in some places (as is the case in almost all limestone countries) by the sudden turning at right angles of the naters from the upland valleys and their breaking through the mountain ranges which bound them. Thus the Gran Sasso and the Maiella are separated by the deep valley of the Aterno, while the Tronto breaks through the range between Monte Vettore and the Pizzo di Sevo.

This structure of the great mass of the central Apennines has in all ages exercised an important influence upon the character of this part of Italy, which may be considered as divided by nature

into two great regions, a cold and barren upland country, bordered on both sides by rich and fertile tracts enjoying a warm but temperate climate.

The district west of the Apennines coincides in general with Etruria and Latium. The northern part of Tuscany consists to a considerable extent of the lower slopes and of offshoots of the Apennines, which, apart from the slopes and spurs of the main range that constitutes Tuscany's northern frontier toward the plain of the Po, throw out several outlying ranges or groups. Of these the most remarkable is the group between the valleys of the Serchio and the Magra, commonly known as the mountains of Carrara. Two of the summits of this group, Pizzo d'Uccello and Pania della Croce, attain 5,843 ft. and 6.096 ft. Another lateral range, the Prato Magno, which branches off from the central chain at Monte Falterona and separates the upper valley of the Arno from its second basin. rises to 5,426 ft.

The rest of this area is for the most part a hilly, broken country, of moderate elevation, but Monte Amiata, south of Siena, an isolated mass of volcanic origin, attains a height of 5,689 ft.

South of this the country betneen the frontier of Tuscany and the Tiber is in great part of volcanic origin, forming hills with distinct crater basins, in several instances occupied by lakes (Lago di Bolsena, Lago di Vico and Lago di Bracciano). This volcanic tract extends across the Campagna of Rome till it rises again in the group of the Alban hills, the highest of which, Monte Faete and Monte Cavo, rise to more than 3,000 ft. There the Apennines are separated from the sea, about 30 mi. away, by the undulating volcanic plain of the Roman Campagna, from which the mountains rise in a wall-like barrier of which the highest point, Monte Gennaro, attains 4,170 ft. South of Palestrina again, the main mass of the Apennines throws out another lateral mass, known in Roman times as the Volscian mountains (now called the Monti Lepini), separated from the central ranges by the broad valley of the Sacco, a tributary of the Liri or Garigliano, and forming a large and rugged mountain mass, 4,521 ft. in height, which descends to the sea at Terracina, and between that point and the mouth of the Liri throws out several rugged mountain headlands which constitute the natural boundary between Latium and Campania; *i.e.*, between central and southern Italy. Besides these offshoots of the Apennines there are in this part of central Italy several detached limestone mountains, rising like islands, of which the two most remarkable are Monte Argentario on the coast of Tuscany near Orbetello (2,083 ft.) and Monte Circeo (1,775 ft.) on the edge of the Pontine marshes. The two valleys of the Arno (*q.v.*) and the Tiber (q v.) form the key to the geography of central Italy west of the Apennines.

On the Adriatic side the central range approaches much nearer to the sea, and consequently the rivers that flow from it are of little importance. From Rimini southward some of the largest are: (1) the Foglia; (2) the Metauro; (3) the Esino; (4) the Potenza; (5) the Chienti; (6) the Aso; (7) the Tronto; (8) the Vomano; (9) the Pescara; (10) the Sangro; (11) the Trigno, which last forms the boundary of the southernmost province of the Abruzzi and may therefore be taken as the limit of central Italy on the eastern side. This district is much broken up by these rivers and by smaller torrents, but is fertile. especially in fruit trees, olives and vines. It has always been populous, with many small towns but no great cities. Its chief disadvantage is the absence of ports, the coast preserving an almost unbroken straight line, with the single exception of Ancona, the only port worthy of the name on the eastern coast of central Italy.

Southern Italy. — The great central mass of the Apennines, which traverse central Italy from northwest to southeast, continues in the same direction for about 100 mi. farther, from the basin-shaped group of the Altipiano del Matese (which rises to 6,726 ft.) to the neighbourhood of Potenza, in the heart of the region of Basilicata. nhich corresponds roughly to Roman Lucania. The whole of the district knonn in Roman times as Samnium is occupied by an irregular mass of mountains, of much inferior height broken up into a number of groups, intersected by tortuous rivers. This mountainous area. which has an average breadth of from 50 mi. to 60 mi., is bounded on the west by the plain of Campania, called the Terra di Lavoro, and on the east by the broader and more extensive region of Apulia, composed partly of level plains but for the most part of undulating downs, contrasting strongly with the mountain ranges of the Apennines which rise abruptly above them. The central mass of mountains, however, throws out two outlying ranges, the one to the west, which separates the Bay of Naples from that of Salerno and culminates in Monte Sant'-Angelo above Castellammare di Stabia (4,720 ft.), while the detached volcanic cone of Vesuvius (over 4,000 ft.) is isolated from the neighbouring mountains by an intervening strip of plain; the other on the east forming Monte Gargano (3.461 ft.), a detached limestone mass which projects in a bold spurlike promontory into the Adriatic and makes the only break in the otherwise uniform coast line of Italy on that sea.

From the neighbourhood of Potenza the main ridge of the Apennines runs nearly due south to within a short distance of the Gulf of Policastro and thence to Monte Pollino, the last high summit. The range continues, however, through Calabria to the southern extremity or "toe" of Italy; but the broken limestone range, which is the true continuation of the chain as far as Nicastro and Catanzaro and keeps close to the west coast, is flanked on the east by a great mass of granitic mountains, rising to about 6,000 ft. and covered with considerable forests, from which it derives the name of La Sila.

A similar mass, separated from the preceding by a low neck of Tertiary hills, fills up the whole of the peninsular end of Italy from Squillace to Reggio di Calabria.

The long spurlike promontory which projects toward the east to Brindisi and Otranto is a continuation of the low tract of Apulia, with a dry calcareous soil of Tertiary origin. Monte Vulture, which rises in the neighbourhood of Melfi and Venosa to 4,357 ft., is of volcanic origin. East of Vulture the ranges of low bare hills called the Murge of Gravina and Altamura gradually sink into those which constitute the peninsula between Brindisi and Taranto ending in Cape Santa Maria di Leuca, the southeastern extremity of Italy. This projection, the "heel" of Italy, in conjunction with the great promontory of Calabria, forms the Gulf of Taranto, which is about 70 mi. wide.

Of the rivers of southern Italy, the Liri (*q.v.*), which has its source in the central Apennines above Sora, not far from Lago Fucino, and enters the Gulf of Gaeta about 10 mi. E. of the city of that name, brings down a considerable body of water. So too does the Volturno, which rises in the mountains between Castel di Sangro and Agnone, flows past Isernia, Venafro and Capua and enters the sea about 15 mi. from the mouth of the Garigliano. About 16 mi. above Capua the Volturno is joined by the Calore, which flows through Benevento.

The Silarus or Sele enters the Gulf of Salerno a few miles north of the ruins of Paestum. South of this the watershed of the Apennines is near to the sea on the west. Hence the rivers that flow into the Adriatic and the Gulf of Taranto have much longer courses than those of the nest coast, though all have the character of mountain torrents. Proceeding south from the Trigno there are: (1) the Biferno and (a) the Fortore, both rising in the mountains of Samnium and flowing into the Adriatic west of Monte Gargano; (3) the Cervaro, south of this great promontory; (4) the Ofanto, the Aufidus of Horace, which rises about 15 mi. W. of Conza and in its lower course flows near Canosa di Puglia and traverses the battlefield of Cannae; and (5) the Bradano, which rises near Venosa, almost at the foot of Monte Vulture, and flows toward the southeast into the Gulf of Taranto, as do the Basento, the Agri and the Sinni. The Crati, which flows from Cosenza northward and then turns abruptly eastward to enter the same gulf, is the only stream worth mentioning in Calabria; while the arid limestone hills projecting eastward to Capo di Leuca have no rivers at all.

Lakes and Islands. — The great lakes of Italy lie on or near the northern frontier, Orta, Maggiore, Como, Iseo and Garda. These are glacial lakes of great depth, long and narrow and surrounded by mountains. The lakes of central Italy are either alluvial, such as Trasimeno [the only large lake left since Fucino was drained between 1854 and 1876), or crater lakes. The latter

are found in the volcanic districts west of the Apennines and occupy deep cup-shaped hollows which have undoubtedly at one time formed the craters of extinct volcanoes. Such is the Lago di Bolsena, the smaller Lago di Vico (or Cimino) and the Lago di Bracciano, while to the south of Rome the lakes of Albano and Nemi have a similar origin.

The only lake in southern Italy is the small Lago di Matese in the heart of the mountain group of the same name. On the coast of the Adriatic north and south of the promontory of Gargano are brackish lagoons opening to the sea.

For the two great islands of Sicily and Sardinia, see the separate articles. Of the smaller islands that lie near the coasts of Italy, the most considerable is that of Elba (*q.v.*). North of this and about midway between Corsica and Tuscany is the small island of Capraia (*q.v.*). Gorgona, about 25 mi. farther north, is still smaller. South of Elba are the equally insignificant islets of Pianosa and Montecristo (*qq.v.*), while Giglio (*q.v.*) lies much nearer the mainland, immediately opposite the mountain promontory of Monte Argentario. The islands farther south in the Tyrrhenian sea are of an entirely different character. Of these Ischia and Procida, close to the northern headland of the Bay of Naples, are of volcanic origin, as is also the more distant group of the Ponza Islands (*q.v.*). The island of Capri, on the other hand, opposite the southern promontory of the Bay of Naples, is a precipitous limestone rock. The Aeolian or Lipari Islands (*q.v.*), a volcanic group, belong rather to Sicily than to Italy.

The Italian coast of the Adriatic presents a great contrast to that sea's opposite shores, for while the coast of Dalmatia is bordered by a succession of islands, great and small, the long and uniform coast line of Italy from Otranto to Rimini has not a single closely adjacent island; the small outlying group of the Tremiti Islands (north of Monte Gargano and about 15 mi. from the mainland) alone breaks the monotony of this part of the Adriatic.

Geology. — The geology of Italy is mainly dependent upon that of the Apennines (*q.v.*). On each side of that great chain are found extensive Tertiary deposits, sometimes, as in Tuscany, in the district of Monferrato, forming a broken, hilly country, at others spreading into broad plains or undulating downs such as the Tavoliere of Apulia and the area that forms the spur of Italy from Bari to Otranto.

Besides these areas, and if we leave out of account the islands, the Italian peninsula presents four distinct volcanic districts. In three of them the volcanoes are entirely extinct, in the fourth they are still active.

1. The Euganean hills form a small group extending for about 10 mi. from near Padua to Este, separated from the lower offshoots of the Alps by a portion of the wide plain of Padua. Monte Venda, their highest peak, is 1,960 ft. high.

2. The Roman district extends from the Alban hills of Latium (Colli Laziali; see ALBAN HILLS [to be distinguished from Monte Albano north of the Arno]) to the Ciminian hills and thence to the mountains of Radicofani and Monte Amiata. It is generally held that these volcanoes were at first submarine (which would account for the stratification found and for the excellent quality of the volcanic tufa so much used for building stone) and that the coast was gradually raised. (See LATIUM.)

3. The volcanic region of the Terra di Lavoro of Campania is separated by the Volscian mountains from the Roman district. The highest cone of Roccamonfina, at the north-northwestern end of the Campanian plain, is Monte Santa Croce, 3,291 ft. high. The Campi Flegrei cover all the country round Baiae and Pozzuoli and the adjoining islands. Monte Barbaro (Gaurus), northeast of the site of Cumae, Monte Epomeo (2,585 ft.) in Ischia and Camaldoli (1,488 ft.) west of Naples are the highest cones. The lakes Averno (Avernus), Lucrino (Lucrinus), Fusaro (Palus Acherusia) and Agnano (drained) are within this group, which has shown activity in historical times. A stream of lava issued in 1198 from the crater of Solfatara, which still continues to exhale steam and noxious gases; the Lava dell'Arso came out of the northeastern flank of Monte Epomeo in 1302; and Monte Nuovo, northwest of Pozzuoli (455 ft.), was thrown up in three days in Sept. 1538. Since the eruption in A.D. 79, Vesuvius (*q.v.*) has been constantly active.

4. The Apulian volcanic formation consists of the great mass of Monte Vulture.

The whole of the great plain of Lombardy is covered by Pleistocene and Recent deposits. It is a great depression — the continuation of the Adriatic sea — filled up by deposits brought down by the rivers from the mountains. The depression was probably formed during the later stages of the gro th of the Alps.

Climate. — The geographical position of Italy makes it one of the hottest countries in Europe. The effect of its southern latitude is, however, tempered by its peninsular character and by the great range of the Alps with its snows and glaciers to the north. There are thus irregular variations of climate, and great differences exist between northern and southern Italy. The climatic frontier between Italy and central Europe is formed rather by the Apennines than by the Alps.

The great plain of northern Italy is chilled by the cold winds from the Alps, while the damp warm winds from the Mediterranean are to a great extent intercepted by the Ligurian Apennines. Hence that part of the country has a cold winter climate, so that while the mean summer temperature of Milan is higher than that of Sassari, Sardinia, and equal to that of Naples, and the extremes reached at Milan and Bologna are a good deal higher than those of Naples, the mean winter temperature of Turin is actually lower than that of Copenhagen. The lowest recorded winter temperature at Turin was 5° F.

Central Italy also presents striking differences of climate and temperature according to the greater or less proximity of any given area to the mountains. Thus the greater part of Tuscany and the provinces between it and Rome enjoy a mild winter climate. The increasing height of the Apennines as they proceed south produces a corresponding effect upon the temperature. In the central range of the Apennines are the coldest districts of Italy. In all the upland valleys of the Abruzzi snow begins to fall early in November, and heavy storms occur often as late as May. Potenza has one of the coldest climates in the country and the lowest summer temperature. Southern Italy has in general a very different climate from the northern part and, though large areas are occupied by mountains sufficiently high to retain the snow for a considerable part of the year, the districts adjoining the sea enjoy a climate similar to that of Greece and the south of Spain.

Rainfall is heaviest in the Alps and lightest in the lowlands. The prevailing westerly winds bring rain to the west of the mountains, leaving the east comparatively dry. There is permanent snow only in the Alps.

Flora. — About 4,000 species of flowering plants have been identified in Italy, very few of which are endemic. Although there is a certain amount of overlapping, they belong to two distinct types of plant community: the central European species from the north; and the Mediterranean species from the south and east. Characteristic of the central European element are coniferous and deciduous forests and brushwoods, perennial herbs that die down before the winter frosts begin and alpine plants. These types are found in the Italian Alps and most of the northern plain and along the Apennines as far south as northern Sicily. Along the coastal strips (particularly by the Tyrrhenian sea) and around the shores of the Alpine lakes, the mildness of the climate enables Mediterranean and even subtropical plants to flourish. Coniferous forests containing Mediterranean species of pine and juniper, macchie (low scrub), hills clothed with olives, flowering annuals and plants with underground bulbs are characteristic of the Mediterranean element. They are mainly found in the peninsula and in the islands. The characteristic cypress, found in and around so many villages and cemeteries, the ilex growing on the hills and the stone pine. found chiefly near the coast, are also native trees. The high proportion of evergreens has a marked effect on the landscape in winter.

In the montane zones of the Alps and, to a lesser extent, of the Apennines, there are extensive coniferous forests consisting of various pines, larch. silver fir and spruce (only native in the Alps and northern Apennines but planted elsewhere). Of deciduous trees the beech is widespread in the Alps and along the Apennines

to northern Sicily uhere it grows up to 6,000 ft. or more on Mount Etna. The sneet chestnut covers vast areas in the montane zones, but in Sicily it grows mostly on the mountains of the northeast. It was planted to replace the native oaks because of its food value. Deciduous brushwoods in this zone consist of oaks (often coppiced), hazel and other shrubby plants. In the Alps, above the forest limit, come the brushwoods where the green alder is often the dominant plant with dwarf junipers, alpine roses, etc. This kind of brushwood is less well developed in the Apennines. In the Mediterranean regions, characteristic of the macchie are the strawberry tree *(Arbutus)*, mastic, *Pistacia terebinthus*, heaths and aromatic herbs.

Up in the mountains, above the brushwoods, alpine pastures occur between the rocks and the bogs. In addition to many grasses, sedges and rushes, brilliantly flowering plants such as gentians, saxifrages, *Primula* and many more flourish. Among the rocks and stones grow houseleeks. stonecrops, edelweiss and so on. On the screes and slopes alpine pinks, alpine anemones, gentians, dwarf rhododendrons and others find a footing.

It is remarkable that many of the more conspicuous plants of Italy are of comparatively late introduction. More than 350 which are now established were unknonn in ancient times. The orange and lemon are late importations from the east and they and the mulberry. which has been cultivated for centuries, are abundant in all areas free from frost. Vines. both wild and cultivated, grow everywhere. Prickly pears (*Opuntia*), agave and Indian corn, so common on the shores of southern Italy and along the Riviera di Ponente. are of Mexican origin and so could not have been introduced earlier than the 16th century. The sweet chestnut was introduced by the Romans, or possibly before. The eucalyptus is of quite modern introduction and has been extensively planted in malarial districts. Among trees the locust tree *(Robinia pseudoacacia)* and the bastard indigo (*Amorpha fruticosa)* from North America are naturalized and grow everywhere. Two North American aquatic plants have become important because of their high rate of increase, the Canadian pondweed *(Elodea canadensis)* and *Azolla caroliniana*.

Fauna. — The natural fauna of Italy shows relationships with the fauna of central Europe, the Balkans and Africa. The number of species of beasts and birds is much smaller than it should be because of the unchecked killing that continued for centuries. Some animals owe their preservation to the big landowners of the past and are now protected by the state. Bears are extinct except for a few in the upper Sangro valley in the Abruzzi; wolves are rare and are found chiefly in the Abruzzi, in the mountainous districts of the south and in Sicily. Roe deer are the commonest deer, but there are also red deer in certain places such as the Venetian Alps; the chamois still lives in the Alps but is uncommon; the ibex or wild goat *(stambecco)* is restricted to the Gran Paradiso national park. The most abundant of the larger mammals is the wild pig. The arctic hare, marmot and ermine occur in the high Alps; the wildcat haunts the coniferous forests of the Alps, Tuscanp and Sicily. The west slopes of the Calabrian mountains and Sicily are the chief homes of the hedgehog. porcupine and badger. Hares, foxes, martens, weasels, squirrels, dormice and moles (absent from Sicily) are found in all suitable places. The sea mammals include the common dolphin.

Shooting has made birds noticeably scarce so that there are very few smaller resident species. The most widespread of the larger birds is the partridge, but in the Alps there are still blackcock, capercaillie, ptarmigan and other game birds. There are many kinds of waterfowl, mostly migratory, in the marshes, and a small colony of green ibis near Vercelli. Birds of prey, such as eagles, falcons and vultures, being inedible, have escaped persecution and are common. In the spring and autumn migrating birds, especially the smaller ones such as quails, larks and thrushes, are snared in huge numbers for food.

There are not very many fresh-water fish. except eels; the most important are trout in thk mountain streams, pike and perch in the northern rivers and lakes, and tench and salmon. Of sea fish there are many varieties, the tunny, sardine and anchovy being commercially the most important. Small cuttlefish are commonly eaten. Lizards are found everywhere. Among poisonous animals are vipers in the mountains. especially in the Alps, a centipede (*Scolopendra*), the little scorpion, the tarantula, vault spiders and many mosquitoes. Migrating grasshoppers sometimes attack parts of the country. There is a great variety of seashore animals, especially along the southern shores.

See J. Sion, "Italie," in L. Gallois and P. Vidal de la Blache (eds.), *Géographie universelle*, vol. vii, part 2, pp. 235–394 (Paris, 1934); and A. Mori (ed.), *L'Italia: caratteri generali* (Milan, 1936).

(T. A.; M. M. C.)

ARCHAEOLOGY

Archaeology had its beginnings in Italy in the attempt, made even before the Renaissance, to satisfy the curiosity of pilgrims about the marvels of ancient Rome. A more unscientific guidebook than the *Mirabilia Urbis Romae*, probably composed *c.* 1140–43 (*see* R. Valentini and G. Zucchetti, *Codice Topografico della Città di Roma*, iii, p. 6, Rome. 1946) and first issued in manuscript, could hardly be found; but its very flaws betrayed the need for more adequate statements and revisions soon came. A more effective spur to accurate knowledge of antiquities was the desire of artists to collect and study ancient fragments as models for their own work. Niccola Pisano in the 13th century turned to antiquarian studies for this purpose; much of Andrea Mantegna's work shows him to have had an almost excessive enthusiasm for the antique; and Michelangelo began his modelling nith a study of the collection of antiques that the Medicis had made in Florence. Similarly painters sought for hints in the buried rooms that contained the wall decorations of Rome's imperial palaces.[1] In some rooms of Nero's Golden house, discovered and first entered in the 15th century, many artists left their names on the stuccoed walls while going through with torch and notebook, and designs from the same rooms were copied and used by Giovanni da Udine and Raphael in decorating the loggias of the Vatican. Even more diligent and exact was the study of Roman architectural remains by the Renaissance architects. Brunelleschi made an exhaustive study of the Roman monuments before he began the construction of the dome of Santa Maria del Fiore in Florence in 1417; Raphael, who for several years was commissioner of antiquities at Rome, drew up elaborate plans for the publication of ancient monuments; Bramante and Michelangelo, who had to prepare themselves for the task of designing the new St. Peter's, spent much time in appraising such structures as the Pantheon and Constantine's basilica. The voluminous notebooks of architects[2] (Giuliano da Sangallo. Baldassare Peruzzi, Pirro Ligorio, Andrea Palladio, Labacco and others) reveal a keener study and saner comprehension of the principles of Roman architecture than was possessed by the students of the 17th century. Since many structures seen by these men later disappeared their notebooks have proved to be of inestimable value to modern archaeologists. Finally, there mere men at the very dawn of the Renaissance who appreciated the value of the information contained in ancient inscriptions. Cola di Rienzi, for instance, in 1347 read to the people the bronze fragment of Vespasian's so-called *lex de Imperio*, exhibited by him on that occasion at the Lateran to prove that in antiquity the emperors of Rome derived their authority from the people.

THE RENAISSANCE

The First Museums. — The Renaissance had a far larger store of architectural remains to draw upon than did later students; of statuary. however, there was but little. Though a Constantinian description of the city, as transmitted through devious channels, appears to have mentioned the existence of 3,j8j bronze statues in Rome in the 4th century. Poggio. when travelling through the city in the 1jth century, could find only the "Capitoline Wolf" and the equestrian statue of Marcus Aurelius; and in the 20th century there were but few more bronze statues from Rome itself. Bronze, of course, had suffered most from the vandalism of the middle ages,

[1] T. Ashby, *Drawings of Ancient Paintings in English Collections* (Brit. School, 1914–16); F. Weege in *Jahrb. Arch. Inst.*, pp. 151–229 (1913).

[2] *E.g.*, A. Bartoli, *I Monumenti Antichi di Roma nei Disegni degli Uffizi di Firenze* (1914–22); Ashby, *Drawings Attributed to Andreas Coner* (Brit. School, 1904).

but antique marble statues were almost as scarce in Poggio's day. However, the great activity in building that set in at Rome in the 15th century led to quarrying in the old ruins for building materials; and in such delving many marble statues were found which, if noticed by artists, were saved from the contractors' limekilns. Pope Sixtus IV, who was guilty of destroying several old structures in his search for materials, is to be thanked for starting the good custom at Rome (the Medicis had anticipated him at Florence) of saving such statuary by founding the Capitoline museum in 1471. A generation later (1506) Julius II established the Belvedere court in the Vatican palace to serve as a museum, and the Laocoon group found that year was placed there, to join the famous "Apollo Belvedere" and soon to be joined in turn by the Apollonius torso. Shortly after. Michelangelo at public expense set up the equestrian statue of Marcus Aurelius on the Capitoline and arranged the fragments of the consular *fasti*, recently found, in a room in the palace of the Conservatori specially adapted for them.

Destruction of Ancient Remains.—Excavations were not yet conducted solely for the acquisition of knowledge of art or of the past. The digging was a more or less haphazard mining for objects to sell or to use in decorating villas, or it was conducted under papal concession with stipulations to produce so many cartloads of marble or travertine. In such cases the fragmentary statues that were found all too frequently went into the limekiln. For constructional and decorative work Roman marble had gone far and wide. There are precious marbles in the cathedral of Aachen that were brought from Rome by Charlemagne; a large part of the cathedral of Pisa was built in the 11th century at the expense of the ruins of Ostia. The baptistery of Florence and the cathedral of Orvieto are largely of Roman material, as are even some tombs in Westminster abbey. Practically all the palaces and churches of Renaissance Rome derived their marbles from the old ruins. Nearly half the outer ring of the Colosseum and large parts of the Basilica Julia. of the Circus Maximus and of many other buildings were allotted to contractors. Almost all the buildings of the Forum, now represented by bare cores of concrete and brick, had their marble facings stripped off by quarrymen long before the scientific excavator cleared away the debris in the 19th century. Fortunately the art-loving draughtsman was often at hand to sketch the architectural decorations before they were hauled off, and the scholar often had a chance to copy the inscriptions before they were destroyed. And though marble made a very fine lime and fragments of statuary therefore risked much in being discovered, there was a good demand for the statuary itself by the end of the 11th century. From that time most of the best objects brought to the surface doubtless survived.

In 1444–46 Flavio Biondo composed a *Roma Instaurata* which was much more than an improvement on the traditional guidebooks. It rejected mediaeval legends and described old Rome from a careful study of classical texts, also attempting (with no little success) to identify the ruins then existing. The book is modern in the spirit of its scholarship, and its publication proves that many were interested in what may legitimately be called archaeology. In 1453 Biondo's *Italia Illustrata* did the same work for a large part of Italy. To be sure the modern reader discovers many errors in these two books, but if they are approached from the *Mirabilia* rather than from the point of view attained after centuries of research. the merits of this courageous scholar can only be admired. It is not surprising that by 1478 Rome had an academy of antiquaries devoted to the study of topography and monuments as well as of texts.

After the disastrous looting of Rome by the imperial army in 1527. interest in ancient art waned for a time. The popes of the 16th century after Julius II did little for the museums and mere very free in giving grants to contractors to tear down and use the materials of old monuments. Thus the tomb of Caecilia Metella and the Janus Quadrifrons were saved only by the remonstrances of the populace after grants had been given to dispose of them. The famous Septizonium stood till 1588 when Sixtus V ordered Domenico Fontana to use its materials for the repairs of several churches and public buildings.

Inscriptions.—Meanwhile a scientific interest in inscriptions was growing. It has been shown how Rienzi made use of one to demonstrate a historical fact. Ciriaco of Ancona[1] (*c.* 1390–*c.* 1450), attracted to the subject by a collection of inscriptions made by Poggio, made careful copies during his extensive mercantile journeys, inspired by the conviction that these stones often attested facts of history more reliably than the texts. His collection, prepared before the invention of printing, did not survive as a unit, but his manuscripts were freely used by other scholars. After him others made similar collections, often intercepting the stone on the way to the limekiln and rescuing its readings. The large collection of Panvinius (Onofrio Panvinio, 1529–68) seems to have fallen into the hands of Smetius, a diligent Dutch epigrapher whose own cpllection (as published with additions by Justus Lipsius, 1588) in turn went into the first great corpus of inscriptions that purported to be complete, the famous collection of Jan Gruter (1603). Joseph Justus Scaliger (1540–1609) made this corpus available for antiquarian studies by classifying its vast store of facts in 24 indexes. Raphael Fabretti (1619–1700) was the next scholar who gathered and interpreted inscriptions with success, publishing his thorough work on the Roman aqueducts in 1680. The marchese Francesco di Maffei (1675–1755) did valuable service by submitting to keen criticism the large collection of Lodovico Muratori; Gaetano Marini (1742–1815) emended and explained the difficult inscriptions of the Fratres Arvales (1795), and finally Bartolommeo Borghesi (1781–1860), by his keen analysis of the accumulated material and his vast series of studies in history and administration which were based largely upon epigraphical sources, determined and illustrated the methods of epigraphy. Theodor Mommsen, inspired by the work of Borghesi, elaborated a plan for a new and more scientific collection of all Latin inscriptions and, producing a volume to serve as a model, persuaded the Berlin academy to undertake the publication of a complete corpus on this plan. From 1862 the volumes of this *Corpus Inscriptionum Latinarum* were issued in a consistent stream.

17TH AND 18TH CENTURIES

Private Collections.—To return to the subject of sculpture, it was chiefly in the 16th century that the great princely collections of Italy were formed—the older Borghese (later sold to Napoleon), the Barberini, the Pamphili treasures, the even more remarkable ones of the Ludovisi and the Giustiniani, not to mention a number of smaller ones. Parts of these were made up by purchase. but digging on the vast estates of the princes themselves yielded no small part of them. When some of these nobles were forced to sell portions of their collections, the courts of Madrid and Dresden began to buy antiquities extensively, and in the 17th and 18th centuries Englishmen made purchases for the decoration of their country places *(see* F. Poulsen. *Greek and Roman Portraits in English Country Houses,* Oxford, 1922). Thus English, French and German dilettanti became interested in Greek and Roman art and had no small share in encouraging a more careful study of the subject.

Herculaneum.—Meanwhile Herculaneum and Pompeii had become known. In 1709 Emmanuel Maurice, duc d'Elbeuf, sank a shaft through the lava where it was known that ancient remains lay, and these were speedily identified as belonging to Herculaneum. By good fortune the ancient theatre was soon found and many pieces of bronze and marble statuary recovered. In 1738 Charles VII of Naples (later Charles III of Spain) continued the work, which he placed largely under the direction of Spanish military engineers. Diaries of valuable objects found were now kept, though as yet no systematic records of the daily excavations. In 1750–55 the splendid Villa of the Papyri with its scores of statues was excavated. Two years later the Accademia Ercolanese was formed. Between 1757 and 1792 it published eight finely illustrated volumes of excavated objects and these, though deficient in aesthetic analyses, are still of value as a record. King Charles also made trial excavations at Pompeii. where the debris was more easily moved. His operations were begun by about 12 men burrowing here and there for chance finds. Not till 1763, when the advice of the Accademia Ercolanese was followed, was the debris

[1] *See* Sir J. E. Sandys, *Latin Epigraphy,* p. 22 (Cambridge, 1927).

permanently removed from the excavated areas. Notes of finds were still kept in desultory fashion. A careful record of daily work was not thought of, and no attempt made to preserve what was not immediately taken to the royal collections.

Winckelmann.—In 1755 Johann Winckelmann, inspired by the collection of antiquities which Dresden had acquired from Rome. went south to study. He spent years with the collections of Rome and Herculaneum and, as a fruit of this study, issued in 1764 his epoch-making *History of Ancient Art,* in which he attempted to outline the history of art from early Egyptian times (the Vatican had a few examples of Egyptian art discovered in the debris of Rome) to late Roman times. To be sure there were at Rome and Naples very few examples of genuine Greek art; consequently Winckelmann could not produce a well-proportioned history. Indeed the English dilettanti of the period had acquired in their travels in Greece a more accurate comprehension of the best in ancient art though they were at the time more concerned in describing and analyzing portions than in recording the story of the whole. The services of Winckelmann were of the kind that appeal particularly to the scholar. in that his book provided a model of careful description, aided the memory and gave points of view for the classification of new discoveries. The book mas very influential at the time and nhen, before the end of the century, the Pio-Clementino museum was opened in the Vatican, Giovanni Battista Visconti, and still more his son Ennio Quirino, wrote the catalogue of the splendid collection with a mastery of the technique that owed much to Winckelmann.

The Napoleonic period brought new funds and some enthusiasm for excavations. The work at Pompeii was pushed with more vigour and nith some system. The French architect Charles Mazois brought out a valuable publication of the finds, especially architectural. The eagerness to find works of art worthy of the museum was still dominant, but it was no longer the sole object. The savants in Napoleon's train cannot be denied an appreciation of the encyclopaedist's vienpoint. At Rome the most important archaeological work of this regime was the very costly excavation of the centre of Trajan's forum, a work not then finally completed. During this period however. Italian archaeology came near to receiving a severe blon in that Napoleon removed to Paris many of the best norks of the art of Rome (1797) and, with them, the able archaeologist Ennio Visconti. But with the fall of Napoleon the papal delegate to the peace conference successfully reclaimed most of the treasures that had belonged to the Vatican and Capitoline museums. Italy thus regained its position of first importance for students of classical archaeology.

THE 19TH CENTURY

Upon the re-establishment of the papal government the work of excavation continued. Carlo Fea *(see* below) has a strong claim to be considered the founder of scientific excavations, though the above-mentioned works by Fabretti and Marini rank high as publications. An epoch in archaeology was marked by the foundation of the Instituto di Corrispondenza Archeologica in 1829 by a group of about 70 scholars, about equally divided among Italian, German. French and English savants. Its purpose mas to get support from as wide a circle of scholars and dilettanti as possible for good reporting and publication of finds, to raise the standards of work, to discuss antiquities in frequent sessions and to gather an adequate library in Rome. The head of the institute was the duc de Blacas (Pierre Louis Jean Casimir, duc de Blacas d'Aulps), while the more active spirits were the German scholars Eduard Gerhard and Christian, baron von Bunsen, and the Italian Carlo Fea. The annual publications. called the *Annali* and the *Bollettino,* and the occasional *Monumenti Inediti* kept the members all over Europe well informed in careful reports of all important work progressing and did much to encourage excavators to do their work in the most approved fashion. After many vicissitudes the body finally (in 1871) emerged as the German Archaeological institute, which down to World War II carried out excellent work at Rome.

During the 19th century official and unofficial excavations were carried on all over Italy *(see* Adolf Michaelis, *A Century of Archaeological Discoveries,* Eng. trans., 1908). A brief survey of what was accomplished in the Roman Forum will best reveal the trend of archaeological work. After 1800 there n-as at least no more sheer vandalistic quarrying. Indeed the wholesale mining of the 15th and 16th centuries had not left many usable pieces of building material in the debris. Hence the excavators of the 19th century had little hope of finding much except bare foundations with which to reconstruct the ground plans of the old Forum. However, the spirit of historical criticism, revealed in the works of Giovanni Vico. Ednard Gibbon and Barthold Niebuhr, was non also the driving spirit of the archaeologists. Hence it is not surprising to find that Carlo Fea. placed in charge of excavations by Pope Pius VII in 1803. determined upon a thorough removal of all debris and an orderly recording of finds for the primary purpose of reconstructing the plans of the buildings of which he should find traces. He worked systematically near the arch of Septimius Severus and near that of Constantine. The French government continued nith no loss of zeal from 1810 to 1813, adding the Velia near the arch of Titus to the program. (A few years later, in 1821, Giuseppe Valadièr was commissioned by Pius VII to restore the arch.) With the return of Pius VII Carlo Fea again was placed in charge, now delving into the debris near the three columns of Castor. Some aid was now accepted from foreigners interested in the work, such as Elizabeth. duchess of Devonshire, and the duc de Blacas, nho was the French ambassador. From 1827 to 1835 much was accoinplished near the temple of Concord. and a portion of the Basilica Julia was uncovered under the direction of Antonio Nibby. Pius IS employed the somewhat too imaginative Luigi Canina who continued the work at the west end of the Forum. Fea, Nibby and Canina unfortunately were all somewhat misled by the fantastic plans of the Forum drawn by the 17th-century architects. Stefano Piale, in 1832, submitted these plans to sharp criticism but failed to carry conviction against the voluminous and picturesque publications of Canina. It was not till about the middle of the century that archaeologists reached some degree of consensus about the correct orientation of the Forum and the right designation of several of the foundations. After Canina's death excavations progressed very slowly until 1870, nhen the ne\\ royal government took up the nork with vigour. placing in charge Pietro Rosa, who had excavated on the Palatine for Napoleon III. Rosa cleared a large part of the Basilica Julia and of the central part of the Forum during the next six years. Unfortunately he sometimes left his finds in tantalizing confusion. In 1876 Giuseppe Fiorelli, nho had developed an excellent technique at Pompeii (1860–75), came to Rome to take charge. He knew the value of meticulous reporting and was influential in having the Reale Accademia Nazionale dei Lincei begin in 1876 the valuable official publication ot excavations in the *Notizie degli Scavi.* Fiorelli cleared most of the area along the Sacred Way from the temple of Divus Julius to the arch of Titus; and in 1882–84 Rodolfo Lanciani, to whom Roman topography owes much, demonstrated in the clearing of the Atrium Vestae that archaeologists needed not only to excavate and report but also to protect the ruins and dispose of the objects found in such a way that the student might correctly read the meaning of what was left.

The imperial street level had now been reached throughout the central part of the Forum, and after 1884 the state suspended work until more properties could be bought. However, several individuals, notably Christian Huelsen, W. L. Nichols and O. L. Richter, were permitted to make researches which proved fruitful. Meanwhile historical criticism was somewhat influencing archaeology in that it demanded data on the period of early Rome and insisted that the spade must penetrate beneath the imperial pavements. In 1898, when Guido Baccelli was minister of public instruction, the energetic and imaginative architect Giacomo Boni was placed in charge of excavations and permitted to dig to lower levels. The results mere impressive. In 1899 the "black stone" was found and beneath it the famous archaic inscription with many primitive objects about it. Then there came to light the old Vulcanal, foundations and decorative terra cottas of the early republic and finally, in 1901–03, the *sepulcretum* on the edge of the Forum, which at once confirmed many traditions regarding primitive Rome. The public was perhaps more ready to appreciate the new discov-

eries than the archaeologists to interpret them. but scholars of all nations especially Huelsen. Richter and T. Ashby, aided in the publication and in the discussion of the finds. The abovemementioned German institute had excellent scholars on its staff, and the French school had been established in 1873, the American School of Classical Studies in 1894 (later merged with the American Academy in Rome) and the British school in 1901. The Forum was to these a fruitful laboratory of observation. After 1904 Boni shifted his interests more and more to the Palatine but left to his successors the task of utilizing his notes on the excavations.

Meantime there were many sporadic finds of importance all through Italy, rome in systematic excavations, others in the course of private building operations. The Alexander mosaic. nhich indirectly contributed much to the history of painting, came to light at Pompeii in 1831, the "Lateran Sophocles" at Terracina in 1837, the "Augustus of Prima Porta" in 1863, the foundations of the Capitoline temple in 1865, the house of Livia in the French excavations of the Palatine in 1869, the house of the Farnesina gardens in 1878. the Apollonius bronze pugilist in 1884, the Ludovisi throne in 1887, the silver treasure of Boscoreale in 1895 and the last fragments of the "Ara Pacis" in 1903 and 1937.

ETRUSCAN AND PREHISTORIC

Etruria.—In Etruria occasional finds had been made ever since the Renaissance and gathered to public and private museums. These had created a local interest in Etruscan art but a general enthusiasm was hardly aroused until 1827 when scme tombs with remarkable wall paintings were opened at Corneto (the ancient Tarquinii). The very next year Lucien Bonaparte found that his estate in Etruria contained a large part of the vast cemetery of ancient Vulci, and the feverish excavations that followed brought to light hundreds of the finest Greek vases. When these were carefully published by Gerhard in the *Rapporto Volcente* of the Instituto di Corrispondenza Archeologica in 1831, which contained the first logical classification of such ware, the real study of Greek vase painting began.

When in 1836 Alessandro Regolini and T'incenzo Galassi found at Cerveteri the remarkable tomb nhich bears their name. and the objects nere placed by Pope Gregory XVI in the Vatican, the artistic outlook was at once widened by connecting Etruria nith the east. Xlphonse François, in 1844, found at Chiusi the splendid black-figure vase later placed in Florence, and this proved stimulating to archaeological study by filling a serious lacuna in the story of vase painting. When in 1848 George Dennis issued his remarkable work called *Cities and Cemeteries* of *Etruria,* most of the important sites cf Etruria had been discovered and to a large extent exploited.

Meanwhile the marchese Giovanni Campana had. in private excavations conducted largely for the sake of enlarging his own collection. found the tomb at Veii named after him (1842). It was not till 18jo that he disclosed the Grotta dei Rilievi at Cerveteri, with its painted stuccoes and its remarkable terra-cotta sarcophagus. He was exceedingly successful in the Etruscan field; but in his enthusiasm he neglected sadly to record his excavations, and when because of bankruptcy his magnificent collection nas sold, the larger parts to Paris and St. Petersburg, Italy had lost not only very precious relics of past art but also much of the evidence essential to the proper coinprehension of that art. Campana was. of course, working for himself in a divided Italy nhere uniform state supervision of excavations could not exist. During this period it nas largely as a result of the activities of the Instituto di Corrispondenza Xrcheologica at Rome that specialists were at times allowed to inspect diggings. to report them with some care and by their reports. to shame exploiters into some respect for scientific interests. But it was only after the unification of Italy, when such excavations were placed under the supervision of a government department, that they could be properly controlled and adequately published. It would be difficult to overstate the debt that art and archaeology one to the Italian go ernment for its enlightened interest, for its generous expenditure on excavations, museum buildings and publications and for its intelligent choice of genuine scholars to conduct the necessary work.

Prehistoric Archaeology.— Prehistoric archaeology ultimately became very important in Italy, but it was slow in arousing attention because of the nealth of classical works of art to be found and interpreted. The Terramara sites of the Po valley were locally known in the 18th century, but were pronounced to be Cimbric or Boian sites of little interest. As early as 1817 Alessandro T'isconti had had the breadth of view to give a valuable description *(Diss. Acad Rom.,* i, 2) of the Iron Age cemetery discovered by chance shortly before in the Alban hills, but the objects found were not properly cared for and their importance was not generally recognized. Real interest was awakened only after the first Hallstatt finds had attracted scholarly attention in 1846 and the pile dwellings of Zurich had been found in 1854. In 1853 the Villanovan cemetery near Bologna was discussed by Giovanni Gozzadini, who first proposed the theory that the Villanovans were proto-Etruscans. Louis Gabriel de Mortillet, excited by the discoveries at Zurich, set out to find similar settlements on the borders of the Italian lakes and succeeded in 1860. The next year Bartolomeo Gastaldi made a first attempt at explaining the construction of the Terramara sites; and Luigi Pigorini, with an enthusiasm and keen judgment which for more than 60 years proved so fruitful for Italian prehistory, turned to the problem in 1862 and 1564. After giving a good survey of this field of study at the anthropological congress at Stockholm, Sned., in 1874, he founded in 1875 the *Bollettino di Paletnologia Italiana,* which at once became a leading publication distinguished for thoroughness and sanity. He now built up a remarkable prehistoric museum in Rome and induced the government to grant funds for systematic excavations on prehistoric sites and to impose a careful supervision over private excavations. G. A. Colini. who later had charge of the museum in the Villa Giulia (devoted largely to Etruscology). also turned his talents to the investigation of prehistoric remains, issuing an important series of studies in this field. Antonio Taramelli also norked tirelessly on the island of Sardinia, and Paolo Orsi, while chiefly interested in the Greek civilization of Sicily and Magna Graecia. by no means neglected the prehistoric sites of his field. Oskar blontelius, nith his monumental work *La Civilisation primitive en Italie,* was useful in spreading a knonledge of this subject. That was followed in England by T. E. Peet's *The Stone and Bronze Ages in Italy* (1909) and by D. Randall-MacIver's *The Villanovans and Early Etruscans* (1924) and *The Iron Age in Italy* (1927). The remarkable corpus of prehistoric finds contained in Friedrich von Duhn and Franz Messerschmidt's *Italische Graberkunde* (1924, 1939) is a work of profound erudition; von Duhn had for 50 years been reporting all the important excavations nith a steady judgment and unsurpassed grasp of the subject.

Excavations in the 20th Century.— After about 1910 excavations were continued with renened vigour by the government and in the charge, usually, of the most competent scholars Of these undertakings only the most important can be mentioned In the north the researches at Este and in Picenum led to discoveries of great importance to anthropology, and abundant material nas found at Bologna, Vulci, Veii, Terni and in the Alban hills for the further study of the Villanovan period

For Etruscan studies. Caere yielded exceedingly fine Greek vases besides valuable funerary objects and inscriptions of importance in restoring the history of Etruscan culture from the earliest days till Roman times. Unfortunately. very fen of these tombs have been published *(see* Raniero Mengarelli in *Studi Etruschi,* p. 145, 1926; Pallottino, *La Necropoli di Cerveteri*). Veii proved unexpectedly fruitful. The foundations of a three-cella temple were found, and near it considerable fragments of the late 6th-century terra-cotta figures which once stood upon the ridgepole and later were placed in a special room in the Villa Giulia. The "Apollo Contending With Hercules" is a masterpiece (Pallottino, *La Scuola di Vulca,* 1941). On the acropolis of the city were found parts of the old fortifications, foundations of several Etruscan dwellings, tno public buildings and a large elliptical basement supposed to be the foundation for a straw-thatched town hall of very early date. Farther north nere discovered the stone walls of a 7th-century dwelling house of five rooms—the oldest

structure of its kind in Italy (*Not. d. Scavi*, p. 166, 1913; p. 380, 1922). The tombs proved that Veii was once a Villanovan city which fell into the hands of Etruscan rulers some time before Rome's foundation.

At Populonia, which prospered on the manufacture of the iron ore of Elba, many important finds were made. During World War I numerous shiploads of iron slag from the ancient Etruscan furnaces were removed for resmelting, and in the process an old cemetery was uncovered. These tombs and others near by were found to be well stored with urns, arms and ornaments, the first harvest of which A. Minto published in a volume entitled *Populonia*. A similar series of excavations at Marsiliana was also published by the same scholar. The systematic exploration of the site of the city of Tarquinii yielded far-reaching results, especially from the walls and the great temple with its terra-cotta adornment (*Not. d. Scavi*, p. 193, 1948). At Orvieto a 4th-century Etruscan temple with excellent pedimental terra cottas was found, important especially because of the tendencies of contemporary Greek art which they reflect. Good illustrations of these finds were published in *Dedalo* (vol. vi, p. 137, 1925–26). Vignanello yielded good Greek vases as well as much Etruscan ware. A grave at Todi was found to contain numerous red-figure vases and some Etruscan armour. Finally, at Rome, on Monte Mario behind the Vatican, casual building operations revealed a very interesting 7th-century Etruscan village built over the site of an early Bronze-Age settlement. A special journal for Etruscology called *Studi etruschi* was launched at Florence in 1926. The corpus of Etruscan inscriptions was also advanced by several fascicules with many new inscriptions, but by the 1950s no real advance had been made toward their interpretation.

LATER FINDS IN ROME

The city of Rome at mid-20th century was still yielding a constant stream of ancient works of art. The government secured possession of the Capitoline hill and ordered the excavation of the site of Rome's chief temple. The massive foundations of Tarquinius' structure were laid bare and found to agree with the dimensions recorded by ancient authorities (*Not. d. Scavi*, vol. xviii, p. 38, 1921). Unfortunately, little or nothing of the decorative terra cottas of the old temple came to light, but an interesting deposit of early votive objects was found not far from it. At the foot of the hill, the vicinity of the church of Sant' Omobono proved to be rich in early materials, chiefly terra cotta. On the Palatine the rear of the imperial palace was cleared in 1907, and excellent wall paintings and mosaics of the Claudian and Neronian periods were brought to light in abandoned rooms beneath. In other rooms found under the front of the palace were discovered wall decorations of great interest dating from the Sullan period (*see* ROME: *Palatine Hill*). The so-called Villa Mills was stripped of its modern decorations to facilitate the examination of the walls which proved to be ancient. The most valuable treasure yielded by the Palatine was the exquisite "Nike" or "Aura" (Brunn-Bruckmann, *Denkmaler*, nos. 766–767). In the 1950s, the administration of Forum and Palatine was in the midst of a thorough investigation of the deepest levels and the earliest periods of occupation of both sites.

The government excavated a large part of the Augustan Forum. The numerous architectural fragments found from the temple of Mars Ultor, the portico near by and the marble covering of the enclosing wall are of great beauty and precision, and several inscriptions of historical importance also came to light. This excavation was continued northwest into Trajan's Forum and southeast into Nerva's. Furthermore the theatre of Marcellus was freed from its clutter of ugly shops; the temple of Fortuna in the Forum Boarium, two unidentified temples near San Nicola dei Cesarini and a sacred area containing four temples not far from Pompey's theatre were liberated; and the mausoleum of Augustus was thoroughly studied.

Many rooms of Nero's Golden house near the Colosseum were cleared. The debris had been searched long ago for works of art, but the walls, protected by the superimposition of Trajan's buildings, were found to be decorated in a style resembling that of the Claudian rooms of the Palatine. The small and richly coloured panels set in embroidered stucco are excellently executed but overloaded in design, as are the Renaissance loggia arabesques which they inspired.

In many places on the walls were found the signatures of Renaissance artists who had crawled over the debris to study the ceiling decorations (*see* above). Among statues found elsewhere should be mentioned, besides the "Nike," an excellent portrait of Augustus (*Not. d. Scavi, p.* 223, 1910), an "Artemis" from Aricia (*Jahrb. Arch. Inst.*, p. 112, 1922) and a bronze of considerable quality representing a youth of the Julio-Claudian house, taken to New York city (*Am. Jour. Arch.*, p. 121, 1913). Furthermore, some forgotten fragments of great importance, which had long lain neglected and awaiting study in the basement of the Vatican, include three heads from the Parthenon and a good copy of the head of one of the "Tyrannicides."

During World War I there was discovered under the railway outside of Porta Maggiore a mysterious underground "basilica" in an almost perfect state of preservation, probably of the 1st century A.D. It had been built by sinking shafts in which the concrete walls and the piers of the nave were moulded. After a concrete vault had been cast over the walls, the enclosed earth had been removed and the walls and ceiling plastered and very richly stuccoed in low relief with mythological and genre scenes. It is, perhaps, the best preserved monumental structure of the Roman world, and the lavish stucco work, though not quite as delicate as that of the house found in the Farnesina gardens, shows an ease and freedom of execution which give it high rank. Scholars inclined to the belief that it was the meeting place of a group devoted to some mystical cult (J. Carcopino, *La Basilique pythagoricienne de la Porte Majeure*, 1927). The tomb of the Aurelii found on the Viale Manzoni (*Mon. Ant.*, vol. xxviii, p. 289, 1922) awakened much comment because of its excellent figures in fresco and the Christian symbolism that some of the paintings appear to contain. There is a seated figure before a flock that seems to symbolize Christ as judge. Eleven excellent standing figures were with less certainty identified with the Apostles. Later excavations of imperial Rome also disclosed the evidence of oriental cults: the shrine of Jupiter Dolichenus on the Aventine was fully excavated and its equipment installed in the Capitoline museum. The two largest Mithraea known also came to light in this period, one under San Clemente, the other under the baths of Caracalla (*Not. d. Scavi*, p. 317, 1912). The tomb of the Scipios was at last carefully examined and restored.

Meanwhile, outstanding developments were taking place in the early Christian field. In the early decades of the 20th century, beneath the church of San Sebastiano, were found a number of decorated columbaria of the 1st century made for pagan cremation, which in the 2nd century had been converted into Christian burial places; the area was then levelled off and a room for funeral banquets constructed. The walls of this room contained a great number of invocations to Peter and Paul rudely scratched. These finds promised to have an important place in early Christian history (*Not. d. Scavi*, p. 3, 1923).

Then, in the late 1940s, systematic explorations beneath St. Peter's proved extraordinarily rich in results for both pagan and Christian antiquities. Restorations of the churches of Santa Sabina, Santi Quattro Coronati and San Giorgio in Velabro also revealed earlier structures of value to church history. In the rapid expansion of Rome following World War I a very large number of tombs with sarcophaguses, hundreds of important inscriptions and three new series of catacombs were found. These were reported in the *Notizie degli Scavi*.

LATER FINDS ELSEWHERE IN ITALY

Outside Rome the havoc of war incidentally revealed further details of the ancient structures at Palestrina, Albano Laziale and Terracina; and the most important excavations in Latium disclosed Horace's villa on his Sabine farm (*Mon. Ant.*, p. 457, 1926), an important votive deposit at Tivoli, details of Domitian's palace at Albano and of Hadrian's villa near Tivoli, a splendid temple with its terra-cotta decoration of the republican

period at Lanuvio (Mon. Ant., vol. 27, p. 293, 1921), valuable fragments of a pre-Julian calendar at Anzio (Not. d. Scavi, p 73, 1921) and a very important part of the seaport town of Ostia. At Ostia the finds were so numerous that a mere enumeration would require pages. The walls and gates of the oldest settlement (4th century?), which Virgil seems to describe in *Aeneid* vii, were disclosed; the more extensive wall of the 1st century B.C. was traced throughout, and two of its excellently constructed gates cleared; the forum of the late republic was excavated and a temple of Rome and Augustus found at one end and, beneath the pavement of the forum, a series of barrack rooms and offices of the oldest town. Many new temples, the offices of the city guard, the offices of the foreign shippers, the large cistern of the city, numerous state granaries, the foundations of what seems to be the earliest temple of Jupiter, the municipal senate house, a very interesting safety storage house and much else could now be studied. Of particular interest in revealing the plan of city dwellings were the extensive ruins of the Casa di Diana which, rising to three or four stories, contained many suites of independent apartments which received their light through windows opening to the streets. This, rather than the Pompeian type of dwelling, was now assumed for the city of Rome. Subsequently, a vast program of excavation in the seaward quarters of the city disclosed still more temples, a late classical type of dwelling, and abundant sculptures and inscriptions (see G. Calza, Ostia, 1949).

The excavations at Pompeii yielded in 1925 a bronze ephebus in the classical Greek tradition (A. Maiuri, Ant. Denkmaler, p. 43, 1929), perhaps the most striking work of art that the buried city had disclosed; and in 1930 a complete silver table service, of the finest craftsmanship, marvellously preserved (Maiuri, La Casa *del Menandro* e il *suo* tesoro *di argenteria*, 1933). The work of clearing the western part of the city progressed without interruption and was even carried some distance east along the line of a principal street, leading to the discovery of a great palaestra near the amphitheatre. A large number of houses of moderate size with fair wall paintings have been found; among the paintings were several of religious import—a Cybele group, a Pompeian Venus, a group of the 12 gods and a series of interesting mythological scenes (Not. d. Scavi, 1911 *ff.*). Of particular interest are several houses with balconies and an office decorated with representations of armour, supposed by some to be the headquarters of the *juvenes*, the ancient "Boy Scouts." The newly found structures were carefully restored and the paintings well protected from weathering and decay. Systematic investigations beneath the ground level of the first century yielded valuable information as to the earlier phases of the city. V. Spinazzola's report on the excavations of 1911–23 appeared in 1913.

The systematic excavation of Herculaneum, after a long period of inactivity. was resumed in 1927, and there the application of perfected technical processes led to important results. Important excavations were conducted on the Greek sites of lower Italy and Sicily, beginning with Cumae. for centuries the Greek tutor of Italian barbarians. There, investigations at the citadel added to knowledge of the temple of Apollo and revealed the vast subterranean galleries which must have inspired the opening passages of the 6th book of the Aeneid (Maiuri, I *Campi* Flegrei, 1934). In southern Italy. Paolo Orsi excavated Locri (see Oldfather, in Pauly-Wissowa, *Realencyclopädie, s.v.*), Caulonia (*Mon. Ant.*, xxiii, p. 685, 1914–16), Medma (*Not.* d. Scavi, p. 37, 1917) and other sites, with striking finds of Greek vases, fine architectural decorations in terra cotta and large numbers of clay votive figurines of no mean artistic value. At Cirb in Calabria he found a head from an acrolithic Apollo of c. 460 B.C. (Orsi. *Templum Apollinis* Alaei ad *Crimisa Promontorium*, 1933); and at Velia the remains of three temples. (For subsequent developments at this important site, see *Am. Jour. Arch.*, vol. lv. p. 178, 1951). But the most important work of the kind was Orsi's extensive excavation in Syracuse. especially at the great temple of Athena. There was found a rich store of objects from pre-Greek huts, early Greek edifices and many exquisitely executed terra-cctta fragments from structures antedating the temple of the Deinomenids (*Not.* d, *Scavi,* p. 519, 1910, and *Mon. Ant.*, vol. xxv, pp. 353–762, 1919). The most striking developments in the south after Orsi's death were in the prehistoric field and especially in the Aeolian Islands, where early settlements came to light. Meanwhile, in 1934, the chance find of the "Warrior of Capestrano" (Giuseppe Moretti, *II Guerriero italico* di Capestrano, 1936) cast a ray of light on the early inhabitants of the central Italian uplands; and in 1951 the exploration of two of Rome's early military colonies. Alba Fucens and Cosa, gave promise of filling notable gaps in the knowledge of the republican period. Furthermore, the state began a detailed archaeological survey, For-ma *Italiae*. (See also ROME: The Ancient City.) (T. F.; A. W. V. B.)

HISTORY

From the fall of the Roman empire till modern times the Italians had no political unity, no independence, no organized existence as a nation. Their history is not the history of a united people, centralizing and absorbing its constituent elements by a process of continued evolution, but of a group of cognate populations, exemplifying various types of constitutional development.

The early history of Italy will be found under ROME and allied headings. The following article is therefore mainly concerned with events succeeding A.D. 476, when Romulus Augustulus was succeeded by Odoacer. Prefixed, however, are three sections dealing with ancient languages and peoples of Italy, with the unification of the country under Augustus and with the growth of the road system, etc.

Ancient Languages and Peoples.—The ethnography of ancient Italy is involved in obscurity. The country attracted, even in early ages, successive swarms of invaders from the north. Ancient writers are agreed as to the diversity of races that was found within the limits of the peninsula. The traditions transmitted to us are often conflicting, while the idioms that prevailed in Italy in and before the 5th century B.C. are preserved, if at all, only in a few scanty and fragmentary inscriptions. (See, *e.g.*, LATIN LANGUAGE; OSCAN; VOLSCI; UMBRIAN LANGUAGE; ETRUSCAN LANGUAGE; LIGURIA; and below.) These imperfect materials combined with notices derived from ancient writers and the evidence of archaeological excavations furnished results of reasonable certainty.

The name "Italians" was at one time confined to the Oenotrians. According to Antiochus of Syracuse (*apud* Dion. Hal., Ant. *Rom.*, ii. 1), the name of Italy was first applied only to the southern portion of the Bruttium peninsula (now known as Calabria). But in the time of that historian. as well as of Thucydides, the names of Oenotria and Italia, which were then regarded as synonymous, included the shore of the Tarentine gulf as far as Metapontum and thence across to the gulfs of Laus and Poseidonia on the Tyrrhenian sea. It thus comprised only the two provinces subsequently known as Lucania and Bruttium (see references s.~. "Italia" in R. S. Conway's Italic Dialects, p. 5). The name seems to be a graecized form of an Italic *Vitelia*, from the stem vitlo-, "calf," and perhaps meant "calf land." "grazing land."

The term Italy now comprises the whole peninsula with the northern region as far as the Alps. Only the Etruscans did not speak an Indo-European language. Apart from Etruscan and the dialects of the Greek colonies, like Cumae. Neapolis and Tarentum, from the south to the north, the different languages or dialects in separate existence between 600 and 200 B.C. were: (1) Sicel; (2) South Oscan and Oscan; (3) Messapian; (4) North Oscan; (5) Volscian; (6) East Italic or Sabellic; (7) Latinian; (8) Sabine; (9) Iguvine or Umbrian; (10) Gallic; (11) Ligurian; and (12) Venetic.

It is probable that Venetic, East Italic and Messapian were connected and, with the ancient dialects spoken in Illyria (*q.v.*), might be provisionally entitled the Adriatic group. The Sicel language was of Indo-European character. How far the language or languages spoken in Bruttium and at certain points of Lucania, such as Anxia, differed from Oscan is not clear (see BRUTTII). No inscriptions can be referred nith certainty to the language of the Ligures. Other evidence seems to link them with the *-CO-* peoples (*see* VOLSCI).

It is difficult to determine the dates of the earliest appearance of

Gallic tribes in the north of Italy. Archaeological stratification shows that the Gallic period supervened upon the Etruscan. The Celtic and Etruscan elements together occupied the greater part of the district between the Apennines and the Alps down to its romanization in the course of the 2nd century B.C. Their linguistic neighbours were Ligurian in the south and southwest, and Venetic on the east.

A large force of Gauls came as far south as Rome in the year 390 B.C. Some part of this horde settled in what was henceforward known as the Ager Gallicus, the easternmost strip of coast later known as Umbria, including the towns of Caesena, Ravenna and Ariminum. A bilingual inscription (Gallic and Latin) of the 2nd century B.C. was found as far south as Tuder, the modern Todi (Italic Dialects, ii, 528; Stokes, Bezzenberger's Beitrage, ii, p. 113).

For the languages of the Italic group in the narrower sense—(1) Oscan; (2) the dialect of Velitrae, commonly called Volscian; (3) Latinian (*i.e.*, Latin and its nearest congeners, like Faliscan); and (4) Umbrian (or, as it may be called, Iguvine)—two principles of classification offer themselves, the first purely linguistic, the second linguistic and topographical. There is a broad distinction between the dialects which preserved the Indo-European velars and the dialects which converted the velars wholly into labials. For example, Latinian quis contrasted with Oscan, Volscian and Umbrian *pis* (see further LATIN LANGUAGE).

The only Latinian dialects of which, besides Latin, inscriptions are known as Faliscan and Marsian (see FALISCI; MARSI). The place names of the Aequi (*q.v.*) suggest that they belong to the same group in this respect. Except, therefore, for a very small and apparently isolated area in the north of Latium and south of Etruria, all the tribes of Italy, though their idioms differed in certain particulars, are left undiscriminated. Tradition asserts very strongly (1) the identity of the Sabines and Samnites; (2) the conquest of an earlier population by this tribe; and (3) evidence of the identity of the Sabines with one element in the population of Rome itself.

The ethnical or tribal and oppidan names of communities belonging to the Sabine stock are marked by the use of the suffix -NO- as in Sabini. There is some linguistic evidence that this stratum of population overcame an earlier population, which used, generally, ethnica in *-CO-* or -TI- (as in *Morruci*, Ardeates, transformed later into Marrucini, Ardeatini).

From this it follows: (1) Latin will be counted the language of the earlier stratum of the population of Rome and Latium, probably once spread over a large area of the peninsula and akin in some degree to the language or languages spoken in north Italy before either the Etruscan or the Gallic invasions; (2) what is called Oscan represented the language of the invading Sabines (more correctly Safines); and (3) what is called Volscian, known only from the important inscription of the town of Velitrae, and what is called Umbrian, known from the famous Iguvine tables with a few other records, would be regarded as Safine dialects, spoken by Safine communities more or less isolated in the midst of the earlier and possibly partly etruscanized populations (as early as the 4th century B.C. their language had suffered corruptions which it escaped both in the Samnite mountains and in Rome).

The **Augustan** Settlement.— In the very earliest times the name of Italy was correctly applied only to the southern part of the peninsula; only gradually was it extended to the central regions, such as Latium and Campania, which were designated as Opicia by writers as late as Thucydides and Aristotle. Under Roman rule the term was confined to the regions of the central and southern districts, exclusive of Cisalpine Gaul, and this continued to be its official signification down to the end of the republic. But the name came to be generally employed as a geographical term much earlier. Polybius repeatedly applied it to the whole country as far as the foot of the Alps; and this was a familiar use of the term in the days of Cicero and Caesar. The official distinction was, however, still retained: Cisalpine Gaul still constituted a province, and it was not till Caesar crossed the Rubicon that he entered Italy.

Augustus gave a definite administrative organization to Italy as a whole, and his division into 11 regions continued in official use till the reign of Constantine.

The first region comprised Latium, including the Volsci, Hernici and Aurunci, together with Campania and the district of the Picentini, and thus extended from the mouth of the Tiber to that of the Silarus (see LATIUM).

The second region included Apulia and Calabria, together with the land of the Hirpini (*q.v.*).

The third region contained Lucania and Bruttium; it was bounded on the west coast by the Silarus, on the east by the Bradanus.

The fourth region comprised all the Samnites (except the Hirpini), together with the Sabini (*q.v.*) and the cognate tribes. It was separated from Apulia on the south by the Tifernus river, and from Picenum on the north by the Matrinus.

The fifth region was composed solely of Picenum, extending along the coast of the Adriatic from the mouth of the Matrinus to that of the Aesis, beyond Ancona.

The sixth region was formed by Umbria, in the more extended sense of the term, as including the Ager Gallicus, along the coast of the Adriatic from the Aesis to the Ariminus, and separated from Etruria on the west by the Tiber.

The seventh region consisted of Etruria, extending from the Tiber to the Tyrrhenian sea and separated from Liguria on the north by the Macra river.

The eighth region, termed Gallia Cispadana, comprised the southern portion of Cisalpine Gaul and was bounded on the north by the Padus or Po river, from above Placentia to its mouth; it was separated from Etruria and Umbria by the Apennines, and the Ariminus river was substituted for the Rubicon as its limit on the Adriatic.

The ninth region comprised Liguria, extending along the seacoast from the Varus to the Macra and inland as far as the Padus river, which constituted its northern boundary from its source in Mt. Vesulus to its confluence with the Trebia just above Placentia.

The tenth region included Venetia from the Padus and Adriatic to the Alps, with the neighbouring peninsula of Istria and, to the west, the territory of the Cenomani (*q.v.*).

The 11th region, known as Gallia Transpadana, included all the rest of Cisalpine Gaul from the Padus on the south and the Addua on the east to the foot of the Alps.

The Roman Roads.—The mainstay of the Roman military control of Italy was the splendid system of roads. As the supremacy of Rome extended itself over Italy, the Roman road system grew, each fresh conquest being marked by the pushing forward of roads through the newly won territory and the establishment of fortresses. It was in Italy that the military value of a network of roads was first appreciated by the Romans. Also, it was for military reasons that from mere cart tracks they were developed into permanent highways.

From Rome roads radiated in all directions. Communications with the southeast were mainly provided by the Via Appia and the Via Latina, which met close to Casilinum, 3 mi. N.W. of Capua, the centre of the road system of Campania. There the Via Appia turned eastward toward Beneventum, while the Via Popilia continued in a southeasterly direction through the Campanian plain and the mountains of Lucania and Bruttium as far as Rhegium. Other roads ran south from Capua to Cumae, Puteoli (the most important harbour of Campania) and Neapolis. From Beneventum, another important road centre, the Via Appia itself ran southeast through the mountains past Venusia to Tarentum on the southwestern coast of the "heel," and thence across Calabria to Brundusium; Trajan's alternative road ran northeast through the mountains and the lower ground of Apulia, reaching the coast at Barium. Both met at Brundusium, the principal port for the orient.

The only highroad of importance froni Rome eastward, the Via Valeria, was not completed as far as the Adriatic before the time of Claudius; but on the north and northwest started the main highways which communicated with central and northern Italy

and with all that part of the Roman empire which was accessible by land. The Via Salaria, a very ancient road, with its branch, the Via Caecilia, ran northeastward to the Adriatic coast as did the Via Flaminia, which reached the coast at Fanum Fortunae and thence followed it to Ariminum. The Via Flaminia was the earliest and most important road to the north; and it was soon extended (in 187 B.C.) by the Via Aemilia running through Bononia as far as Placentia, in a straight line between the plain of the Po and the foot of the Apennines.

In the same year a road was constructed over the Apennines from Bononia to Arretium. Along the west coast the Via Aurelia ran up to Pisa and was continued by another Via Aemilia to Genoa. Thence the Via Postumia led to Placentia and Cremona, while the Via Aemilia and Via Julia Augusta continued along the coast into Gallia Narbonensis. The road system of Cisalpine Gaul was mainly conditioned by the rivers which had to be crossed and the Alpine passes which had to be approached. Cremona, on the north bank of the Po, was an important meeting point of roads, and Hostilia another; so also were Patavium and Aquileia, farther east. (See also ROADS AND STREETS.)

As to the roads leading out of Italy, from Aquileia roads diverged northward into Raetia, eastward to Noricum and Pannonia and southward to the Istrian and Dalmatian coasts. Farther west came the roads over the higher Alpine passes—the Brenner from Verona, the Septimer and the Spliigen from Clavenna, the Great and the Little St. Bernard from Augusta Praetoria and the Mont Genèvre from Augusta Taurinorum. Westward two short but important roads led from Rome on each side of the Tiber to the great harbour at its mouth. (X.)

Goths and Lombard% — Thedeposition of the western Roman emperor Romulus Augustulus by Odoacer in 476 opened a new period in Italian history. The revolution had been caused by the refusal of the western government to settle its barbarian army on Italian soil. The soldiers, who wanted to follow the example of Germanic peoples in other provinces of the empire, elected Odoacer their king, and after the deposition of the puppet emperor they were settled in Italy, Roman landowners ceding one-third of their lands. This settlement of a barbarian army was a turning point: Italy now shared the fate of other imperial provinces. Theoretically, the government of the country passed in 476, or at least after the death in Dalmatia of the last legitimate emperor of the west, Julius Nepos (480), to the eastern emperor at Constantinople. In fact, Odoacer was the master of Italy. He wanted not to detach it from the empire but to govern the Roman population as viceroy, while ruling his barbarian soldiers as king; and the emperor Zeno acknowledged his authority by accepting him as patrician.

In 488 Zeno sent the Ostrogoths under their king Theodoric (Theoderic or Dietrich) to Italy to attack Odoacer, with whom relations had become increasingly strained. In 493 Odoacer, having surrendered Ravenna, was killed by Theodoric. The dual government of Italy was continued. King of the Goths, who were settled like Odoacer's people before them, Theodoric ruled over the Roman population as imperial viceroy; and the Roman administration was left intact, civil offices being usually filled with Romans, military ones with Goths.

Theodoric having died in 526, his daughter and successor Amalasuntha was in 535 imprisoned and killed by her cousin Theodahad; this was the signal for Byzantine intervention. Justinian had recently recovered North Africa from the Vandals; the conquest of Italy was the next step. Belisarius, the victor over the Vandals, was sent to Italy, and the fall of Ravenna in j40 seemed practically to conclude the campaign. But Gothic resistance revived, and it took the eastern emperor more than 12 years to break it. The decisive battle was won by his general Narses, commanding a new imperial army, near Tadinae in 552; the last Gothic stronghold fell in 555. Italy came under Byzantine government. The country had been devastated by the wars, and Byzantine taxation lay heavily on it. Although the frontier defenses were reorganized, internal conditions must have assisted the Lombards when they invaded Italy under Alboin in 568.

The Lombard conquest (see LOMBARDS) led to the permanent settlement of a Germanic people in Italy and thus showed the failure of Justinian's policy of imperial recovery. But the Lombards were unable to conquer the whole of the peninsula, and the division of Italy into a Iarge Lombard and a smaller Byzantine part was to have far-reaching effects. Alboin died in 572, having conquered nearly the whole of the Po valley and Piedmont. From 574 to 584 the monarchy was suspended. About 30 dukes ruled over the conquered territories. But the conquest continued after Alboin's death, and was extended to central and to southern Italy. After the restoration of the monarchy by Authari in 584, the duchies remained the basis of Lombard government but were subordinated, in varying degree, to the king; the great southern duchies of Spoleto and Benevento were virtually autonomous. The Lombards did not recognize Byzantine sovereignty, and the dual government of the Germanic and Roman population was abandoned. The methods of settlement were infinitely harsher than under Odoacer and Theodoric, for the Romans were treated as a conquered nation. Large numbers of the Roman nobility appear to have been killed, and their lands confiscated.

The Roman coloni had already lost most of their freedom; they now became assimilated to the Lombard half-free. But a free Roman population survived in the towns. From the end of the 7th century the condition of the Romans seems to have improved; the peace with the Byzantines *c.* 680 probably contributed to this. In the course of time the Lombards assimilated much of the relics of Roman civilization, thanks largely to the adoption of Catholicism by the formerly Arian Lombards (the monarchy was permanently Catholic from 653). The decline of the Lombard idiom and the increasing use of the language of the conquered by the conquerors was a striking symptom of it.

The Roman city territories survived as administrative districts in the duchies, the dukes usually residing in their chief towns. A number of towns were under royal officials (gastaldi). The towns thus retained some importance as administrative centres of the Lombard kingdom; they were moreover seats of bishops and served as market places for the surrounding countryside, urban trade and crafts fulfilling at least some local functions.

Byzantine Italy was mainly confined to stretches of the coast with their hinterland. By the middle of the 7th century, it included Istria; the islands of the Venetian lagoon which had been settled by refugees from the mainland; the territories of the exarchate of Ravenna proper and of the Pentapolis (roughly from Rimini to Ancona); Perugia; the "heel" and the "toe" of Italy, separated by the duchy of Benevento; and the small territory of Naples and the fairly extensive one of Rome. including part of southern Tuscany. (See RAVENNA, EXARCHATE OF.) Moreover, Sicily, Sardinia and Corsica remained under the empire. In the imperial territories of Italy, the framework of the earlier Roman administration survived. As in other Byzantine provinces, the combination of civil and military power became characteristic of Byzantine administration. The exarch at Ravenna was the governor of imperial Italy; under him, dukes commanded new military districts; below them were tribunes as governors of tomns. Byzantine officials and local landowners. often identical, came to form a new ruling class; and this development contributed to bring about decentralization, which was also fostered by the difficulties of central government over the widely dispersed territories. Thus in Naples the dukes had acquired a semi-independent position by the 8th century; in Rome, the pope increased his secular authority (already considerable during the pontificate of Gregory I, 590–604), upheld by vast estates in Italy and Sicily. To a minor extent, the position of bishops in other towns tended to develop on similar lines. The revolution that swept Byzantine Italy in 726, although primarily provoked by the emperor Leo the Isaurian's iconoclastic policy, revealed these separatist tendencies. The papacy, which had taken a leading part in the revolution, suffered a setback after its suppression; but by 754 it had become virtually supreme in the Roman duchy.

Under the Lombard king Liutprand (712–744), the peace between Greeks and Lombards came to an end. The revival of Lombard expansion reflected the internal strengthening of the monarchy from the end of the 7th century. Liutprand seized

territories around Ravenna; he threatened both Ravenna (captured for the first time in *c.* 732–733) and Rome. King Xistulf (749–756) pressed this new attack with vigour; c. 751 Ravenna was finally lost by the Byzantines. The next move was against Rome; and in 753 Pope Stephen II crossed the Alps to appeal for help to the Frankish ruler Pippin the Short. Pippin invaded Italy twice. in 754 and 756, and both campaigns led to Lombard defeats. Aistulf was forced to return the recently conquered territories; but Pippin, instead of restoring them to Byzantium, gave them to Pope Stephen, to whom the promise of an extensive donation had been made in 754. Thus he became one of the founders of the papal states. The next Frankish intervention, under Charlemagne (*q.v.*), was caused by Lombard attacks on Pope Adrian I and ended in the annexation of the Lombard kingdom by Charlemagne, who assumed the title of king of the Lombards (774). He confirmed, and perhaps increased, his father's promise of donation to the papacy; but the establishment of Frankish rule created a new situation in which the wider territorial aspirations of the popes were not fulfilled. The latter remained in the possession of the Roman duchy, the small duchy of Perugia, the exarchate of Ravenna and the Pentapolis; but Charlemagne could make his authority felt within the new papal states. He now began to use the title of Roman patrician conferred already on Pippin by Stephen II. The imperial coronation in 800 was not only a recognition of his European power; it also confirmed and strengthened the position of the Frankish ruler in Rome and the papal states.

Carolingian Italy. — Frankish Italy had become a province of the new western empire. Its special place was recognized by the conferment of the royal title on its governor; but the centre of the empire lay north of the Alps. Charlemagne took over the Lombard administration with few major changes, the dukes and *gastaldi* being, as a rule, replaced by tounts. But the counts were more strictly subordinated to the monarchy than the Lombard dukes had been; at the same time, collaboration of counts and bishops mas encouraged, as in the rest of the empire. Frankish noblemen were not only entrusted with leading offices but were also granted lands and privileges in Italy; the new immigration strengthened the Germanic element in Italian society, into which feudalism now began to penetrate.

The partitions of the Carolingian empire during the 9th century changed the status of the Italian kingdom several times. Louis I the Pious, when he divided the empire in 817, decided that it should go to his son and coemperor Lothair I; and the treaty of Verdun (843) extended Lothair's territory as far as the North sea. Within this new dominion, between the French and the German kingdoms, Italy came once more under a separate administration and was given by Lothair to his son Louis, who retained it after his father's death. He had previously been crowned emperor as Louis II; but his position remained that of a king of Italy. He was the only Carolingian ruler after Charlemagne who made real — although futile — efforts to improve the internal conditions of the kingdom, which had suffered from the weakening of public authority. He also helped, with considerable success, to defend Italy against the Arabs. The Arabs had begun the conquest of Sicily in 827 and had taken Palermo (831) and Messina (843), an invaluable base for incursions into southern Italy. Conflicts and rivalries in that region assisted their attempts. Thus in 839 a double election led to civil war in the duchy of Benevento. Seizing Bari and other plates, the Arabs began to settle on the mainland. Their attacks along the Tyrrhenian coast threatened the maritime towns as well as Rome, uhich was partly sacked in 846. Naples, Amalfi and Gaeta put up a determined resistance, and Louis succeeded, after several campaigns, in taking Bari from the Arabs. The years after his death (875) were the epilogue of Carolingian rule in Italy. In 887 Charles the Fat, who had reunited the whole empire for a short time, was deposed by the East Franks. A section of the Italian nobility followed suit by electing Berengar of Friuli king of Italy (888).

The **Italian** Kings. — The following decades were marked by intermittent struggles for the Italian crown, in nhich the main contestants were powerful Italian princes — margraves or dukes of Friuli, of Spoleto, of Ivrea — the kings of Provence and the kings of Burgundy. Even the most successful of the Italian kings never succeeded in controlling the whole kingdom; and the possession of the imperial crown was not more than the possession of an additional title implying the right to protect the pope. Nor were they able permanently to defend the country against the Hungarians, who periodically ravaged northern Italy from 898, thus adding new dangers to the Saracen incursions. The growth of feudal powers provided the background to the political struggles; already before 888 the margraves of Friuli, Tuscany and Spoleto had ruled over large dominions; they were followed by others, such as the margraves of Ivrea and the counts of Turin. But also at a lower level, feudalism spread during the 9th and 10th centuries. As elsewhere in Europe, this went hand in hand with the disintegration of royal authority.

The Italian kings, in their need for support and also in order to provide for the better defense of the towns against the incursions, granted public rights in the towns to bishops whose secular authority — which had undoubtedly grown during these times of trouble — was thus strengthened. In Rome the house of Theophylact rose from the beginning of the 10th century to princely power at the head of the nobility. The papacy came to depend on it; and after the death of Theophylact's grandson Alberic, Alberic's son was elected pope as John XII (955). By that time the secular authority of the papacy was practically limited to Rome and the territory around it; but there Alberic pursued, in the pope's stead, a vigorous administrative policy. In southern Italy the Byzantines much improved their position toward the end of the 9th century. In successful struggles against the Saracens, they recovered the territories that had been conquered by them on the mainland; they reorganized their administration in the two new "themes" of Calabria and Longobardia; and they temporarily wielded considerable influence among the principalities and towns of south Italy, to which they gave valuable protection against the Arabs.

The Saxon and Franconian Emperors. — The German king Otto I came to Italy in 951 and forced the king of Italy, Berengar of Ivrea, to do homage to him (952). But in 960 Pope John XII appealed for help against Berengar's and his son Adalbert's aggression. Otto crossed the Alps again and was crowned emperor in Rome in 962, while Berengar's power collapsed. **A** new chapter in the history of Italy began.

Otto I laid the foundations on which German rule in Italy was to rest until the 12th century. Determined to assert his sovereignty over the feudal magnates, he accepted and fostered them as long as they were loyal to him. As the Italian kings had done, he made or confirmed grants of jurisdiction to Lombard bishops in their towns. (Bishops probably did not become counts until the 11th century; and even then the privileges were with very few exceptions confined to the towns and land around them. In Tuscany, moreover, jurisdiction was granted only in few relatively late cases; and even in Lombardy not all bishops received such grants.) In Rome he tried to revive the authority of Charlemagne but met with the resistance of the Romans; and although he made and deposed popes at will, there was strong opposition against his nominees, culminating in risings. In southern Italy Byzantine recovery had been only temporary; and the princes there soon regained their full liberty of action. They did homage to Otto, who thus extended his influence to the south. Pandulph of Capua was made margrave of Spoleto and Camerino and became Otto's most powerful supporter in that region. Western imperial designs on southern Italy led to war with Constantinople; peace was concluded, and Otto II betrothed to the Byzantine princess Theophano in 972.

Once again Italy had become part of an empire whose centre was north of the Alps. This was a source of both strength and weakness. It had helped Otto to succeed where the Italian kings had failed; on the other hand, government from Germany and occasional expeditions were to prove doubtful substitutes for continuous presence. Of all Otto's successors before Frederick II, only his grandson Otto III may have contemplated a change in this policy by taking up his residence in Rome. Inspired by

the ideas of Roman renewal, he may have thought of making the city the imperial capital. But he was probably far less prepared to abandon earlier traditions of German rule than might appear.

Italian opposition to the emperors was not lacking. After Otto III's death, the margrave Arduin of Ivrea was elected king of Italy by his supporters (1002); but his brief reign remained confined to northern Italy and met with much resistance from the episcopate. There were risings against the emperor in Pavia in 1004 and in 1024 (on Henry II's death) and in Ravenna in 1026. At the same time social tensions between nobility and episcopate and between higher and lower nobility began to foreshadow later conflicts in the communes. Thus in 1036 the Milanese lower nobility of the *valvassori* rose against the powerful archbishop of Milan, Heribert; aiter their expulsion from Milan, the revolt spread over Lombardy. Conrad II's feudal law of 1037 aimed at satisfying their claims by making all fiefs hereditary and consequently granting equal rights to the *valvassori* and to the higher nobility of the *capitani*.

The feudal law was issued during the unsuccessful siege of Milan, Heribert having rebelled against the emperor. This showed that a powerful episcopate was not always an asset and that there were limitations to the loyalty of the Lombard bishops—even before the investiture contest. Heribert strikingly personified the power that the Italian bishops could wield. Although not count of Milan, he was the actual ruler of the tonn and of a considerable territory outside it, and lord over a large number of vassals. Soon after, however, the power of the archbishops of Milan was broken during the civil and religious strife which began in 1056 with the Milanese reform movement of the Patarenes.

Rome continued to be a major problem for the emperors. In 1046 Henry III intervened in a contested papal election. Gregory VI. Benedict IX and Silvester III were all deposed and a German bishop elected in their place as Clement II. Eager to foster ecclesiastical reform, Henry III helped decisively, by his interventions in the papal elections, to assure its victory at the curia; Clement II and his successors were not only Germans but also supporters of the reform movement. But the reformed papacy soon turned against the time-honoured relationship between church and state and thus threatened one of the pillars of imperial government in Lombardy; while the Lateran decree of 1059 practically eliminated the influence of both the Roman nobility and the emperors on papal elections.

The investiture contest between pope and emperor began in 1076. It weakened ecclesiastical loyalties and made Matilda of Tuscany, the most powerful of the Italian rulers, Henry IV's enemy. Yet, despite the Norman alliance (see below) and the help of Matilda, Gregory VII could not prevent Henry's capture of Rome (1083–84). Norman help, when it came, was a double-edged weapon. Although it forced Henry to withdraw, the devastation of Rome by the Norman army ruined Gregory's position there—he died at Salerno in 1085. The conflict continued under his successors. In 111j Matilda died without heirs, and the succession to her vast properties, which she had left first to the papacy but probably later to Henry V, became a new source of conflict between empire and papacy.

The Normans in the South. — Pope Nicholas II, meanwhile, had in Aug. 1059, at Melfi, invested the Norman adventurer Robert Guiscard (*q.v.*) with all conquests in Apulia and Calabria and with all future conquests in Sicily; on the same occasion he invested another Korman, Richard of Aversa, with the principality of Capua. This was a landmark in the momentous events that had been taking place in southern Italy from the time when Norman mercenaries arrived in 1017 and served in a revolt against the Byzantines. From that time the Normans had taken part, in increasing numbers, in the conflicts between the principalities of southern Italy. Their permanent settlement began c. 1029 when Rainulf was granted Xversa. In 1041 they began their conquest of Apulia; a few years later Robert Guiscard was entrusted with that of Calabria. He pressed successfully the conquest of Calabria and Apulia and, with his brother Roger, began that of Sicily in 1060. The fall of Bari (1071) marked the final collapse of Byzantine power in Italy. In Sicily, Palermo was captured in 1072; but it was not until 1091 that the whole island was won from the Arabs. At first Roger governed Sicily as a separate county; but his son, the second Roger, united it with the duchy of Apulia after the death of Duke William (1127). In 1130 this Roger became king of Sicily, having obtained the investiture from the antipope Anacletus II; and in 1139 this was confirmed by Innocent II. In his powerful state, which included all Norman conquests in southern Italy and Sicily, Greek, Arabic and Norman institutions were welded into a new and singularly efficient structure, in which the feudal nobility and the towns were strictly subordinated to the monarchy. (See SICILY.)

Age of the Communes. — By the 11th century, several Italian towns had reached considerable prosperity. They were mostly in Byzantine territory or had maintained contact with Constantinople and could thus take full advantage of the revival of eastern trade.

Foremost mere Venice and Amalfi, the latter reaching the height of its commercial power about the middle of the century: others included Bari, Otranto and Salerno. For a short time a serious rival of Venice, Amalfi declined after having submitted to the Normans in 1073. Then Venice received. with the privilege of 1082, exemption from all customs duties within the Byzantine empire. During the 11th century Pisa, the natural port of Tuscany, began to rise amid struggles with the Saracens. whom it defeated repeatedly; and Genoa. which was to be its rival for centuries, was following suit. Among the inland tom-ns—as yet less conspicuous — Pavia, which had owed much of its early prosperity to its role as capital of the Lombard kingdom. was rapidly outdistanced by Milan; Lucca, on the Via Francigena from Lombardy to Rome, and ior a long time the residence of the margraves of Tuscany, was the most important Tuscan inlacd town.

The importance of fortified centres during the Kungarian and Saracen incursions contributed to the development of towns. Town walls were rebuilt or repaired, providing security both to citizens and to people from the country; and the latter found further places of refuge in the many fortified *castelli* with which the countryside began to be covered.

Simultaneously, local self-government developed. The movement began first in the Byzantine territories; thus Venice elected its doges (dukes) from the early 8th century onward, Amalfi, annual magistrates from the 9th century. In the Italian kingdom, on the other hand, the authority exercised by bishops or counts gave scant scope for urban liberties. Assemblies in front of the church, known since Lombard times, as well as the introduction of the Carolingian jury, were humble beginnings. The citizens helped to defend their towns against Hungarians and Saracens; and the notables (boni homines) took some part in local administration by assisting the bishop or count.

The communal movement created a new situation in northern and central Italy from c. 1080, while the Norman conquest of southern Italy put an end to the progress of municipal autonomy in that region. Whether it took the form of a conflict with the established authorities or of peaceful transition, the ultimate result of the communal movement was full self-government. Originally the communes were, as a rule, associations of the leading sections of the town population; but they soon became identical with the new city-state. Their first opponents were often. but by no means always, the bishops; in Tuscany, where margravial authority was strong, Henry IV encouraged rebellion against Matilda by granting extensive privileges to Pisa and to Lucca in 1081; and Matilda's death in 1115 made it possible for Florence to achieve independence. The investiture contest, which was liable to undermine episcopal authority, often encouraged the citizens to assume a bolder attitude in urban politics. But even before the contest, the Patarenes in Milan showed, after 1056, how dangerous to episcopal authority religious conflict could become.

The first organs of the commune were the general assembly of all its members (parlamento, concio, *arengo*) and the magistracy of the consuls; the latter are first mentioned at Lucca *c.* 1080. At an early date a council began to replace the unwieldy assembly for ordinary political and legislative business; and with the growing complexity of the constitution, further councils emerged,

conditions varying considerably from town to town. Communal law constituted a blend, under the influence of the revived Roman law, of urban customs and the new communal legislation. During the 12th century, the consular office was usually monopolized by the class that had taken the initiative in the establishment of the commune. This class was usually composed of small feudal or nonfeudal landomners and the wealthier merchants. In Pisa and Genoa the commercial element was predominant, while in parts of Piedmont the commune derived from the associations of the local nobility. Thus the early commune was predominantly aristocratic. The fortified towers of the leading families, resembling the feudal castles of the countryside, were characteristic of these conditions. In Italy there had in fact never been the same separation between town and countryside as, for instance, in northern France and in Germany; feudal society had penetrated into the towns, while nonnoble citizens were often landomners outside their walls. This link between town and country was to become progressively stronger and more complex in the course of communal history.

From the beginning the conquest of the country (contado) became one of the main objectives of communal policy. The small fortified townships (*castelli*) and the lesser rural places, which had also been widely affected by the communal movement, were now absorbed by the city-states. The divisions and subdivisions of feudal property, partly the result of the Lombard law of inheritance, weakened many feudal houses and thus facilitated the conquest, while the bishops could not prevent the extension of communal control to their lands. The members of the country nobility were subjected one by one and often forced to become citizens; others did so voluntarily. Only a small number of more powerful families, such as the house of Este, the Malaspina, the Guidi and the Aldobrandeschi, succeeded in maintaining their independence, and that not without frequent losses and concessions. Soon, however, it became evident that the territorial conquests, as well as the growth of urban liberties, must lead to conflict with the empire.

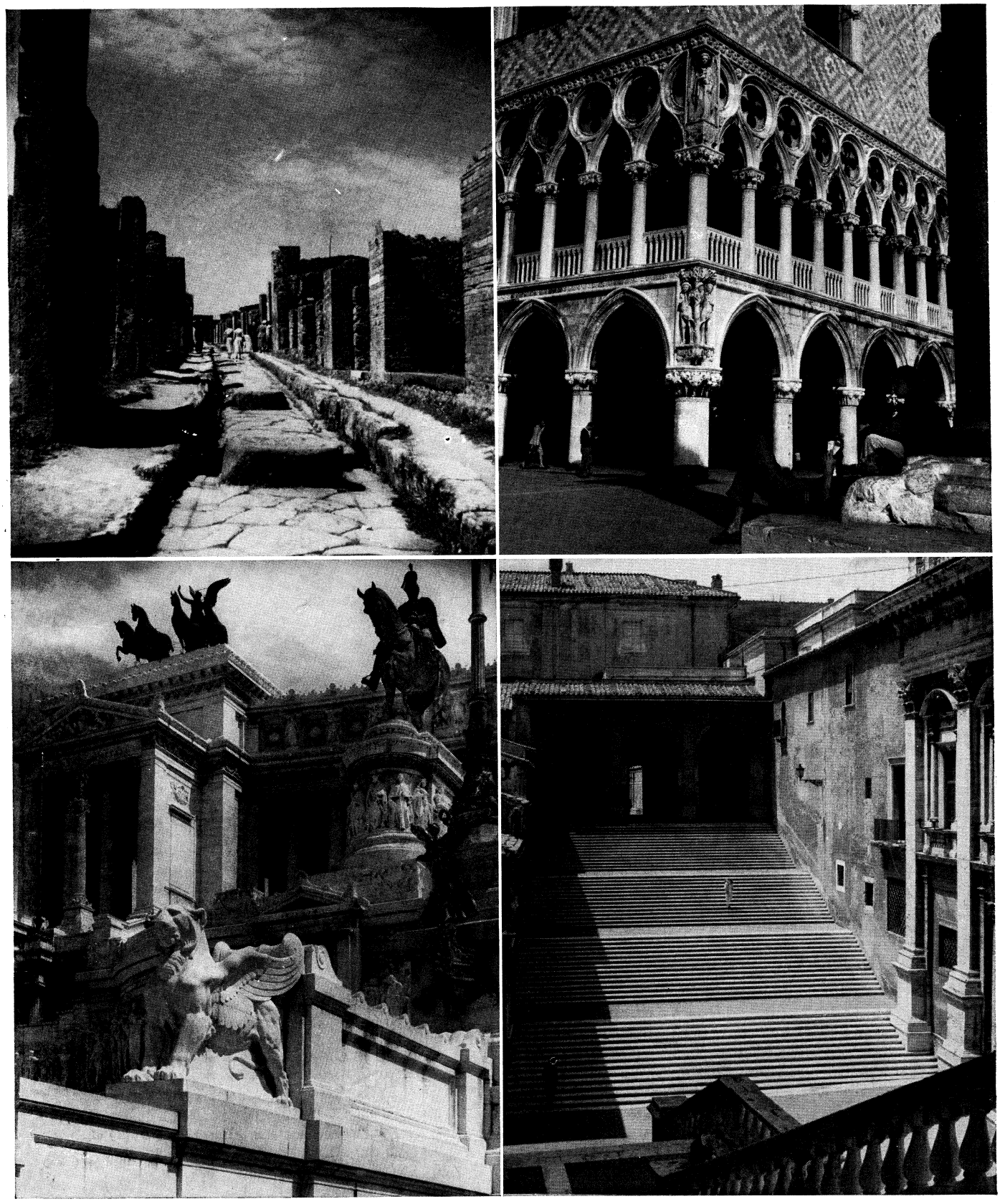
The Hohenstaufen Emperors. — That conflict began soon after the accession of Frederick I Barbarossa, the second Hohenstaufen emperor (1152). The decrees of Roncaglia (1158), issued at the beginning of his second Italian expedition, with the assistance of members of the new Bolognese law school, placed imperial policy on a new basis. Frederick's predecessors Lothair II (or III) the Saxon and Conrad III had only rarely intervened in the affairs of northern and central Italy. Conrad III never came to Italy at all. By the time of Frederick Barbarossa's first expedition (1154) the communes had greatly increased their power, and no organized attempt had been made to check them. Frederick tried to strike at the core of the problem by claiming for the empire the royal rights (regalia) which had in so many cases been usurped by the communes. The victims of this usurpation, however, had been far less the emperor himself than the bishops and the nobility, who for a long time had been in possession of most of the regalia. The innumerable grants of royal rights had formed an integral part of the traditional system of imperial government. Frederick intended to replace it, to a wide extent, by one of direct control. Imperial officials were to administer town and countryside; and if the communes were to be left some of their liberties, they were to owe them entirely to the emperor. In fact the emperor began soon to differentiate between the communes; those which took his side were granted considerable concessions, such as free elections of the consuls. The violent resistance of Milan and other towns mas largely responsible for this turn of Frederick's policy. It was significant that Milan's enemies, such as Lodi and Cremona, vigorously assisted in the siege of that town and shared in its destruction in 1162. On the other hand the revival of the struggle between empire and papacy provided the anti-imperial towns with a powerful ally. The double papal election of 1159 led to a schism; and while Frederick recognized Victor IV, Alexander III was prepared to support any communal reaction against the emperor. After the fall of Milan, Venice, threatened by the extension of imperial power, had taken the initiative in founding the Veronese league (1164); and in 1167 a second league was formed, including other Lombard towns. In the same year the two leagues joined and entered into close contact with Alexander. In the meantime Frederick had taken Rome; but an epidemic had decimated his army (1167), and his return route to Germany was almost cut by the Lombard revolt (1168). As a result, imperial authority practically collapsed in Lombardy and was much weakened in Tuscany. After his return to Italy, Frederick was prepared to give up the execution of the Roncaglian decrees. as was shown in the negotiations of Montebello (1175); but these negotiations were ineffective, and in 1176 Frederick was defeated by Milan near Legnano. In 1177 Frederick concluded a separate peace with Alexander III; and an armistice with the Lombard league was culminated after six years by the peace of Constance (1183). The Lombard communes were left the regalia inside the towns and, on certain conditions, in the territory, and they retained nearly all their liberties; but the consuls were to be invested by the emperor (a right of which he seems to have hardly ever made use). The peace concerned, however, only Lombardy. In Tuscany, Spoleto and the Marches, the imperial position had been greatly strengthened during the previous years, and the administrative reorganization that had failed in Lombardy was carried out with considerable success in that region. Moreover, Frederick was preparing the extension of German rule to the kingdom of Sicily.

The emperors had made repeated attempts at conquering the Norman kingdom. In 1137 Lothair II had achieved a short-lived success in Apulia; in 1166–67 Frederick had planned an attack on the kingdom. In 1184 the Sicilian heiress Constance, King Roger's daughter, was betrothed to Frederick's son and successor I-Ienry, an event of far-reaching importance for Italy and the empire.

At Frederick's death in 1190, Henry VI had already begun to assert his and his wife's claims to Sicily, King Roger's grandson William II having died in 1189. But resistance led by Tancred, an illegitimate grandson of King Roger, was strong. The kingdom had to be conquered, and it was not until 1194 that Henry succeeded in doing so. He left the Norman regime unchanged; the highly centralized Sicilian state was an invaluable addition to the resources of the empire in Italy. Henry's unsuccessful plan to make the empire hereditary would have led to permanent union, since the Sicilian crown was hereditary. Placing imperial rule on a much stronger basis than it had ever possessed: it would have been fraught with dangers for the political independence of the papacy. Thus the papacy made a determined effort, after Henry's death in 1197, to destroy forever the union of Sicily and the empire. Henry's death was followed by a double imperial election; in Italy, imperial administration disintegrated rapidly, the communes recovering everywhere what they had lost. Innocent III (1198–1216) took full advantage of this reaction and substituted papal government for imperial administration in the duchy of Spoleto and in the march of Ancona, thus once more extending the papal states to the Adriatic sea. Constance of Sicily renounced the imperial crown on behalf of her son Frederick, the new king of Sicily, and appointed Innocent III to be his guardian after her death (1198). The next step in the separation of Sicily from the empire was the renunciation of the kingdom by the Welf Otto IV (1201), who had been recognized emperor by Innocent against the Hohenstaufen Philip of Swabia. But after his imperial coronation in 1209, Otto turned to its conquest, the continuity of imperial policy proving stronger than promises and a change in dynasty.

In Sicily, the preceding years had been marked by internal disorders which threatened to destroy the work of the Norman monarchy. In 1211 Innocent decided to play off the young king Frederick against Otto by supporting his new election as future emperor in Otto's stead. Crowned as German king at Mainz (1212), Frederick II grew rapidly more powerful; and the battle of Bouvines (1214) sealed Otto's fate. But the success of papal policy was only temporary, for Frederick too did not keep his promise to separate Sicily from the empire.

Between 1220 and 1230 Frederick continued with great vigour and much success the policy of his German and Norman ancestors in Italy and Sicily. The years after his imperial coronation in



PHOTOGRAPHS (TOP LEFT) HARRIET L. MILBURN, (TOP RIGHT) ERNEST RATHENAU-PIX FROM PUBLIX, (BOTTOM LEFT, BOTTOM RIGHT) PIX FROM PUBLIX

ROME, VENICE AND POMPEII

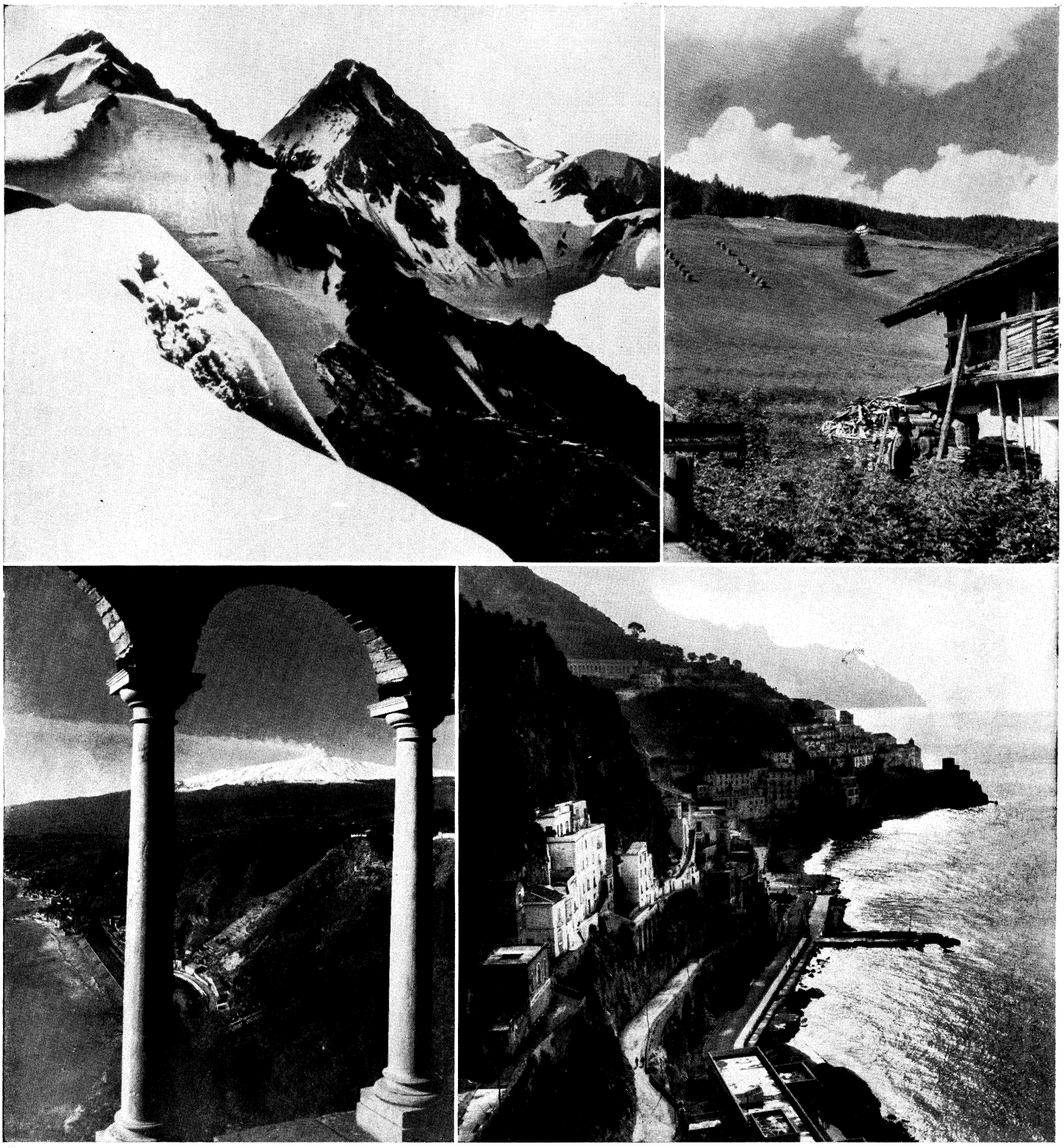
Top left: Ruins along an ancient road in Pompeii, showing the chariot tracks and centre stone blocks which were used both as stepping stones and as "brakes" to keep the horses from going too rapidly

Top right: Part of the arcade and loggia of the Doge's palace in Venice

Bottom **left:** Monument to Victor Emmanuel II in Rome, symbolizing the achievement of Italian unity

Bottom *right:* Stairway leading to Monte Caprino, a monastery on the southern height of the Capitoline, one of the hills of Rome

ITALY



BY COURTESY OF (TOP LEFT) ENCYCLOPAEDIA BRITANNICA FILMS; PHOTOGRAPHS (TOP RIGHT) FRANCIS SANDWITH FROM BLACK STAR, (BOTTOM LEFT) EWING GALLOWAY, (BOTTOM RIGHT) BURTON HOLMES FROM EWING GALLOWAY

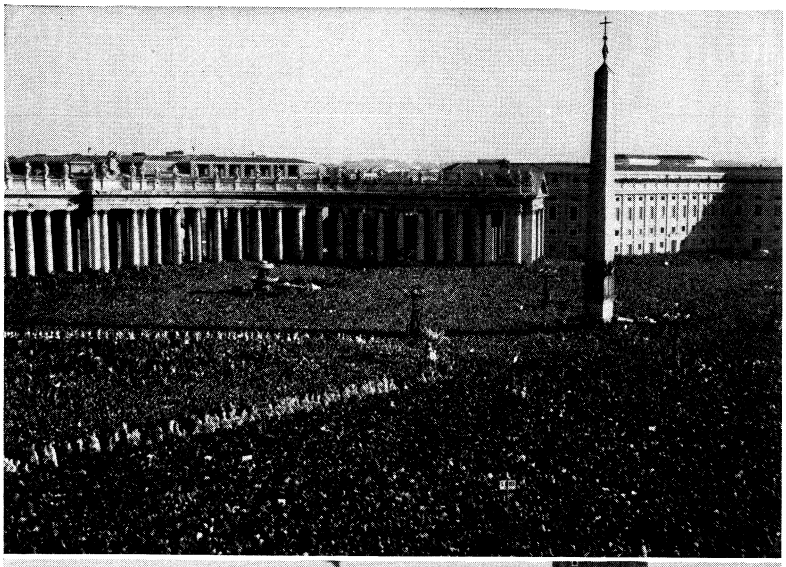
CONTRASTS IN THE ITALIAN LANDSCAPE

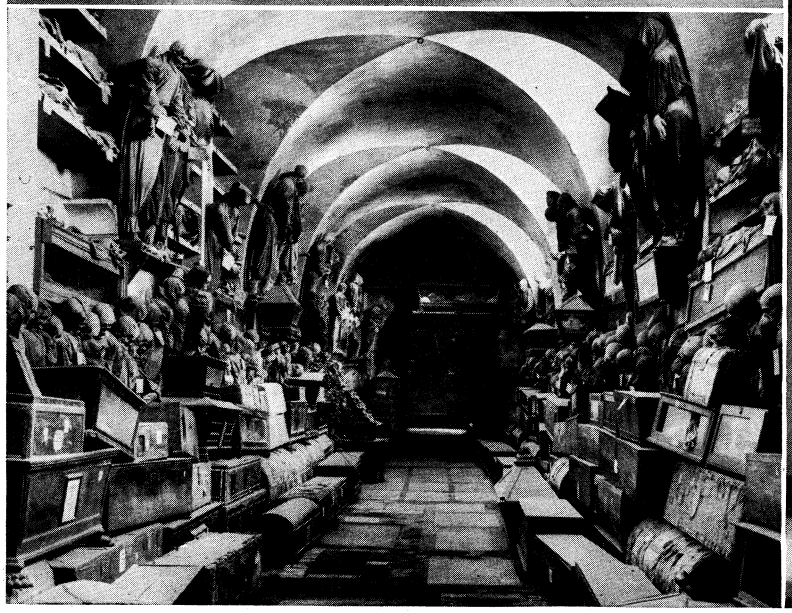
Top left: Snow-capped Alpine peaks in northern Italy

Top right: The countryside in Dobbiaco (known as Toblach in Austria), a health and sports resort in the Italian Tirol

Bottom left: Snow-covered slopes *of* Mt. Aetna in Sicily, highest volcano in Europe; its base is densely populated because of the fertility of its volcanic soil

Bottom right: View of the old city of Amalfi, at the entrance to a deep ravine on the coast of the Gulf of Salerno



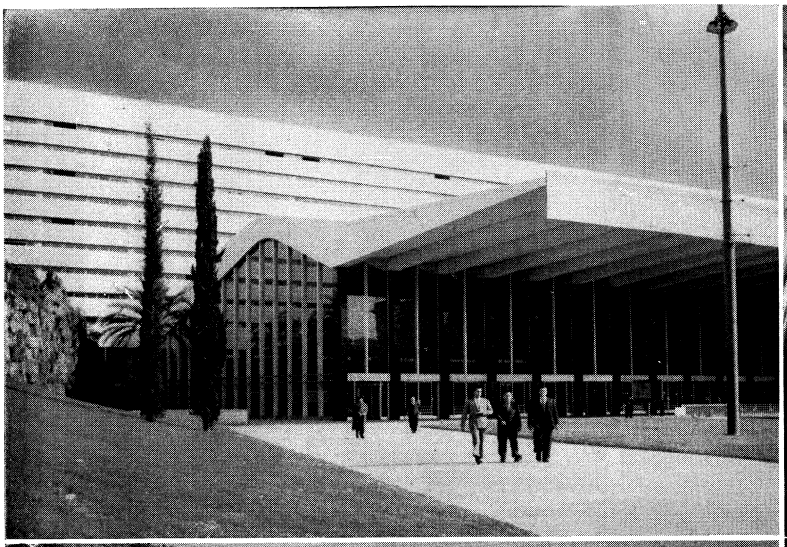


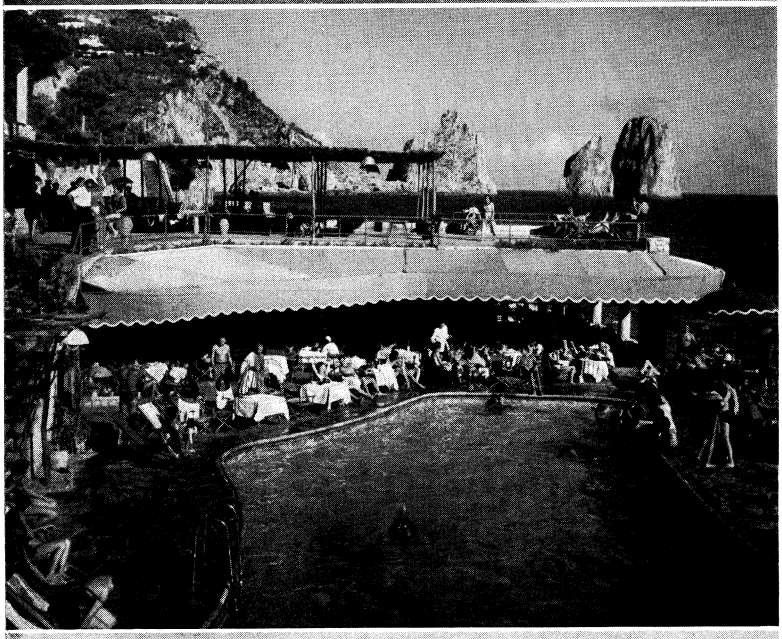
PHOTOGRAPHS (TOP LEFT, CENTRE LEFT) WIDE WORLD. (TOP RIGHT) ERNEST RATHENAU-PIX FROM PUBLIX (BOTTOM LEFT) EWING GALLOWAY, (BOTTOM RIGHT) BAKAL-PIX FROM PUBLIX

FAMILIAR SIGHTS OF RELIGIOUS AND SECULAR INTEREST

Top left: St. Peter's square in Rome filled with throngs of people awaiting a public appearance of the pope
Top right: Two monks on a street in Florence
Centre left: Feeding the pigeons in St. Mark's square, Venice
Bottom left: Catacombs in Palermo, Sicily
Bottom right: The leaning tower of Pisa

ITALY

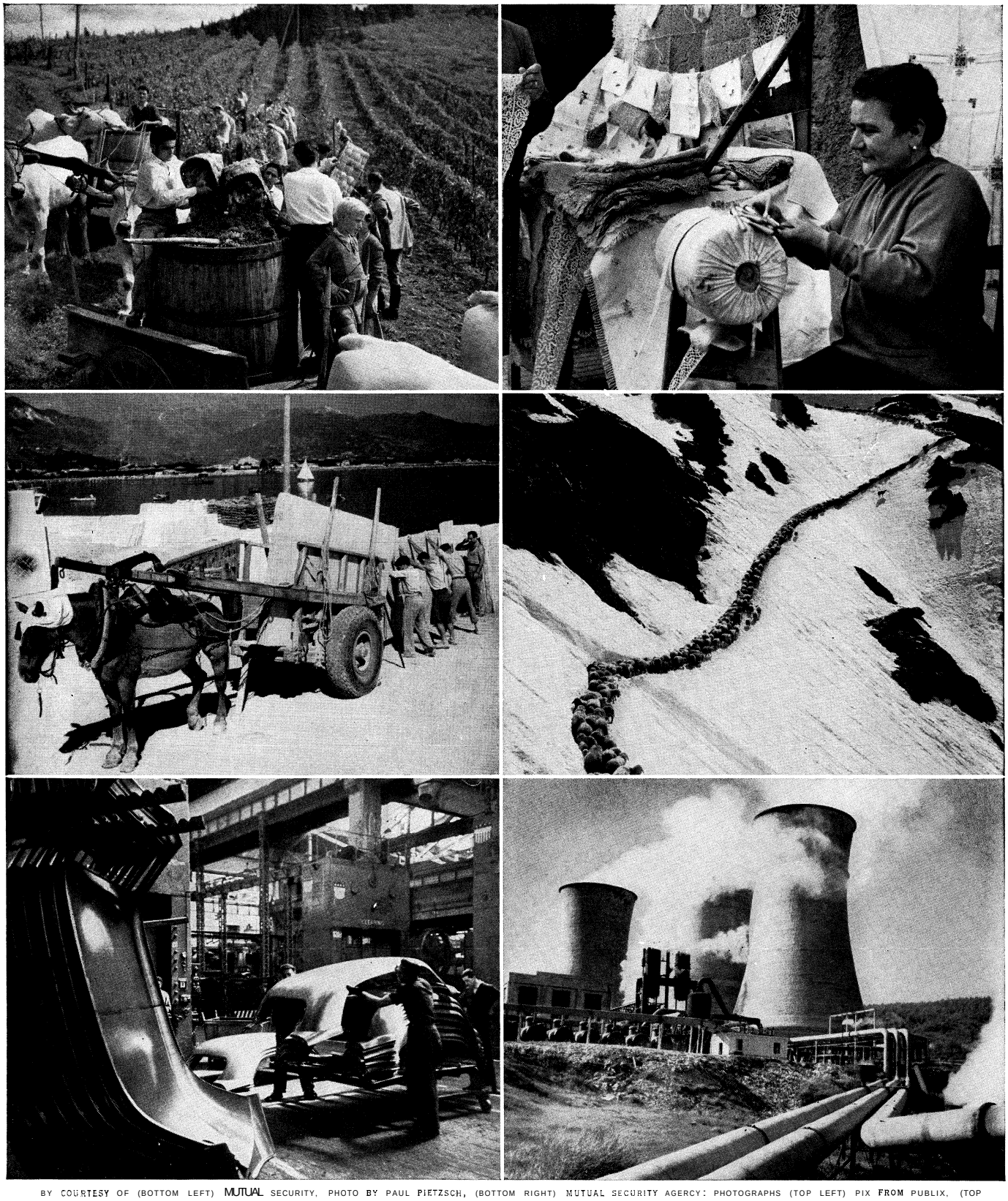




PHOTOGRAPHS (TOP LEFT) PIX FROM PUBLIX, (TOP RIGHT) KURT SCHRAUDENBACH/B PS PIX FROM PUBLIX, (CENTRE LEFT) DANIEL-PIX FROM PUBLIX. (BOTTOM LEFT) BURTON HOLMES FROM LEWING GALLOWAY, (BOTTOM RIGHT) PAUL SENN FROM BLACK STAR

THE MODERN FACE OF ITALY

Top left: Railway terminus in the Piazza Ciriquecento, Rome
Top right: Dining hall of a 16-story circular building for vacationing children. It is on the Mediterranean shore between Leghorn and Genoa and is sponsored by the Fiat works of Turin for the children of its thousands of employees
Centre left: Swimming at a resort on the isle of Capri
Bottom left: Post office building, Naples
Bottom right: Apartment building, Rorne



BY COURTESY OF (BOTTOM LEFT) MUTUAL SECURITY, PHOTO BY PAUL PIETZSCH, (BOTTOM RIGHT) MUTUAL SECURITY AGERCY: PHOTOGRAPHS (TOP LEFT) PIX FROM PUBLIX, (TOP RIGHT) BURTON HOLMES FROM EWING GALLOWAY, (CENTRE LEFT) PAUL SENN FROM BLACK STAR, (CENTRE RIGHT) TRUDEL-PIX FROM PUBLIX

ITALIAN INDUSTRY AND AGRICULTURE

Top ***left:*** Grape harvest time at Chianti, source of one of the finest of Italian wines

Top *right:* Lacemakers of Portofino, northern Italy

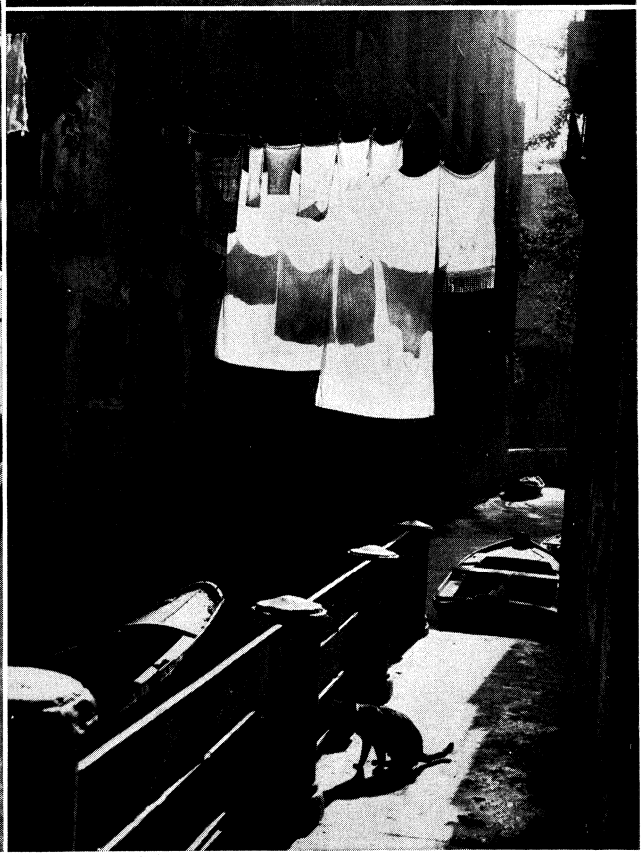
Centre left: Marble from the quarries of Carrara in Tuscany, some of which were worked in Roman times. The only modern change in the traditional cart is the pneumatic tires

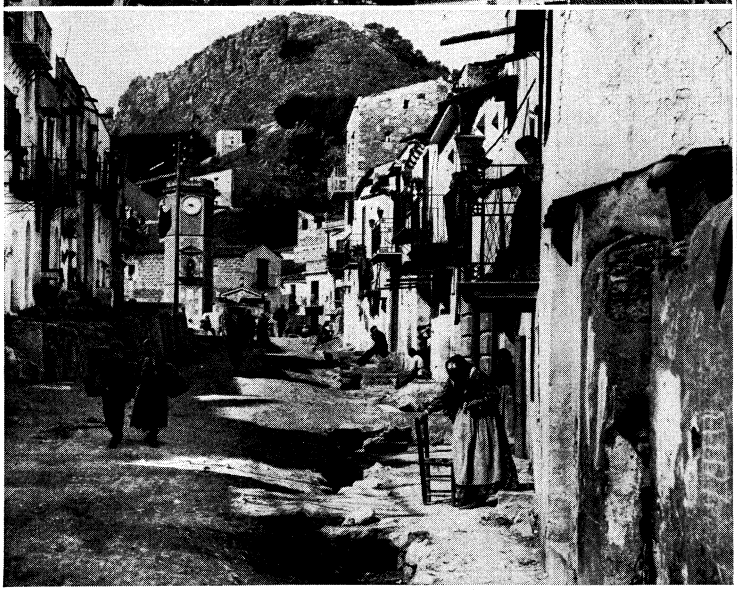
Centre right: Thousands of sheep, guided by Italian shepherds, being guided across the Tirolean Alps during the annual trek to summer grazing grounds in Austria. Shepherds dig a trail in the glacial snow a day or two beforehand, with the help of trained dogs

Bottom left: Fiat automobile plant in Turin

Bottom right: Refrigerators at *a* volcanic power plant near Larderello. Natural steam, probably of deep magmatic origin, either heats the water into artificial steam which then drives the turbines or is sent directly to the turbines. The refrigerators cool hot water from condensers of the turbines so that it may be used again for condensation

ITALY





PHOTOGRAPHS (BOTTOM LEFT) EWING GALLOWAY: (ALL OTHERS) PIX FROM PUBLIX: PHOTOS BY (TOP RIGHT) DOROTHY HOSMER, (CENTRE LEFT) E. TOMCZAK, (BOTTOM RIGHT) ERNEST RATHENAU

SCENES IN ITALIAN CITIES

Top left: One of the winding, narrow alleys in the old section of the port city of Genoa
Top right: A stepped street in Amalfi, province *of* Salerno
Centre left: Air view of Florence, dominated by the Duomo (Santa Maria del Fiore), begun in 1298 and consecrated in 1436
Bottom left: A village street in Palermo, Sicily
Bottom dght: Venetian houses west of the Grand canal

1220 were mainly devoted to rebuilding and consolidating the structure of the Norman monarchy. Further reforms took place in later years, and the constitutions of Melfi of 1231 admirably reflected the spirit and working of the highly centralized and bureaucratic Sicilian state. In northern Italy, active intervention began in 1226 and immediately led to the revival of communal resistance; and when in 1227 the new pope Gregory IX excommunicated Frederick after his failure to keep the date appointed for the crusade, the pattern of the reign of Frederick I was reproduced, the papacy allying itself with the Lombard towns against the emperor. Peace with the papacy in 1230 was of short duration. Open war with the Lombards broke out again in 1236; the great defeat of the league at Cortenuova (1237) was not fully exploited by Frederick; and in 1239 Gregory once more excommunicated the emperor. The capture of Rome now became a major objective; Frederick may have been on the eve of attaining it at the time of Gregory's death (1241). Peace negotiations with Innocent IV and the league broke down in 1244; and Innocent deposed the emperor at the council of Lyons (1245). In the following years the struggle continued with unprecedented violence. Despite numerous setbacks, the imperial cause seemed to be in the ascendant when Frederick suddenly died in 1250.

After 1237 he had reorganized imperial administration in northern and central Italy, introducing and adapting Sicilian methods of government. Vicars-general with wide authority governed new provinces, while under them local officials .administered towns and countryside. The preponderance of natives of the Sicilian kingdom in the Italian administration significantly contrasted with the leading role played by Germans under Frederick I and Henry VI. Sicily had become the main pillar of imperial rule in Italy, and its great resources held out a substantial promise of success. At the same time Frederick tried to preserve the support of the German princes by far-reaching concessions (1232).

Frederick's death was a turning point in the history of Italy; it marked the end of the Hohenstaufen policy of placing the country under a centralized monarchical government. The conflicts betneen Frederick's successors and the papacy continued until 1268. In 1265 Pope Clement IV invested Charles of Anjou with the Sicilian kingdom, where King Manfred, Frederick's illegitimate son, had been consolidating his power. In 1266 Manfred was defeated and killed in the battle of Benevento. Two years later Frederick's young grandson Conradin made a supreme effort to save the fortunes of his house; after a triumphant entry into Rome he was beaten by Charles at Tagliacozzo (1268) and executed at Naples.

During the struggles between papacy and empire Italy had become divided into two parties, papalist and imperialist, which in the course of the 13th century assumed the names of Guelph and Ghibelline. This had not only affected relations between states but had also divided the population of the towns, thus giving fresh impetus to local factions. The names of Guelph and Ghibelline remained a tragic legacy of the Hohenstaufen period to the political life of Italy.

Monarchies and Communes in the 13th Century.—By the end of the 12th century, the communes had triumphed in Lombardy and Tuscany; but although the communal movement extended also to other parts of the country, it did not prevail everywhere. Large regions of Italy retained or developed monarchical institutions — foremost the Sicilian kingdom, but also the papal states, Piedmont and Sardinia. Feudalism formed an important element of monarchical Italy, nhich represented also in this respect a contrast to the antifeudal policy of the communes. R'ith other European countries, monarchical Italy had in common the development of assemblies of estates (*parlamenti*), in which the towns were represented. Originating primarily from the earlier feudal assemblies, the parliaments of the 13th and 14th centuries reflected the attempt to give the towns together with the feudal classes an influential place in the political structure of the monarchical states. They thus constituted also a new development in the position of the towns, which often enjoyed considerable local autonomy under monarchical control. Conditions varied considerably, however, both with regard to the functions of the parliaments and the rights of the towns. Thus the papal states, comprising many communes which had been only recently acquired, contrasted with the Sicilian kingdom where the towns had remained strictly subjected to the monarchy from the time of the Norman conquest, whatever the privileges that had been granted to them.

In communal Italy, the internal conflicts that began to disrupt the communes in the 12th century created new and far-reaching problems. Caused by rivalries and feuds within the ruling oligarchies and already, sometimes, by social conflicts, they led toward the end of the 12th century to the institution of a single executive magistrate (*podestà*). This innovation did not, however, put an end to internal strife. While the consular government disappeared at the beginning of the 13th century, it became the general rule for the *podestà* to be a citizen of another town, so that the executive could no longer be the object of family rivalry. The struggles between the municipal parties, led by powerful families from which they often took their names, became a permanent feature of communal politics, and strife was intensified by the custom of the blood feud (vendetta) and by the expulsions of the defeated party. The growth of Guelphism and Ghibellinism gave the local parties endless possibilities of outside support and added fresh violence to their struggles. But they were no longer alone in their desire for political control.

The increase of economic prosperity and the growth of the town populations led to a challenge of the virtual rule of the aristocracy in the communes. The prosperity was primarily the result of the expansion of Italian trade and the development of Italian banking and industry. The crusades provided Venice, Pisa and Genoa and, indirectly, other towns uith new trading centres on the fringe of Asia; the fourth crusade gave Venice an empire in the Levant, the economic value of which was immeasurably great. The restoration of the Byzantine empire in 1261 was not a serious blow to Venice's new dominion; but it gave Genoa vast commercial opportunities at Venice's expense. The Sicilian policy of the papacy after 12jo—the offers of the kingdom first to Edmund, son of Henry III of England, and then to Charles of Anjou — provided Italian bankers and merchants with new fields of action. Hand in hand with increasing prosperity went immigration into the towns, the new citizens being recruited from all classes. The rise of the merchant and craft guilds was closely related to these developments, another form of organization of the *popolo* being military companies. The popolo roughly corresponded to the middle classes, and the final stage of its political formation was reached when it was organized like a commune, with executive, councils and statutes of its own. Conflicts betneen the aristocracy and the *popolo* began early but generally did not reach full strength until the 13th century. A first attempt to settle them led in Milan and other Lombard towns to the government's being shared between the two classes. Later on in the 13th century the organized *popolo* sometimes succeeded in establishing control of the commune, as in Florence in 12 50 and 1282.

Instability and civic strife were general traits of the 13th-century communes; the fate of the vanquished was bitter, the political exile becoming a typical figure; and the victor's desire for permanent power was determined not only by ambition but also by the fear of the consequences of defeat. To grant special powers to the leader of one's party or of the *popolo* might appear the easiest method to achieve this end; but the breaking donn of constitutional limitations opened the road for the establishment of despotic government.

Interstate conflicts, which had existed even before the rise of the communes, were a constant feature of Italian politics from the 12th century onward. Caused by quarrels over boundaries, by commercial and political rivalry or by Guelph and Ghibelline loyalties, they present a bewildering picture, which nevertheless reveals some patterns. Thus the conflicts betneen Pisa and Genoa, the principal rivals on the Tyrrhenian coast both aiming at control of Sardinia, continued intermittently throughout the 12th and 13th centuries and culminated in Pisa's decisive naval defeat of Meloria in 1284. which sealed its decline as a great maritime power. In the meantime, the struggle between Genoa

and Venice over the eastern trade, beginning in the 12th century, had been intensified by the establishment of Venice's Levantine empire in 1204 and the restoration of the Byzantine empire under Michael VIII Palaeologus in 1261. Commercial rivalry must have been largely responsible for Milan's traditional enmity with Pavia and Cremona. In Tuscany the struggles between Pisa and Lucca began in the 11th century. Lucca, once the most powerful Tuscan town, had been overtaken by Pisa, the chief Tuscan port. Florentine expansion led to mortal enmity between Florence and Siena from the 12th century onward, while Florence's growing economic and political power brought about struggles with Pisa from the beginning of the 13th. One effect of these conflicts was that the emperors always succeeded in enlisting the services of communes against other communes. Another result of the conflicts and of the territorial policy of the communes in general could be the acquisition of city-states by more powerful neighbours. But in this respect too the rise of the *signoria* proved a new departure.

Rise of the **Signorie.**—Frederick II's administrative reforms, as well as the temporary establishment of autocratic rule over seyeral north Italian towns by the Ghibelline Ezzelino da Romano (d. 1259) and then by Frederick's former official, the margrave Hubert Pallavicini (d. 1269), were important elements in the rise of despotism in Italy; while Piedmontese feudalism helped the margrave William of Montferrat to extend his control over many communes of Piedmont between 1260 and 1290. But the broad stream of despotism sprang from internal developments in the communes, in particular from the struggle for political power, from the frequent internal crises and also from the desire for peace at any price. The offices of *podestà* and *capitano del popolo* served as starting points; the new rulers, usually influential citizens and sometimes feudal lords, were given special powers and longer terms of office, notwithstanding constitutional limitations. They had reached their goal when *parlamenti* and councils elected them *signori* (lords) for life with unlimited po ers and when hereditary succession was assured. The new regime preserved the framework but not the spirit of the communal constitutions; under the absolute rule of the *signore* magistracies, councils and elections were left in existence. The *signori* owed their power originally to a measure of consent; and even when they had consolidated it they had still reason to care for popular support. But republican resistance was not lacking, and family rivalries could also lead to sudden changes of fortune.

The new regimt began in Lombardy and the Romagna; it was not until the early 14th century that it seriously affected Tuscany. By that time, a number of leading northern *signorie* had reached a strong position: the Visconti in Milan, the Scaligeri (Della Scala) at Verona, the house of Este at Ferrara. The Carrara established their *signoria* at Padua first in 1318 and finally, after an interlude of Della Scala rule, in 1337; the Bonacolsi of Mantua were replaced by the Gonzaga in 1328.

Meanwhile Florence and Venice were carrying out constitutional reforms which were doubtless responsible to a large extent for their survival as republics. In Florence the reforms of 1282–93 based the government on the 21 guilds, with the predominance of the greater guilds; and the Ordinances of Justice (1293–95) consolidated the rule of the *popolo* by excluding the magnates, who were largely identical with the nobility, from nearly all important offices. Similar measures against the magnates had been taken shortly before in Bologna (1282) and were subsequently taken in other towns. In Venice, on the other hand, the aristocracy decisively consolidated the regime which it had been building up from the 11th century onward by closing the great council, thus making membership practically hereditary (1297–1323). After further reforms during the 14th century, the aristocratic constitution remained almost unchanged until Napoleon's capture of Venice in 1797.

The **First** Angevins in the South.—The Angevin conquest of the Sicilian kingdom opened a new chapter in the history of southern Italy. Charles I retained much of the existing administration as reorganized by Frederick II; but the conquest was followed by a strengthening of feudalism, largely a result of the immigration of French noblemen. Relations between natives of the kingdom and French were at first often hostile. In Sicily they deteriorated to such an extent that the tension culminated in 1282 in the great revolt of the Sicilian Vespers (*q.v.*) which led to a new separation of Sicily from the mainland. The Sicilians offered the crown to Peter III of Aragon, and the Angevins were unable to wrest Sicily from him or his successors. Although the war of the Vespers was ended by the treaty of Caltabellotta in 1302, hostilities began again soon after. For the Angevins at Naples the reconquest seemed essential not only for their prestige but also for their security.

Charles I of Naples had at first acquired control of nearly all Tuscany and part of Lombardy, but his influence in those regions depended on the papacy and the Guelphs and was therefore necessarily weakened when their need to seek his protection against the empire disappeared after 1268. His power outside the kingdom was thus only temporary; but his Italian policy was resumed by later Angevins. Relations between the Sicilian kingdom and the Tuscan merchants remained very close. Charles' conquest of the kingdom could hardly have succeeded without their loans; and the commercial advantages that they derived from his victory were correspondingly great.

Guelphs and Ghibellines in the 14th Century.—The virtual absence of imperial authority between 1268 and 1310 constituted a momentous change in the political situation. The papacy profited from it in several respects. While in the Guelph towns of Tuscany its influence became considerable, its territorial power was, at least potentially, strengthened by the emperor Rudolph's final renunciation of the Romagna in 1278. In Florence the Guelph party split into the Blacks and Whites at the end of the 13th century; and Boniface VIII (1294–1303) asserted his influence there by intervening, while nearer Rome he pursued with great success ambitious territorial plans for his family, the Gaetani, at the expense of the Colonna and Aldobrandeschi. The setting-up of the papal residence at Avignon in 1309 proved a setback for the Italian policy of the papacy from which it did not recover until the 15th century. Republics and *signorie* freely asserted their independence, conditions being particularly favourable to the growth of small *signorie*—*such* as those of the Ordelaffi at Forli, of the Manfredi at Faenza, of the Malatesta at Rimini, of the Da Polenta at Ravenna, of the Pepoli at Bologna and of the Montefeltro at Urbino. Rome was the stage of constant struggles between the baronial families, the Colonna, the Orsini, etc.; and the remarkable successes of Cola di Rienzo in 1347 illustrated the weakness of the papacy.

In 1310 the German king Henry VII arrived in Italy, the first claimant to the empire for many decades to undertake an Italian expedition; in 1312 he was crowned emperor. The expedition led to a revival of Ghibellinism and strengthened the position of the Lombard *signori* who sided with Henry. Matteo Visconti recovered the rule of Milan, and the title of imperial vicar granted to him and to the lords of Verona and Mantua tied them to the imperial cause by improving their legal status; the imperial vicariate, however empty a title it became after Henry's death, continued to be sought after by the *signori*. For the time being, the greatest obstacle to Henry was Guelph Florence. A siege (in the autumn of 1312) had to be raised. Henry died in 1313, on his way to attack King Robert of Naples, the other great Guelph power. The expedition remained an episode, but the Ghibelline revival retained its importance for some time to come. During the struggles with Pope John XXII it became connected with antipapalist heresies, and prosecutions for heresy played an important role in papal warfare against the Ghibelline *signori*. In Tuscany the rise of Uguccione della Faggiuola as lord of Pisa (1313) and Lucca (1314) and then that of Castruccio Castracani, who ousted Uguccione from Lucca in 1316, was a heavy blow for Guelphism. The Florentines suffered crushing defeats in 1315 and in 1325. After the latter they made Charles of Calabria (son of Robert of Naples) *signore* of Florence (d. 1328). Castruccio acquired Pistoia and Pisa (1325, 1328) and threatened Florence with encirclement; but he died in Sept. 1328, and his dominions broke up immediately. The Italian expedition (1327–30) of the

emperor Louis IV the Bavarian was a fresh stimulus for Ghibellinism; its final decline resulted primarily from the scant role of the empire in Italian politics after this time; the two expeditions of Charles IV (1354–55, 1368–69) were of little consequence and vividly illustrated the eclipse of imperial authority.

The papacy had once more fought the Ghibellines vigorously; at the same time, John XXII had made a determined bid to recover control of the papal states. The papal legate in Italy, Bertrand du Pouget (1319–34), achieved only temporary successes; but the house of Este came to terms with the pope and were created papal vicars of Ferrara—a title copied from the imperial vicariate and soon to be generally used by the papacy to assert at least a minimum of sovereignty over the despots of the papal states.

Expansion of the **Signorie.**—One of the outstanding developments of Italy in the 14th century was the territorial expansion of a number of city-states. Expansion beyond the boundaries of the *contado* had occurred before the rise of the *signorie;* but the *signorie* were in *a* singularly favourable condition to carry it forward, since one man could be elected *signore* of more than one town. Thus Matteo Visconti of Milan (d. 1322) and Cangrande I della Scala of Verona (d. 1329) laid the foundations of great territorial states in northern Italy. The brief intervention of King John of Bohemia in that region (1330–33) proved ultimately an advantage to the Lombard *signori,* who extended their territories when John's power collapsed. In the race for territorial acquisitions—that is to say, acquisitions of other city-states—the Visconti were momentarily outpaced by the Della Scala, whose power stretched in 1336 from the march of Treviso to Lucca. It was rumoured that Mastino II was aiming at the Lombard crown. The leagues of 1336–37 against them brought about their fall. After the peace of Venice in 1339, the Della Scala dominions were practically reduced to Verona and Vicenza (Parma and Lucca being lost in 1341).

These events were characteristic of the instability of the *signorie.* Towns were often as easily lost as gained, and at home also the position of the *signori* was not always secure. On the other hand, republicanism continued to suffer reverses. Thus in Padua communal government came to an end in 1328, and in Tuscany the *signoria* gained much ground after Henry's expedition, Florence itself being not immune from it.

The war against the Della Scala had an aftermath in the war over Lucca. Sold by Mastino della Scala to Florence, Lucca was attacked and then taken by Pisa (1341–42). The result of this setback and of internal discontent was the *signoria* of the duke of Athens, Walter II (Walter VI of Brienne), in Florence from 1342 to 1343. It was followed by antidespotic reaction and by a period of increased political influence of the lesser guilds. These were also years of economic crisis for Florence. The difficulties and final bankruptcy (1345) of the great houses of Bardi and Peruzzi ruined many other companies and shook the economic life of the town. The Black Death of 1348, which decimated the population, caused further disaster.

In 1343 Robert of Naples died; during his long reign Naples had once again played a leading role in Italian politics as protector and leader of the Guelphs. But several years before his death Robert had practically withdrawn from these wider fields of action, and under his granddaughter heiress, Joanna I, a period of internal troubles began for the kingdom.

A new Italian problem had meanwhile arisen in the shape of the companies of mercenaries. Nearly all under foreign commanders, they had spread over Italy from the early 14th century onward. The internal troubles of the kingdom of Naples after Robert's death provided them with fresh opportunities, while the peace of Brétigny and Calais (1360) released many soldiers for service in Italy. Their ravages and disloyalties caused infinite hardships. But the Italian powers themselves were largely to blame as they made constant use of the companies. It was not surprising that the frequent leagues against the latter had little success.

Italy From 1350 to **1454.**—Giovanni Visconti acquired Bologna, the gateway to Tuscany, in 1350 and Genoa in 1353. The former event led to war with Florence, the first in a long series of conflicts between Milan and Florence. Genoa was lost in 1356 and Bologna in 1360, but both remained prominent objectives of Visconti policy. At that time a new political factor of lasting importance was emerging in northwestern Italy. The count of Savoy, Amadeus VI, subdued the Piedmontese branch of his house (1360–68) and established a powerful dominion which combined French and Vaudois with Italian territories. It was not surprising that he clashed with the Visconti (1372–75), equally aiming at predominance in western Lombardy. While the Visconti state was temporarily divided after Giovanni's death in 1354 into three and then into two parts. Florence was recovering from the earlier crises and was once more extending its territory, being well on the way to complete hegemony in Tuscany. The Guelph party was virtually in control of the state from 1354; resistance against its dictatorial methods flared up in 1378 and developed into a revolt of the poorest section of the population, the *popolo minuto,* against the traditional preponderance of the rich *popolo grasso* (the revolt of the *ciompi*). But by 1382 the *popolo grasso* had not only recovered, but permanently strengthened its position.

In the papal states a fresh attempt was made from 1353 onward to restore papal authority. The great successes of the new legate, the cardinal Gil (Aegidius) Alvarez de Albornoz, led to a complete change in the political situation. He forced the Malatesta and the Ordelaffi to submit and reorganized papal administration (the Egidian constitutions of 1357 remained its basis until the early 19th century). These achievements paved the way for the return of the papacy to Rome. Urban V attempted it in 1367, Gregory XI in 1376 during the mar of 1375–78 with Florence—a state now apprehensive of the effects of the papal recovery. Gregory's death in 1378 was followed by the outbreak of the Great Schism.

The last two decades of the century form. in more than one respect, a landmark. The War of Chioggia between Genoa and Venice ended with the failure of Genoa's supreme bid to destroy the power of its rival (1381) and thus decided the long struggle between the two powers. The Great Schism ruined the work of Albornoz in the papal states; in Naples, it led to civil war. Joanna I having adhered to the antipope Clement VII, Urban VI called her second cousin Charles of Durazzo (Charles III of Naples) to Italy against her; Joanna made Louis I, duke of Anjou, her heir. It mas not until 1399 that Ladislaus, Charles III's son, finally prevailed against Louis II of Anjou, as his father had done against Louis I (d. 1384). In Lombardy and Tuscany, the last 15 years of the century were marked by the rise of Gian Galeazzo Visconti. Having in 1378 succeeded his father Galeazzo in his parts of the Visconti dominions, he deposed, in 1385, his uncle Bernabo and thus reunited the whole Visconti state, giving it a stronger and more centralized administration. He attacked the Della Scala of Verona in 1387 and the Carrara of Padua in 1388 and annexed all the territory of the former and most of that of the latter. Florence feared that expansion into Tuscany would follow; war between Florence and Gian Galeazzo broke out in 1390 and again in 1397. In the meantime, the lord of Milan was raised to ducal rank by the emperor Wenceslaus, the first *signore* to reach princely dignity (1395). He acquired Pisa, Siena and Perugia in 1399–1400 and Bologna in 1402. He seemed on the eve of attacking Florence when he suddenly died in 1402.

Gian Galeazzo had divided his state between his sons Giovanni Maria, who became duke. and Filippo Maria; but it rapidly broke up at the hands of his former captains, of local *signori* and of neighbouring states. The tide seemed indeed to have turned in favour of Venice and Florence. The Florentines conquered Pisa in 1406, thus gaining at last direct access to the sea. Venice seized most of Gian Galeazzo's conquests in eastern Lombardy. In 1405 it destroyed the Carrara, who had recovered Padua in 1390 and taken Verona after Gian Galeazzo's death.

These events were a landmark in the history of Venice, the beginnings of an active policy of territorial expansion on the Italian mainland where it had previously been primarily interested in commercial control. In 1416 war with the Turks began, the first of the wars during which Venice was to lose its Levantine empire.

In 1419–20 it finally conquered the Friuli; by 1420 it had recovered Dalmatia (lost in 1358). Complete control of the Adriatic sea, a fundamental objective of Venetian policy, appeared to be near realization at a time when Venice had become one of the great mainland powers.

At the beginning of the 15th century, Naples re-emerged under King Ladislaus for a short period of Italian power. Reviving the policy of earlier Angevins and taking advantage of the troubles of the papacy, Ladislaus occupied Rome and Latium and advanced into Tuscany in 1408–09; after a withdrawal, he again seized Rome and advanced north in 1413–14. He clashed with the Florentines, faced by another invasion of Tuscany. But at the height of his power Ladislaus died (1414). Under his sister Joanna II the kingdom was once more plunged into a mar of succession. In the meantime another and more lasting political revival had begun in northern Italy. Filippo Maria Visconti succeeded Giovanni Maria after his assassination in 1412; by 1421 he had reconstructed the Visconti state roughly within the boundaries of 1385, thus reawakening the fears not only of Florence but also of Venice, which owed so much to the break-up of the Visconti dominions. The submission of Genoa in 1421 and intervention in the Romagna (1422–23) recalled earlier Visconti objectives. War broke out with Florence in 1423 and with Venice in 1426; and mars continued intermittently until the middle of the century. Venice pushed its frontiers farther west by acquiring Brescia. Bergamo and Crema; it concluded final peace in 1454. Florence had already changed alliances earlier.

In 1447 Filippo Maria died, and the Milanese republic was restored — after nearly two centuries of despotic rule; but in 1450 his son-in-law, the former condottiere Francesco Sforza, took Milan and restored despotism under a new dynasty. A friend and ally of Cosimo de' Medici, he put an end by his victory to the long struggle between Florence and Milan.

The rebuilding of the territorial power of the papacy, which began after the accession of Martin V (1417), was a slow process; after promising beginnings under Martin, the situation deteriorated again under Eugenius IV (1431–47). But by the middle of the century the tide had turned; the council of Basle had been dissolved and Francesco Sforza had in 1447 lost the march of Ancona (which he had acquired in 1433). Nicholas V pursued a policy of pacification, and it was not until Sixtus IV that a fresh advance in territorial policy began.

In Naples the succession crisis lasted intermittently until 1442, when Alphonso V of Aragon, who was already king of Sicily, took Naples. Joanna II, who had at first adopted him as heir, had gone over in 1423 to Louis III of Anjou, Martin V's candidate. At her death in 1435 she left the kingdom to Louis's heir, René of Anjou; and now Alphonso made a fresh bid for the kingdom. After his victory he was invested with it by Eugenius IV (1443); but René of Anjou did not abandon his claim, which in 1494 was to form the legal basis for the French king Charles VIII's Italian expedition.

In Florence the government underwent a momentous change in 1434. From 1382 Florence was ruled by a group of leading families, headed from 1393 by hfaso degli Albizzi and, after his death in 1417, by his son Rinaldo. In a difficult position because of an unsuccessful war against Lucca (1429–33), Rinaldo struck against his chief rival, Cosimo de' Medici, whose family had been rising in political importance from the end of the 14th century. Cosimo was banished in 1433; but in 1434 Rinaldo fell from power and Cosimo was recalled while the Albizzi were exiled. A new epoch in Florentine history began. At first Cosimo followed largely the traditions of the oligarchical government and only cautiously extended his power beyond that enjoyed by the Albizzi. His position was greatly strengthened by the successes of his diplomacy. By making Francesco Sforza an ally of Florence, he established a new policy of friendship with Milan.

The peace of Lodi between Milan and Venice (1454) and the conclusion of an Italian league (1454–55) marked the end of a period of wars. The conflicts of the first half of the 15th century had helped to bring the new Italian art of war to maturity. Its founder had been, toward the end of the 14th century, Alberico da Barbiano; and mercenary warfare in Italy had subsequently passed into the hands of Italians. Muzio Attendolo Sforza and Braccio da Montone, who had both served under Alberico, gave rise to two difierent schools of warfare; at the beginning of the Neapolitan struggles under Joanna II they fought in opposite camps, adding military rivalry to the political issues. The rise of the Italian condottieri also led to new political developments. While minor signori, eager to increase their revenues, often served as condottieri, condottieri would sometimes become *signori*—an ambition more natural to Italian than to foreign captains. Shifting loyalties remained, however, a characteristic feature of the condottieri. The governments often suspected their generals and sometimes acted against them, the most spectacular example being the execution of Francesco da Carmagnola by Venice in 1432.

The new alignment of forces in Italy after 1450 was to determine much of the history of the following decades. The political map of the country had been simplified by the territorial expansion of Milan, Venice and Florence; five great powers now completely overshadowed the remaining smaller states, and the idea of a balance between them was beginning to take shape. After 1454, the Italian league and the triple alliances between Milan, Florence and Naples, although not permanent, pointed in this direction and held out at least some promise of peace. (N. R.)

The Italian League. — The second half of the 15th century witnessed a movement toward confederation among the Italian states. A common language and a common culture fostered the sense of nationality. This found expression in the league of 1455, the members of which were pledged to preserve peace among themselves and to resist foreign intervention. An alliance between Milan, Florence and Venice following the peace of Lodi had brought the league. into being. Nicholas V, eager to turn the forces of Italy against the Turk after the fall of Constantinople, ratified it in the name of the papacy and used his influence to bring Naples in. Almost all the lesser states were enrolled as adherents of one or the other of the five leading powers. The aim of the league was to maintain the balance of power by resisting acts of aggression on the part of any member state and to keep the foreigner out. It was instrumental in defeating René of Anjou's attempt to win the crown of Naples on the death of Alphonso V of Aragon (1458) and in securing the succession for the latter's illegitimate son Ferdinand I (Ferrante); in so doing it gained for Italy a respite from foreign intervention. When the pope and Venice made a combined attack on Ferrara in 1482 the intervention of Milan, Florence and Naples saved the city for the house of Este. Thus the league became a guarantee of the independence of the smaller states, enabling each to make its individual contribution to the civilization of the Renaissance. Freed from the burden of major wars, Italy enjoyed a period of prosperity in which all the arts flourished and the separate states were drawn closer together in pursuit of 'their common interests.

During these years political institutions tended everywhere toward despotism. The Medici became more indispensable to Florence and the Bentivoglio more autocratic in Bologna. Perugia submitted to the dictatorship of the Baglioni and Siena to that of the Petrucci. The head of each family was recognized as the leading citizen of his republic, being a despot in fact but not in law. Other rulers, who had been given the lordship of their city by popular decree, strengthened their title by obtaining investiture from pope or emperor. Thus the Gonzaga lords of Mantua became imperial margraves, the Este were invested with Modena by the emperor and with Ferrara by the pope. Imperial investiture as duke of Milan, for which Francesco Sforza had negotiated in vain, was granted to his son Ludovico. The interests of the popes approximated more and more to those of Italian secular rulers. Their aim was to establish their direct authority throughout the states of the church, and their means was the bestowal of lands and offices upon their relatives. Sixtus IV (1471–84) controlled the Sacred College through his Della Rovere and Riario nephews, and established another nephew, Girolamo Riario, as lord of Imola and Forli as a step toward the subjugation of Romagna. Thanks to the work of architects and painters brought thither by successive popes, Rome became a splendid

Renaissance capital. The despots made life fuller and gayer within their cities and added to their prestige abroad. Nevertheless their position was precarious. Citizens nurtured in the republican tradition acquiesced in despotic rule only so long as they felt its advantages. The murder of Galeazzo Maria Sforza in Milan (1476) and the attempt on the part of members of the Pazzi family against the Medici in Florence (1478) are typical of an age in which no ruler could rely upon the continued loyalty of his subjects. In Naples the Angevin baronage was ever ready to revolt against Ferdinand of Aragon. Even Venice, the most stable of Italian states, was unpopular with the nobles in its subject cities. conscious of insecurity at home and fearful of attack from neighbouring powers, each state thought more of securing some temporary advantage for itself than of the preservation of Italian unity. Lorenzo de' Medici (Cosimo's grandson, Lorenzo I il Magnifico) almost alone worked consistently for peace, using his tact and skill to minimize occasions for quarrelling. His death (1492) was the prelude to foreign invasion.

The French Invasions, 1494–1512.—X new age opened for Italy when Charles VIII of France turned his mind toward the pursuit of his claims to Naples, as the heir of René of Anjou. At this time a serious quarrel had broken out between Naples and Milan. Galeazzo Maria Sforza, Francesco's son, was succeeded as duke of Milan by his infant son Gian Galeazzo, the boy's uncle Ludovico (il Moro) acting as regent. When Gian Galeazzo grew up and married (1489) Isabella of Aragon, daughter of Alphonso, duke of Calabria (later Alphonso II of Sicily). Ludovico retained the government in his hands. He and his brilliant wife, Beatrice d'Este, usurped the place of the rightful duke and duchess, thereby arousing the indignation of the Neapolitans. Piero de' Medici, who succeeded to his father Lorenzo's supremacy in Florence, was incapable of healing the breach between his allies. while the election of Rodrigo Borgia to the papacy as Alexander VI increased the tension between the Italian powers. Ludovico, feeling himself isolated and expecting an attack from Naples, threw himself on the side of Charles VIII, who entered Italy as his ally (1494). Hardly had Charles passed through Lombardy on his unhindered march southward before Gian Galeazzo died. Ludovico, who incurred grave suspicion of having poisoned him, became duke of Milan. In Florence, Charles VIII's coming resulted in the expulsion of Piero de' Medici and the establishment of a republican government allied with France and drawing its inspiration from Fra Girolamo Savonarola. Savonarola's preaching brought about an astonishing religious revival in the city; but opinion turned against him as the first enthusiasm faded and as neither the new constitution nor the French alliance achieved the good results that he had foretold. In 1498 he was tried and executed on the charge of heresy. Meanwhile Charles VIII had won the throne of Naples and lost it again. In 1495 he was back in France, having narrowly escaped defeat at the hands of Italian forces at Fornovo as he crossed the Apennines; Spanish arms reinstated Ferdinand I's grandson in Naples as Ferdinand II. Charles had gained nothing, but his expedition paved the way for more formidable invaders. His cousin the duke of Orléans, who succeeded him as Louis XII in 1498, at once prepared to enforce his claims on Milan, inherited from his grandmother Valentina Visconti. Ludovico Sforza fled to the imperial court and on his return to Milan with an army in 1500 found the Castello in French hands. At the battle of Novara his Swiss mercenaries refused to fight against their compatriots in French service. Ludovico was captured and taken to France (he died at Loches in 1508). Louis XII, now duke of Milan, in 1500 concluded the treaty of Granada with Ferdinand the Catholic whereby France and Spain agreed to divide Naples between them. The conquest was easy and Frederick, the last representative of the illegitimate line of Aragon in Naples, retired to France. Ferdinand, however, soon picked a quarrel with his ally. The French were driven out by the end of 1503 and the two Sicilies were reunited under the Spanish crown. An important step toward Spanish domination of Italy had been taken.

Meanwhile the Italian powers made use of foreign invaders for their own ends. Louis XII had found it politic to ally himself with Alexander VI before coming to Italy; thus the pope's son Cesare Borgia embarked on his campaign of conquest in Romagna supported by French troops. Cesare seemed to be upon the point of creating a powerful Borgia state. embracing not only Romagna but Tuscany. when Alexander's death (1503) brought about his own fall. Most of his acquisitions in Romagna reverted to the Holy See. but Venice added to the cities that it already held there. The Venetian republic had gained ports in Apulia when helping to defeat Charles VIII and towns in Lombardy as the price of its alliance with Louis XII. Its territorial gains had been made at the expense of its neighbours, and these now included the pope and the kings of France and Spain. Thus Pope Julius II was able to bring a formidable array of enemies against the republic in the league of Cambrai (1508). Julius II's aim was to restore power and prestige to the church and, first of all, to bring all papal lands in Italy under his direct rule. He had already conquered Bologna and forced the Baglioni in Perugia to submit to his authority when he joined in the attack on Venice. The defeat of Venice at the battle of Agnadello (1509) mas followed by the dissolution of its mainland dominion. It was forced to accept the pope's terms, renouncing its claims to independence in ecclesiastical matters and ceding the cities which it held in Romagna. Julius was now undisputed master of the states of the church. with the sole exception of Ferrara, where the duke, Alphonso I d'Este, sheltering under the protection of France, refused obedience to his suzerain. Thereupon the pope proclaimed his intention to free Italy from the barbarians and formed the Holy league to drive out the French. In 1512 the battle of Ravenna was fought between Spanish: papal and Venetian forces on one side and French and Ferrarese on the other. Gaston de Foix, the brilliant French commander, bought victory dearly with his death. Before his leaderless forces had time to recover from the shock the Swiss, as members of the Holy league: invaded Lombardy, drove out the French and set up Maximilian Sforza as duke of Milan. In the same year the armies of the league restored the Medici to power in Florence. Only the death of Julius II in 1513 saved Ferrara for the house of Este.

Charles V.—The expulsion of the French brought Italy hope of freedom from foreign rule and moved Machiavelli to write his Prince. He dedicated it to Lorenzo II de' Medici who, because of the return of his family to Florence and the election of his uncle Giovanni to the papacy as Leo X, had. in Machiavelli's eyes. only to follow the advice laid down for him in order to become the saviour of Italy. Such hopes were illusory. The Italians had neither the will nor the power for united resistance to the foreigner, and France had been expelled at the cost of increasing the predominance of Spain. By the victory of Marignan (1515) Francis I of France broke the power of the Swiss and regained the duchy of Milan. The election of Charles V as emperor in 1519, following his succession to the Spanish kingdoms. was the prelude to the struggle between Habsburg and Valois which vexed Italy for the next 40 years. Charles began by driving Francis from Milan and investing Francesco Maria Sforza with the duchy. In 1525 Francis' attempt to regain it ended in his defeat and capture at the battle of Pavia. Alarmed at the growth of imperial power in Italy, Pope Clement VII (Giulio de' Medici) deserted Charles for Francis and engineered the league of Cognac (1526) to drive his former ally from Italy. Charles determined to make Clement see reason by force of arms, and in 1527 fresh troops from Germany joined the Spaniards in Italy. A mutinous and starving army led by the constable duke of Bourbon appeared before Rome. Bourbon was killed in the first attack, and the sack of Rome followed. The horrors of the outrage reverberated through Europe, and although Charles was not directly responsible his hold upon Italy was in jeopardy. Within three years; however, Habsburg domination of Italy was an accomplished fact. Andrea Doria brought Genoa and its fleet into Charles's service. Clement VII came to see that his interests both as Medici and as pope would be best served by alliance with Charles. When he was a prisoner in Castel Sant'Angelo the Medici had again been expelled from Florence, and the price of his forgiveness of Charles was the loan of imperial forces to overthrow the last Florentine republic. Flor-

ence fell after a heroic defense (1529–30) and Alessandro de' Medici (Lorenzo II's son) became duke of Florence. By the treaty of Cambrai (1529) Francis I renounced his claims on Milan and Naples, and when Charles was crowned emperor by Clement VII at Bologna (Feb. 1530) he had become the arbiter of Italy.

Charles V's settlement of Italy was based on the principle of favouring the interests of the native rulers in order to secure their support against France. He used his influence to reconcile Alphonso of Ferrara with the papacy. He restored Francesco Maria Sforza to Milan and married him to his niece Christina of Denmark, despite his treachery in having joined the league of Cognac. He raised Federico Gonzaga of Mantua to the rank of duke and in 1536 confirmed his succession to Montferrat. Cosimo, of the younger line of Medici, who in 1537 succeeded Alessandro as duke of Florence, was invested with Siena in recognition of his aid in suppressing the last Sienese republic. In 1569 he obtained from Pope Pius V the title of grand duke of Tuscany. The duchy of Parma and Piacenza, which the Farnese pope Paul III had created in 1545 for his son Pierluigi, was brought into the Habsburg orbit by the marriage of Duke Ottavio Farnese with Charles V's natural daughter Margaret. Thus throughout the Spanish supremacy Italian princes continued to preside over their courts, to cultivate the arts and to adorn their cities with sumptuous buildings. Nevertheless the great days of Italy were over. and the country as a whole suffered steady decline in wealth, prestige and freedom. In its later stages the war with France was fought for the most part outside Italy, but Francis I and Henry II in turn pressed their claims to Milan and Naples and never let slip an opportunity of fomenting Italian opposition to Habsburg rule. The death of Francesco Maria Sforza without heirs in 1535 was followed by fresh outbreaks of war and fruitless negotiations with France, until Charles settled the fate of Milan by investing his son Philip with the duchy (1540), at the same time transferring all imperial rights in Italy to Spain.

The Spanish Ascendancy. — In 1559, after Charles had ceased to rule, the treaty of Cateau-Cambrésis between Philip II of Spain and Henry II of France marked the final renunciation of Valois claims to Italian territory and added further to the Spanish dominions by assigning to Philip the Tuscan ports known as the Presidii. With Spanish viceroys in Milan and Naples, Italy had ceased to be independent. The power of the papacy had, however, increased rather than diminished during the Franco-Spanish wars. It had gained new life from the Counter Reformation, the work of Baroque architects added yearly to the splendours of Rome and the authority of the popes in the states of the church was undisputed. When, in 1597, Alphonso II d'Este died childless, Clement VIII refused to invest his cousin Cesare with Ferrara. The house of Este made Modena its new capital, where Cesare and his descendants reigned until 1859; and Ferrara was at long last incorporated in the papal states.

In 1631 Urbino, which had been renowned as a centre of the Renaissance under its Montefeltro rulers, also fell to the papacy. the last duke, Francesco Maria II della Rovere, having arranged for the devolution of his state to Urban VIII. Individual popes might pursue a policy of opposition to Spain, but papal government was as repressive in character as that of the Spaniards. In 1542 the Inquisition, already a recognized feature of Spanish rule, was established in Rome. Henceforth printing was controlled throughout Italy, heretics were sought out and burned, the least symptom of political unrest called forth punitive measures. Spain and the Counter Reformation destroyed the free spirit of an earlier age and sapped the energies of the people.

Among the Italian secular states Venice retained the greatest measure of independence. By 1517 it had recovered the bulk of its Lombard territories, which were to enjoy relative prosperity under its rule until the coming of Napoleon; and in spite of the submission forced from it by Julius II, the church in its dominions remained to a large extent under state control (Venice gave asylum to fugitives from the Inquisition for many years before it yielded to papal pressure and expelled heretics). This policy brought on Venice the enmity of both the papacy and Spain and led in 1606 to the contest with Paul V in which Paolo Sarpi acted as the champion of the republic. Venice was strong enough to ignore the interdict imposed and to secure its removal by a compromise that involved no surrender of principle. Nevertheless Venice had ceased to be a great power. The discovery of the Cape route to India robbed the city of its monopoly of the spice trade and thus struck a mortal blow at its commercial prosperity. Already in the 15th century its carrying trade had become less profitable through rivalry with the Turk. Now the trading system that it had built up declined in value because of the advantages of the sea route to western Europe enjoyed by the Portuguese. Meanwhile the city fought a losing battle for its dominion in the Levant. It shared in the triumphant victory over the Turk at Lepanto (1571), but in the peace that followed failed to recover Cyprus. In 1669 Crete was surrendered to the Turk after a 20-year struggle. By 1718 only Corfu remained of a once vast empire.

Italy as a whole declined in prosperity through the shifting of trade paths consequent on the discovery of the new world. The Florentine cloth trade had long passed its zenith, and the preeminence of Florence in banking passed to new centres of exchange such as Antwerp. In Genoa the noble families who had laid the foundations of Genoese maritime and colonial power were rich enough to build fine palaces, but their overseas empire was dwindling and the sale of Corsica to France in 1768 marked its end. Of the Spanish territories Lombardy in particular suffered from the presence of large military forces, taxation was everywhere excessive and government officials corrupt. An occasional rising took place, as for instance that of Masaniello in Naples (1647) and the rebellion of Messina (1676–78), which was first aided and then deserted by a French fleet. For the most part the people acquiesced apathetically in a regime which, while it cared little for their welfare, based itself on the principle of noninterference.

The most hopeful feature of the dreary years of Spanish domination was the emergence of Savoy as an Italian power. Charles III of Savoy had supported the emperor Charles V in his struggle with France until, in 1536, Francis I occupied his dominions. Thus Emmanuel Philibert, when he succeeded his father in 1553, was a duke without a duchy. He had distinguished himself in the service of Philip II of Spain, notably at the battle of St. Quentin (1557), and the treaty of Cateau-Cambrésis restored him to his possessions. When he had recovered Turin, which with certain other Piedmontese fortresses remained in French hands for a few years after his restoration, he transferred his capital to Turin from Chambéry. From that time Italian Piedmont took the place of French Savoy as the centre of interest for its dukes. In 1601 Charles Emmanuel I acquired Saluzzo, but had to cede Bresse, Bugey, Gex and Valromey to Henry IV of France. On the outbreak of the War of the Mantuan Succession in 1628 he hoped to secure the duchy of Montferrat. French aid, however, set up Carlo Gonzaga, duke of Nevers, in both Mantua and Montferrat, although the peace of Cherasco (1631), nine months after Charles Emmanuel's death, assigned considerable territories in the latter duchy to Savoy. The death of the last Habsburg king of Spain, Charles II, in 1700 provoked the War of the Spanish Succession, in which the conflict between Austrian Habsburg and Bourbon claimants necessarily involved Italy. Savoy held the key to the passes of the Alps between France and Lombardy, and Victor Amadeus II, with a good army and a united people, was courted by both sides. He was encouraged in resistance to France by his second cousin, Prince Eugène, a leading general in the Austrian army, who in 1706 relieved Turin and drove the French from Italy. The part played by Savoy in the war won for its duke a voice in the peace negotiations and a share in the spoils.

Austrian Ascendancy in the **18th** Century. — The terms of the peace of Utrecht (1713) recognized the duke of Anjou as Philip V of Spain but assigned Milan, Naples and Sardinia together with Mantua (from which the last Gonzaga duke had been ejected during the war) to his rival the archduke Charles. Thus Austria replaced Spain as the dominant power in Italy. Victor Amadeus, who aimed at securing Milan. had to be content with Montferrat and the island of Sicily with the title of king. Italy was sacrificed to the balance of power in Europe and its territories were assigned

to new rulers without regard to their history or traditions. The division of Sicily and Naples and their separation from Spain provoked great discontent, and this was exploited by Elizabeth Farnese, the Italian wife of Philip V of Spain, in the interests of her onn family. She was aided by the king's minister Giulio Alberoni, like herself a native of Parma, uho engineered abortive invasions of Sardinia and Sicily. Thereupon Austria took possession of the latter island, forcing Savoy to accept Sardinia in exchange (1720). From that time until they became kings of Italy. the dukes of Savoy bore the title of king of Sardinia. On the outbreak of fresh war between Habsburg and Bourbon over the Polish succession, Charles (eventually Charles III of Spain), the eldest son of Philip V's marriage with Elizabeth Farnese, led an expedition to Italy and won recognition as king of the Two Sicilies (Charles VII of Naples) in 1735. He failed however to gain the succession to Parma, where he had been proclaimed duke on the extinction of the Farnese line, or to Tuscany, where Medici rule ended with the death of grand duke Gian Gastone in 1737. Instead, Tuscany went to Francis of Lorraine, who had to yield his own duchy to France, and Parma was added to the Lombard dominions of Austria. Yet another European conflict, the War of the Austrian Succession, had its repercussions in Italy. When the emperor Charles VI died in 1740, the Bourbon kings of France, Spain and Sicily joined in the attempt to despoil his daughter Maria Theresa of her heritage. The failure of their efforts and the re-establishment of Austrian power in Italy was largely the result of the rivalry between Charles Emmanuel III of Savoy and Charles of the Two Sicilies.

During the War of the Polish Succession they had fought together against Austria, and Charles Emmanuel had occupied Milan for three years. Elizabeth Farnese, however, was anxious to secure Milan for one of her sons, and Charles Emmanuel, seeing that the prize that he coveted would not be won in alliance with the Bourbon powers. now went over to the Habsburg side. Under the treaty of Aix-la-Chapelle *(1748)* he failed to obtain either Milan or Genoa but received territories in Lombardy, which brought the eastern frontiers of his kingdom to the Ticino. The principal gain for the Bourbons was the establishment of Elizabeth's second son, Philip as duke of Parma, Piacenza and Guastalla. Italy settled down to a period of peace under an Austrian family system presided over by Maria Theresa and her husband, Francis of Lorraine-Tuscany (now emperor as Francis I). On her death in 1780 her eldest son. the emperor Joseph II, ruled in Lornbardy; her second son, Leopold, was grand duke of Tuscany; her daughters Maria Carolina and Maria Amalia were married to the Bourbon cousins Ferdinand of the Two Sicilies and Ferdinand of Parma; a third son, Ferdinand, ruled in Modena as husband of the heiress, Maria Beatrice d'Este. Genoa retained independence under French protection. Venice had entered upon the last stage of political decay and was famous chiefly for its theatre. pageants and gay luxurious life. The republic of Lucca was in the hands of a close oligarchy. In the Apennines the little republic of San Marino preserved the constitutional forms of a mediaeval city-state.

The Enlightenment in Italy.— The years 1748–92 were marked by reforming movements on the part of the principal rulers of Italy. Among the evils which cried out for remedy were the prevalence of crimes of violence, the appalling poverty of all but a fraction of the population, the excessive nealth and numbers of the clergy and. more especially in the south, the abuses arising from feudal privilege. In Lombardy a fixed tax on land known as the *censimento,* together with the abolition of privileges, did much to distribute the financial burden more evenly and to develop agriculture through its encouragement of the small proprietor. Under the terms of a concordat extorted from the papacy, many ecclesiastical possessions mere subjected to taxation, about 100 monasteries were suppressed and their property diverted to charitable and educational purposes Cesare Beccaria's famous pamphlet *Dei delitti e delle pene* inspired judicial reforms by which torture nas abolished and the criminal law made more humane In Tuscany, where the despotism retained something of the paternal and popular character given to it by the Medici, the grand duke Leopold I (later Holy Roman emperor as Leopold II) earned for himself a place among the leading *illuminés* of the age. Free trade, equality of taxation, prison reform, reduction of the armed forces, limitation of the power and wealth of the church were among the many salutary changes introduced by himself and his ministers. Charles of the Two Sicilies and. after Charles's accession to the throne of Spain in 1759, his viceroy Bernardo di Tanucci, did their best to improve the lot of the peasants by abolishing a number of personal services, admitting the right of appeal from feudal to royal courts and allowing peasants to sell their produce in the open market. They also made it their policy to assert the rights of the crown against the church in matters of justice, finance and clerical appointments. The expulsion of the Jesuits from the Sicilian kingdom and the discontinuation of the yearly tribute of a white palfrey in recognition of papal suzerainty over Sicily were among the signs of that emancipation of secular rulers from papal control which distinguished the period. By 1773 opposition to the Jesuits and their political influence had grown so strong that Clement XIV suppressed the society. The Savoyard kings, Charles Emmanuel III and Victor Amadeus III who succeeded him in 1773, pursued a similar policy, striving to improve social conditions in semibarbarous Sardinia and to increase the authority of the crown at the expense of both church and feudatories. Everywhere, however, reforms were made in the interests of the despot, imposed on the people without consultation and, for the most part, carried out by alien rulers. Even members of the house of Savoy were foreigners in Sardinia, and although they enjoyed in full measure the loyalty and support of the people of Piedmont, their rule there was rigidly authoritarian. Nevertheless the greater prosperity and awakened interest in the problems of government which followed on the reforming movement encouraged Italians to think and act for themselves. Vittorio Alfieri's tragedies which denounced tyranny and exalted liberty; the popularity among the growing middle classes of the Masonic lodges as a means of association; and the works of historians, economists, philosophers and scientists, who found in periodicals such as the Milanese *Il Caffé* a platform for the discussion of their ideas—all these were among the signs of new activity in Italy on the eve of the revolutionary period. (C. M. Ay.)

The French Revolutionary Period.— In March 1796 Napoleon Bonaparte was appointed by the Directory in France to command the army of Italy *(see* FRANCE: *History).* He began the invasion of the peninsula almost at once. Most of the Italian states formed part of the anti-French system, but none was able to offer an effective resistance. The Sardinian monarchy had already been weakened severely by the loss of Savoy and Nice in the French campaign of 1792 (Victor Amadeus III having joined the coalition against France; *see* FRENCH REVOLUTIONARY WARS) and by internal revolutionary movements. An Austrian system existed, based on Austrian Lombardy and dependent on marriage and family alliances, but Tuscany, potentially its most useful component, was determinedly neutral. The kingdom of Naples. another important unit in the Habsburg connection, was crippled by a clerical reaction and a feudal social structure which impoverished the peasant masses and stood in the way of all centralization. Parma and Piacenza and Modena, also aithin the Austrian orbit, were themselves occupied in undoing the effects of previous reform. The republics of Venice and Genoa, decaying under a narrowly oligarchical rule, preserved their stability with difficulty; Austrian designs on the Venetian hinterland were evident, while the Genoese had proved their own inability to govern both in Corsica and Liguria. The smaller republics, Lucca and San Marino, stagnated in an obscurely municipal isolation. The papal states had an administration perhaps even less adequate.

Bonaparte's campaign opened brilliantly with the defeat of the Piedmontese forces and the resultant defection of Sardinia from the Austrian alliance (armistice of Cherasco, April 27, 1796). The French army then crossed the Po, overran Parma and Modena, and on May 15 entered Milan, the capital of Austrian Lombardy. The remnants of the Austrian army were blockaded in Mantua. By June Ferdinand IV of Naples asked for, and obtained, an armistice. A part of the French army then invaded the papal

territories of Bologna and Ferrara (the Legations) and forced Pius VI to seek terms. In Feb. 1797 the peace of Tolentino was signed by French and papal representatives. Meanwhile, Bonaparte met and defeated the Austrian counterattack in a campaign that carried him to within 50 mi. of Vienna by the end of March. The negotiation of the preliminaries of Leoben closed the fighting.

At the beginning of the invasion there already existed in Italy some revolutionary groups. These were enthusiastically pro-French. There had already been risings led by these groups against the authorities of Piedmont, Naples and the Legations. At this time the bulk of the population greeted the French invasion with indifference and rarely with hostility. But the character of the occupation, the systematic plundering and exaction that were necessary both to supply an army living on the country and to maintain a flow of money to the Directory soon changed the indifference of the Italians into a sullen discontent. There were violent outbreaks against the French at Pavia, Genoa and Verona during 1796 and 1797 and others of less importance elsewhere. At the same time the hopes of the Italian Jacobins were dashed by the Directory's distrust of nationalist elements (which might favour the growth of a strong Italian state) and by the opportunism of Bonaparte's own policy.

The prestige and power which Bonaparte commanded at this time were such that he was able to reorder the peninsula almost at will. His conception of Italian policy was wholly different from that of the directors, who silently acquiesced in his actions so long as the stream of money continued to flow from Milan to Paris. The central feature of Bonaparte's conception was the establishment of a strong north Italian state.

In Oct. 1796 Reggio nell' Emilia, Modena and Bologna were associated to form the first of the revolutionary states founded in Italy, the Cispadane republic. Its constitution was based on revolutionary principles. In July 1797 the Cisalpine republic came into existence at Milan (it bore for a short time the name of the Transpadane republic). Within a month the Cispadane was merged in the Cisalpine, and the latter was soon enlarged by the addition of territory from the Venetian hinterland and from the Swiss cantons of the Valtellina. Like the Batavian republic, the Cisalpine had a constitution modelled on that of France. It possessed a nominally complete independence, maintaining its own embassy at Paris, but the presence of French forces, the continuous strain of a monthly subsidy to the French republic and the suspicion with which it was regarded by the rest of Europe prevented it from ever playing an effectively independent role.

Bonaparte's reorganization of northern Italy was completed by the remodelling of Genoa, henceforth called the Ligurian republic, and by the conclusion with Austria of the treaty of Campo Formio (Oct. 17, 1797). The preliminaries had agreed that the Venetian republic should bear the strain of the territorial compensations to be given to Austria for its losses in Lombardy. In the treaty of Campo Formio these compensations were extended to include the city of Venice itself, and the republic of St. Mark passed out of existence.

As had been their practice in Genoa and Venice, the French openly encouraged the democrats of the remaining independent Italian states to provoke the incidents which provided the formal excuse for invasion. It was in this way that Charles Emmanuel IV was forced to relinquish his Piedmontese possessions in Dec. 1798. He made vain attempts to control a revolutionary situation Inflamed by "patriotic" insurgent expeditions from the supposedly friendly Cisalpine republic but inevitably failed. He retired to Sardinia, leaving Piedmont to be annexed to France.

Joseph Bonaparte, French ambassador in Rome, similarly encouraged the Roman Jacobin minority in spite of the peaceful protestations of his government toward the papal states. The disturbances which arose soon furnished the excuse for invasion. In Dec. 1797 the French general Léonard Duphot was killed by papal security forces in a riot provoked by the Jacobin clique. In spite of the offer of redress and apology at once made by the papacy, Joseph Bonaparte withdrew to Florence, protesting that his safety was endangered, and Pierre Alexandre Berthier (who had succeeded Bonaparte in command of the army of Italy) occupied Rome, deposed the papal government and installed a puppet administration under the name of the Roman republic (Feb. 15, 1798). The unpopularity oi this government increased daily as its inability to stop French plundering became manifest. Pius VI was exiled, ultimately to France, where he died in 1799.

The kingdom of Naples brought about its own occupation by the decision of Ferdinand IV (I of the Two Sicilies) to re-enter the war against France. He was encouraged by the presence of a powerful British squadron under Horatio Nelson in the Mediterranean and by its victory over the French fleet at Aboukir in Aug. 1798. At the same time it appeared that shortage of supplies, the absence of Bonaparte in Egypt and the activities of the Directory's political agents had greatly reduced the army of Italy's fighting capacity. Ferdinand's own designs on former papal territory were the deciding factor; and on Nov. 28 the Neapolitan army, newly rebuilt by Sir John Francis Edward Acton and led by the imperial general, the baron von Mack, occupied Rome. At the same time a sea-borne expedition landed at Leghorn. The French had abandoned Rome, but after Jean Étienne Championnet had shaken off the control of the political agents, he defeated Mack at Civita Castellana. The re-establishment of the Roman republic and the general retreat of the Neapolitan army follo ed. Championnet pursued closely, hampered by a guerrilla war which began to flare up on the flanks of his advance.

The evacuation of the Bourbon court to Palermo (Dec. 21) and the surrender of Mack gave the signal for a revolutionary outbreak at Naples against the pro-French democrats who wished to hand the city over to Championnet. Three days of the most bitter street fighting were necessary before the French restored order. On Jan. 23, 1799, the Parthenopaean republic was proclaimed. The hatred of the populace of Naples and of the Calabrian peasantry for the supposedly atheist French and their Neapolitan allies almost completely stultified the reforms of the new administration. The inexperience of the democrats proved disastrous after the replacement of Championnet by Alexandre Macdonald and the removal of the only restraint on the exploitation of the new state. With the coasts surveyed by British warships it was inevitable that the countryside should slip almost at once out of the control of the government at Naples.

The revolutionizing of the republic of Lucca at the same time as the creation of the Parthenopaean republic was the last extension of French power in Italy before the onslaught of the second coalition.

The reconquest of Italy by the Austro-Russian army was accomplished even more quickly than the French campaign of 1796. The Russian marshal Suvorov inflicted a severe defeat on the French army at Cassano (April 28), and J. V. M. Moreau ordered Macdonald's army to move north to prevent the division of the French into two isolated groups. After another defeat, the French under B. C. Joubert, who had assumed command, retired on Genoa, and only Masséna, in Switzerland, was left as a protection to the southern frontier of France. The occupation of Lombardy by the Austrians necessarily resulted in the collapse of the Cisalpine republic, and the Roman and the Parthenopaean survived scarcely longer. In the south, above all at Naples itself, a period of the most cruel reaction began.

Russia soon recognized the determination of the Austrians to exploit to the full the situation created by the successes of Suvorov. The defection of Russia from the coalition followed. Neither the Austrians nor any of the restored authorities paid any attention to Italian national aspirations, which were, for a brief period after the French collapse, at their strongest. It was the second disillusionment in five years for patriots of all parties.

On Oct. 9, 1799, Bonaparte landed in France. A month later, by the coup d'état of Brumaire, he became first consul.

The reconquest of Italy did not begin until Bonaparte was completely sure of his security in France. In May 1800 he led a new army across the St. Bernard and marched straight on Milan. The city was re-entered (June 2), and the Cisalpine republic restored. On June 14 Bonaparte defeated the main Austrian army at Marengo, near Alessandria. During the truce that followed, Italy was once more at the disposal of the French army.

Better discipline and greater consideration for local opinion were shown by the army of the second French occupation. At the same time Bonaparte preserved a moderate limit to his diplomatic demands. Pius VII was allowed to continue in possession of the papal states. Tuscany, Piedmont and Liguria were put under provisional governments. When the final peace settlement was made (treaty of Lunéville, Feb. 8, 1801), the Cisalpine and Ligurian republics retained their independent existence and the settlement of Campo Formio was in general restored. The treaties of Aranjuez with Spain (March 21) and of Florence with Naples (March 28) completed the pacification of Italy. By the former, Louis, son of Ferdinand, duke of Parma, was enthroned in Tuscany as king of Etruria; and by the second, Ferdinand IV of Naples agreed to the closing of all Neapolitan ports to British shipping and to the admission of some French garrisons. Lastly, on Sept. 21, 1802, Piedmont was incorporated into the French republic and given representation in the legislature.

This phase of territorial reorganization was completed by the consolidation of Bonaparte's control of the Cisalpine republic. A *consulta* was held at Lyons, at which Talleyrand and his assistants engineered the passing by the nominally independent Cisalpine delegates of various changes in the constitution and the election of Bonaparte as president. The state was now called the Italian republic and was ruled autocratically by Bonaparte through a local administration presided over by the Lombard patriot and moderate, Francesco Melzi d'Eril.

The Napoleonic Empire. — On May 18, 1804, the first French empire was proclaimed. Numerous Lombards hoped that the offer of the crown of Italy might persuade Napoleon to accord a more genuine degree of independence to the Italian republic; and his acceptance of the offer was followed by his coronation at Milan (May 26, 1805) with the old iron crown of the Lombard kings, the traditional formula *Dio me l'ha data, guai a chi la tocca* being invoked. In the reorganization which followed this ceremony, Eugkne de Beauharnais was appointed viceroy and Melzi d'Eril retired to take a less active part in the affairs of the north Italian state. The subordination of the interests of the new kingdom of Italy to those of France remained as marked as ever.

New territorial changes followed. Lucca was granted to Elisa Bonaparte as a principality, while Parma was annexed to the empire. In June 1805 the government of Genoa was forced to ask for incorporation in the empire, and the Ligurian republic came to an end. This disregard of the provisions of Lunéville, which had been intended to guarantee the independence of the new states, led to the formation of the third coalition, Great Britain, Austria and Russia, later joined by Naples. After a fresh series of defeats the Austrians quickly agreed to the treaty of Pressburg (Dec. 26, 1805), which imposed the recognition of the Napoleonic settlement in Italy, the surrender of Austrian Venetia to the kingdom of Italy and submission to the French occupation of Istria and Dalmatia.

On Feb. 15, 1806, Joseph Bonaparte entered Naples. The Bourbon court once more fled to Palermo under Anglo-Russian protection. A British landing and the prolonged resistance of Gaeta did something to inflame the peasant rebellion which almost immediately broke out against the French; but Calabria was brutally pacified by a policy of savage reprisal. Joseph was proclaimed king of Naples (March 30), and under his rule the beginnings of a long-needed campaign of reform did much to alter the feudal structure of society and the chaos of feudal law. Judicial and criminal procedure were reformed in accordance with the Code Napoléon. These reforms were continued by Joachim Murat, who succeeded Joseph as king in 1808. Their effects were important but limited by the economic imprisonment of the kingdom within the continental system and by the failure of the government to achieve any important redistribution of land.

The restrictions of the continental system were a subsidiary cause both of the occupation of Tuscany by Elisa in 1808 and of the deterioration of relations of the empire with the papacy. Napoleon had shown care to enlist the authority and advocacy of the church in his support whenever possible, and to this end the concordat of 1801 had been directed. In spite of this, a refusal to grant papal sanction for the divorce of Jerome Bonaparte and the need to perfect the continental blockade led to the occupation of Rome (Feb. 2, 1808) and the overthrow of the papal government. In April 1808 the papal Marches were annexed to the kingdom of Italy; and after the occupation of Vienna in 1809 Napoleon proclaimed from that capital the end of the temporal power. Pius VII, having prepared a bull of excommunication against those concerned in this transaction, was immediately arrested and exiled (July 5). In 1810 Rome was formally annexed to the empire and declared its second city. Reforms were initiated and the Code Napoléon introduced — to the great resentment of a population strongly influenced by a numerous and newly dispossessed clergy.

There was at this time no part of the Italian mainland not dominated by Napoleon. Only Sardinia and Sicily remained under governments which had existed before the French invasions. The effects of this subjection on the economic life of the peninsula were disastrous, save in those areas where the blockade could be flouted with impunity. Those provinces annexed to France were the most rigorously controlled, but the kingdom of Italy was equally mercilessly exploited in French interests. Besides the local burden of the support of a large French garrison, the contingents for the Italian forces were a strain on the manpower resources of the peninsula. The drain of bullion was almost complete, and the liquidation of landed wealth did not go fast or far enough to offset this acute shortage. The commerce of the ports, so dependent on British Mediterranean trade, was ruined by the blockade. The natural markets of north Italian industry, Germany and Piedmont, were arbitrarily closed by the workings of the imperial customs system. The restraints thus imposed on industry and the lack of a strong *bourgeoisie* able to play an important national role were not unconnected.

By introducing the French commercial and banking codes, Napoleon contributed something valuable to Italian commerce. At the same time the improvement in communication brought about by the program of public works of the Napoleonic administrations was to help later development. The most important Napoleonic contribution to the historical development of Italy, however, was probably not material but ideological. A diffused experience of a common system of administration, the beginnings of a system of public education, common obligations of military service for natives of all regions and the existence of a common legal code counted for much in the formation of the patriots of the early years of the Risorgimento. The unpopularity of the French itself strengthened the independence of those who, like Ugo Foscolo, having been disappointed in their early hopes of the French, had been driven to rely more on purely Italian resources. Ultimately the failure of the French seems the result rather of an inability to press reform far enough than of overzealous innovation. Above all, little or nothing was done to associate the masses with the new regime by reforming the distribution of landed property. Almost all the Italian Jacobin manifestoes of 1796 had asked for this, but only the slightest beginnings were made by the Napoleonic reforms.

After the battle of Leipzig (Oct. 1813), the Austrian invasion of Italy began. In the face of a superior enemy, Murat deserted Eugkne de Beauharnais, who had refused his suggestion that they should seek a separate peace. At the same time, patriotic groups hampered Eugène's defense, hoping that Italian independence would follow a French collapse. The armistice of Schiarino Rizzino (April 23, 1814) recognized the kingdom of Italy, but too late to prevent the patriots associated with Count Confalonieri from gaining control of Milan. Eugène retired to Bavaria, knowing a restoration of himself to be impossible, and the Austrians at once occupied Lombardy. There mas no chance that they would surrender power to the once more disillusioned patriots. Murat's belated attempt during the Hundred Days to re-establish a Napoleonic state in the peninsula and his subsequent execution removed the last obstacles to the process of restoration.

The Restoration. — The restoration in Italy could not be a complete return to the order of 1791. Austria retained possession of Venetia, and prudence dictated to the statesmen of the con-

gress of Vienna that continued Austrian predominance in Italy should guarantee the peninsula against French influence. The cotnbined territories of Venetia and Lombardy were to be ruled as a single province, by a not unduly harsh or unjust administration. But the remoteness of the imperial government at Vienna and an increasingly illiberal regime soon aroused discontent in the Austrian province. Marie Louise, the former empress of France, ruled Parma, Piacenza and Guastalla in the Austrian interest and preserved some of the Napoleonic administrative and legal structure in the duchy. In Modena a complete reaction began under the rule of Francis IV, son of the previous duke, Maria Theresa's son Ferdinand. But Tuscany under Ferdinand III, the emperor Leopold II's son, was an oasis for Italian liberals during the years of persecution. But as Austrian princes, the rulers of Tuscany were always susceptible to pressure from Metternich on any major issue. Liberal hatred of Austria all over the peninsula sprang from the knowledge that Austrian intervention was the ultimate guarantee against constitutional reform anywhere in Italy.

Among the non-Austrian rulers restored in 1815, the king of Sardinia received some increase of territory by the addition of Liguria to Piedmont. Within Piedmont, the reaction against French innovations was violent but tempered by a jealousy of Austrian domination of northern Italy, which made some identification of the cause of Sardinia with that of Italy appear inevitable. In the papal states the reaction was catastrophic, the attempted reforms of Ercole Cardinal Consalvi collapsing under the incompetence of the central administration and the revived influence of the Jesuits. Almost from the first days of the restoration the provinces which had formerly belonged to the kingdom of Italy were in a state of revolutionary unrest. In Naples Ferdinand IV was hampered in his effortsto restore the *ancien régime* by the intransigence of Sicily (which had enjoyed some degree of liberty under a constitution imposed upon Ferdinand by the British forces of occupation) and by his dependence on many of the administrators and officersof the Murat epoch. Of the smaller states, Lucca passed to the formerly Parmesan Bourbons (in the person of Marie Louise, widow of Louis king of Etruria) and suffered some degree of clerical reaction, while San Marino survived the process of restoration almost unchanged.

The Early Revolutionary Movements.—Some middle-class and patriotic groups soon began to regret the passing of the Napoleonic administration and its opportunities. Discontent first became vocal in the Italian secret societies. The period of the ascendancy of the Freemasons ended with their quasi-official patronage by the French; but a group of societies known as the Carbonari had replaced them. These societies had originally come into existence at Naples as an anti-Bourbon force under the French administration; after turning to opposition under the restoration they had acquired an almost regularized existence as the focus of discontent in the south. Always largely middle class, they soon lost all contact with the masses, who remained loyalist and clerical in their sympathies.

In 1814 and 1815 the Carbonari spread to the Romagna. A similar organization in Piedmont, the Federati, derived its inspiration directly from France and was patriotic and anti-Austrian in purpose. The revolutionary plots of 1820 and 1821 were the work of these and similar societies and seldom looked beyond the confines of single states.

A revolution at Naples in 1820 forced Ferdinand to grant a constitution (July 7), which was based on the Spanish charter of 1812 (see SPAIN: History). A ministry of former Napoleonic officers and administrators was set up but had to face almost immediately a second insurrection at Palermo. This was wholly separatist in aim, a movement of all classes that cut across the constitutional revolution of the mainland. A local quarrel between Palermo and Messina further complicated the situation. No Sicilian deputies were present at the parliament which opened at Naples on Oct. 1. At the same time. at the congress of Troppau, Metternich had made clear the determination of the Holy alliance to preserve the Vienna settlement in Italy. Ferdinand, in spite of his constitutional oaths! applied to the Holy alliance for help. An Austrian army overthrew the revolutionary government in March 1821 and reconquered Sicily for the crown soon after. It remained in occupation until 1827 and enforced a violent reaction under the king and his police chief, Antonio Capece Minutolo, prince of Canosa.

A similar movement, but localized to a greater degree in the officer corps and more specifically anti-Austrian, broke out in Piedmont. Charles Albert of Savoy-Carignano, the heir apparent to King Charles Felix of Sardinia, was cognizant of the plot and assumed the role of regent for a few days when the *pronunciamiento* took place in March 1821. His grant of a constitution was at once revoked by Charles Felix; he was arrested; and after a few weeks an Austrian army recaptured Turin for the king. The chief result of the plot was the disgrace of Charles Albert and a temporary weakening of the normally anti-Austrian trend in Piedmontese policy. Both the Neapolitan and Piedmontese movements suffered from being the plots of small groups rather than true revolutionary movements; the same was true of the Lombard liberals, who suffered imprisonment after a series of trials (1821–23) and were almost all drawn from the ranks of the educated and noble classes. The investigation of the Piedmontese plot led to their discovery, and their contribution to the Risorgimento could consist only in the example of their courage and the legend of their martyrdom. The work of one, Silvio Pellico, was a notable contribution to the literature of the national movement.

Central Italy, especially the Legations, also suffered from disturbances. After the July revolution at Paris and the spread of the illusion that France would not permit Austrian intervention, the movement took a serious aspect in the papal Marches. The revolutionaries believed they had the support of Francis of Modena, who had toyed with the idea of a central Italian kingdom, and risings took place at Parma and Bologna, while that at Modena itself was forestalled by the arrest of the chief conspirators. But with Tuscany and Lombardy quiet and their hopes of help from France disappointed, the revolutionary governments which were set up proved helpless.

Their own internal divisions left them to face the Austrian invasion singly, not in alliance. Louis Philippe ordered the occupation of Ancona by a French force as a counter to the extension of Austrian power which the new restorations brought with them, and this completed the disillusion of those who had looked to him for help (Feb. 1832). A five-power memorandum had been addressed to the papal government recommending internal reforms before the final occupations of Bologna and Ancona but was virtually ignored by the papal administration.

The failure of Carbonarism was one of the stimuli prompting Giuseppe Mazzini to seek a new outlet for Italian discontent. On the succession of Charles Albert to the throne of Sardinia (1831), Mazzini addressed to him an appeal to lead a nationalist movement. Alarmed by a recent incursion of Italian patriots into Savoy from France, the king did nothing, apparently as Mazzini had hoped. Mazzini therefore proposed to rely solely upon a national insurrectionary movement, aiming at unity in a free republic. He envisaged the creation of the new Italy in terms as much moral as political and looked to patriotism and example rather than to diplomacy and tactics as his methods. In 1831 he founded the revolutionary organization Giovine Italia, whose influence spread rapidly among Italian exiles and inside the peninsula. But though it was more broadly based and national in outlook than the Carbonari, its recruitment still drew on a relatively small class of young bourgeois and middle-class radicals and made no effectiveappeal to the masses. In addition, Mazzini's distrust of Piedmont and his rejection of foreign intervention stood in the way of any final success. But from 1833 to 1845 repeated raids and insurrections organized by Giovine Italia kept alive the unionist cause and the tradition of revolt. Only with the failure of the expedition of the Bandiera brothers to Calabria in 1844 was the bankruptcy of this method in the face of popular apathy at last fully realized.

Federalism and Reform **in the** *1840s.*—In reaction against the waste of life and ill-success of Mazzini's program, moderate opinion tended to crystallize about federal conceptions of the solution of the Italian problem. In 1843 Vincenzo Gioberti published

his *Del primato morale e civile degli italiani*, which advocated a federal union of the existing states which would look to the papacy for leadership. A Piedmontese group, including Cesare Balbo and Massimo d'Azeglio, advocated a similar federation, but claimed its leadership rather for Piedmont as necessarily the main defender of the peninsula. Charles Albert's attitude toward Austria had stiffened in the years before 1846, and an unavowed toleration was given to the Turin moderates who emphasized the anti-Austrian rather than the constitutional aspects of the Italian problem. The election of Pius IX (June 16, 1846) in succession to the staunchly conservative Gregory XVI was the beginning of the crisis of the early Risorgimento. Pius was a man of liberal and patriotic views, influenced by Gioberti's conception of the role of the papacy and not clear, at the beginning of his reign, how far these views were incompatible with the European status of the papacy and the existence of the temporal power. His influence over the other Italian sovereigns and over the country clergy and nobility, none of whom would have been likely to adhere to the national movement without his example, was immense in 1846 and 1847.

Pius at once instituted a number of overdue reforms. An amnesty was granted, plans for railway development were drawn up, Rome received a municipal government, the laity were admitted to the civil administration, a council of state was set up, a new press law granted some degree of freedom of publication and a civil guard was formed. The democratic party, encouraged by these concessions, became more uncontrollable and Pius more alarmed as this process gathered momentum.

Alarmed by the reforms, Metternich permitted Josef Radetzky, the Austrian commander, to occupy the papal town of Ferrara on July 17, 1847, as a precautionary move and Parma and Modena later in the year. At the same time he approached France with a view to joint Austro-French intervention to stifle the reform movement. These measures identified Pius more firmly than ever with the growing national and liberal cause. Negotiations began for a customs union of Tuscany, Piedmont and the papal states, but were fatally hampered by the disparity between the essentially negative papal conception of such a union and the Piedmontese conception of it as a positive anti-Austrian force. More important was the response in the other states to Pius' example of internal reform. Lord Minto's ambiguous advisory mission from the British cabinet contributed to the same end. Leopold II of Tuscany granted a press law (May 6, 1847) which was immediately followed by a burst of reformist propaganda. Lucca was granted a civil guard on Sept. 1, Tuscany two days later. The growing violence of the democrats, above all at Leghorn, was already making settled government difficult in Tuscany.

Charles Albert had hoped to avoid constitutional reform but was constrained by moderate opinion to accept a more liberal ministry and to concede a press law. The wave of reformist agitation that followed prompted further reform in police and administration. By the end of 1847, Piedmont was also affected by the spread of democratic faction, notably at Genoa, and Charles Albert, like Pius, was already feeling compromised by his association with reform.

The War of 1848–49.—The situation was suddenly and radically transformed by the Sicilian revolution of Jan. 12, 1848, the first revolution of the year of revolutions. As in 1821, the local separatist movement of the island was complicated by a constitutional revolution on the mainland that soon followed the Palermo revolt. The islanders demanded independence or the Spanish constitution of 1812; and to preserve his grip on the mainland Ferdinand II (V of Naples) granted a constitution which went far beyond any previous reforms in any of the Italian states. But Sicily proclaimed its independence of the Bourbon monarchy on April 13.

Encouraged and frightened by the events at Naples, other sovereigns granted constitutions. Tuscany received one on Feb. 11, and Pius granted one on March 14. The only constitution that was to survive the revolutionary war was that of Piedmont (March 4), which became the constitution of united Italy.

The European situation was a favourable one for the reform parties. The February revolution in Paris and the March revolution in Vienna made any active intervention unlikely. Lombardy had been disturbed by riots and outbreaks in the early months of 1848. Finally, when news of the Vienna revolution reached Milan, that city rebelled in its turn and after the famous "five days" of battle forced Radetzky to withdraw (March 18–23). Simultaneously, a revolt at Venice restored the ancient republic under the leadership of Daniele Manin (March 22). Charles Albert saw that the moment for effective action against the Austrian army had come and led his army across the Ticino to Milan (March 24).

The Piedmontese army was weakened by detachments to the French frontier and did not succeed in catching Radetzky before he took refuge in the fortress area of the Quadrilateral (Verona, Peschiera, Legnago and Mantua). Charles Albert pursued him, broke into the Quadrilateral (battle of Goito, April 18) and soon afterward won the battle of Pastrengo (April 30), which forced the Austrian army to depend upon Venetia for its communications but did not shake its tenure of the fortresses. Tuscany and Naples had by now declared war, and a papal force under Giovanni Durando crossed the Po with the aim of operating on the Austrian communications in Venetia.

The decay of this still favourable situation began with a papal allocution of April 29 in which Pius, obsessed by the danger of an Austrian and German schism, disavowed any intention of declaring war on any Christian nation. The internal divisions of the Italian movement at once assumed a much enhanced importance. The Lombard rebels were already bitterly divided into pro-Piedmontese and anti-Piedmontese factions. Charles Albert's motives were also deeply distrusted by the Tuscan democrats. He himself would not entertain the notion of seeking French support, fearing the accession of strength that the Piedmontese republicans would draw from it. In addition, the north Italian peasantry was almost everywhere indifferent or hostile to the Piedmontese army.

Charles Albert's failure to take Verona was the military turning point of the campaign. An army under Laval Nugent evaded interception and reinforced Radetzky on May 25. Ferdinand II of the Two Sicilies had by this time recalled the Neapolitan troops (which had been moving northward) in order to deal with the revolution at Naples, now wholly out of hand (May 17). The annexation of Parma, Piacenza and Modena to Piedmont by, plebiscite gave Charles Albert no military help, while the similar annexations of Lombardy and Venice (July 7) increased suspicion of his real motives.

At the end of July Radetzky turned on Charles Albert and defeated him in a succession of battles around Custozza (July 23–27). To save the Piedmontese army Charles Albert abandoned Milan, amid the hostility of the city which was enraged by his "treachery." On Aug. 9 he withdrew from further fighting by concluding an armistice at Vigevano.

In all the states the extremist democrats now tended to assume power, though they were in fact incapable of controlling their followers. A revolt in Bologna failed to force Pius into a declaration of war, but drove out the Austrian garrison. In Rome the moderates were wholly discredited, and Count Rossi, an able liberal, tried in vain to preserve order. His ministry was ended by his assassination (Nov. 15). Pius fled in disguise to Gaeta on Nov. 24 and refused to return. A constituent assembly voted the end of the temporal power and proclaimed a republic (Feb. 9, 1849), and Pius appealed for armed intervention to secure his restoration.

Similar deteriorations took place in Tuscany and in Naples. Leopold and Ferdinand both abandoned the attempt to control the extremists and went to Gaeta. The Tuscan republic was proclaimed on Feb. 8. A few days earlier, a Roman invitation to Piedmont to nominate delegates to a constituent assembly for all Italy was rejected summarily by Gioberti's government. This government was soon replaced by another, under Urbano Rattazzi, which hoped to reopen the war. To redeem past promises to the Lombard patriots and to avoid the necessity of accepting an Austrian peace the armistice was denounced at its expiry (March 12), and war began on March 20. On March 28 Charles Albert abdicated after the decisive defeat of Novara. His successor, Victor Em-

manuel II, hastened to make peace.

Italy was now at the disposal of the Austrian army. Lucca and Florence were occupied, and Leopold II returned to his capital under Austrian protection (July **28**); Ferdinand of the Two Sicilies had crushed the Sicilian rising on his return. Already in April, unwilling to allow Austria to act alone in the restoration of the papacy, the government of Louis Napoleon had sent a French force under Nicolas Charles Victor Oudinot to Civitavecchia. The French suffered an initial defeat at the hands of Giuseppe Garibaldi, and the Roman republic, under Mazzini, defended itself heroically for a month; but Oudinot broke into Rome on June **29**. The assembly was dissolved a few days later, and the keys of the city sent to Gaeta. Garibaldi, with some of the garrison, set out for Venice and reached San Marino before his small force fell completely to pieces. Venice itself, deprived of Piedmontese naval support, surrendered on Aug. **26**. A peace treaty between Austria and Piedmont, imposing a heavy indemnity on Piedmont and restoring the territorial settlement of 1815, completed the pacification of **1849**.

This pacification marked. in general terms, the end of the revolutionary phase of the Risorgimento and the beginning of the diplomatic phase. The revolutionaries failed because of their internal dissensions, because of the distrust of Piedmont by the smaller states. because of the Piedmontese distrust of France and because of the confusion over the role which the papacy should play in the making of Italy. Moreover the mass of the population was unmoved by the revolutionary appeal. Only at Venice, Milan and Rome did genuine popular movements of all classes have any effect. The military superiority of Radetzky both in the quality of his troops and in generalship was the final factor assuring the Austrian restoration of **1849**. (J. M. Rs.)

Piedmont in 1850.—The defeat of Piedmont, together with the failure of Mazzini's republic at Rome and Manin's at Venice, led to a second restoration of the old despotic regimes and to the virtual occupation of central Italy by Austrian troops. The war had shown how little feeling there was among Italians for unification. Thereafter Piedmont alone among Italian states retained any initiative or independence, and this was largely offset by defeatism and by a cleavage between moderates and revolutionaries which failure in battle had exacerbated. There was serious dissatisfaction with the government. A revolt in Genoa necessitated the blockade and bombardment of the city by royal troops. It was resented that the armistice had been arbitrarily signed by the king without the participation of his ministers; and because of a hostile left-wing majority in the chamber, the king had to appeal against parliament to the people in a personal proclamation from Moncalieri. Only after new elections was the treaty of Milan ratified, early in 1850.

Neither the armistice nor the proclamation of Moncalieri had shown much regard for constitutional proprieties. Unlike other Italian states, Piedmont preserved intact its new constitution of **1848**, but this statuto was a conservative document, the handiwork of men of the right like Cesare Balbo and Ottavio di Revel. There was always a danger that Victor Emmanuel II might follow the example of Ferdinand of Naples and repudiate his constitutional oath. His mother and his wife were both Austrians, and he must have appreciated that representative institutions as yet evoked little esteem in the country. Massimo d'Azeglio, who was prime minister from **1849** to 1852, though a sincere liberal, had been disillusioned by the events of recent years into thinking that perhaps the *statu* - had gone too far and that a long time would be needed before Italians were ready for freedom and national unity. Most people probably uould have agreed with him.

Gradually, however, and almost unintentionally there developed the habit of ministerial responsibility to parliament. The presence of exiles from other provinces helped to identify Piedmont as the nucleus of a future Italy and to mollify the provincialism and illiberalism of Turin. Administrative unification helped to fuse the royal dominions of Savoy, Piedmont, Sardinia and Liguria, and deputies self-consciously learned to speak Italian instead of French or dialect so as to make themselves understood. A railroad was built to link Turin with Genoa; the Siccardi law was passed to curtail ecclesiastical jurisdiction; and battle was joined to limit the aristocratic monopoly in the senate, the army and the bureaucracy.

Cavour.—In **1850** the ministry was strengthened by the inclusion of Count Camillo Cavour, a financial expert who had recently entered parliament. Cavour soon set about breaking the hold of the house of Rothschild upon Piedmontese finances and defied the experts by imposing heavy taxes and changing the country's economy to one of almost complete free trade. This helped to destroy the restrictions of economic paternalism and municipalism and also won the favour of Great Britain as a new market for its exports. Conquering his own initial unpopularity, Cavour showed himself to be by far the ablest man in the coalition. He skilfully made a tacit aliiance with Urbano Rattazzi of the centre left to supplant D'Azeglio and then resigned, early in 1852. D'Azeglio's cabinet soon foundered on the king's refusal to permit the passage of further anticlerical legislation. Cavour was the obvious successor, as he was more amenable on this point, and his *connubio* (union) with the left gave him effective control of the chamber. In November he duly became prime minister. During the next nine years he was to preside over the formation of a new kingdom of Italy.

The *connubio* of right centre and left centre prevented the emergence of a two-party system in Italy; but it also prevented the king's following Louis Napoleon's example of a coup d'état. Cavour yielded to the king by withdrawing the civil marriage bill in **1853**, but the radicals were strong enough in his cabinet to force through an attack on mortmain lands and ecclesiastical salaries. In **1855** Luigi Nazaridi Calabiana, bishop of Casale. led a clerical counterattack against Cavour, and the king tried to veto a bill to dissolve some of the monasteries; but when Cavour resigned Victor Emmanuel was forced to recognize that he was not strong enough to flout parliamentary wishes too openly and sensibly gave way.

By this time Cavour was becoming chiefly interested in foreign policy. He continued to deplore the activity of those who wanted to unify Italy. His government condemned Mazzini to death and expelled hundreds of the extreme radicals, hounding their journals out of existence, revising the jury system when necessary and introducing harsher press laws. Nevertheless, nationalism was no longer a mere literary aspiration among the intellectuals, and Cavour was gradually being converted to the view that many of the visionary ideals of Mazzini were neither so dangerous nor so utopian as he had thought. In preparation for the future he made a deliberate attempt to show other European states that Piedmont not only could govern itself wisely and liberally but also was a force to reckon with abroad and could speak for Italians elsewhere in the peninsula. The army was reorganized by Gen. Alfonso Ferrero La Marmora. Austria was publicly reproached for its harsh rule in Lombardy and for its confiscation of the property of those Lombards who had fled into exile at Turin.

Cavour realistically perceived that Charles Albert and Mazzini had both been in error to think that foreign alliances were superfluous. French support was indispensable if Austria was to be withstood. It was thus the more disastrous when in 1854–55 the outbreak of the Crimean War temporarily healed the rivalry of France and Austria, and Piedmont's old game of playing one off against the other no longer worked. So as not to be completely isolated, Cavour subsequently joined in the war. He was forced into this step by the king, who was eager to retrieve the reputation of his army and had arranged if necessary to supplant a recalcitrant Cavour with a more warlike cabinet of the right. Cavour forestalled this by accepting the mar, overruling the almost unanimous opposition of the other ministers and courageously committing his country without any guarantees or conditions to a war where no direct national interest was involved. So doing, he kept power at home and hung onto French sympathy until better times should allow him to exploit it. As a reward, Piedmont was later given a seat at the peace conference in Paris (1856), where a few hours were given to general discussions on the unfortunate state of Italy. This was not much, but it was more than Cavour had at one time expected. The Italian question was at last open. Austria was isolated again,

and its occupation of central Italy was becoming recognized as a breach of the Vienna settlement.

At once Cavour began to prepare for a third war of independence against Austria. Railways were built with military strategy in mind; a naval base was constructed at Spezia; fortifications were erected at Alessandria—by royal decree, in order to avoid a parliamentary debate. By these means a moral ascendancy was captured over the rival republican program of Mazzini. The two programs, opposite though they seemed, each stimulated the other and both proved to be necessary ingredients of the process of unification. But the failures of Francesco Bentivenga in Sicily (1856) and of Carlo Pisacane in Naples (1857) showed that the time for isolated republican conspiracies was over and that the need was rather for diplomatic action backed by a regular army and the organization of a state.

Another sign of the times was that, instead of dreading Piedmontese expansion, other Italians were beginning to welcome it. The Venetian Daniele Manin, the Tuscan Baron Bettino Ricasoli, the Sicilian Giuseppe La Farina and Luigi Carlo Farini from the papal states were all turning to collaborate with Turin. The exiled Manin, founder of the National society, promised in a famous challenge to renounce his republicanism if only the house of Savoy would accept the doctrine of unity. Meanwhile about 30,000 exiles from other provinces had taken refuge in Piedmont—whereas hitherto men like Gabriele Rossetti, Anthony Panizzi and Pellegrino Rossi had rather taken foreign citizenship. As these later exiles were people of education for the most part, they came to have great influence on the press and on politics in Turin and largely contributed to the education of the Piedmontese in *italianità*. Cavour himself, though he refused the proffered alliance of Mazzini, accepted that of the National society and began to think that unity might not after all be the "nonsense" that he had lately called it.

The elections of Nov. 1857 came as a reverse to Cavour. Savoy, Sardinia and Liguria returned an opposition majority, and had he not been so self-confident he would have resigned. He also came near to a breach with the king over the latter's disreputable private life; and it weakened him still further when Rattazzi left the ministry early in 1858. Luckily for him, French support was now so firm that even Felice Orsini's attempted assassination of the emperor in Jan. 1858 could not shake it. Cavour cleverly divined that the Second Empire, though conservative at home, was revolutionary abroad and needed a policy of prestige and military victory. Furthermore, Piedmont was a necessary buffer which France could not allow to be defeated by Austria. It was rather a French interest to chase Austria altogether from Italy, especially as France could name as its price the provinces of Savoy and Nice.

The *War* of 1859.—In July 1858, unknown even to his colleagues, Cavour had secret talks with Napoleon III at Plombières, where together they hatched a plan to create a kingdom of north Italy including Lombardy, Venice and the central duchies. It then became Cavour's task to provoke a war by the following spring in such a way as to make Austria seem the aggressor. This might not have been so easy had not Austria also regarded the war as inevitable. After an alliance had been signed between France and Piedmont in Jan. 1859, Austria declared war in April. The French won the battle of Magenta in June, and the allies entered Milan. This was shortly followed by a second indecisive victory at Solferino. Napoleon, however, was disillusioned with the lack of support from other parts of Italy and knew that Cavour was working behind his back to annex Tuscany and Umbria as well as the other territories already agreed. This acquisition of part of the papal states would not only have scandalized Napoleon's Catholic subjects but also have created a stronger kingdom in Italy than he desired to see. Accordingly in July he unexpectedly arranged an armistice at Villafranca. The peace of Ziirich in November eventually gave Lombardy to Piedmont, but not Venice, not the formidable Quadrilateral and not the duchies. Napoleon's plan was to leave Italy a relatively weak confederation of small states under the general presidency of the pope, and in this plan, for the moment, he almost seemed to have succeeded,

Cavour protested unavailingly against this desertion and reached the point of using most disrespectful language to the king at the latter's headquarters in Monzambano. Reluctantly, but realistically, the king accepted the accomplished fact, and Cavour resigned in July 1859. For six months he was out of office, while a stopgap Rattazzi-La Marmora ministry proved itself unequal to the situation.

During this time attention was first fixed on central Italy, where the outbreak of war against Austria had caused spontaneous risings against the old ruling houses and their Austrian garrisons. Napoleon was resolutely opposed to the annexation of the duchies by Piedmont; and though royal commissioners had been sent to Bologna, Florence, Modena and Parma, these were obliged to resign after the armistice of Villafranca. However, the local revolutionary governments refused to be dismayed. Elections were held to confirm the triumph of the nationalists; more or less open dictatorial powers were conferred on Farini and Baron Ricasoli respectively; and Gen. Manfredo Fanti was seconded from Piedmont to organize an army of central Italy, with Garibaldi as his second in command.

Cavour, although out of office, had continued to give advice and encouragement to these revolutionaries in their effort to annex themselves to Piedmont. In Jan. 1860 he saw how to recapture the political initiative; and after ousting La Marmora he proceeded to upset Napoleon's original plans by offering to exchange Savoy and Nice for permission to carry out this new annexation. A treaty was signed in March to ratify his scheme. Plebiscites were held in each several region to confirm the exchange (March–April), so successfully that their sanction in each case was almost unanimous. The parliament that met at Turin on April 2 thus included Lombards, Tuscans and Romagnols. In less than a year Piedmont had more than doubled its size, against the strong wishes of most of Europe. It now included about 11,000,000 people, or half the population of the peninsula. Only the sacrifice of Savoy and Nice marred the general satisfaction.

Garibaldi's Conquest of Southern Italy.—The next stage in unification was the annexation of Sicily and Naples, and for this Italy had to thank the much-maligned radicals of the extreme left. In May 1859 Ferdinand II of the Two Sicilies was succeeded by his son, Francis II, who continued the traditional policy of refusing a constitution or a friendly alliance with Piedmont. There was little evidence of much nationalist sentiment in the south, but the brutal persecution and crass unenlightenment of the Bourbons had generated a widespread desire for change. In Sicily this was supported by a bitter and age-old dislike of rule from Naples; and Francesco Crispi, with other friends of Mazzini, found it easy to prepare and begin an insurrection. Early in May 1860 Crispi persuaded Garibaldi to lead 1,000 men from Genoa to support this revolt. They reached the island just before order had been restored. Aided by a peasants' revolt against the landlords, which spread disorganization and terror, Garibaldi wrested Palermo from a strong garrison of troops; and by the beginning of June nearly all the island was cleared of Bourbon soldiery.

Cavour had given no help to the original expedition and indeed had done his best to persuade Garibaldi not to sail. Excited however by the amazing success of the revolution, he quickly made up for this and soon sent royal commissioners to arrange the annexation of Sicily. Garibaldi was nevertheless determined to hold onto his dictatorial powers. His intention was that the states of Europe might be confronted with the acquisition not only of Sicily, but of Naples and Rome as well; and he knew that, were Cavour in charge of the revolution, the French could use their influence on him to stop his further progress. Crossing to the continent, he occupied Naples in Sept. 1860. Francis II fled to Gaeta, but the Bourbon army at last held Garibaldi on the Liri (Garigliano) river.

Unification, 1861.—Cavour then decided on one of his boldest strokes and in September, on the flimsiest of excuses, invaded the papal states. Napoleon III would never have allowed this but for the plea that Garibaldi could otherwise have carried the revolution into the Holy City itself. Carefully leaving intact Rome and its surrounding countryside, the northern army captured Umbria and the Marches, defeating the papal troops at Castelfidardo and entering Neapolitan territory in the middle of September. This simul-

taneously put pressure on Garibaldi to yield his conquests, and plebiscites were held in October which purported to express the wish of the people of Sicily and Naples for annexation to Piedmont. Garibaldi reluctantly retired to his island home of Caprera; Farini was sent to organize an emergency government in the south; and Gen. Enrico Cialdini supervised the capture of the last Bourbon strongholds early in 1861. Umbria and the Marches were also annexed, and representatives of these provinces and of the south were present when in Feb. 1861 parliament met at Turin and declared Victor Emmanuel to be king of Italy—his title remained Victor Emmanuel II. to show that it was no new state but a continuation of the old kingdom of Sardinia.

His lifework thus accomplished, Cavour died in June 1861 worn out with responsibility and with the strain of carrying virtually the whole burden of the country's administration. His achievements were the result of no preconceived plan, but of enlightened opportunism over means and ends. He had been an ambitious man. second to no one in unscrupulousness and Machiavellianism; but he remained faithful to the broad tenets of liberalism. Along with a remarkable power of grasp and penetration, he had courage and firmness of decision, a sense of proportion and a tact and skill in manoeuvre which in combination amounted to genius. It was a great misfortune for his country that he died so early and before the initial problems of the newly unified kingdom had been properly tackled. In his last days he attracted the applause of parliament by his proclamation that the capital of Italy had to be Rome. But how to proceed thither, how to reconcile the pope and Catholic opinion to a unified Italy, he did not yet know. Furthermore, he left behind him neither a properly stable parliamentary majority nor responsible and able leaders who could take over where he had left off.

Ricasoli, Rattazzi, Farini and Minghetti.—From June 1861 to March 1863 the prime minister was Bettino Ricasoli. Problems calling for his immediate attention included the "Roman question" and the desultory negotiations which Cavour had conducted with the Vatican. There was also the problem of administrative unification, the harmonizing of many diverse provincial systems of law and of varying levels of taxation: and a way had to be found to inject regional pride uith a common national consciousness. The inadequate administrative staffs of the government departments in Turin had to be suddenly expanded and taught how to deal with an infinite variety of local difficulties. Armies which had lately been fighting each other had to be persuaded to fuse amicably, and promotion in both military and civil services had to be distributed regionally so as not to offend mounded susceptibilities. Much ill-feeling was caused among Garibaldi's volunteers by the preferential treatment accorded their defeated enemies in the former Bourbon army. Serious opposition was also encountered from the many people in each province who would have liked to see many more concessions to local autonomy. Federalists like the Lombard Carlo Cattaneo refused to take their seats in a central parliament. Former capital cities such as Naples and Florence had to reconcile themselves to demotion. The Garibaldians and the yet more extreme Mazzinians were highly indignant that the Turin government had halted the revolution without marching into Rome. Adherents of the old regimes sometimes refused to take the oath required in favour of the new order and often were only biding their time against the day of a counterrevolution and the restoration of the old Bourbon and Habsburg rulers.

Ricasoli was a man of iron will and high ideals, and more ready to tolerate Mazzini than Cavour had been. He was also, as a Tuscan, a bulwark against the Piedmontization of the kingdom which many people so disliked. But he lacked alike the ability and the desire to win popularity, and he treated the king with tactless condescension. Victor Emmanuel therefore began to intrigue with Rattazzi to replace him, and the Piedmontese lawyer thus returned to power from March to Dec. 1862.

Rattazzi's great failure was in his incompetent handling of another attempt by Garibaldi to march on Rome. In June 1862 the volunteers began to reassemble in Sicily; and when no obstacle was put in the way of their landing in Calabria, Garibaldi assumed that the government, as in May 1860, was standing aside to see what his chances of success would be. Rattazzi tardily realized that, since a French garrison was still established in Rome, the expedition must be stopped; and in August Garibaldi was wounded and captured by the regulars at Aspromonte.

The next ministry, that of Farini, was quickly terminated on account of the premier's ill-health, and Marco Minghetti took office from March 1863 to Sept. 1864. A convention was signed with France in Sept. 1864, under which French troops were to be evacuated from Rome on the understanding that Italy would guarantee the inviolability of the Holy City. As an earnest of good will, the Italian capital was to be moved from Turin to Florence, with the implication that former designs on Rome had been renounced. The news of this pact at once provoked an insurrection at Turin, whereat the king simply dismissed Minghetti and summoned another Piedmontese, General La Marmora, to succeed him. The September convention was duly honoured, and in 1865 the capital mas transferred to Florence.

La Marmora and the War for Venice.—One of the chief problems in these years after 1860 was the endemic plague of brigandage in southern Italy. This was now organized for political purposes by the Bourbons from their exile in Rome, with the active support of the Vatican; and it had soon attached to itself a program which embodied most of the political and economic grievances of Naples. Southerners resented that they had been conquered and were treated almost as & defeated colony. Claims for local autonomy were not met after 1860; conscription was introduced; far larger taxes imposed than southerners had known under the loose and ineffective rule of the Bourbons; and the abolition of the old protective system also left the industries of the south helpless before competition from the north. So widespread was the disaffection that D'Azeglio made a published statement to the effect that the Neapolitan plebiscite in favour of annexation must have given a false notion of popular wishes Sixty battalions of soldiers were scarcely enough to control the situation, and civil war continued off and on for four or five years, marked by great ferocity on both sides. More people were said to have died in this prolonged campaign than in all the other wars of the Risorgimento put together; and even when law and order were restored the fundamental social and political reasons for unrest continued. Only after 1900 was the southern question to be given adequate recognition by politicians and students of sociology. No completely satisfactory solution was ever to be found.

The new kingdom of Italy took its first steps in foreign policy by preparing a fourth great war of liberation against Austria for the acquisition of Venice. Cavour had begun intriguing in 1860–61 for an insurrection in Hungary, and Victor Emmanuel was so keen on war that he entered into a secret understanding with Mazzini, unknown even to his ministers. As a foreign alliance was indispensable and as France already thought Italy quite strong enough, negotiations were opened with Prussia, where Bismarck was scheming to upset the preponderance of Austria in Germany. Austria then took fright and sought to purchase Italian neutrality by offering the peaceful cession of Venice. This offer La Marmora almost surprisingly refused. A strong faction existed which desired a prestige victory and hoped to conquer the province of Trentino as well. War was assured from the moment when a treaty was signed with Prussia in April 1866. Hostilities began in June.

The Italian army and fleet. though a good deal larger than those opposed to them, were sadly lacking in generalship, provisions and morale. General La Marmora (resigning the premiership to Ricasoli) planned a direct attack on the Quadrilateral, ignoring the lessons of 1848 and 1859 and refusing to collaborate in the efficient Prussian plan which in a bare fortnight led to the crushing victory of Sadowa. Instead the Italians were beaten at Custozza. The king had insisted on helping to direct operations; and this, together with the divided command and all the jealousies and incompetence of the general staff, led to a quite unnecessary retreat and prevented exploitation of the simultaneous Prussian success. Garibaldi was deliberately kept as much as possible in the background, though once again his volunteers came off better than the regulars. Worse still, the feckless Adm. Carlo Persano had to be repeatedly ordered out of harbour by the government and then led

his superior fleet to defeat at Lissa (for which he was dismissed from the service).

Meanwhile Bismarck, who wanted Austria as a friend against France, made a separate armistice in July, and Italy was forced to follow suit. Peace was eventually concluded in October. Austria ceded Venetia to Napoleon as a mediator, and he allowed a plebiscite to be held to confirm its union with the rest of Italy. This was a considerable acquisition. But the hoped-for prestige victory had not been won, and the Trentino was to remain in Austrian hands until 1918. Italians had overestimated their strength and internal cohesion and were now disappointed and depressed.

Ricasoli and Rattazzi, Second Ministries.—Ricasoli's second ministry lasted from June 1866 to April 1867, hardly longer than the average length of life of a government in the unstable conditions of Italian parliamentarism. The Austrian war almost coincided with a rebellion in Sicily, which lost Ricasoli much support. Sicily had never been reconciled to conscription and had been indignant at the martial law and military occupation which Gen. Giuseppe Govone had been obliged to enforce for the preservation of order in 1863. In 1866 a provisional government was set up by insurgents at Palermo, and an expeditionary force had to be sent from northern Italy to subdue the island once more. In March 1867 Ricasoli dissolved the chamber to try and secure a larger majority; but the elections did not improve his position and he resigned in favour of Rattazzi.

One of the few good features of Rattazzi's governments of 1862 and 1867 was his appointment of Quintino Sella and Francesco Ferrara as finance ministers. These men were responsible for facing the very serious question of the annual budget deficit coming on top of the heavy expenditure incurred in the wars of the Risorgimento. In some years the deficit was 50% of the total revenue, and it made matters worse that the ruling classes in the state habitually refused to burden themselves with an efficient system of tax collection. The introduction of a forced paper currency in 1866 lowered the national credit still further. As a partial remedy, the large areas of land held in mortmain by the church were nationalized in 1867 and bought up (mostly by speculators on terms very favourable to themselves) to help stabilize the national finances. The tobacco monopoly was also farmed out by the exchequer to a private company, to the great gain of the latter. In Jan. 1869 the hated grist tax on the grinding of corn was reintroduced, and this provoked extensive rioting among the poor on whom it weighed heavily and disproportionately. These various measures, socially and even economically undesirable though they often were, partially bridged the gap between revenue and expenditure.

The Occupation of Rome.—The sale of ecclesiastical lands was only one among a number of anticlerical measures. The situation and status of Rome inevitably made the Risorgimento an anticlerical movement, and not until 1929 did the pope recognize the absorption of the centre and the south into a unified Italy. In the years immediately after 1860, former concordats were repudiated, prominent churchmen were prosecuted and refused permission to exercise their functions, a civil marriage ceremony was introduced and declared obligatory and many more monasteries were dissolved. From the other side, Pius IX in 1864 issued a Syllabus of errors wherein all the major principles of liberalism were condemned as inconsistent with the Catholic faith.

In 1867 Garibaldi led another march on Rome, hoping to prove that the Italian people themselves could carry out the work of unification without French or Prussian aid. Once again Rattazzi dithered, in the expectation perhaps that it would convince Napoleon that there would be no peace until Rome was Italian. Then he changed his mind and resigned in October, giving place to Gen. Luigi Menabrea. Meanwhile Garibaldi found to his dismay that the people of Rome were indifferent if not hostile to his invading army, and when Napoleon III sent another expedition to defend the city, the volunteers were easily defeated at Mentana in November. The Italian government had again to decide against Garibaldi and sent its army to help his discomfiture. The delivery of Rome still awaited the aid of a powerful foreign ally.

The chance came in 1870 when the Prussian victory of Sedan finally destroyed Napoleon III's empire, and the French garrison of Rome was again withdrawn. The way had been paved by the meeting of the Vatican council in 1869–70 and its proclamation in July 1870 of the infallibility of the pope. This symptom of the increasing centralization and clericalization of the church revived some of the old opposition to ultramontanism among Catholic states and made it easier for an Italian column to bombard the city of Rome with impunity. Victor Emmanuel, as a sincere Catholic if one of irregular life, was until the last moment reluctant to take this step. But the ministry under Giovanni Lanza and Quintino Sella, which took office in Dec. 1869, threatened him with a major constitutional crisis if he refused; and the Prussian victory left no obstacle except the paper undertakings of Minghetti's convention of Sept. 1864.

On Sept. 20, 1870, Gen. Raffaele Cadorna forced a breach in the Porta Pia; and after a token resistance Pius IX accepted what he had not the force to withstand. A plebiscite was held in October which—as usual—gave an overwhelming majority for union with Italy. At last the Risorgimento seemed to have achieved its purpose: apart from Trento, Trieste and other frontier rectifications (some Italians were soon to add the names of Dalmatia, Corsica, Malta and Tunis) unification appeared to be complete, and attention could be concentrated on constitutional and economic problems at home.

First in importance was now the problem of trying to reconcile the Vatican to the loss of temporal power and to the existence of a secular and even anticlerical government in the Holy City itself. Defying excommunication, the civil authorities requisitioned the Quirinal and other palaces. In 1871 they then passed what they hoped was the generous Law of Guarantees to regulate the position juridically, so far as possible implementing Cavour's doctrine of "a free church in a free state." The pope's position was to be sacred and his person inviolable. While free discussion was allowable on religious matters, insults and outrages against the Catholic faith were punishable. The pope was allowed ownership of the Vatican and Lateran palaces and promised an annuity of more than 3,000,000 lire. He was to have diplomatic immunity for foreign representatives attached to his court. The state gave up its old jurisdictionalist rights over the church, and bishops no longer had to swear fealty to the king.

This law was thought by the left to give far too much liberty to the church. But Pius IX naturally thought it gave away too little; and consequently he refused to accept it as valid, rejecting even the annuity. He and his successors remained voluntarily "imprisoned" in the Vatican, refusing even to recognize the existence of the kingdom of Italy, declaring in the "*non expedit*" that it was inexpedient for Catholics to vote in the national elections and that they could be "neither electors nor elected." For the most part this was a formal protest only. In practice, methods of co-operation were devised and legal fictions developed to allow religious organizations to hold property and to grow in number and authority. Nevertheless it had the unfortunate effect of helping to prevent the growth of a strong conservative party in parliament, and outbursts of clericalism and anticlericalism contributed to perpetuate a cleavage in society that was always unhealthy and often dangerous.

In 1871, parliament and the government offices were moved once again, this time from Florence to Rome, and an attempt was begun to turn Rome into a modern capital. In the next 30 years many of its old picturesque areas were to be pulled down to make way for new and not always tasteful construction.

Minghetti's Last Ministry.—The ministry of Giovanni Lanza lasted from 1869 to 1873. During this time Sella did much to bring national expenditure more into balance with the revenue, though this was purchased by keeping taxation high and inequitably assessed and by selling the capital asset of the ecclesiastical lands. When the next prime minister, Minghetti, was able to announce a budget surplus in 1876, at last the new Italian state seemed to be paying its way. Many thought the price had been too high, but no one could deny that it had been a considerable achievement.

By this time Cavour's carefully built-up parliamentary majority had undergone much change. Inside the so-called right there were

many varying opinions and personal rivalries. Sella, for instance, could never sit in the same cabinet with Minghetti. The Piedmontese formed a regional group of their own in parliament to protest against the removal of the capital from Turin. and the Tuscans did the same when it was later moved again from Florence. Above all the south remained turbulent and voted increasingly for the left.

Rattazzi had died in 1873. but Agostino Depretis and Francesco Crispi were building up a composite left-wing group which stood for the concession of more democratic reforms and soon included a number of deserters from the right. After the elections of 1874, the opposition parties were nearly equal in strength to those of the government. Mazzini had died in 1872, and his extreme republicans were no longer a force to be reckoned with. Garibaldi was lending his name to the prophetic but unrealistic program of an incipient Socialist party; and yet, after going to fight for the French in 1870, he made only rare appearances on the political stage. Radicals like Crispi and Felice Cavallotti dutifully accepted the oath of loyalty to the king; and so, apart from the clericals on the right, there was only a handful of extremists on the left who remained outside the prescribed limits of the constitution.

A skilful tactician like Cavour might have known how to make another *connubio* with Depretis. Instead, the ministry of Minghetti became even more repressive and arbitrarily arrested some of its political opponents. When its plan to nationalize the railways antagonized a group of Tuscan and Lombard mercantile interests, a chance vote in March 1876 brought to an end the period of rule by the right. Their honest, courageous and thrifty conduct of government had set the country well on its way to power and prosperity; but they had at last lost the confidence of the people, and the need now was for younger men, with new ideas and more of a social conscience.

Depretis and the Parliamentary Left.—The year 1876 began a long period of government by the left. The first cabinet of Agostino Depretis was almost entirely composed of men new to office, most of them former radicals, many of them former republicans, but all of them now liberal monarchists. Their program comprised extension of the franchise, the decentralization of government, the abolition of the grist tax and other impositions which bore heavily on the poor, and a pervasive anticlericalism; but in other respects they were content to follow the policy of their predecessors, and people were able to say that government by the right and by the left was in practice much the same, except that the latter was perhaps not so good.

The new minister of the interior, who was the former radical agitator Baron Giovanni Nicotera, immediately set about preparing for the elections with all the mixture of corrupt and legitimate influence which Italian practice allowed to the authorities in power. The results achieved in Nov. 1876 gave an overwhelming majority of 420 ministerialists against about 87 seats for the ('opposition": over the whole of the south only 4 opposition deputies were returned. This eclipse of the conservative right proved very bad for political education in Italy, and conflict was soon transferred to inside the government coalition itself, with the result that successive ministries proved even more unstable than before.

Nicotera's electoral machine brought with it an increase in political corruption; and yet the lack of party discipline and of fixed party principles meant that there mas an absence of clear conflict between alternative policies. The dissolution of parties dated back at least to Cavour's connubio, and the confusion of political principles had also been a feature of government by the right. By now they were regarded as deliberate methods of government, in the attempt to avoid extremes, to perpetuate a broad coalition of the centre and to provide no chance of a return of the old right to power. Successive prime ministers came to power just by a slight shift of emphasis inside the general framework of this coalition, usually for personal reasons and not because some great principle was at issue. It was a system of government that soon became known by the name of *trasformismo* or transformism and was to be claimed as a typical and even praiseworthy manifestation of Italian politics.

Depretis, who had severely censured the political morality of the connubio in 1852, thus effected a very similar parliamentary liaison when he was himself faced with the responsibility of office. Gradually he won over the more moderate members of the right, like Minghetti, for a policy of mild reforms. One example was Michele Coppino's Education act of 1877 intended to bring in compulsory elementary education. When Nicotera's authoritarian and unconstitutional actions endangered the continuance of the coalition, Depretis replaced him by Crispi (Dec. 1877); and Crispi, who had roundly condemned transformism when out of office, now welcomed it as the means of attaining power.

The succession of Humbert (Umberto) to the throne on the death of his father Victor Emmanuel II in Jan. 1878 confirmed the almost universal acceptance of the monarchy. A month later Pius IX died, and the election of Leo XIII as pope served as an occasion to restate the cleavage between church and state. More than once Leo mas to threaten that the papacy might remove itself from Italy if the claims of the church did not receive more respect.

Meanwhile one ministry followed another in quick succession. Depretis had to form a second cabinet in Dec. 1877; Benedetto Cairoli formed a ministry in March 1878; Depretis returned at the end of this year but fell in July 1879, after a vote in which Cairoli and Nicotera joined the conservative opposition; Cairoli succeeded once more but had to resign again in November and reconstruct his cabinet with the help of Depretis. The advent of the left in power was evidently not leading to a more stable and durable government despite such a huge majority; nor, it was noticed, was its rule notably much more liberal or enlightened than that of its predecessors.

Foreign Policy: Tunisia and *the* Triple Alliance.—Not until after 1880 did Italy meet any severe test in the field of foreign policy. France, Prussia and Great Britain all had good reasons for wanting a moderately strong kingdom in Italy as an essential element in the balance of power, and Cavour had thus been able to run risks in the confidence that he had everything to gain and not a great deal to lose. With the completion of unity, however, Italy was no longer content to acknowledge the patronage of foreign states and in return lost its status of a protected territory. In France. the republican Adolphe Thiers reversed Napoleon III's pro-Italian sympathies. The appearance of a distinct and active Italian foreign policy, backed by eager participation in the armaments race, made other nations more chary of their support. Gen. Cesare Ricotti-Magnani was reorganizing the Italian army on the Prussian model; naval supremacy over Austria was declared to be essential; and the armaments industry was receiving heavy subsidies. The stronger Italy became, the more difficult it was to back down with honour from a position that was maintained only with a dangerously high expenditure of money and resources. Lacking iron and coal. Italy was at an inherent disadvantage here; and though in naval construction for instance it temporarily led the world, each new invention or process causec! an increasingly disproportionate outlay of the national income. A vicious circle was soon set up. Italy's prestige became more and more involved; the state spent more and more money on interests that flourished on war scares and war production; and patriotism developed into nationalism and imperialism. The country became increasingly sensitive over real or imaginary affronts at the same time as it became ever more difficult to withdraw with dignity once any commitment had been made.

The same increase in strength helped to make Italy, in a moment of abandon, give up its valuable independence and enter the European system of alliances. Traditionally it had been able to play off Bourbon against Habsburg, France against Germany and vice versa, remaining free from commitments until it could intervene decisively. This had been the policy of the house of Savoy in the 17th and 18th centuries. But now, instead of limiting its ambitions to the preservation of the balance of power (in which it could act as an important makeweight), Italy was induced to side openly with Germany just when Germany had upset the balance by defeating France in 1870. The long-term result was to bring Crispi to a humiliating defeat.

There had been little sign of this in the period 1869–76 when Emilio Visconti-Venosta was foreign minister, although an ex-

change of visits between the rulers of Austria, Prussia and Italy in 1873–75 had marked the beginning of a reconciliation between the three conservative central monarchies. Then in 1877 Crispi paid a visit to Bismarck that convinced him Germany was the state of the future and that Italy should hurry up with its armaments and attach itself to this rising star. In his view it would have been unheroic just to try and restore the balance of power. As Victor Emmanuel II said, "Italy must not only be respected, she must make herself feared." This belligerent attitude was encouraged by Cairoli's failure to bargain successfully at the congress of Berlin in 1878 for a share in the disintegrating Turkish empire. The policy of "clean hands" provoked the indignant wrath of Crispi and his friends.

The final impetus to the German alliance came over the frustration of Italian colonial ambitions in Tunisia. For more than 40 years Italian explorers and missionaries had been penetrating into North Africa, sometimes with government encouragement. The Genoese chamber of commerce and, especially, the Genoese shipbuilder Raffaele Rubattino had spent much time and money in prospecting for colonies, and attempts had been made to purchase concessions as far away as the East and West Indies. The cutting of the Suez canal in the 1860s gave an additional incentive to colonization. In 1869 the government, working through Rubattino, made a settlement at Assab on the Red sea. Opponents pointed out the risk of war, the impossibility of maintaining a strong colonial movement without more resources and a larger army than Italy could afford and the lack of a financial or industrial surplus sufficient to exploit colonies once acquired. But although responsible statesmen expressed doubts about the course of events. appetite was now whetted, and prestige was thought to demand the extension of this settlement inland and the establishment of another colony in Tunisia.

There was indeed a substantial Italian population already living in Tunisia, and the acquisition of the country was considered necessary for the security of Sicily. But when Austria, Russia and Great Britain all suggested to Italy that it might compensate itself there for Austrian expansion into the Balkans, Visconti-Venosta and Cairoli agreed that Italy could afford only economic penetration. France also had claims to this region, and French hostility could not be lightly provoked. But Cairoli mismanaged the position and led on public opinion at home to look on Tunisia as a natural extension of the mother country at the same time as he knew that his government had neither the will nor the means to forestall the intervention of France. Then, in 1881, a French force entered the regency in pursuit of rebels from Algeria, and in May the bey signed the treaty of Bardo accepting French protection. In the following year Great Britain won a similar status in Egypt. Italy had to watch the last vacant stretches of North Africa being occupied by other countries and the balance of power in the Mediterranean turning against it. On grounds of security, and even more on those of prestige, this aroused the most bitter feelings.

It was partly in reaction to this setback that the government decided to make a formal alliance with Austria and Germany, and to sacrifice the advantage of not being bound to either of the big power groups of Europe. This was a breach with tradition. Austria had been the hereditary enemy for as long as people could remember, and its retention of Trento and Trieste, to say nothing of the presence of its fleet in the Adriatic and its ambitions along the Balkan coast, seemed to mark Austria out almost inevitably as Italy's opponent in any future war. From the Austrian point of view, moreover. Italy represented the principle of nationality which threatened the very existence of the Austro-Hungarian dual monarchy. Yet although the comparative weakness of Italy made it of little potential use as an ally, Austria wanted a guarantee for its southern frontier. Bismarck was likewise anxious to enlist Italian aid or benevolent neutrality against France should the latter contemplate a war of *revanche*.

Italy itself by now appreciated the case for ending its apparent isolation in Europe. in order to prevent further humiliation at the hands of France. The loss of Tunisia thus enticed the country away from its natural policy of "no commitments" and unadventurousness. An Austrian alliance would preclude the recapture of Venice in another war. It would also obtain formal acceptance by one of the leading Catholic powers of Italy's conquest of Rome, and this was important in that the pope was still hoping for foreign intervention to restore him his old authority. In domestic politics there was the further consideration that the treaty of Bardo had seriously shaken the parliamentary position of the left, and some success abroad was necessary to restore confidence.

For these reasons the foreign minister, Pasquale Mancini, opened negotiations for an Austrian alliance; and in May 1882 the triple alliance was signed. It was to last until May 1915. Germany, Austria and Italy undertook to support each other if ever attacked by other powers and to maintain a benevolent neutrality if one of the three states was forced to declare war. Austria and Italy in particular promised to maintain the status quo in the Balkans; but if ever this should become impossible, neither of the two powers was to occupy territories without previous agreement and adequate compensation. The Austrians tried to include in the treaty a clause which bound signatories to maintain a conservative policy at home, but Italy refused to accept this.

What Italy gained from this treaty was a comfortable feeling that it was no longer isolated. There was not much profit in a guarantee against the unlikely event of French invasion, and the offer of compensation in the Balkans was to prove illusory when the moment came for its application. In exchange for this, Italy had given up its freedom to negotiate with both sides. It had apparently reconciled itself to the Austrian possession of Trento and Trieste. Also, whether intentionally or not, it mas committing itself to fight in some future war in which it might have little apparent interest and, in the meantime, to increase expenditure on military provision.

By article five of the constitution, the king had the right to make treaties of alliance on his own responsibility. He need only inform parliament of the obligations that he had assumed for the country whenever he thought fit. The triple alliance was in fact kept secret, though the knowledge that the government had thrown in its lot with the former national enemy was not long in leaking out. It was noticed with some irritation that Humbert had even been seen in the uniform of an Austrian colonel at Vienna.

Meanwhile some of the nationalists were beginning to propagate the cult of irredentism, that is to say the extension of nationalist aspirations to Trieste, Trento and the other terre irredente or "unredeemed lands" still owned by Austria. In Sept. 1882 there was an incident when an "Italian" from Trieste. Guglielmo Oberdan, attempted to assassinate the Austrian emperor Francis Joseph; and his subsequent execution made of him a martyr in the eyes of many Italian patriots.

It was an early sign of the fact that the apparent completion of Italian unity in 1870, far from making Italy a satisfied power as the Risorgimento leaders prophesied, had created an appetite for yet further expansion. Moreover, the larger Italy became, the greater was its strength to effect such expansion. The simultaneous pressure of Austria down into the Balkans and the remarkable growth of national consciousness among the Slavs who surrounded Trieste were alarming signs that the passage of years might weaken instead of strengthen the Italian case. If expansion did not come soon, it might never come.

Irredentism was as yet only on the fringe of Italian politics. Depretis had not been very happy about the triple alliance but was a realist and was determined to make the most of it. It was fortunate for Italy that, when the alliance came up for renewal in 1887, a heightening of tension between Germany and France and between Russia and Austria made friendship more desirable than it had been in 1882. As a result, Italy received larger concessions and more particular regard for Italian interests in the Mediterranean. Crispi then tried, for a time with success, to divert nationalist sentiment away from the debatable northern frontier to colonial expansion, from irredentism to imperialism.

Domestic *Politics*.—It is difficult to describe the balance of forces in parliament during these years 1880–87, because there were no exact parties, and political allegiance was to persons rather than to principles. After the elections of 1880, the centre groups

of Depretis and Cairoli were confronted with an increase in representation for the extremists both right and left. The so-called "historic left" round Crispi and Nicotera could number more than 100 deputies whenever they could be induced to vote together. Minghetti and Sella on the right commanded even more. In this fluid position there was a new cabinet almost every year, and if it was usually led by Depretis, this was only because of his superior skill in avoiding the more controversial issues and in building up a personal majority by clever and not always scrupulous concessions to the local interests which dominated in each constituency.

In 1881–82 there was introduced a Franchise Reform bill which quadrupled the electorate to make a total of more than 2,000,000 voters. This had been part of the original "program of Stradella" with which Depretis had come to office in 1876. It had been generally recognized that the suffrage should be extended along with the gradual growth of education and economic prosperity. Even some of the conservatives agreed with this, in the hope that the middle and lower classes of society would prove a conservative influence (in which belief they were not far wrong). The age limit and the tax qualification being reduced, the vote was thenceforward possessed by all who had their education certificate or who paid at least 19 lire a year in taxes.

The same law also tried the experiment of abolishing the old single constituencies and introducing the *scrutin de liste* (single ballot) as a method of voting. It was intended thereby to secure a better representation for minorities; and enlargement of the electoral districts was expected to strike a blow at the local cliques which had simply managed to adapt the new techniques of democracy to perpetuate their control of municipal and village administration. The experiment failed, and the old methods were resumed in 1891. Another effect of the Franchise act in practice was to give more weight to the industrial north against the agricultural south and also to cities generally against the country districts. The results of this were not long in showing themselves during the severe agricultural crisis which set in after 1885.

The passage of this bill shows how Depretis was strictly adhering to the policy of moderate reform, defying the extremists on either side. His primary aim was to keep his amorphous centre majority intact and himself supported in power by a moderate consensus. Trimming his sails to the prevailing wind, he soon abandoned the radicals and made overtures to the centre right under Minghetti. By 1882–83 it became clear that a new government majority was in being and that *trasformismo* had effectively confused the old nomenclature of left and right.

Depretis thus remained in office more or less continuously until his death in 1887. The forced currency was abolished in 1883, when the treasury resumed payments in gold. Abolition of the grist tax came into effect in 1884, and a new cadastral survey was taken for a reform of the land tax. In 1885 a convention was made whereby the state railways were farmed out to three private companies for 20 years. Enlightened public health measures were passed, and a government commission of inquiry into the condition of agriculture at last brought to light some of the necessary facts upon which an agricultural policy waited.

This legislative program received the general support of parliament, for the various groups in opposition seemed to be incurably divided. On the right, Ruggero Bonghi and Silvio Spaventa tried to stop the disintegration of their party and to resist the dissolvent effects of transformism. On the extreme left there was likewise a small group of radicals, the *estrema*, round Agostino Bertani and Felice Cavallotti, which refused to be confounded in Depretis' policy of compromise and expediency. There was another right-wing group round Antonio di Rudini and Sidney Sonnino which, despite occasional protests, gave conditional support to the government. Then there was the left-wing "pentarchy" formed of Crispi, Nicotera, Cairoli, Giuseppe Zanardelli, Alfredo Baccarini and their several clients, who vociferously claimed that Depretis had unscrupulously abandoned his former party but who then showed that they had nothing to learn from him when it came to tactical alliances in the struggle for power. When Depretis formed his last cabinet in 1887, Crispi and Zanardelli were among its members, despite their recent vilification of the irresponsible financial policy of their new colleague Agostino Magliani. The "wizard of Stradella" had so confused every issue that almost everyone had come to accept transformism. It appeared to be the only method of government which could transcend the bitter personal animosities and the almost anarchical individualism which typified the Italian parliament.

Crispi, to 1891.—The death of Depretis in July 1887 brought to the premiership the far more energetic and bellicose Francesco Crispi, who typically combined headship of the government with the two most important departmental posts, those of home and foreign affairs. Despite his former criticism, Crispi tried to continue with the transformist technique. But his uncompromising dogmatism, his personal churlishness and his impetuousness in action created opposition right and left. Where Depretis had been wont to "open his umbrella" at the first sign of a political storm (this had been his own description of his attitude), Crispi plunged headlong into any controversy; and his ability and enormous self-assurance usually carried him through to victory. Of all the pre-Fascist politicians, this was the man whom Mussolini most admired. He was at once the Jacobin reformer, the autocrat who concentrated all power in himself and rode roughshod over other ministers and even over the constitution itself, and the imperialist who believed fervently in the expansion of Italy and in its mission in Africa. It was unlikely with such a man that domestic politics would continue for long on the same even keel as with his predecessor.

Crispi was soon trying to patch up a reconciliation with the church. He knew the prestige that would accrue from healing the breach between Quirinal and Vatican, and he would have welcomed the aid of the church in his campaign against the Socialists at home and the heretic Ethiopians abroad. Here he met a reverse, for Vatican circles were still frightened that conciliation would expose the pope to suspicion of being unduly subject to Italian political influence and were anxious to demonstrate that he was more Catholic than Italian. Crispi was personally something of a freethinker. After this rebuff he reverted to his former anti-clericalism, and proceeded to nationalize most of the numerous charitable institutions owned by the church.

Crispi's ministry of 1887–91 was marked by a number of liberal reforms, especially the adoption of Zanardelli's new penal code which abolished the death penalty and made it easier for individuals to secure redress against the administration. A Municipal Franchise act widened the suffrage for local elections and gave greater responsibility to elected councils in local government. Crispi also introduced reforms in prisons and public health. Gradually, however, he became corrupted by power and began to think that Italians both needed and would appreciate something more dictatorial—or at least a chancellorship on the Bismarckian pattern. Faced with the problem of making parliament work without the aid of well-disciplined parties, he improved upon Depretis' methods, and while choosing his ministers from both right and left, often pushed through his reforms by arbitrary means or else acted on his own initiative before asking parliament for a retrospective bill of indemnity. Any opposition to himself was regarded as simply factious and irresponsible.

Crispi was his own foreign minister and a bad one. Italy's only hope of asserting influence in Europe was for France to be restored into a better balance with the Central Powers. Yet Crispi took animosity against France to absurd lengths and ostentatiously paid several obsequious visits to Bismarck in Germany, seeking to profit from any future German victories and so inciting his ally on to war.

Instead of opposing Austria as the old school of nationalists had done, he went out of his way to earn its good opinion. He proclaimed the existence of Austria-Hungary to be a necessity for Italy and angrily dismissed his colleague Seismit Doda, the minister of finance, for having failed to protest against irredentist speeches delivered in his presence at Udine. Crispi had convinced himself that Italy was a powerful country which had nothing to fear from war and therefore did his best to pick a quarrel with France. Some of the wilder politicians had been advocating a "bath of

blood" as a test of national virility; before long Crispi was to satisfy their wishes to overflowing in Abyssinia.

It was typical of the parliamentary situation that although Crispi, using every means of pressure, obtained a large majority in the elections of 1890, he was unexpectedly defeated by a vote in Jan. 1891. The slightest point served to reshuffle the many splinter groups in and out of the government, and on this occasion a tactless outburst about the supine foreign policy of his predecessors sufficed to upset him.

A man of such positive opinions could not but have made many personal enemies. He had divined and exploited the general wish in the country for prestige and national greatness and the desire for a government that would be not lax but active and forceful. At the same time he had underestimated the sensible caution of the governing classes, their alarm at his expenditure on military provision, their distrust of the promise of economic gain from colonial expansion, their irritation at his ruthless and dictatorial methods. People saw that he was dividing the country in two and provoking a dangerous restlessness among the poor. And his tariff war with France was proving to have been as unnecessary as it was disastrous.

The Economic Crisis After 1887.—Italy's repudiation of the French commercial treaty and its sudden conversion from free trade to protection mere partly responsible for the severe economic depression of these years from 1887 to 1891—which in turn was to have serious political repercussions. The construction of railway routes through the Mont Cenis and Brenner passes and thence all over Italy had exposed Italian farmers and industrialists to increasing foreign competition and to the price fluctuation of a wider market. At the same time. the triumph of steam navigation was bringing much cheaper freight charges, and this favoured the large-scale import of grain from America and Russia where it could be grown cheaply.

As a result there was a collapse of prices in the 1880s in response to which both industrialists and agriculturalists were loud in their demand for government protection. In particular the steel industry, always rickety because of the absence of fuel and raw materials in Italy, pressed the government to annul the commercial agreement with France and to make the country more independent of foreign supplies. This argument naturally appealed to a man like Crispi who wanted a strong domestic armaments industry and had a *parti* pris against France.

The results of this policy were not long in showing themselves. Complete self-sufficiency was of course unattainable, but any approach to it necessitated an increase in uneconomic and often inefficient production. By the imposition of heavy tariffs on imported metal, domestic consumers were made to subsidize the profits of a parasite industry. Moreover, political corruption became unbridled as the industry bribed deputies and newspapers to maintain this high level of protection.

Worse still, the increase in production from the new factories at Terni and the old workshops along the Ligurian coast had reached a point by 1890 when it exceeded any demand except on the hypothesis of war; and Crispi's belligerent foreign policy received all the more encouragement. The inefficiency of government protection can be judged from its both delaying the switch over in shipbuilding to the use of metal hulls and steam and keeping a wholly disproportionate area sown with cereal crops for which the land was unsuited and in which it gave only a minimal yield. Some protection was no doubt necessary, but the excess to which it was taken was damaging.

The political implications were as unfortunate as they were unforeseen. Instead of being forced to accept Italian conditions in negotiating a new commercial agreement, France easily turned to Algeria for wine and to the far east for silk, and these two staple Italian industries never recovered the ground thus lost. France had been Italy's best customer, taking about 40% of its exports; but these now came to a temporary stop. Southern agriculture received a crippling blow in order to pay for benefits reaped by northern industry, and the consequent increase in food prices took a great number of people below the starvation level, with disastrous political results. Ten years earlier the occurrence of the vine disease Phylloxera in France had led to a great expansion of viticulture in southern Italy; but now, just when the new vines were beginning to come into cultivation, most of southern Italy was turned into one vast depressed area, and before long rebellion was to break out openly.

This economic breach with France began in 1888, and though Crispi was obliged to climb down a little after 1890, the severance of relations had by then led to a heavy withdrawal of French capital. This was in part responsible for the collapse of certain important banks. There had latterly been much overspeculation in building and industrial ventures. and the banks had allowed far more credit than the law allowed. When signs of a financial crack began to appear in 1889, Crispi at first did nothing to halt this inflation of credit but rather encouraged its continuance, fearing the unemployment which would result from a contraction and giving undue weight to the advice of some of the financiers implicated. **A** secret report was written for the cabinet by an investigating committee under Senator Giacomo Alvisi. Though it was not published. it was later known to have revealed serious irregularities. The six banks of issue had abused their rights and by "favour loans" to politicians had come to wield considerable political influence. Bernardo Tanlongo, the director of the Banca Komana, had not only maintained an illegal circulation but had even printed false banknotes to the value of 40,000,000 lire. But far several years more all this remained concealed.

Rudini, 1891.—When Crispi fell before a hostile vote in 1891, he was succeeded from Feb. 1891 to May 1892 by Antonio Starabba, marquis di Rudini, who had led one group of the right ever since Minghetti's death in 1886. This signified the return to a milder and more conservative government. even though the state of parliament forced Rudini into a transformist coalition with Nicotera's faction on the left. Crispi's megalomania now gave way to retrenchment both at home and abroad. Military expenditure was decreased and the finances were thus reduced into better order. The new cabinet was also less anticlerical and more ready to consult parliament than its predecessor. Parallel with negotiations to renew the triple alliance in 1892, there was a noteworthy resumption of friendship with France and Russia; and the campaign for economic self-sufficiency was mitigated by the signature of commercial treaties to open up foreign trade. Despite all this, the parliament was still that elected under Crispi, and after a hostile vote Rudini resigned. His immediate successor was Giovanni Giolitti, a former colleague of Crispi, whose first ministry lasted from May 1892 until Nov. 1893.

Giolitti, to 1893.—Giolitti was a Piedmontese who had come to power by way of the civil service. Like Depretis he was first of all an administrator. His primary object was wherever possible to remain neutral in political differences, letting events take their natural course and so preserving tranquillity in the state at a difficult moment, while allowing new ideas and new ways of thinking to have free play and to usher in a period of progressive reform. Eventually, in the period from 1903 to 1914, Giolitti was to be the dominating figure in politics, and his skilful management of the elections of Nov. 1892 already gave a foretaste of his quality; but this time he came to grief over the question of the banks.

The Bank Scandals.—The scandals indicated in Alvisi's report (see above) were suddenly exposed when a copy of this secret document came to light in Dec. 1892. Giolitti was forced to arrest Tanlongo, whom he had just nominated to the supreme dignity of the senate. Crispi and Giolitti still tried to prevent a public inquiry, for this might damage Italian credit abroad as well as their own reputations. Rut the collapse of one bank after another made it impossible to conceal matters any further. A parliamentary committee of seven under Antonio Mordini had eventually to inquire into the condition of the banks of issue. Its report, read to the chamber in Nov. 1893, established that the two preceding cabinets had been aware of serious irregularities committed by Tanlongo and others; that Tanlongo had heavily subsidized the press; that a number of deputies, including several former ministers, had received from him "loans" of a considerable size Crispi and Giolitti were both found to have had financial dealings with the bank and to have been guilty of grave errors of judgment if no

worse. The air was cleared, the situation was shown to be not quite so bad as some had feared, and suitable reforms were introduced forthwith to make a recurrence of such irregularities unlikely; but the revelations forced the resignation of Giolitti, and he felt compelled to leave the country for a time.

The Sicilian *"Fasci," 1893.*—Giolitti's first experiment in the management of parliament had broken down, for he had not yet learned Depretis' technique of how to keep many groups in common harness. The nationalists disliked his truckling to France when in Aug. 1893 some Italian workmen were killed in a riot at Aiguesmortes. The landowners resented his refusal to take arbitrary action against unrest in Sicily. The contraction of the French market for Sicilian produce, the devastation wrought in the vineyards by Phylloxera and a diminution in the sulphur trade had combined to produce in Sicily a discontent which led to the organization of the peasants into groups known as fasci. Giolitti had refused to dissolve these workers' unions. He had further annoyed the conservative landowners by his advocacy of higher taxation for the rich. They therefore chose to regard him as a dangerous revolutionary who was undermining their social position in collusion with the Socialists; and so they successfully worked for his supersession in office by Crispi, despite the latter's inculpation in the bank scandals.

The peasants who formed the vast majority of the Italian population had not yet become politically class conscious, although their social revolts had punctuated and sometimes contributed to the course of political development during and after the Risorgimento. Their poverty was extreme, and their condition of life became unendurable in years of bad harvest or trade depression. No politicians had bothered much about their lot. Mazzini and the old school of radicals had been more concerned with political than with social regeneration. The Socialist Carlo Pisacane (d. 1857) had been an isolated figure. Then, after the experience of Mikhail Bakunin's revolutionary anarchism, a workers' party had been formed in 1882, in which year Andrea Costa entered parliament as the first Socialist deputy. But the early Italian Socialists had been mostly intellectuals like Antonio Labriola and Filippo Turati. They had also thought of the peasants as a conservative rather than a revolutionary force and had concentrated their attention on the industrial artisans who were multiplying rapidly during the great industrial expansion of the 1880s.

Contrary to the belief of Crispi and his friends, the Sicilian outbreak of 1893 had had little connection with organized socialism. It was rather a hunger rebellion, a protest against the local octrois on food through which the poor paid more than their fair share of the expenses of local government. Once again, as so often in the course of the 19th and 20th centuries, the peasants marched to occupy the large estates or latifondi. The landlords were usually absentee and few of them had done much to improve these scantily cultivated lands; frequently they had usurped the communal lands and so deprived the peasants of the old rights of grazing which had been part of their livelihood. The clash between rebellious peasantry and the authorities in 1893 was in part the result of deliberate provocation by the landowners, who saw in agitation and agricultural strikes a threat to their own prosperity. Crispi recognized in the situation an ideal opportunity to accuse Giolitti of weakness and to rally conservative opinion by magnifying the danger into a major threat of Socialist revolution. This false scare incidentally was used to prevent a proper debate on Mordini's report about the bank scandals (to the great relief of many politicians) and allowed Crispi himself to appear in his favourite pose as the strong man who alone could restore order.

Crispi, 1893–96.—On Giolitti's resignation, the king had first asked Zanardelli to form a government; but, disliking Zanardelli's proposed cabinet, he then put this task into the eager hands of Crispi in Dec. 1893. The fasci were suppressed, and martial law and military tribunals were employed to restore order and send some of Crispi's opponents to the penal islands. Where parliament proved refractory, legislation was enacted by royal decree. The Socialist party was dissolved. An attempt to raise the question of Crispi's complicity in the bank scandals was then quashed by the sudden closure of parliament. Crispi ruled without parliament for almost half a year. After that, elections were held in May 1895 and suitably managed to give the administration a large majority. Crispi's policy of authoritarian government at home and imperial expansion abroad received a fillip which was shortly to prove disastrous both to Crispi and to Italy.

Defeat in *Abyssinia.*—In 1882 Depretis had declared Assab on the Red sea to be a crown colony; but he had then, against Crispi's advice, refused the offer of Great Britain to assist in the occupation of Egypt. The left-wing liberals agreed here with the irredentists and even some of the Milanese industrialists that colonies were an expensive luxury which Italy could not afford. Unfortunately, considerations of prestige and national dignity were thought by others to demand a forward colonial policy. Once the first settlement had been made, moreover, its defense required still further expansion into the interior, and chance conflicts with local tribesmen were soon followed by the dispatch of punitive expeditions. Pasquale Mancini hoped that "in the Red sea we shall find the key to the Mediterranean"; and in 1885 he occupied Massawa. As this was one of the trade outlets for Abyssinia, the move brought down on Italy the antagonism of the negus John and of Alula, ras of Tigre. Certain "frontier incidents" led to a clash in which Alula with greatly superior numbers overwhelmed a force of 500 Italians at Dogali (Jan. 1887). Crispi declared that this could not go unavenged, and preparations were accordingly made for a larger expedition.

From his original distrust of colonialism, Crispi had changed into an exaggerated imperialist. On the death of the negus John in 1889, he backed Menelek, king of Shoa, in a war of succession against John's son Mangasha. A treaty was signed with Menelek in May 1889 at Uccialli, the Italian text of which gave the Italians the illusion that they possessed an acknowledged protectorate over Abyssinia. It also agreed to an enlargement of the original Italian colony, which in Jan. 1890 was given by royal decree the new title of Eritrea. In 1891–93 the governments of Rudini and Giolitti had retreated a little from this aggressive attitude, but Crispi's resumption of office in 1893–96 witnessed a further penetration into Tigre. In July 1894, Gen. Oreste Baratieri captured Kassala from the dervishes. In Eritrea, the French Lazarist missionaries were expelled and replaced by Italian Franciscans. Aduwa was occupied in 1895.

Serious disagreements had existed in the cabinet and war office over this extended occupation. Financial stringency forced Crispi to stint supplies and to urge Baratieri to make the territories pay for their own conquest. Meanwhile the new negus was forced into a common opposition with the ras of Tigre and with the dervishes. In Dec. 1895 Menelek destroyed an Italian column at Amba-Alagi, and only then did the Rome government realize the incompetence of Baratieri and decide to replace him. Hearing of this, the unfortunate general precipitated a larger engagement to retrieve his reputation and, after gross tactical errors, was completely routed with 6,000 men at Aduwa in March 1896. To make matters worse, in a public communiqué he threw the blame for defeat upon his troops. His own subsequent court-martial rather showed up his personal responsibility and that of the government which had chosen him and directed the campaign.

The news of this defeat came as a cruel blow to a public opinion which had been indoctrinated by Crispi in an exaggerated view of national strength. This was the penalty for handing power over to a strong man who treated all criticism of himself as unpatriotic. It was also a commentary on the Italian parliamentary system for failing to produce a powerful party in opposition which could focus discontents and place an alternative policy before the country. The elections of 1895 might have been interpreted as showing that Italians were glad to have a strong man who knew his own mind and could cut through the interminable criticism of factious groups in parliament. If so, the electorate had its deserts. Crispi had taken too much on himself and had been able neither to stand back and see where his policy was leading nor to look after the executive details. He tried hard to put the blame on the military, so that the king would confirm him in office; but the king had more sense. Troops were withdrawn from Abyssinia, an indemnity was paid to the negus and Kassala ceded to Great Britain.

Rudinì, 1896–98.—A new cabinet was formed in March 1896 by Gen. Cesare Ricotti-Magnani, who, however, made over the premiership to Rudini. This leader of the moderate right introduced his own brand of transformism once more, by making an alliance with the radical left of Cavallotti. An amnesty was accorded to those involved in the Sicilian outbreak. The liberal Zanardelli was brought in to strengthen the cabinet. and Visconti-Venosta was once more persuaded to take over the foreign office after an interval of 20 years. A *rapprochement* with France was the natural corollary of this latter appointment, and the recognition of the French position in Tunisia put an end to 15 years of tension. In Eritrea Ferdinando Martini inaugurated a period of relative quietude and prosperity. Crispi's policy was everywhere reversed.

But social unrest, far from abating, had rather grown as a result of Crispi's rule of martial law. It needed only another rise in the price of bread, and disturbances began to spread. The elections of May 1897 significantly strengthened the Socialists and the radical and republican groups that with them made up the parliamentary *estrema.* The Italian Socialist party had met for its first conference in 1892 and had laid down a program which refused all idea of co-operation with a nonsocialist government. Rudini took alarm at this parallel growth of economic distress with political insubordination, especially after the outbreak of mob rioting during May 1898. Martial law was proclaimed in Milan, Florence, Leghorn and Naples, and one military officer ordered the use of cannon in the streets of Milan. There was much loss of life. Military tribunals then imposed severe sentences. Universities were closed; thousands of Catholic and Socialist papers and associations were suppressed on the supposition that they were guilty of inciting to revolution.

Pelloux.—Indignation over these panic provisions led to Rudini's defeat in parliament in June 1898, and the king summoned Gen. Luigi Pelloux to replace him. Measures were introduced to give the administration greater freedom to suspend the ordinary constitutional guarantees of popular liberties whenever it was thought necessary in the interests of order. As these met with opposition from the left, Pelloux proclaimed them to be law by simple royal decree. The Socialists met this by the method of parliamentary obstruction, the only possible rejoinder to which was a proposal to reform the standing orders of the chamber so as to make it permissible for the speaker to cut debate short. In June 1899 discussion on emendation of the standing orders was arbitrarily cut off and a vote called. When the Socialist deputies overturned the voting urns they were imprisoned, and parliament closed. The courts, however, declared Pelloux's decree law unconstitutional and void, and when parliament assembled again the opposition deputies walked out of the house in protest. Pelloux thought it better to appeal for a verdict to the country and when the elections turned against him in June 1900 he resigned.

This conflict had narrowly averted the danger of a modification of the constitution in an authoritarian sense. It had taught the various groups of the *estrema,* including the Socialists, to work together; and with them were now associated the so-called constitutional left of Zanardelli and Giolitti. Very rarely indeed in Italian history has it been possible for such a common alliance of groups to be formed at a critical moment with a common policy of opposition and to present the electorate with something like a clear choice. Yet the narrowness of the victory had exposed a dangerous weakness in the parliamentary system. The bank scandals had already weakened people's confidence in parliament; so had the practice of obstruction, the quick succession of insecure governments, the readiness of the house to abdicate before a parliamentary dictator who alone could "get things done," and the evident malpractices in the conduct of elections. Important doubts about the nature of parliament were being raised by responsible liberals like Ruggero Bonghi, Gaetano Mosca and Sidney Sonnino, and suggestions were made that the king's authority might be increased, so that the ministry in power should not be responsible to parliament. Pelloux's failure momentarily removed this possibility; but many people had had their faith shaken in liberal democracy, and when the opposition groups fell away again from their common front there was always the danger that another Crispi or Pelloux might find it all too easy to upset parliamentary government altogether.

Saracco.—Some of the responsibility for what had happened fell on King Humbert, who, although he had not played a very active part in the politics of this stormy decade, had not advanced his reputation as a constitutional monarch and had on occasion actively intervened on one side of the current political dispute. A few weeks after summoning the elderly senator Giuseppe Saracco to succeed Pelloux, the king was assassinated by an anarchist, Gaetano Bresci, at Monza in July 1900. The deed was stated to be in revenge for those who had lost their lives at the hands of the authorities at Milan in 1898. Humbert was succeeded by his only son, Victor Emmanuel III. The new king was less popular than his father; but he was not the sort of man to carry out Sonnino's plan to reinforce the royal prerogative and began his reign as a model constitutional monarch.

Giolitti, 1901–05.—Saracco had been chosen as premier, like many of his predecessors, without much regard for the balance of opinions in parliament or in the country. His defeat in Feb. 1901 gave Victor Emmanuel the chance to restore confidence and tranquility by bringing in the left-wing liberals under Zanardelli with a broad but essentially liberal cabinet. The strongest man in it was the minister of the interior, Giolitti, who in 1903 succeeded Zanardelli as premier.

The chief problem these men had to face was that of the growing labour unrest, which Crispi and Rudini had failed to subdue by repression and martial law. Giolitti and Zanardelli had strongly championed the rights of parliament against the "exceptional laws" which Pelloux had tried to pass. They also maintained that the conservative imperialists were far more a peril to social and political stability than were the insurgent poor or the Socialists. They believed that the country would only settle down if a new equilibrium was achieved which gave the working classes a greater stake in the nation and a greater share in its prosperity. The rich had so abused their power, said Giolitti, that "we have a large number of taxes paid predominantly by the poor, but not a single tax that is exclusively on wealth as such." He therefore asked for more social justice, being confident that in the long run this would add greatly to the wealth of the community and that it would turn would-be rebels into defenders of social order. Henceforth labour unions were to be encouraged instead of prosecuted, and the government was to remain neutral in strikes so that wages as well as profits might find their own level.

It was a symptom of the advance in industrialization that the years after 1901 saw such a wave of strikes. Agricultural unrest still continued, as the peasants attempted to obtain better contracts with landlords or to resume former rights over enclosed common land. The drift of workers to the towns or overseas had a gradual effect in putting more bargaining power in the hands of the better-placed agricultural workers and in getting for them wages nearer to those current in the new centres of industry. Among the town artisans, however, strikes were even more common, so that Giolitti's theory was soon put to a severe test.

Naturally the Socialists exploited these grievances to the full and tried to organize labour leagues wherever possible. But from the first the Socialists were divided into a number of factions and so never constituted such a danger as their numbers and doctrines might have suggested. A revolutionary wing was led by Enrico Ferri, advocating uncompromising class warfare, while the moderate Riformisti represented by Leonida Bissolati-Bergamaschi were ready to ally with the democratic liberals. It was the aim of Filippo Turati to keep both these wings from open breach, and at the Socialist congress of 1900 he secured a compromise whereby the objectives of each were approved as a maximum and a minimum program for the party. As the minimum program included such aims as the amelioration of wages and conditions of work, Giolitti saw enough common ground there to try and attract the Riformisti away from their friends and into the government coalition. His concessions to the Riformisti were thus not just a sign of weakness (as his enemies said) but part of a larger plan to divide the party and to weaken the syndicalist, anarchist and

revolutionary factions inside Italian socialism. The party congress of 1902 marked the temporary triumph of the Riformisti, and this gave him encouragement.

At the same time Giolitti remained firm with the extremists and he showed that he could break a strike wherever he thought it was irresponsible or merely political, or wherever it affected public servants. Early in 1902 the employees of the Mediterranean railway threatened to strike for the recognition of their union and for greater security in employment. As this might have paralyzed the whole economic life of the country, the government called out all the railwaymen who were army reservists. In 1903 the Socialists refused an invitation to join the cabinet, but the fact that Giolitti made them the offer was significant. In the same year Ferri became editor of the party paper Avanti and ousted the Riformisti from their position of leadership. Another alarming symptom was the appearance of the Syndicalists, who proclaimed themselves opposed to all legislative parliamentary action and who favoured only direct revolutionary propaganda. In Sept. 1904 a general strike was proclaimed which spread to nearly all the industrial centres.

Giolitti saw that it possessed a frankly revolutionary character and so would lack some of the popular support which the ordinary grievances of the working classes evoked. Accordingly he gave the strikers full play, putting them in the wrong by his moderation and showing how ineffective was the general strike as a method of revolution. The strike fizzled out, and the feeling of reaction thereby generated against socialism was such that Giolitti was able to force a general election in which the extreme left suffered a minor defeat.

This was a triumph of political skill, just as the elections themselves were a triumph of administrative ability. By now Giolitti had learned how to keep a broad coalition in being and how to keep controversial issues as far as possible below the surface. His cabinet included several men from the right: Tommaso Tittoni, the prefect of Naples, as foreign minister and Luigi Luzzatti at the treasury. No sooner had his offer of an alliance to the extreme left met with a rebuff than he turned perceptibly toward the other direction. Zanardelli's project for the introduction of divorce legislation was thrown over in a new effort to conciliate the Catholics; and as a result the elections of 1904 saw some of the latter at last participating openly in politics.

This alliance with the Catholics was in the end to be an important access of strength; but the delicate balance thus contrived was not immediately stable, and by March 1905 Giolitti felt the need of retrenchment while he cast about for some new formula of cohesion. The railway workers had been practising a system by which they could obstruct and delay traffic without leaving themselves open to prosecution, and Giolitti's handling of the situation had met with much criticism. In order to escape further unpopularity, he made way for one of his own friends, Alessandro Fortis, as the next prime minister.

Fortis and Sonnino, 1905–06.—Some of the old ministers continued in office under Fortis. It was a colourless administration. Its most important measure was a bill for the purchase of the railways by the state. Haphazard enterprise had built many lines that were proving uneconomic to run, and it was generally agreed that only the state could foot the bill and deal with the railway strikes which were becoming so familiar an event. Fortis met considerable opposition from southern agricultural interests over the commercial agreement with Spain, which allowed the import of Spanish wine on favourable terms. In Feb. 1906 he fell, and the succession devolved on Sidney Sonnino and the right centre.

Sonnino had been waiting for this a long time. By now he had given up his earlier proposal that Italy needed a less parliamentary type of government, and people looked to him for a restatement of liberal conservatism within the limits of the existing constitution. His ministers included Luzzatti and Antonio Salandra from the right and beside them—by an incongruity now familiarized by long usage—two militant radicals from the extreme left, Ettore Sacchi and Edoardo Pantano. As Giolitti had won over a number of leading politicians from the right, Sonnino was forced to look far afield in order to make up a majority different from Giolitti's, and so a typical transformist gesture landed him with this unholy compact of irreconcilables. Ferri also decided to vote for Sonnino when he had refused to support the more liberal Giolitti. With such a composite majority it was unlikely that the government would last long. After three months, when it became obvious that Sonnino was far less able than Giolitti to manage labour strikes, the latter returned to power with another cabinet (May 1906).

Giolitti, Sonnino and Luzzatti, 1906–11.—Giolitti's third ministry had the unusually long duration of three years (1906–09). As before, it was mainly built up from the left centre, but Tittoni returned to the foreign office. It began auspiciously with the conversion of the public debt to 3½%, on lines already prepared by Luzzatti. Subsequent changes in the personnel of the ministry brought Pietro Bertolini over from Sonnino's party as minister of public works, and this tore another hole in the opposition alliance. When Gen. Ettore Viganb was succeeded by the senator Severino Casana, this was the first time that a civilian had ever been war minister. (It had been customary for the king to retain a specially close control over the service ministries as over the department of foreign affairs and often to appoint "nonpolitical experts" to direct them. Army generals had taken a special oath of obedience to the throne, and therefore frequently acted as servants of the king inside the cabinet, continuing in office from one ministry to the next. Indeed, Casana was quickly succeeded by another senior officer.)

This was a period of prosperity for Italy. For almost the only time in modern history, the annual budgets showed a favourable balance between 1900 and 1910, until another African war started the deficit again. Foreign trade doubled in this decade, wages rose, the general standard of life improved. Recognition of the southern question at last allowed the passing of remedial social legislation for the betterment of backward areas. The surplus agricultural labour which had depressed standards in rural districts was now taking to emigration overseas at the rate of 500,000 a year. This helped to raise wages at home, and the flow of remittances sent home by prosperous emigrants became an important item in the balance of payments. Meanwhile the development of hydroelectric power opened up new possibilities for Italian transport and industry, which had hitherto been crippled by the high cost of imported fuel. The Fiat company was formed in 1899 as a pioneer in automobile construction. By the concluding years of World War I it had become a great complex of highly modernized factories.

Meanwhile the relations between church and state began to show signs of change. Pope Leo XIII (1878–1903), although intransigent in word, showed much more political aptitude than his predecessor. His successor, Pius X (1903–14), was distinctly less insistent in his claims to temporal power, and his own political conservatism made him anxious that clerical influence should be felt in parliament to offset the advance of socialism. At the same time many prominent Catholics were trying to reconcile the church to the ideals of liberal democracy and even to vie with socialism in advocating social reform. From either angle it was now apparent that the refusal to recognize the loss of Rome had damaged both church and state; and since outside Rome the relations between clergy and local authorities had remained quite cordial and co-operative, many people on both sides argued that greater formal reconciliation was possible than the ultras had hitherto believed.

In local elections Catholics had always been allowed to vote, and it seemed only a natural extension when in June 1905 an encyclical practically abolished the non *expedit* and allowed more active participation by Catholics in national politics. The simultaneous breach between the Vatican and the French republic also made it more desirable to find a new lay ally and not to place every Italian in the dilemma of being either a good Italian or a good Catholic when the majority wished to be both. A number of religious institutions in the near east, formerly under a protectorate of the French government, were now placed under Italian protection. Giolitti also tried to make a compromise on the subject of religious education in such a way as to offend neither the Catholics nor the Freemasons and other anticlericals. At the elections of March 1909 more than a score of clerical deputies were returned, who

seemed to have forgotten about the temporal power and were ready to accept the lately anathematized monarchy.

In Dec. 1909 Giolitti's administration was defeated over a point of procedure, and Sonnino returned to office for a few months. In March 1910 Luzzatti succeeded with yet another hotchpotch ministry, Each of these short governments tried to outdo the other in reforms, hoping thereby to gain support enough to form a coalition that mas durable and coherent. But neither had the strength to carry them through, and it soon became obvious that they were only holding office on sufferance until Giolitti saw fit to return.

It was a current belief that Giolitti had resigned merely in order to run away from temporary unpopularity and was biding his time to watch political developments and intending to resume office at the first opportune moment. Those who had criticized his apparently weak handling of the strikes now had occasion to see that such men of the right as Sonnino and Luzzatti were equally powerless and that Giolitti's tactics might actually be taking the sting out of the *estrema*. In March 1911 Giolitti was summoned to form his fourth cabinet, which he made up for the most part of men who had served under Luzzatti. Once again he offered posts to the Socialists if only they would give up their maximum program and their tactic of nonco-operation with all bourgeois government. But in 1911 the extremists were recovering the control of the Socialist party which they had lost in 1908, and Turati decided that acceptance of Giolitti's offer might split the party beyond hope of recovery.

Foreign Policy, 1896–1911.—In the field of foreign affairs, the post-Crispi generation began to appreciate that the triple alliance had given Italy a false illusion of strength (which indirectly had led to Aduma) with little compensating support and assistance. Between 1896 and 1901 Visconti-Venosta therefore moved the country back into a middle position where it was courted by both Germsny and France and where its influence was consequently the greater. The triple alliance was renewed in 1902; but public opinion was no longer so favourably disposed toward it, and it was partially neutralized by written undertakings toward France. Victor Emmanuel III in Oct. 1903 visited Paris, and in April 1904 Pres. Émile Loubet returned the compliment in Rome. Meanwhile, the final rupture between France and the Vatican was also welcomed in Italy. French rights in Morocco were officially recognized, in return for recognition of an Italian sphere of interest in Tripolitania. An Italian note sent in Nov. 1902 gave a guarantee that the triple alliance was no longer directed against France. Another sign that the alliance was wearing thin was the independent understanding reached with Great Britain about interests in the Mediterranean.

Giolitti favoured this policy of good-neighbourliness and noncommitment. The triple alliance was again renewed in 1907 and 1912 but it was no longer an exclusive pact and, whatever it said on paper, was in practice to bind Italy hardly at all. On the contrary. Austria's petty·persecutions of its Italian subjects in the *irredente* provinces. support of the anti-Italian Slav elements on the Adriatic littoral and active propaganda incompatible with Italian interests in the Balkans as well as the anti-Italian war talk of Austrian military circles imperilled the relations of the two allies. A typical clash occurred in Oct. 1902 when the German students at Innsbruck rioted against the Italians at the university. In reply to this there was a renewed campaign of irredentism. Italian schools and commercial agencies were encouraged from Rome to form outposts of Italian culture and influence in Trieste and the Alto Adige (as South Tirol now came to be called).

Such was the position of growing tension when the Austrian annexation of Bosnia in Oct. 1908 upset the balance of power in the Balkans. Tittoni failed, moreover, to obtain the compensation explicitly allowed under the provisions of the triple alliance, apart from a tacit understanding that Italy could retort by the "pacific penetration" of illontenegro. The episode was a warning to Italy of what to expect from its ally, and led to the granting of greater credits for the army and navy. In 1909 an agreement was made with Russia at Racconigi to keep a wary eye on Austrian expansion in eastern Europe. In 1910 a new Nationalist party held its inaugural meeting in Florence, and its leaders Enrico Corradini and Luigi Federzoni began to reassert the old doctrine of expansion, antidemocracy and totalitarianism. These men were to link the period of Crispi with that of Mussolini. They welcomed war as an end in itself, as a test of national power and an example of virility; in domestic politics they were to ally themselves with those who wanted more discipline and fewer concessions in labour disputes. There was no lack of money to aid such a combination of causes. and their dramatic appeal to public opinion evoked a surprising amount of enthusiasm.

Conquest of Libya.—The nationalist movement soon concentrated its forces in advocating the occupation of the Turkish dependency in Tripolitania. Since the disaster of Aduwa there had been little that was spectacular to show in the colonial field—only an abortive expedition to China in 1898 and steady commercial exploitation in Eritrea and Somaliland. It was now argued once more that national self-confidence could only be restored by a successful venture in North Africa. No regard was paid to the even greater need for spending any available capital in the impoverished provinces of southern Italy and Sicily. Sentiment and prestige were held to outweigh all other considerations. Some people even deluded themselves into thinking that Tripoli was an area that Italians could settle and fructify.

Before long, Turkey became alarmed at Italian intentions and hence unwilling to allow further commercial concessions in North Africa without a guarantee of good conduct, which Italy was not able to supply. When the French took Morocco in 1911 and when Germany, foiled at Agadir, began to look farther east, it became apparent that Italy would have to intervene politically or else run the risk of losing its claims by default. Even Giolitti, anxious as he was to avoid foreign complications and expensive new responsibilities, could not afford to disregard the feeling concentrated behind the proposal to invade Tripoli. His majority in the house was imperilled. So without thinking twice or stopping even to make the preliminary diplomatic and military preparations that caution might have counselled, he provoked the necessary incidents and declared war.

The extreme left (including the Socialist Benito Mussolini) disapproved of this imperial venture; but otherwise public opinion was favourable enough. The war began in Sept. 1911 *(see* ITALO-TURKISH WAR), and in November Italian sovereignty was declared to extend over Tripolitania and Cyrenaica. The course of hostilities proved more difficult than had been expected. The rest of Europe was unfriendly and, while Austria placed a veto on the extension of fighting to the Adriatic and the Balkans, a serious diplomatic incident arose with France over the right to search vessels suspected of carrying contraband.

Peace preliminaries were finally signed at Ouchy in Oct. 1912, the sultan retaining only spiritual authority over the inhabitants of the annexed territories while Italy was given possession in North Africa and occupation of the Dodecanese Islands. But although Turkey thus acknowledged defeat, the indigenous Berbers carried on the war vigorously. Before long the Senussi hsd limited effective Italian control to a narrow coastal strip. Libya was yet to cost Italy dear. The expense of the war had again unbalanced the budget. In return for this, there was little increase in trade with North Africa or in settlement there. At home it had marked a significant victory for the parties that believed in violence, imperialism and authoritarianism. War had been declared and annexation proclaimed without the sanction of parliament, and the whole episode represented a decline in the standards upon which Giolitti had built his system of liberal government.

Giolitti's Domestic Policy, 1911–14.—Giolitti's last great reforms had been carried through in this period 1911–12. Luzzatti had introduced a scheme for extending the franchise, but Giolitti had defeated him by unexpectedly announcing his conversion to a much wider plan which in the end raised the electorate from 3,000,000 to 8,000,000 voters. Even the bulk of Catholics and conservatives nelcomed this, because they hoped that enfranchisement of the illiterate southern peasants would aid them rather than the radical left. In practice it was to help the transference of power from the old liberal ruling classes to new mass parties, whether Socialist, Catholic or Fascist.

Other reforms at this time included the payment of deputies, the government monopoiy of life insurance and a new Education act. The Coppino law of 1877 had nominally introduced compulsory elementary education; but the simplicity of avoiding laws and regulations in Italy had rendered it a dead letter, and almost half the people of Italy were still given as illiterate in the census of 1911. Luigi Credaro's act of 1911 was to meet with the same opposition of inertia; and though loans were offered at easy rates to local authorities for educational improvements, the communes were too poor and too lethargic to take them up.

One of the results of the Libyan war was to divide the Riformisti on the issue of pacifism, and this opened the way for the revolutionary faction to capture the Socialist party in the 1912 congress. Bissolati and Ivanoe Bonomi were expelled from the party for their approval of the government's African policy and formed a new group prepared to collaborate with the other constitutional parties in parliament. Turati stayed behind in the Official Socialist party; but he was now in a minority, and Benito Mussolini became editor of ***Avanti*** with an antidemocratic, intransigent "maximalist" program.

This split among the Socialists, together with the growing strength of the Nationalists and the entry of the Catholics into politics, made Giolitti turn slightly more toward the right. In Oct. 1913 the first elections were held under the wider franchise, and for these Giolitti made a compact which included Sonnino and the clericals. Since the extreme left would not join his majority, he had to strengthen himself in the other direction. The pact arranged by Vincenzo Ottorino Gentiloni earned him the support of the church, especially valuable in the rural constituencies; and although both the Radicals and the Socialists increased the number of their deputies to more than 70 each, the government did not at first seem to be in any danger. But the anticlericals, whether on the right or the left, took fright at this betrayal of the liberal position; and many others were offended at the scandalous methods by which votes were purchased or forged by the election managers. The defection of the Radical ministers from the cabinet early in 1914 then convinced Giolitti that he had better retire once again and wait for a more favourable moment to resume office.

Without realizing the fact, however, he had come almost to the end of his political career, and he was never quite able to reconstitute his majority. For more than a decade he had appeared to be a virtual parliamentary dictator. During this time the country had advanced notably in wealth and renown. Although Giolitti was to go down in history as a great corrupter of politics, in all probability the damage was done before he came on the scene, and his methods were not significantly worse than those of his predecessors. What he contributed was a competence in administration and a realism that saw the trends of the time and fell in with them. Many people were to look back on this as a golden age and to forget the premonitory signs of breakdown already beginning to appear.

World War I.—The events leading up to World War I found Italy in 1914 still officially allied to Germany and Austria. When in 1912 the triple alliance came up again for renewal, Italy had not dared to renounce it lest the act be taken as a positive affront to its former allies. Giolitti's government knew of Austrian intentions against Serbia in the Balkans, but did little to prepare the country for war and was no doubt hoping to invoke the clause in the alliance that gave Italy the expectation of compensations for any Austrian advance. Under the right-wing government of Antonio Salandra after March 1914, the marchese di San Giuliano continued as foreign minister with the moderately germanophile policy that he had maintained under Giolitti.

In June 1914 riots broke out at Ancona against this conservative government; a general strike was called, the peasants rose against the landowners and the revolutionary Socialists Mussolini and Pietro Nenni tried to turn the rising into an organized revolution all over Romagna and Emilia. Many towns were captured and run by the revolutionaries as autonomous republics, and only with difficulty did the troops and police restore order. One political motive behind the revolt had been a protest against conscription and against the bellicose nationalism that threatened to involve Italy in a greater and more costly war than that in North Africa. Acceptance of the implications of the triple alliance was likely to cause grave division at home.

It brought general relief when the Austrian declaration of war against Serbia was met by an Italian declaration of neutrality. Italy claimed that it was not bound by the alliance to take part in an aggressive policy or to fight against England; moreover it had not been consulted over the actions that precipitated the outbreak of hostilities. There was no thought at first of intervening with Great Britain and France; it was simply intended that independence of action should be reserved, and care was taken not to denounce the triple alliance in case future policy should dictate a claim for compensation from Austria in the Balkans as the alliance itself prescribed. The decision for neutrality was accordingly not left to parliament but was taken by an executive act that allowed Italy greater freedom of movement.

On San Giuliano's death in October, Salandra appointed Sonnino to the foreign office. One of his first actions was the occupation of the town and harbour of Valona on the Dalmatian coast. Peaceful penetration by Italy had been continuing for some while in this area, and there was thought to be a danger that Austria and Greece between them might spoil everything if Italy did not quickly stake out a territorial foothold. Occupation was also a countermove against the advance of the Slavs, which had lately been causing considerable preoccupation in Italy; it was also a pledge to hold against the possibility of victory by Austria.

At the same time, negotiations proceeded with Vienna over the compensations in the *terre irredente* which Austria might be prepared to surrender in payment for Italian benevolent neutrality. The "triplicists" were fairly numerous in conservative and diplomatic circles and in the army. The Catholics were firmly in favour of neutrality, because they disliked "atheist" France and Orthodox Russia, and their natural sympathies lay with Catholic Austria. Many people in Vienna were quite certain that Italian finances would not stand a war and thus thought that they could play for time in these negotiations. For them, the cession of territory to Italy was feared as a possible signal for the breakup of the whole Austrian empire; and Trieste in particular was indispensable as a port in the Mediterranean. Only too late, in March 1915, was some move made to meet Italian wishes, so as to prevent Rome from intervening on the other side.

By this time, feeling in many quarters was hardening in favour of intervention on the side of the Allies. The irredentists and the Nationalists saw that this was perhaps the last chance for completing Italian unity and affirming Italy's position as a great power. The democrats, Freemasons, republicans and Reformist Socialists were in favour of intervention out of sympathy with France against militarist and authoritarian Germany. As for Mussolini and the revolutionary Socialists, they abruptly changed from pacificism to the other extreme of bellicosity when they perceived how war might generate a revolutionary situation from which they stood to profit. Accordingly, Mussolini broke off from the Official Socialist party, resigned the editorship of *Avanti* and founded a new paper, *Il Popolo d'Italia,* which supported intervention.

Sonnino and Salandra were determined not to let the war end without trying to acquire at least a part of the Italian districts in Austrian possession and to secure a rectification of the frontiers of 1866 (which left Italy open to invasion). They had first demanded from Austria the Trentino, the Isonzo valley and a free hand in Albania. At the same time as negotiations were proceeding on these lines, the entente was approached to know what price would be offered by the other side for Italian aid. There was a danger that if it did not choose its partner quickly, the war might end soon without Italy's obtaining any advantage. On April 26, 1915, the treaty of London was concluded between Italy, Great Britain, France and Russia. In return for intervention, Italy was to receive the Trentino and all the Tirol up to the Brenner pass, Triesta, Gorizia, Istria and Dalmatia down to Cape Planka. Fiume was, however, not included. A week later, the triple alliance was at last denounced. All this had been done without reference to parliament or to public opinion and probably even without debate in the cabinet. There is little doubt that the majority of

the deputies agreed with Giolitti in advocating the continuance of a neutral policy as that from which Italy had most to gain. Giolitti knew at first hand the weakness of the armed forces and also believed that something could be obtained in the end from Austria in return for a simple and easy promise of nonintervention. But he dared not be too open in advocating these opinions for fear of weakening the government in its negotiations with Vienna. It came as a complete surprise to him and everyone that the king had dissolved a 30-year-old alliance and committed the country to war on his own executive authority.

Salandra was thus faced with a potentially hostile parliamentary majority as soon as the news of his act leaked out. So he put off the summoning of parliament and allowed free rein to interventionist demonstrations, bringing back Gabriele d'Annunzio from his exile in France for the purpose. Austria made a last-minute effort to offer some of the *terre irredente*. But Giolitti had done nothing to organize the opposition deputies to make criticism effective and was not himself in Rome. The king was also committed, and the king's influence on parliamentary votes was considerable. Mobilization proceeded, and the king refused to accept Salandra's resignation. When it finally met on May 20, parliament had only to ratify a *fait accompli*. Giolitti called off the struggle in order to save the national honour. Three days later Italy declared war on its ally of yesterday, and Salandra justified his action by invoking what in a celebrated phrase he called *sacro egoismo*.

Once it had voted full powers to the government, parliament played very little part during the rest of the war. The military leaders upon whom responsibility fell for planning the successive campaigns were severely handicapped by the lack of munitions and industrial capacity. The army had not yet recovered from the Libyan war. When expectations of an early victory began to recede, it also became clear that there were serious weaknesses in generalship and organization. On the Isonzo front the Italians had a decisive superiority in numbers, but the difficulty of the terrain, coupled with the fact that no strategic plans were ready for such a war against a recent ally, made progress almost negligible for the first year. Then in May 1916 the Austrian victories in the Trentino and on the Asiago plateau shook the cabinet, and in June the almost 80-year-old Paolo Boselli became prime minister. The new ministry was notable for little except that it included representatives of the Catholics and the Reformist Socialists. In Aug. 1916 Gorizia was captured by the Italians. Italy also at last declared war on Germany and so removed a source of friction with its other allies. In April 1917 an agreement was concluded with the French and British at Saint-Jean-de-Maurienne whereby in any future partition of Turkish territory the Smyrna area was to be assigned to Italy.

The strain of protracted war, the collapse of Russia and the grave privations at home had accentuated the feeling of depression in Italy. Enemy and neutralist propaganda contributed to this. The Socialist Claudio Treves coined a widely publicized phrase, "Next winter not a man in the trenches": and this, together with Pope Benedict XV's allusion to "the useless carnage" of the war, began to affect public opinion and the war-weary troops. On top of everything, Gen. Luigi Cadorna and his subordinate officers made certain serious military errors, and an Austro-German penetration at Caporetto in Oct. 1917 thrust the Italians right back into the plain of Lombardy on the Piave river.

The front was at last stabilized, British and French troops being hurried in to help. Cadorna was replaced by Gen. Armando Diaz. Boselli resigned in favour of Vittorio Emanuele Orlando, under whom Sonnino still retained the foreign office; and the radical Francesco Nitti was brought into the treasury. In the effort to repair the defeat, a magnificent response came from all sides now that the country was so obviously in danger.

In Jan. 1918 Pres. Woodrow Wilson published his fourteen points, and the Italians began to see how war aims to give autonomy to the peoples of Austria-Hungary and to rectify the northern frontier "along clearly recognized lines of nationality" would affect them adversely. But for the moment no protest was made, and potential differences between Italians and Slavs were buried in the effort to win the war. A Congress of Oppressed Nationalities was held at Rome in April 1918, and it presented to Orlando the so-called pact of Rome, which bore the promise of hopeful collaboration between both peoples. But this pact never received official sanction; and although Slav units fought on the Italian front, Italian ambitions were still directed to domination of the Adriatic and so meant inevitable conflict sooner or later with the Dalmatian populations.

In June 1918 another Austrian offensive was successfully halted on the Piave, and a final counteroffensive begin. While one Italian contingent was helping the Allies in Macedonia, Diaz won the victory of Vittorio Veneto at the end of October, after which an armistice was signed with Austria at the Villa Giusti near Padua on Nov. 3. In the whole course of the war Italy had lost between 400,000 and 600,000 men killed. It had been invaded and had suffered enormous damage and privations. It was not a strong nation, either physically or psychologically, which had to stand up to the strains of the postwar period.

The Peace Settlement, 1919.—In Feb. 1919 the Italian government presented a memorandum to the peace conference embodying and justifying its territorial claims. These for the most part corresponded to those agreed upon in the treaty of London of 1915, except that Fiume was also included. This represented a victory for the Nationalists, whose spokesman was the foreign minister, Sonnino. On the other hand, the so-called *rinunciatori* or renouncers were ready to give up Dalmatia, part of Istria and the Trieste hinterland, because they wanted at all costs to conciliate the Yugoslavs; while they claimed Fiume as Italian. some of them were even prepared to renounce the Alto Adige because of its German-speaking population; and Bissolati had resigned from the cabinet in 1917 when Sonnino had unexpectedly and arbitrarily declared the existence of an Italian protectorate over Albania. This division was fundamental and irreconcilable among Italian politicians and was even present inside the peace delegation. Bissolati resigned once again, and he was followed by Nitti in Jan. 1919. Sonnino, however, stuck to the treaty of London and was unmoved by the implications of the fourteen points or by the Yugoslav counterclaims up to the old Italo-Austrian frontier.

In Feb. 1919 the Adriatic question came up before the Paris conference, and these differences were brought out into the open. As no progress was made, Wilson published in April his famous appeal to the Italian people over the head of their government, setting forth his reasons for opposing the Nationalist claims. This appeal aroused considerable indignation, and the Italian delegation withdrew in protest from Paris for a fortnight. In Rome Orlando received an overwhelming vote of confidence and found adherents even among the Socialists. But he then had to return to Paris for fear that his allies might conclude a separate peace. There he failed to make any advantage out of the fact that the other powers wanted Italy to sign the German treaty and accept the League covenant. Meanwhile he had allowed D'Annunzio and the Nationalists to stir up popular feeling for the acquisition of both Fiume and Dalmatia. He had hoped that this would act as a pressure on the Allies to make them yield; but in fact it only aroused in Italians a sense of frustration at his own inability to get results, and in June a defeat in the chamber forced him to resign in favour of Nitti.

The settlement finally achieved for Italy gave the nation a great deal, if not all, of what it had fought for. Wilson agreed to allow strategic considerations to outweigh "clearly recognized lines of nationality" in many places. Italy got the Brenner frontier, although this meant the inclusion of many German-speaking people in the two new provinces of Trentino and Alto Adige; also the great port of Trieste and a compromise settlement in Venezia Giulia and the Istrian peninsula which brought 250,000 Slavs under Italian rule. In Sept. 1919 the peace treaty with Austria was signed at Saint-Germain-en-Laye, leaving the question of Fiume and Dalmatia still open. This was both more and less than what the treaty of London had promised. The other Allies had been enabled to disregard this treaty on the grounds that the United States had not signed and did not recognize it, just as the agreement of St. Jean-de-Maurienne was given up on the plea that it had not

been officially ratified. Italy thus did not obtain a footing in Asia Minor: nor did it acquire any material compensation in Africa for the German colonies which passed to other nations as mandated territory. Italy's chief gain—and it was very considerable—was that its old hereditary enemy, Austria-Hungary, was no more and that the principal *terre irredente* had at last been redeemed.

There was, nevertheless, general dissatisfaction at these results, and the Nationalists were able to manufacture a legend that Italy had won the war but lost the peace. The fact was that once again, as before in 1870, the balance of power in Europe had been upset, so that Italy, which was still essentially a weak country, found it impossible to make its influence felt by holding the scales. The situation was rendered worse by the fact that Orlando and Sonnino proved unyielding and unrealistic in negotiation and refused to face the fact that Yugoslavia was also one of the victorious powers which had claims that could not be disregarded. The aim of security defeated its own ends when it made an enemy of such a neighbour.

Internal Politics, 1919.—The governments of Orlando and Nitti had many internal difficulties with which to contend. Demobilization brought with it the dismal prospect of unemployment. The financial situation was serious, and the budget statement presented in Nov. 1918 showed a deficit of 6,271,000,000 lire. The bread subsidy involved a huge expenditure and could not easily be abolished because of the steeply rising prices and their effect on the cost of living. Doles to the unemployed and subsidies to the farmers and to the industrialists added to this burden. The working classes were now well organized for political action, and politicians did not dare to risk their popularity by a deflationary policy. In Jan. 1919 the Partito Popolare Italiano was formed by some of the Catholics, with a more definite program and a more complete organization than the elder Catholic group. Its leader was Don Luigi Sturzo, a Sicilian priest, who advocated reforms of a Christian-Socialist character, including the expropriation of some of the larger landed estates for the benefit of the peasantry, with compensation to the landlords. His party also had a large trade-union following and went far toward winning the rural workers from the Socialist labour leagues. But the church itself, though trying at first to have nothing officially to do with this new party, could not avoid using indirect influence to make it more and more conservative; and especially when Pius XI succeeded Benedict in 1922 the Popolari found themselves progressively divided and undermined. Although they obtained 100 deputies in the elections of 1919, they never had the strength that their numbers warranted.

The Official Socialists, with 156 deputies after those elections, were the largest compact party in parliament, if not in the whole previous history of the Italian parliament. They also controlled the local government in more than one-third of the provinces. But they, like the Popolari, were frightened at formulating a definite program with which to confront the difficulties of the times, because any such program would threaten some vested interest and lose electoral support, and any precise wording of a policy threatened to split the party into two or more fragments. Playing for safety, they continually refused to take responsibility for positive action, preferring just to oppose every government in turn and rejecting every suggestion of a progressive alliance against the forces of conservative reaction. Yet they also continued to frighten middle-class opinion with threats of revolution, which apparently they had little intention of carrying out. The Socialist congress in 1919, against Turati's advice, voted for the expropriation of the capitalists, if necessary by violence, and for the institution of a soviet republic in imitation of Russia. As an earnest of their supposed intentions, a series of avowedly revolutionary strikes broke out in every trade and even in the public services. Small wonder that propertied men began to fear for their livelihood and looked about for someone to lead a counterrevolution. It was not appreciated that the Socialist movement was far too irresolute and divided to be dangerous. Ever since Mussolini and the Syndicalists had left the party before the war, it had adopted a pacifist and defeatist mentality.

The man who was eventually to be engaged by the counterrevolution was of course this same Mussolini. But in 1919, the year in which the Fascist party was inaugurated, he had not yet completed his *volte-face* from revolutionary, republican socialism to being the spokesman of conservatism and monarchy. His party program included such demagogic measures as the imposition of a capital levy, the confiscation of ecclesiastical property and an unusually large tax on war profits. In the elections of November, the Fascists obtained not a single seat. This failure helped convince Mussolini that there was little hope of power if he continued to follow the radicals in his party instead of the trimmers and the opportunists.

The strength of socialism and the existence of these two new parties, the Popolari and the Fascists. made the task of forming the customary government coalition exceptionally hard. There had been little previous history of highly organized, dogmatic parties in Italy; and in this new situation the necessary compromises inherent in Giolitti's system were difficult to achieve. The electoral law of Sept. 1919 had adopted the proportional system, whereby the voter voted not for a candidate but for a list. Sonnino and Giolitti had opposed this change, because the gainers would clearly be the Popolari and the Socialists, both of them being well organized and based on mass appeal. In the subsequent elections, Giolitti, Nitti and Salandra had gone on with their small, bickering groups instead of sinking their differences and rivalries in the interests of a liberal bloc with a common list in order to counter the unconstitutional objectives of the extreme left and right. This was to invite failure. Subsequently, in the new parliament, each of them in turn was to foil the others' attempts to form a government of the centre.

Fiume and the Treaty of **Rapallo.**—Meanwhile, fresh troubles had broken out at Fiume, which, as an Italian island in a Slav sea, was a natural danger spot, one moreover where D'Annunzio's propaganda had dangerously involved the national honour. Clashes between Italians and French troops induced an inter-Allied commission to recommend the importation of British police to the town, and this mas the signal for D'Annunzio to lead some mutinous soldiers in a piratical raid on the city. Public opinion had been led to believe that Fiume was naturally Italian, unreasonably snatched away from Italy by jealous allies at the peace conference. It was also feared that the trade of Trieste would languish if Fiume remained independent under some rival power, because they were rival ports for the commerce of central Europe. D'Annunzio captured the city in Sept. 1919 and ruled it for more than a year to the accompaniment of much posing and speechifying.

Nitti's government officially deplored this adventure; but with such an uncertain majority in parliament, Nitti did not dare use forceful measures to restore the authority of the state. Indirectly, if not also directly, he helped to keep the Reggenza del Carnaro in existence and used it as a bargaining counter to convince Europe that Italy had been badly treated and must be appeased if war was to be averted. Apart from antagonizing the Slavs, the result was to set an example of successful, unpunished illegality and to fan the flames of nationalist ardour still further. The men of Fiume and the techniques they had employed there were later to be of great assistance to Mussolini.

Nitti's policy was just to let the spirit of unrest wear itself out, regardless of the immediate danger to the country. Yet at the same time he annoyed the Nationalists by granting an amnesty to deserters and by advising army officers to go about in mufti and disarmed when off duty. When he created a force of royal guards to preserve order against a new outcrop of strikes and riots, this was strongly resented by the Fascists and Socialists, against whom it had been directed. Such was the combination of forces against him that in June 1920 he resigned.

This brought back Giolitti to power for his last and least effective term of office. His foreign minister, Count Carlo Sforza, had to meet certain troubles in Albania, where Salandra had established an Italian protectorate. The cost of this occupation had been considerable. and it had still not won over much enthusiasm in Albania itself. Armed conflicts were frequent, and the unpopularity of the whole venture now led to another mutiny among the Italian troops. Giolitti gave in to this, surrendered the protectorate and withdrew the Italian army. This infuriated the Nationalists. At

the Spa conference in July 1920 Italy succeeded in getting its share of the German indemnity raised to 10% and that of the Austrian, Hungarian and Bulgarian indemnities to 25%. An interim settlement was made with Turkey in the treaty of Sèvres, signed in August. Then in November the outstanding differences with Yugoslavia were settled in a conference at Rapallo. Italy at last waived its claims to Dalmatia, except for the town of Zara. A frontier was agreed which allowed Italy possession of the islands of Lagosta and Pelagosa. Both powers recognized the independence of Fiume. The Italian-speaking inhabitants of the territories assigned to Yugoslavia were entitled to opt for Italian citizenship; and full freedom of language, culture and religion was promised to Yugoslavs in Italian territory.

This settlement brought considerable gains to Italy, although the fact that any concessions at all were made to the other party rankled with D'Annunzio and his friends. By a secret clause, which soon became public property although Sforza denied its existence, Port Baros adjacent to Fiume was promised to Yugoslavia. D'Annunzio, the self-styled regent of Fiume, refused to recognize this treaty, and Giolitti was at last bold enough to send Gen. Enrico Caviglia to oust him. He surrendered at the first show of force. It was then agreed to withdraw Italian troops from Dalmatia and Fiume, although they remained in Fiume during 1921 since the town elections were considered to demand their presence. Not long afterward, Mussolini decided to upset this arrangement and recover Fiume for Italy.

Giolitti's Last Government. — The temporary settlement of Fiume and the agreement of Rapallo showed that Giolitti had a clearer idea than most others of the path that Italy should follow. In domestic affairs he aimed once more at a compromise policy in order to secure as broad an agreement as possible. But the war of class against class was by now too strong for him. Internal troubles were reaching their worst in the autumn of 1920, and there were industrial, agricultural and railway strikes in various parts of the country.

In September a serious agitation broke out in the metallurgical industries. The factory owners, most of whom had made large profits in the war, were alarmed at the signs of a slump and decided that they could not afford to yield to the demands of their employees. Strikes at the Romeo works in Milan were thus countered by a lockout. In reply to this, the Federation of Metallurgical Workers called on all the metalworkers in Milan to remain permanently at the factories without working. The Federation of Mechanical Industries then extended the lockout to the whole of Italy. The workmen responded by seizing a number of factories and trying to manage them on their own without the owners or managers.

This was the famous "occupation of the factories," which some held to be the supreme justification of the Fascist revolution. In fact it was a haphazard affair, not desired or planned by the Socialist party. Giolitti skilfully avoided using force, for this might have united the several factions of socialism and also would have played into the hands of those counterrevolutionaries who were stirring up social and industrial conflict in the hope of precipitating a showdown. By simply letting matters take their own course, he successfully showed at once the weakness of the extreme left and the hollowness of the alarm shown by interested reactionaries on the right. Unfortunately he went too far in his pacifism and did not always take action to repress actual hooliganism and the more and more frequent breaches of the peace. The Fascists and the red guards outdid one another in armed disorder; and private justice grew up to supplement the evident deficiencies of public justice. Mussolini publicly welcomed the occupation of the factories; but before long he saw that his best hopes of achieving power were to throw his lot in entirely with the reactionaries, instead of trying to curry favour simultaneously on all sides.

For the moment, in Sept. 1920, Giolitti intervened with an acceptable compromise by which the workers evacuated the factories in return for some concessions — their effort to manage the factories on their own had proved a hopeless failure. The centre of interest shifted to the country districts where the braccianti or landless labourers had always been on the verge of starvation and were now being driven by postwar conditions into a state where they had almost nothing to lose and apparently almost everything to gain by insurrection. Nitti had already been forced, in a decree sponsored by Achille Visocchi, minister of agriculture, to allow retrospective sanction to some of the forcible land occupation effected by the peasants in fulfilment of promises made during the war. Over large areas in Emilia and the Romagna the labour leagues had acquired great authority in local government and were sometimes beginning to dictate terms of employment to the landlords. The latter replied that, if these wage demands were conceded, they would not have enough income remaining to pay their taxes; and to show their temper they set about organizing armed resistance. The Agrarian Association of Bologna was particularly effective in the organization of armed squads, and the Fascists soon emulated the technique.

Property owners everywhere began to rally in defense of their way of life. For them Giolitti came to be feared as a man who desired higher income tax and death duties and allowed strikes to continue with impunity and an eight-hour day to be enforced in industry. At the same time his fixed idea of letting social forces find their own level unimpeded played incidentally into their hands; for when they really set their minds to it they could muster far more massed power than the Reds, especially when aided by the organizing genius and ruthlessness of a Mussolini. It was perhaps natural for the middle classes after the Russian Revolution of 1917 to fear revolution only on the left and not from the right. Giolitti himself had little idea that fascism was to be feared and rather hoped to make use of it as he had made use of Catholicism or socialism to suit his own purposes — in this instance to bring socialist ambition within bounds.

His policy of domestic nonintervention was soon bearing fruit. At Bologna the Red leaders had to fly for their lives where lately their word had been law. The town council was forcibly dissolved and the Fascists wrecked or burned down various buildings owned by the Socialists. Throughout the Po valley the Fascists proceeded to break the domination of the "Red baronies"; the revolutionary leagues which had controlled labour in that area were dispersed; and one Socialist town council after another resigned in fear or was dissolved.

Parallel with this there was a disintegration at Socialist party headquarters. A demand arrived from Russia that the Italian party should carry out its old "maximum" policy and expel all those tainted with the Reformist heresy. The reason given was that only by violent revolution and absolute submission to the orders of Moscow could socialism succeed. At the general congress of the party at Leghorn in Jan. 1920 a compromise resolution was adopted. Turati, Treves and the main trade-union body grouped in the Confederazione Generale del Lavoro (C.G.L.) showed that they were still prepared to collaborate in the parliamentary system and still wanted at all costs to keep the comprehensiveness of the party intact. The Communists (represented by 18 deputies) thereupon broke away, formed a party of their own and tried to assert themselves in what amounted to almost open civil war against fascism. The vicious circle of assassination and reprisal thereby received a new stimulus.

In this atmosphere Giolitti's policy of social neutrality did not work. The need to repair the great financial deficit was already forcing him to commit himself on many points where it might have suited him to keep silent. At the end of 1920 he had brought in legislation about the registration of bearer bonds, which was designed to diminish some of the general tax-avoidance then so prevalent; and this had seriously shaken the adherence to his majority of share-capital owners. It was furthermore the final cause of alienating the church and the Popolari, for bearer bonds had been a common method of evading the law against ownership of property by the church. Another much-criticized move was the abolition of the bread subsidy in Feb. 1921, for this made enemies of many Radicals and Reformist Socialists. Financially such a measure was inescapable; but socially it seemed inequitable, and the consequent rise in food prices added fuel to the growing class war.

Because of the insecurity of his parliamentary position, Giolitti

dissolved the chamber in April 1921 and held elections in May. Altogether misreading the situation, he made an electoral alliance with the Fascists and Nationalists, hoping that this would give him a majority, but such a one as would leave him master of his allies instead of their slave. Out of 535 seats, the Popolari increased their representation to about 108; there were about 123 Official Socialists, 34 Reformists and 15 Communists; there were 64 Radicals, 10 Nationalists and 35 Fascists; and the remainder was made up of nondescript liberals. The fact that there mere now 35 Fascists in parliament where the 1919 elections had returned none must be in part attributed to Giolitti's error. Incidentally, he had permitted the use not only of the usual government influence on elections by corruption and intimidation but also of violence and even a reign of terror in many areas where police were told to maintain the fiction of "nonintervention." To crown all. Mussolini and the Nationalist Federzoni at once passed over to the opposition in parliament. They attacked Giolitti for his support of the League of Nations, for the occasional radicalism of his domestic policy and for his continued belief in the methods of parliamentary democracy. As he had not obtained the requisite majority, in June Giolitti resigned.

Bonomi and Faeta.—From June 1921 to Feb. 1922 the prime minister was Ivanoe Bonomi, with a cabinet in which the Popolari were at first the preponderating influence. Bonomi, although a Reformist Socialist in origin, had never altogether exculpated himself from the accusation that as war minister under Giolitti he had connived at military stores' passing into possession of the Fascists. Under his government fascism continued its gradual process of building up a nation-wide party organization, comprising a mixture of every extreme, idealists and undesirables, republicans and monarchists, agrarians and former syndicalists, reactionaries and Sorellian or Blanquist revolutionaries. There was nothing new in such a mixture for Italy, except that it included few but extremists of one shape or another. What was new and bewildering was the competitive armed violence of Fascist and Socialist squads—in which the Fascists nearly always proved to have better resources, more arms, much more money and greater cruelty and ruthlessness.

In many areas the Socialists soon dared not show themselves and had to allow their houses, printing presses and party headquarters to be pillaged at will, being forced in the end to advocate nonresistance and invoke government aid for the preservation of law and order. Local Socialist administrations were expelled in one place after another, the popular vote being simply set aside as irrelevant. The trade-union organization was crushed piecemeal, and rival Fascist syndicates erected in the unions' place. Still the government stood aside, perhaps secretly glad that the largest opposition group was thus neutralized and expecting that fascism with its small group of deputies could be easily tamed when its work of destruction was complete.

Meanwhile Mussolini was playing his own game of transformism. Although he held some powerful cards, his position in parliament was still very weak. The Fascist party was by no means united on policy, and he was only one leader among many. It was necessary to trim his sails to each favourable wind and to manoeuvre both with other parties and inside his own party. Thus in Aug. 1921 he signed a pact with the Socialists (which later on he preferred to forget). It was intended as a test of strength, to see if his other colleagues would follow him, and perhaps in the hope that the two avowed revolutionary parties might make up their differences and overthrow the parliamentary form of government which both affected to despise. But the local leaders—Dino Grandi, Roberto Farinacci, Italo Balbo *et al.*—dug in their toes at this sudden and illogical change of front; and when the agrarian backers of fascism brought Mussolini to book he changed back again and tried to cover up his tactical error. The threatened split in fascism was healed before the liberals and Socialists could think of joining forces against him.

Attacked on all sides, the Bonomi cabinet resigned in Feb. 1922. A ministerial crisis lasted for almost a month, during which each parliamentary leader in turn declined to form a cabinet, believing that he could achieve nothing with parliament so divided and factious and would only lose his reputation in a useless cause. At last a nonentity was found—as in so many similar moments in the past—who was sufficiently colourless and pusillanimous to avoid any definite commitment and who thus obtained a bare majority. This was Luigi Facta, the last prime minister before Mussolini. In the next few months some achievement was registered in the reconquest of Tripolitania from the Senussi and in the international economic conference which opened at Genoa in April; but at home there was a continuance of industrial troubles, and another unpredictable shift among the parliamentary groups in July put Facta in a minority.

Once again, the country had no government at all for several weeks and the Fascist squads pursued their old course unmolested and unpunished. Nitti, Filippo Meda, Giolitti, Bonomi, Sturzo, Turati, Orlando, none of these was prepared to sink mutual differences and personal dislikes to give the country a strong government which was also liberal and constitutional. Each was waiting for a "more favourable moment" in which to resume office; each faction. moreover, was beginning to suspect that no cabinet would succeed in which Mussolini was not a partner—such was the impressiveness of Mussolini's character, the force of his propaganda and the evident weakness of the state authorities. Accordingly, a number. of groups entered into unofficial relations with him, to prepare the way for receiving office in a future coalition. Meanwhile Facta returned to his position as premier, because, although defeated, there was manifestly no other combination which would yet work at all.

On July 31 a general strike was called throughout all Italy by an unofficial committee of certain labour unions, proclaimed to be a "legalist" strike by Turati because its professed object was to affirm the authority of the state against the Fascists. This was thought to be the last weapon yet remaining to the left, and it was a futile one. It upset the general public and its ridiculous failure proved to be the ultimate confession of Socialist bankruptcy. Not even at this moment were the Socialists anything like united over aim or tactics. Mussolini, on the other hand, saw in this strike his great chance to show himself the defender of law and order, the only element of authority and power when the state itself was apparently powerless.

The Fascists and Nationalists therefore ordered a general mobilization and issued a manifesto calling on public servants and the workers "to shake off the yoke of the politicians by whom they were led" and giving the government 48 hours in which to prove its power and break the strike—"after which fascism will assume full freedom to supplant the state." This was an admirable opportunity for the Fascists to seize control of the administration of such major towns as Milan, Genoa, Leghorn and Ancona, where the Socialists were still entrenched, and so to open the road for the final march on Rome.

The Socialists had for years dominated the town council of Milan, which was the industrial capital of the country and its wealthiest and most populous city. The commercial classes there were naturally pleased when Fascists took the place of the strikers and restored the train services on which they were so dependent. Much pleasure was also given in the same quarters when on Aug. 3 a veritable invasion of the town ended in the burning down of the building where the Socialist paper ***Avanti*** was printed and when finally the town hall was occupied and the Socialist administration forcibly ejected. At Genoa the Fascists led a similar and equally successful operation against the port consortium which was largely under the influence of the Red dockers' union.

Instead of arousing violent indignation, these illegal actions almost seemed to put the state authorities in the wrong and the Fascists in the right, for public opinion was probably against the strike. They also discredited the Socialist movement and its leaders and caused further divisions and loss of morale inside the party. Above all they discredited the government, which had shown itself unable to deal either with the strike or with the criminal actions of the strikebreakers. The continuance of the widespread anarchy was a primary aim of Mussolini's, because the economy of Italy was beginning to recover after the immediate postwar years. Strikes were diminishing, the cost of living was evening out and trade was reviving. But it was imperative for

Mussolini to keep up the appearance that economic breakdown was round the corner. All this had been achieved for him by Socialist incompetence and intransigence.

The new coalition which Facta formed in Aug. 1922 contained some well-intentioned liberals but also some people who, if not actual traitors, were at least disloyal. Once again the weakness of the Italian system of government was revealed. In the first place it had no room for an organized opposition ready to focus discontent and ready to take office with a clearly expounded opposition policy for the country's choice. In the second place it represented a series of imprecise coalitions, all of which lacked a common denominator, none of which dared risk discussion or action on the most burning questions of the day. The problem of whether or not to crush fascism while there was still time would have split this particular cabinet and so mas never squarely faced. Yet the liberal ministers did not resign from it, for the principle of collective responsibility had never been precisely established.

The strength of fascism at this moment is difficult to assess. The full support of the government election agents had not enabled the Fascists to win more than 35 seats in parliament; and although they were becoming strongly entrenched in local administration, this was usually by intimidation and terror. In southern Italy there was said to be very little fascism until after Mussolini's forcible conquest of power. It had some influence at court through the queen mother Margherita and in virtue of the threat that the popular Emanuele Filiberto, duke of Aosta, would be put up as a Fascist pretender to the throne if the king proved unyielding. The agrarians and industrialists were naturally in sympathy with a movement which came to stand for strikebreaking, lower wages and substantial economic protection; demobilized pfficers and the educated unemployed were especially open to Fascist propaganda; many among the Nationalists and the Catholics fell for its more specious attractions; and disorderly elements at every level of society welcomed the violence, the plunder and the chance to work private grudges off with impunity.

Whether or not all this amounted to a strong numerical body of opinion, it affected many among the so-called governing classes. The fact remains that many of the self-styled liberal newspapers were coming to approve the punitive raids of the Fascist squads and gave moral support to the Fascist demand for political power. Salandra, Giolitti, Nitti, Bonomi, Benedetto Croce and Luigi Albertini (editor of the *Corriere della Sera)* either actively or passively assisted the momentary alignment of public opinion which made possible the final coup d'état—although they all later regretted the fact.

Rather than positive strength, it was the weakness of its enemies that made this coup possible. At the Socialist congress held early in Oct. 1922 the party split into two further groups: the Unitari or collaborationists round Turati, Treves and Giacomo Matteotti; and the uncompromising Massimalisti who remained to dominate the official body. The Bonomi Reformists. the Syndicalists and the Communists round Antonio Gramsci had already formed separate groups. As a result of this split, the C.G.L. broke off its alliance with the Socialist party and declared itself a nonpolitical body. Likewise the Partito Popolare was divided by conflicting tendencies, and the Catholic party was seriously weakened when Pope Pius XI enjoined the bishops and clergy to abstain from partisan political activity.

Not the least part of Mussolini's skill lay in the way in which he managed to retain the more or less grudging support of so many liberals at the same time as he openly advocated revolution and the supersession of parliament. At a gathering at Udine on Sept. 29, 1922, he made an important declaration in favour of the monarchy, thereby winning the favour of many nonfascists. The ostentatious abandonment of his earlier anticlericalism and republicanism was typical of the man; but instead of being read as evidence of his fundamental opportunism, it was taken as a conversion to orthodoxy which rendered him "safe." Paolino Taddei, the minister of the interior, advocated the taking of firm steps to stop illegalism in the provinces, but he was again and again overruled by his colleagues. Most of the ministers were now convinced that the ministry would soon fall and were eager not to offend Mussolini, so that they might be included with him in the coalition that would follow.

The "March on Rome," 1922.--On Oct. *24* another Fascist congress was opened at Naples, when the statements of Mussolini and his friends left no doubt that, if not allowed peaceably into the government, they would resort to force. A Fascist quadrumvirate was formed of Michele Bianchi, the former syndicalist who was secretary of the party, Italo Balbo, the commander of the armed *squadre,* Gen. Emilio de Bono and Cesare de Vecchi, while Mussolini retired to await events near the Swiss frontier. As mobilization of the *squadre* continued, all depended on whether Taddei would have his way and whether there would be any clash between the *squadre* and the troops. Gen. Pietro Badoglio, as well as Gen. Emanuele Pugliese who commanded the army units in Rome, guaranteed that at a word from the government they could restore order and crush the threatened insurrection. But Facta, probably from cowardice and incompetence more than from premeditated malice, refused to give precise orders and chose to make Fascist victory almost certain by proffering the cabinet's resignation.

The king did not immediately accept this resignation, and the ministry continued in office several days longer. The various liberal leaders were only just beginning to see from Mussolini's remarks at Naples that he would now be content with nothing less than the lion's share in any new coalition. Early on Oct. 28 Bianchi sent the government a virtual ultimatum, calling for its effective resignation, and this at last provoked Facta to resist. Proclaiming a state of siege, he ordered the military to use force wherever necessary. As the king had only the night before promised to support this policy if ever Facta thought it advisable, the proclamation was published soon after daybreak, and some observers thought that all would now be plain sailing. But the king had taken counsel during the night with Nationalist and Fascist sympathizers, and the suspicion had been implanted in his mind that the army might refuse to obey orders and that the duke of Aosta would be able to force him to abdicate. Accordingly, in a moment of aberration, he refused to sign the decree.

For the constitutional impropriety of this act there can be no excuse. The king was making a political decision in defiance of his ministers. He had decided to appoint a new government based upon a coalition of the extreme right, although this was composed of less than one-fifth of the elected chamber — there was Salandra who led a group of about 30 conservative deputies. and there were also the 3 j Fascists and 10 Nationalists under Federzoni. A great number of precedents existed for choosing a premier from a minority group. But in handing power over to people who gloried in murder and openly proclaimed their contempt of parliamentary institutions, the king was making a gigantic political error which cost his country dear.

For a time the king did not understand the implications of his action, and he asked Salandra to form a ministry. But Mussolini now knew that the king was an accomplice who had committed himself so far that he would not dare to gainsay fascism in anything. As a result, Mussolini, who had long since won Salandra's collaboration by secret hopes of support, now put his veto on a Salandra ministry, knowing that he himself was the only alternative. On Oct. 30 a sleeping-car brought Mussolini to Rome from Milan at the king's invitation, and the so-called "march on Rome" was over. The next day some of the Black Shirts were brought in from surrounding villages to give the illusion of an armed occupation of the city. It did not suit the future dictator to let people think that he had risen to power by almost normal constitutional methods.

First Years of Fascist Government. — With a sure revolutionary instinct the new cabinet was chosen to give the appearance of one of the old familiar coalitions. Apart from Fascists, it included two mar "heroes," General Diaz and Xdm. Paolo Thaon di Revel; a Giolittian, Teofilo Rossi; a Social Democrat, G. A. Colonna di Cesarb; two liberals, Giovanni Gentile and Giuseppe de Capitani; two Popolari, Vincenzo Tangorra and Stefano Cavazzoni. At long last stringent orders were given for the cessation of all acts of violence. Yet the Duce chose to remind the deputies how he might

have simply abolished parliament: he was determined to make it quite clear that it existed on sufferance and could not expect his government to feel responsible to it.

From what one can see, contemporary newspapers reflected a general consensus in their expressions of relief that the long reign of anarchy was over. Indubitably parliament had shown itself incompetent to produce efficient and liberal government. Even the deputies themselves were relieved to sense that there was to be an end to their bickerings, and only about 100 voted against the new government — probably these were just the Socialists. When Mussolini demanded full powers for a year to carry out what reforms he thought necessary, they approved by a vote of three to one what they had always refused to Giolitti and others. So doing, parliament assumed some share of responsibility for all the tragedy of errors which lay in the future.

For several years there was no overt establishment of dictatorship. Numerous precedents existed for government by decree and for the executive's replacing elected councils by nominated government officials in the towns. Only gradually were old methods and institutions changed, at the same time as each of the opposition parties was weakened and divided still further. It was a primary object that there should be no move which could provoke a combination to join in opposition and nothing which should alarm people unduly or make them think that a revolution had taken place or was taking place.

This incidentally gave time for consideration of the *raison d'être* of fascism. Until now it had been to achieve power as an end in itself; but once in office it was time for it to choose between the many tendencies which had entered into the movement, to decide whether it was primarily revolutionary or conservative. Hitherto it had been a movement, not a doctrine, and evidently the objects of its struggle were not apparent even to its own members. An economic policy of economy and retrenchment was therefore borrowed from the old liberal school of economists. The right to strike was curtailed, and a longer working week mas restored. Nitti's royal guards were disbanded because they had dared to take action against Fascist illegality. To replace them, the Fascist squads were institutionalized into a security militia in Jan. 1923, ostensibly to assist in the maintenance of order. Gentile's educational theories were harnessed to make an Education act in 1923. From D'Annunzio was taken much of the choreography and verbal claptrap which had become familiar at Fiume. A form of guild socialism was lifted from the early Syndicalists. Meanwhile the wealthy were courted by repeal of Giolitti's new taxes, by abrogation of the law on the registration of bonds, by winding up the commission considering wartime profits and by the reduction of the sum spent on social welfare. For the moment the finance minister, Alberto de Stefani, pursued a policy of abolishing controls. Only after 1925 was increasing government intervention to become typical of fascism.

Almost at once a fusion was effected with the Nationalist party, and it was the ideas of Federzoni and Corradini which provided the substance of Fascist foreign policy. Mussolini in his earlier years had gone to prison for his pacifist views and had once fled to Switzerland to avoid doing military service. But he now easily renounced his former anti-imperialism and became a bellicose nationalist. In Aug. 1923, when an Italian was killed by bandits in the Balkans, Mussolini presented an immediate ultimatum to Greece and asked for an indemnity of 50,000,000 lire, following this up by the bombardment and temporary occupation of Corfu.

He then turned his attention to making a settlement with Yugoslavia which could compare favourably with that concluded at Rapallo by Giolitti. In Jan. 1924 the pact of Rome finally gave Fiume to Italy in return for recognition of Yugoslav claims to Susak and Port Baros. This began his attempt to revise the treaties of 1919 and was yet another blow aimed at the prestige of the League of Nations. To help the further progress of revision he also made his peace with Germany and Russia, the two chief "have-not" powers of Europe.

In the summer of 1923 a bill was prepared to alter the representative system, so that the electoral list which obtained the largest number of votes should be entitled to two-thirds of the seats in the chamber, while the remaining third was divided among the other lists on a proportional basis. It should be remembered that the last elections had returned only 35 Fascist deputies; and yet both houses gave large majorities to this measure which threatened to make impossible any future alternation of parties in government. The deputies were simply agreeing to give a permanent majority to an avowedly antiparliamentary group. After this success, Mussolini could afford to renounce the full powers accorded him and proceed to the election of a new house that could be guaranteed to give him a yet easier passage to dictatorial power.

The one hope for the constitutional parties was to club together and oppose a single list to that of the Fascists. But in fact, when the elections were held in April, there were six opposition lists; and as the Fascists had all the aid of prefects and police and their terrorist militia, they obtained 65% of the recorded votes, so that they had two-thirds of the seats quite independently of the new law. There were to be more than 400 ministerial deputies in the new house. All the other parties together polled nearly 3,000,000 votes out of 7,500,000. There were 39 Popolari deputies, 25 Reformist Socialists, 22 Maximalists and 19 Communists. Salandra, Orlando and Enrico de Nicola had been included inside the Fascist list, and Giolitti's group had fought in alliance with the Fascists.

The *Murder* of *Matteotti*.—Despite this overwhelming victory, the Fascists — or certain more ruffianly elements among them — brutally assassinated Giacomo Matteotti, a Socialist deputy who had dared to impugn the regime before parliament. Mussolini was forced to disown the murderers and to arrest four leading Fascists as accomplices. The country was scandalized and the government shaken; but although criticism came more into the open and fascism was deserted by many who had joined it only when it had appeared invincible, the opposition did not press home their attack but withdrew from the chamber in passive protest.

This "Aventine secession" was intended to render parliamentary procedure impossible; but it was a futile measure against a man who already claimed to hold power by right of force and not in virtue of responsibility to parliament. Thus the Socialists, the Popolari and some of the radical liberals under Giovanni Amendola cut themselves off from the one place where Mussolini might have been publicly accused. When the king was confronted with evidence of Fascist criminality he was able to reply with the spurious but specious excuse that lack of opposition in parliament gave him no chance to intervene.

Even after Matteotti's murder the liberals in the senate gave Mussolini a convincing vote of confidence, and the Liberal party itself agreed to continue its general support of the government. Several liberals remained in the cabinet until the end of 1924. But in the second half of this year there were some notable defections from the government majority among those who had once welcomed fascism as an auxiliary but now feared it as a master. Orlando and Giolitti ranged themselves against the regime, without withdrawing from the chamber. The philosopher Croce had excused the unconstitutional methods of fascism and its bludgeoning tactics during the elections but now began to see the implications of what had happened for the liberalism which he had preached all his life. In December even Salandra changed his mind. The ex-servicemen's association also assumed an attitude of hostility to the government, at which Mussolini dissolved its directorate and replaced it with his own nominees.

This was a sign that the Duce had tested the weakness of his opponents and their reluctance either to combine against him or even to make direct accusations which he would have to answer. He now felt able to take another step in the establishment of a personal dictatorship. without fear that he m s going too far or too fast. The Matteotti affair had shaken him and caused a serious setback to his popularity; but it was soon almost forgotten. In the chamber he had to contend with only a dozen or so independent liberals and as many Communists. When newspapers like Sturzo's Popolo, the Socialist *Avanti* and Amendola's *Mondo* belatedly tried to impeach him, he replied with a new press law in July 1924 and gave the prefects the right to confiscate issues of "seditious" journals almost at will.

The ***Fascist* Dictatorship.**—Mussolini's final move was pre-

cipitated by the incriminating revelations of a former leading Fascist, Cesare Rossi, which left most politicians expecting that the king would have to force Mussolini to resign. It was, however, too late, and on Jan. 3, 1925, Mussolini dared to take full responsibility for the illegal actions of subordinates which hitherto he had repudiated. He formally announced that he would assume dictatorial powers and challenged his opponents to arraign him before the courts. At last the liberal ministers resigned. Leading members of the opposition were arrested—if they were lucky enough not to be attacked and mortally wounded, as was Giovanni Amendola. The most important national newspapers were forcibly acquired by pro-Fascist interests: the Corriere *della* Sera at Milan, the Giornale *d'Italia* at Rome, La *Stampa* at Turin and the *Mattino* of Naples. Mussolini declared his intention to *fascistizzare* the state. In March Roberto Farinacci, the former labour boss of Cremona, was made general secretary of the Fascist party and proceeded to reorganize it on much more intransigent lines. Other parties were dissolved. Henceforward there was no further room for anything that was not Fascist. This was a pattern which before long was to become familiar in Europe, and Italy had doubtful pride of place as the exemplar of a new order.

The last echoes of the Matteotti case during the Fascist regime were heard in 192j, when Amerigo Dumini and one other were found guilty by the court of appeal "of nonpremeditated unintentional homicide extenuated by the subnormal physical resistance of Matteotti and by other circumstances." Their sentence was shortly remitted so that they had to serve only two months in prison. The members of the administration accused of complicity were naturally exonerated and set free at once.

When a bill for reorganizing the army met opposition in military circles, Mussolini himself took over the war ministry, with Gen. Cgo Cavallero as undersecretary. Gen. Badoglio was appointed chief of staff and entrusted with co-ordination of the army, navy and air force. Adm. Thaon di Revel resigned in 1925, and Mussolini took over the ministry of marine and the newly created air ministry as well.

Mussolini's amazing self-confidence had been a great contributory factor in the rise of his party to power but was in the end to prove disastrous to himself and to Italy, for he centralized more and more in his own hands and became increasingly intolerant of criticism or even the delegation of power. Before long his henchmen saw that their only hope of keeping his good will was not to criticize, but instead to give him the illusion that he was always right. Becoming corrupted by power, he thus concealed from himself his own clumsiness in administration and in the formation of policy.

By trade he had been a journalist, and this he always remained, writing frequent anonymous articles in the press and treating every matter as something essentially simple which he could tackle by a mere surface acquaintance with the facts. At various times he held eight different portfolios himself, and the other ministers were seldom allowed a policy of their own. In return for permission to grow rich and corrupt, the Fascist gerarchi cheerfully left responsibility for decisions to Mussolini. As a result, decisions were not taken, the inefficiency and graft of subordinates was not checked, and in the end Italy was to declare war without anyone's knowing or daring to say that it was shockingly unprepared. Yet Mussolini's self-confidence never allowed him to perceive that all was not well, and he developed a pathetic trust in his own powers of intuition, even reaching the point of provoking the war for which he was so unready.

Economic Reforms.—After 1925 the relatively liberal economic policy of De Stefani was gradually abandoned. and politics played increasing havoc with finance. Expensive projects were undertaken for reasons of prestige or morale, despite the protest of some of the less doctrinaire and more honest and courageous ministers.

In the spring of 1925 financial difficulties had arisen resulting in a serious depreciation of the lira, which fell from about 100 to the pound sterling to close on 150. The government tried to put the blame for this on certain members of the opposition: it was said that they had hoped to break fascism through a financial disaster and had caused a panic by spreading the rumour that the government intended to emulate Germany and wipe out its debts by destroying the currency. So, as De Stefani had by now succeeded in reorganizing the fiscal system and balancing the budget, he was replaced by Count Giuseppe Volpi with a policy of revaluation. In the years 1925–26, Volpi successfully negotiated in Washington and London to reduce the heavy war debts which had been weighing on Italian finance.

Like many other previous governments, fascism made some effort to bring southern Italy up to the standard of the more progressive north, and a series of measures was enacted for co-ordinating land reclamation, drainage and the building of roads and railways. But once again it was to be proved how little necessary relation there was in Italy between legislation and its results. Like so many other Fascist measures, these had their most obvious effect in increasing the bureaucracy as a half-concealed way of meeting the unemployment problem; and the result was to eat up much-needed capital unprofitably, while the growth of bureaucratic regulations led to inefficiency and corruption on a yet larger scale.

Active state intervention in economic life thus became a principal characteristic of the regime, coupled with the aim to achieve self-sufficiency. The heavy industries certainly gained from this policy, for Ansaldo and some of the other big concerns had collapsed when World War I put an end to their artificial prosperity. Some of the landowners also profited from the "battle for wheat," in which heavy subsidies were used to raise output from 5,500,000 to 8,800,000 short tons a year. But both these types of production were uneconomical in Italy and could only be fostered by artificially inflated prices far above world levels: this was hard on the consumer and resulted in a sharp rise in the cost of living. In the struggle for autarky, consumption declined, vines and olive trees which had taken years to grow were cut down to make way for cereals, and the big, "uneconomical" industrial cartels were given much indirect protection for political reasons.

Constitutional Reforms.—A sample of other Fascist measures in these early years will give an idea of how the regime appeared when theory was translated into practice. Because of the "unsatisfactory results of the system of municipal elections," the government placed local administrations under the authority of a podestà appointed by royal decree. A law of Oct. 1925 provided for the appointment of a governor of Rome, and in 1926 the idea was extended to other towns and communes. The authority of the prefects was also strengthened in order to secure better co-ordination of the various provincial services and to take away responsibility from elected councils for the advantage of a nominated government official. Another law (Dec. 1925) was aimed against Freemasonry and its political influence. All associations were obliged to communicate their statutes and membership lists to the authorities, and civil servants were forbidden to belong to secret societies. A law of Nov. 1925 gave power to the government to dismiss any officials who attempted to prevent the enforcement of new legislation or to frustrate government policy.

In April 1926 the Fascist labour syndicates were given legal recognition as exclusively representative of the various categories of workers; 13 corporations were said to exist, representing landlords, peasants, professional men, employers, artisans and so forth. all controlled by the state; strikes and lockouts were declared illegal, and all disputes were to be submitted to compulsory arbitration. The idea, like most else in the Fascist system, was borrowed (this time from D'Annunzio and the Nationalists); but it mas said to be something essentially Fascist. The truth was that Mussolini, once in power, had some difficulty at first in finding any positive significance for fascism and snatched at any straw he could lay hold of. A National Council of Corporations was set up (on paper at least) as a political body, and thus another army of bureaucrats was brought into being, paid out of union subscriptions.

In Dec. 1925 a law was passed conferring greater power of parliamentary initiative on the prime minister and otherwise extending his authority. The king could no longer exercise his constitutional prerogative to dismiss ministers unless it was by the premier's advice; nor could any motion be debated in parliament without the premier's consent. Special penalties mere provided for any offenses committed against him. He was also allowed to issue de-

crees with the force of statute law. Since the Aventinians continued to remain absent from the chamber, the only opposition was concentrated in the tiny groups round Salandra, Giolitti, Orlando and the Communists.

Political life was becoming unreal and artificial. Debates were staged to impress outside observers, but there was no force in them. Decisions were made elsewhere; the reasons for public policy were often kept concealed and the arguments made in public were usually designed just to make good headlines in the press. As formal legislation was henceforth unnecessary, the really important matters were customarily kept away from public scrutiny. Moreover the actual connection between laws enacted and results achieved was frequently negligible.

It would therefore be otiose to describe at length the machinery of the Fascist state or the institutional reforms which had a momentary existence on paper before being superseded by others. One fundamental fact was that the Fascist party became identified with the state. Fascist officials, law courts, soldiers and laws grew up alongside their state counterparts, often with a conflicting authority and a duplicating function. By degrees party officials and institutions were recognized to have a defined function in, the constitution of the kingdom, and the Grand Council of Fascism became a far more important organ of government than was the cabinet of ministers.

In Nov. 1927 the Grand council drafted a new scheme for political representation, which became law in May 1928. In the next parliament the deputies were to number 400 instead of 535. Each of the 13 corporations and certain other recognized bodies of national importance had the right to be represented in a fixed proportion and to submit a list of candidates for election. The Grand council then chose the deputies from these lists, but it could modify them at will and exclude or add any names that it wished. Finally the electorate was called upon to ratify the list of names chosen by the Grand council. Only if the agreed list of candidates was rejected was any provision made for another election between rival lists. The result was to create a mere travesty of parliamentary government. There was no longer any representative system, only a means whereby citizens could express their general approval or disapproval of the policy of the government. A plebiscitary dictatorship had been established in law as well as in fact.

At a meeting of the Grand council in Sept. 1928 the powers and composition of that body were definitely laid down. The prime minister was its chairman, and its members included all the ministers, the quadrumviri of the "march on Rome!" the commander of the national militia, the secretary of the Fascist party and certain other Fascist leaders, the president of the special tribunal and the presidents of the confederation of workers' syndicates, of the agricultural confederation and of the industrial confederation and those of various other semiofficial bodies. The prime minister was to have complete freedom to summon anyone else that he wanted and could say what should or should not be debated in its sessions.

The functions of this Grand council were to ratify the lists of candidates for parliament before presentation to the electors, to decide the policy of the Fascist party and to be consulted on all matters affecting the constitution including the prerogatives of the crown, the succession to the throne, the composition and functions of the senate and of the chamber, international treaties and relations between church and state. It had also to draft and keep up to date a list of persons to be submitted to the crown for succession to the premiership in case of a vacancy. This provision incidentally ensured the continuity of the Fascist regime and welded state and party into what was hoped would be an indissoluble unit.

Persecution of opponents was rigorous but unsystematic and less inhuman than in Germany later. In the early years the squadristi had freely used rubber truncheons and castor oil; but the more or less complete success of Mussolini by 1925 made further opposition seem almost useless except for the most selfless and high-principled of men. In 1925 Croce published an "antifascist manifesto" which received a number of signatures among the intellectuals. Further over to the left, men like Piero Gobetti, Riccardo Bauer, Ernesto Rossi and Carlo and Nello Rosselli in their various heroic ways helped to keep some liberty of thought and action alive. Most of the old leaders went into exile, including Sturzo, Nitti, Turati, Sforza, Nenni and the Communist Palmiro Togliatti, most of them to return when the Fascist interregnum was over.

It was at the end of 1926 that the law was passed dissolving the "antinational" parties; *i.e.*, the Socialists, Republicans and Communists. Special penalties were prescribed for any attempt on the life of the premier and for a new class of offenses now deemed to be treasonable. The punishment of *confino*, or relegation to a fixed place of residence in some insalubrious province, was instituted for persons accused of minor seditious activities. A special tribunal was created for political crimes, which sat in camera and proceeded by methods of summary jurisdiction, after which there was no appeal. The paraphernalia of totalitarian dictatorship was almost complete. In November the surviving Aventinian deputies were declared by the chamber to have forfeited their seats. In order to give greater unity to the conduct of the country's policy, Mussolini himself then took over the ministry of the interior from Federzoni. In December the *fascio* littorio was declared an official emblem, thereby still further identifying fascism with the state.

A scheme for a new criminal code was drafted by Alfredo Rocco, a former Nationalist, and published in Aug. 1927. This embodied earlier provisions for the "protection of the state." Penalties were generally made more severe, and new punishments were allocated to certain offenses against morals, the practice and propaganda of birth control, etc. The death penalty was brought back under fascism, and trial by jury was abolished. A special police body was also created, which like the special tribunal was an arm of the Fascist party rather than of the state. The regime was soon spending ten times as much as its predecessors on security — a commentary on the restiveness of public opinion.

Popular Reactions. — There is, however, little doubt that fascism came nearer than any other government of modern Italy to the repression of ordinary crime. Thus the Mafia in Sicily had for generations maintained its secret organization and its system of private justice, intimidating everyone and always preventing the accumulation of evidence against it; but by 1928 the prefect of Palermo, Cesare Mori, was claiming that he had finally destroyed the society. Only 20 years later did it become apparent that this sort of organized illegalism had never wholly disappeared. The Mafia and the Camorra, like the endemic brigandage of the Napoletano, represented the protest of voluntary or involuntary outlaws against a hostile society. Fascism, like so many previous governments, proved surprisingly ineffective when matched against the natural anarchism of Italians and their basic lack of confidence in the workings of government and the administration of justice.

Mussolini failed similarly in his attempt to "italianize" the 200,000 German-speaking inhabitants of the Alto Adige and the 500,000 Slavs of Venezia Giulia which the settlement of 1919–20 had given to Italy. Italy was not bound by this settlement to respect minority rights and indeed claimed that it possessed no minorities. Already in 1925–26 a vigorous campaign was undertaken to introduce Italians into the local government in these areas and to forbid the use of German or Slav languages. Protests from abroad were laughed at. The Bavarian premier accused the Italian authorities of terrorizing the population and advocated a boycott of Italian goods. But a far more formidable obstacle was the simple nonco-operation of ordinary individuals where so much of their way of life was at stake. When it was ordered that religious instruction should be given in Italian only, many devout Catholics preferred to keep their children home, and even the appointment of keen Fascists as bishops in these frontier areas did not prevent passive resistance on a large scale.

The reaction of the country as a whole to Mussolini's dictatorship can only be surmised. The elections of 1929 and 1934 showed only a few thousand votes registered against the national list, but the figures are of course wholly unreliable. There seems to have been a good deal of grumbling and humorous laughter about the regime, but this is only what one would expect. Not until the late 1930s were there signs that a substantial number of people were aware that dictatorship meant inefficient government at home and suicidal aggressiveness abroad. Until that moment fascism

seemed to be wonderfully successful and was the admiration of many distinguished men even in democratic Europe. It had restored Italian self-confidence, stabilized social order at home and put an end to the postwar orgy of strikes. A nice combination of the carrot and the stick seemed to have rallied almost all Italy behind the regime.

Ecclesiastical Affairs.—One fact which earned for Mussolini much gratitude and admiration was his reconciliation of the Italian state with the Roman Catholic Church. Ever since 1870 there had been a breach between the two, and the pope had refused to recognize the lay occupation of Rome. Mussolini and Pius XI were each realists in their way, and both understood the benefits to be reaped from conciliation. There had been a strong secularist or anticlerical faction in fascism, and perhaps the predominant tendency in the movement was the sceptical nonconformism of Mussolini himself; yet by a skilful adaptation, the Duce turned himself into a favourite son of the church. The treaty and concordat of 1929 have been considered Mussolini's greatest diplomatic achievement. They allowed the existence of the tiny independent Vatican City State, over which the pope exercised temporal rule. A financial convention arranged for Italy to pay nearly 2,000,000,000 lire either in cash or consolidated stock as compensation for church properties seized in 1870. The concordat also regulated the status of the church and of religion in Italy.

Mussolini argued that in this settlement he had surrendered the form and retained the substance. Certainly, he had won a great moral victory in persuading the church to yield what it had not accorded to any of his liberal predecessors, and he proceeded to show that, having once gained this point, he was not going to allow the church such independence as would conflict with his totalitarian concept of the state. In the educational system, Catholic instruction was to be allowed only where it did not run counter to the precepts of fascism. The Catholic Boy Scouts could not continue except within the framework of the Fascist Balilla organization. Catholic Action was compelled to change its functions and limit its scope. In the encyclical Non abbiamo bisogno of 1931 the pope was even forced into some tentative censure of certain more obviously pagan aspects of fascism; but on the whole churchmen continued to give enthusiastic support to the regime, and church and state worked together in relative harmony. Neither side dared to provoke the other beyond a certain point.

Foreign Policy, to *1933*.—Mussolini had begun by saying that he would keep ideology out of foreign politics. But he soon changed this view to one in which every aspect of state policy had to reflect some peculiarly Fascist quality. Fascism was thus identified with national and imperial expansion, with revision of the postwar treaties so that Italy should receive a material reward more consonant with its worth and dignity. In 1925 negotiations with Egypt led to the cession of the Bay of Sollum in return for acquisition of the important oasis of Jarabub, headquarters of the Senussi sect. A treaty of conciliation and arbitration was concluded with Germany in Dec. 1926. In China, Italian troops were landed to assist in the protection of Shanghai. Although the Locarno treaty had been signed in 1925, a year or two later found Mussolini speaking publicly of the great European war which in ten years' time would give Italy its due. When Yugoslavia began to show signs of independence in its foreign policy and concluded a treaty of friendship with France in 1927, Italy reacted by making an alliance with Albania and attempting to renew its former protectorate over that country. By 1932 Mussolini was publicly saying that: "the 20th century will be the century of fascism, of Italian power, during which Italy will return for the third time to be the directing force in human civilization. In ten years' time Europe will be fascist."

Economics and fhe *Corporative* State.—Italy suffered like other countries from the world economic crisis after 1929. Mussolini's financial policy had already been directed to a revaluation of the lira in 1926–27, from 125 to the pound to 90, which many people thought had gone too far and too fast for equity and prosperity. Among other results it had reduced the profits of the export trade and brought a consequent increase of unemployment. Annual budget deficits began to reappear; the balance of international payments persistently showed a loss; exports greatly decreased; and the level of wages fell. The eight-hour day was given up, and before long unemployment soared to hitherto unprecedented levels, The picture was so bad that the government ceased publishing its statistics on wages and unemployment. Matters began to improve by 1933 but then worsened again when Mussolini began his policy of imperial expansion in Abyssinia.

In order to show that a mere matter of shortage of funds was not interfering with the original revolutionary urge of fascism, big schemes of public works were undertaken: showy public buildings in the new "Fascist style," the autostrade for tourist traffic, the electrification of railways, the reclamation of the Pontine marshes. Achievements were, however, only partial, and schemes usually had a political rather than an economic motive behind them. They had to be spectacular rather than efficacious. On the whole, Surprisingly little was spent on works of social welfare by the Fascist state.

One of the more important facts about Italian economic life after 1921 was the drying-up of the great stream of emigration. Before the war, emigrants had numbered more than 500,000 a year, mostly to North and South America; and this had done much to relieve the pressure of population at home, with a distinctly beneficial effect on wages and living standards. Then the United States and other countries of immigration began to impose restrictions on the rate of entry, until after 1924 there were often more Italians returning to their country of origin than there were going out from it.

This was in part deliberate policy, for Mussolini took pride in the high birth rate and evident "capacity for expansion" of his people and found in "overpopulation" a good argument to persuade other countries of his need for colonies. Large families were given economic encouragement, and a substantial bachelors' tax was introduced. But although Mussolini had the fantastic aim of increasing the population from little more than 40,000,000 to 60,000,000 by 1960, he was chagrined to discover that mere legislation was ineffective in stopping Italy from sharing in the general decline of the European birth rate. Meanwhile the great decrease in emigration removed one outlet for economic distress; and the very heavy drop in remittances from overseas settlers to their families at home was to constitute a serious loss in the balance of international payments.

Mussolini affected to believe that the creation of the "corporative state" was the greatest achievement of fascism. It was his object to develop an alternative to both communism and capitalism as a comprehensive method of tackling economic problems: The government had to exercise strict supervision over productive processes, maintaining private enterprise in theory, but reserving the right to intervene when it appeared inadequate. The banking system was remodelled, and government-controlled institutions were created for aiding vital industries in momentary difficulties and for liquidating those that were "unfit to survive." In fact, Mussolini's alternative was to retain the disadvantages of both capitalism and communism, without much in the way of compensation. The syndicates of employers and workmen were later reduced from 13 to 9, then expanded again to 22, and the government set up special labour courts to hear any disputes between them. A National Council of Corporations, composed of about 170 members, was erected as the general staff of the productive forces of the nation; and the councils of the 22 corporations, composed of approximately 800 members, acted similarly for each individual branch of production. The operation of the whole system was in theory to be supervised by the minister of corporations. This mas Mussolini himself, who was also president of each corporation. The machinery mas completely top-heavy, its functions nebulous, its cost enormous. Yet Mussolini was very fond of it and looked to the day when it would supersede the parliamentary system altogether, when the National council would act in place of the chamber. The first step was to let each corporation issue regulations which had the force of law for the branches of production under its control.

Preparation for War.—Tension with France arose in 1933 out of failure to solve the problem of naval parity at the London naval

conference; but the appointment of Sen. Henri de Jouvenel as French ambassador in Rome gave promise of a *rapprochement*. Hitler's rise to power in the same year was welcomed somewhat dubiously. Germany and Italy had much in common: both were revisionist powers abroad and totalitarian states at home. Nevertheless, it was by no means an Italian interest for Germany to extend its boundaries into Austria, and in 1933 Mussolini met the Austrian chancellor Engelbert Dollfuss and promised him Italy's friendship. In March 1934 protocols were signed in Rome by Mussolini, Dollfuss and the Hungarian Gen. Gyula Gombos, which provided for a closer economic union between their states and bound them to consult each other on all political questions of mutual interest. In June 1934 Hitler visited Mussolini at Venice and undertook not to intervene in Austria. But Italy's confidence in Germany was shaken by the purge of the Nazi party at the end of June and by the assassination of Dollfuss in July by the Austrian Nazis with German connivance. Italian troops were sent to the northern frontier ready to defend Austrian independence, and Mussolini extended his patronage to the prince von Starhemberg and Kurt von Schuschnigg.

These events brought about a temporary change in Italian foreign policy. The failure of the disarmament conference and of the London economic conference had caused dissatisfaction with the League of Nations, and at the end of 1933 the Grand council had announced that Italy's membership in the League was dependent on a radical reform of that institution. But in 1934 Italy's break with Germany was followed by a resumption of friendship with the League powers, and negotiations were at once opened with France. The French foreign minister, Louis Barthou, was about to leave for Italy to sign an agreement when he was assassinated at Marseilles in October. His successor, Pierre Laval, resumed discussions and brought them to a satisfactory conclusion in Jan. 1935. In May 1934 supplementary estimates for thousands of millions of lire were issued to cover expenditure on the air force and navy, and it was decided to lay down two new 35,000-ton battleships. Later in the year measures were passed to tighten up the obligation on all males to do military service. From the age of six. boys were to begin military instruction in the Balilla organization.

Italy was at this time just beginning to emerge from the economic slump, but the new war preparations were before long to cause a yet further decline in the standard of living of the people. In April 1934, for the second time, the salaries of civil servants were slashed by 12%. The situation of the treasury was temporarily relieved by conversion of the huge consolidated loan from 5% to 3.5%; but in the following year it had to be reconverted back to 5% under the stress of the Abyssinian campaign.

The Abyssinian War.—Ever since 1932 Mussolini had been preparing the great war against Abyssinia that was to wipe out the humiliating memory of Aduwa. By this time the permanent officials in the foreign office uho had restrained the wildest antics of Fascist policy had retired or been swamped by party placemen. Instead of concentrating the diplomatic and military efforts of the country to keep German influence out of the buffer state beyond the Brenner, ideological arguments were used to divert attention to colonial expansion, and this started the chain of cause and effect which led to the Axis pact and Italy's loss of all its colonies in World War II.

Mussolini at first had stood patron to Abyssinia, signing a pact of friendship and introducing it into the League. It had then been his claim that he had no territorial ambitions and was no "collector of deserts." But for ten years since then he had been preaching the glories of war and the necessity of expansion; he could hardly remain inactive for much longer without trying to apply his theories. A minor clash over the Abyssinian frontier at Wal Wal in Dec. 1934 had not attracted much notice at the time. Then, in Jan. 1935, came the agreement with Laval which seemed to presage a formal military alliance. General De Bono, the minister of colonies, was appointed high commissioner of Italian East Africa, and two divisions were mobilized for dispatch to Eritrea. In March 1935 Gen. Rodolfo Graziani, the most experienced of Italy's colonial commanders, was appointed governor of Italian Somaliland. Next month Italy, Great Britain and France affirmed at Stresa their desire to collaborate in maintaining European peace. This was a part of Mussolini's smoke screen and an attempt to cover his flank against a German move while he was busy in Africa.

Early in 1935 Abyssinia had appealed to the League of Nations under the terms of the covenant; but no action was taken, since it was hoped that the two parties would reach an understanding by direct negotiation. The British minister without portfolio for League affairs, Anthony Eden, then went to Rome with a proposal that Abyssinia should yield some territory to Italy and receive compensation in an adjoining part of the British empire. This Italy refused, for it would have given Abyssinia independent access to the sea and also have foiled the plan to obtain a striking military victory for purposes of prestige. Again in September a five-power committee of the League made compromise proposals; but while Abyssinia accepted them. Italy refused.

In Oct. 1935 open hostilities began, by which time Italy had 250,000 men under arms in east Africa. The Fascist party nominee, De Bono, had to be replaced almost at once by Badoglio, but there was little serious fighting possible for the Abyssinians against Italian strength backed by all the resources of modern military science (including poison gas).

The League had at once declared Italy to be the aggressor and in November brought economic sanctions into force. The absurdity of this action can be judged from the fact that oil was specifically exempted from the embargo. Sanctions just allowed Mussolini to justify his action at home and to point out to Italians how they nere being victimized by the "have" poxers who resented its intrusion among them. Sanctions also split the League countries and in the end forced Italy into alliance with Germany, which was one of the few states not to apply them. Laval and Sir Samuel Hoare, the British foreign secretary, prepared another compromise in December, but there was an outcry by British public opinion at what seemed like concession to an aggressor. Sir Samuel had to resign and was succeeded as foreign secretary by Eden, who already had the reputation of being an enemy of Italy. The whole sanctions policy was attributed to Great Britain by Italian public opinion, and the resultant tension was one more wedge driven into the Stresa front.

Addis Ababa fell in May 1936, and Victor Emmanuel (without being consulted) was given the grandiose title of emperor to mark the establishment of Italian sovereignty over Abyssinia. Badoglio and then Graziani were made viceroys of the new colony. The victory had not reflected any great glory on the Italians, though the organization of the campaign had been workmanlike. Their boasting about the poison gases sprayed on Abyssinian villages was not received well in the rest of Europe. But victory seemed to have done something to reconcile doubters at home to the regime. Fascism was being justified by success, and some even among the "opposition" approved of the war. The Catholics, in particular, seem to have been far more sympathetic to it than to that of 1915–18.

Several more years passed before Abyssinia was effectively occupied and subdued, and during this time the corruption now typical of fascism was much in evidence in the government of the colony. Despite the "economic necessity to expand" that had been argued as a principal cause of the war, the colonies continued to eat up more and more of the limited resources of the fatherland (which many of the sceptics thought might have been more profitably employed in backward areas at home) and gave a disproportionately small return in terms of wealth. Another deleterious effect of the war was its harmful impact upon the domestic economy. The law on the gold reserves of the Bank of Italy had to be repealed, and a tendency toward inflation was not long in showing itself. The budget indicated that the national accounts were wildly out of balance, and even the compulsory loans and other expedients now adopted proved quite ineffective to restore an equilibrium.

Mussolini later confessed that his power and prestige had been at their highest in 1937. After that, matters got out of hand. The fact that Italy, singlehanded, had with apparent success defied 52 nations of the League gave him the false impression that the coun-

try was powerful and could afford to throw its weight about and that the democracies were decadent and could be safely pushed along the path of appeasement. This was to prove a fatal illusion. Unfortunately fascism had outlawed anything in the way of an opposition; and not even the other Fascist leaders dared criticize the infallible Duce. Mussolini was always right: Mussolini ha *sempre* ragione was one of the slogans of the regime. There was thus no one to point out the implications of his aggressive policy, no one to suggest that industrially and militarily the country could not risk provoking a general mar.

From this moment, one may say, Italy was doomed; for Mussolini was not observant or intelligent enough to supply the criticism that was lacking elsewhere. He governed by intuition. oscillating violently from one extreme to another, from antisocialist to socialist, from conservative to revolutionary, from pro-German to anti-German; and though the people believed that there was some logic in this concealed from them, it was rather a morbid psychological trait.

Mussolini and Galeazzo Ciano, his new foreign minister, were ill-informed and thought that they could conduct the diplomacy of a major power with very little preparation or initial study. Italian policy thus remained unpredictable until the last. It was usually based on the shallowest of arguments, and never remained constant for long. Most of Mussolini's subordinates showed themselves to be trivial, irresponsible and incompetent, for he did not like strong men about him, or men with ideas.

The *Spanish Civil War.*—Ciano rose to power through undisguised nepotism, being Mussolini's son-in-law. A few weeks after his appointment as foreign minister, in July 1936, the Spanish Civil War broke out, and it was discovered that ideological reasons compelled Italian intervention against the democratic republic and in favour of the insurgents. Italy stood to gain little save prestige from this war. As things turned out, it gained little even of this and lost considerably in the way of men and military matériel. Mussolini associated himself with the agreement by which outside powers were not to intervene; but his soldiers still remained in Spain, and semiofficial estimates gave them as at least 50.000 in number. Too late Mussolini discovered that, while victory would not bring any material reward, defeat would be ruinous. What he had expected to be a short and glorious war in fact continued for three years, and Black Shirt troops suffered some notable reverses at the hands of an army in which anti-Fascist refugees from Italy were represented.

Germany meanwhile rejoiced to see the rift widening between France and Italy. To save itself from isolation Italy had to pay Germany's price and sacrifice its protection of Austrian independence. In Oct. 1937, moreover, the lira had to be revalued, and a new tax of 10% was imposed on the capital of limited liability companies. Before long the cost of prestige was to seem almost excessive.

Ascendancy of Germany.—Ideological arguments were behind the establishment of the Axis pact with Germany. Naziism and fascism agreed in their totalitarianism, in their opposition to liberalism and democracy and in their violent, revolutionary methods. As Hitler in the early years had learned a great deal from Mussolini, so after 1937 it was Italy that learned increasingly from the more efficient and more successful regime in Germany. The imposition of sanctions had indicated how little Mussolini could expect from the western democracies. So he followed Crispi's example in giving up a position of independence between the power groups of Europe and set his hopes on reaping some incidental gain from Germany's determination to upset the treaty of Versailles. As Italy's interests were mainly concentrated in the Mediterranean, it was against France and Great Britain that its claims were primarily directed.

In Sept. 1937 Mussolini visited Hitler in Germany, where he received a great welcome which flattered his vanity and persuaded him that Germany was bound to win the next war. Italy joined the German-Japanese anti-Comintern pact in November and withdrew from the League in December. This policy coincided with an increased armaments program, and in Jan. 1938 it was decided to lay down two more 35,000-ton battleships and a fleet of submarines. In the interests of further appeasement, however, care was taken not to antagonize Great Britain irretrievably while these preparations were being built up. March 1938 brought the German occupation of Austria, to which Italy had perforce to assent; and so, with the reappearance of a strong state upon its northern frontier, Italy threw away its chief gain from the settlement of 1919. Again in Sept. 1938 at Munich, although Mussolini intervened to prevent a premature war to conquer Czechoslovakia, Hitler was allowed to occupy the Sudetenland. The Munich conference confirmed Mussolini's underestimation of France and Great Britain and forced him all the more into the position of poor relation of Germany.

In Oct. 1938 the Grand council advocated certain measures limiting the professional activities of the Jews and excluding them from the fighting forces and the civil service. This was another sop to Hitler. Until this moment Mussolini had prided himself on his racial tolerance; he had in fact feared that the Germans despised Italians as non-Aryan. This difficulty was now tacitly overlooked, and scholars were turned on to show that the Italians were essentially Nordic. Some leading Italians were dismissed from their posts, to the damage of science and industry.

There is evidence that these new racial laws aroused considerable popular indignation and that they were sometimes disregarded. As fascism continued to become more and more totalitarian, it became more unwieldy, more inefficient, more corruptible and more disliked. The increasing interference in private life was resented by many who had once approved the exaggeration of the state whicn fascism had originally stood for; and the natural anarchism of Italians made much even of Fascist legislation a dead letter. Peasants refused to co-operate with the government in its policy of requisitions, fixed prices and compulsory acquisition of crops by the state. Scholars refused to take the oath of allegiance when it was extended to cover the regime as well as the king and the state. Enrico Fermi, the greatest of Italian scientists, escaped to America. Croce, in his magazine La *Critica*, kept up a continual fire of veiled criticism which must have had considerable influence among the intellectuals.

This is not to say that opposition was widespread or even very important. But as Mussolini's whimsical intuition became ever more decisive in the formation of policy, more and more people became alarmed. About the year 1938 Mussolini seems to have started reverting to the socialism which had dominated his early life and which had always infected one wing of his party. He began to attack everything that was "bourgeois," whether it was golf or first-class compartments on the railway or the pacifist mentality of those who put prosperity before national glory and power. After 1934 the budget was nowhere near balanced, but Mussolini ridiculed the forebodings of his finance minister, Felice Guarneri, who warned him that the country could not stand the pace. From this moment can be dated the growth of a defeatism among many of the financiers and industrialists whose support had once helped fascism into power. The Duce even announced a measure for splitting up the large estates of Sicily.

By the turn of the year 1938–39 matters were getting out of hand. The deputies in parliament were instructed to clamour vociferously for conquest of Nice, Corsica, Tunisia, Jibuti, Malta and Suez. Then parliament was told to vote itself out of existence and to give way to the chamber of fasces and corporations which was to take its place. It could not be allowed that fascism had played itself out. The country had to be in a continual state of revolution. Mussolini denounced the Italo-French agreement of Jan. 1935; but at the same time his jealousy of Hitler made him anxious not to appear to play second fiddle to Germany, and he was soon trying to assert his independence in a separate policy of his own. On a sudden impulse he converted the Rome-Berlin Axis into a formal alliance in May 1939; but there was little real friendship there, and this "pact of steel" gave Italy many of the disadvantages of a formal tie without some of its compensations.

Italy had exercised a predominant influence in Albania for many years; but in April 1939, after Hitler had invaded what was left of Czechoslovakia, Mussolini decided to assert himself by converting the protectorate of Albania into an actual colony. At the

very last minute it was decided to land an expedition there. Victor Emmanuel became king in Zog's place, and a personal union of crowns was thus established. But the other Balkan states were thereby antagonized, and the manner of the occupation was not such as to inspire much confidence in Italy's capacity to carry out a major war. Mussolini secretly told Hitler that the country would evidently not be ready for such a war within three years, and Italy began to plan on this supposition.

In his less sane moments. however, the Duce was carried away by his own rhetorical statements about mobilizing "8,000,000 bayonets"; and the evident willingness of the British prime minister Neville Chamberlain to suffer almost anything in the cause of peace confirmed his false illusion of strength. He was content just to assume that fascism had succeeded in militarizing the nation and in mobilizing indu try to produce a sufficient war potential. Occasionally he pierced the bluff of the service ministries which had multiplied on paper the strength of their units to earn his good opinion. But he chose to ignore the evidence at crucial moments when the issue was that of peace or war.

World War 11.—When he made his pact with Germany evidently Mussolini had not known that Germany, far from intending to wait three years until Italy was ready, was already preparing an invasion of Poland. Hitler also kept his ally quite uninformed about his intention to make a pact with the U.S.S.R. in Aug. 1939. Surprised by German bad faith, Italy became anxious lest it should be drawn into war, and Ciano was dispatched to Berchtesgaden in August. Hitler was, of course, unmoved by Mussolini's attempt to preserve peace and was content to allow that the *casus foederis* had not arisen so that Italian help would not be invoked.

The Italian army leaders were strongly in favour of neutrality, knowing how weak the armed services were. They had always resented the attempt to *fascistizzare* the army. The naval commanders knew how risky it was for a country so dependent on supplies from overseas to challenge the British and French navies. Balbo, De Bono and Federzoni were also reputedly neutralist, and when Germany began hostilities in September, Ciano obtained the succession of the less bellicose Ettore Muti to Achille Starace as secretary of the Fascist party.

This turn of events put Italy back into an arbitral position in Europe, where—as in 1914–15—it could barter its support between either side and profit from the exhaustion of both belligerents. But Mussolini felt this situation to be ignominious. War to him was something glorious and good in its own right; and as he greatly exaggerated Italian power, he could hardly continue for long without following one of his intuitive urges toward joining Germany. Little was done in the meantime to put Italian industry and armed forces on a war footing. Yet Mussolini was overcome with humiliation at having to stand idle while others made history without him. Badoglio and the king reminded him how completely unready the country was for the test of a major war; but when the news arrived of German victories in France and Scandinavia, he became frightened that further delay might make his intervention too late; and without consulting his ministers or the military experts he declared war against Great Britain and France on June 10, 1940.

The record of Italian armed forces during the second half of 1940 was far from brilliant. Despite the fact that France was already reeling from the German onslaught, Italian*troops were able to penetrate only a few miles beyond the French border before their two-weeks' war was concluded on the basis of the *status* quo at the time of the armistice. Mussolini had hoped to receive Nice, Savoy and the ports of Tunisia, but Hitler was more anxious to purchase the confidence of the new regime in France than to satisfy the ambitions of his fellow dictator.

To compensate for this there were victories in Africa against Great Britain. British Somaliland mas taken in August. There were infiltrations into the eastern Sudan and northern Kenya. Then, meeting very slight resistance, the Italians began to invade Egypt. But this was not enough, and soon Mussolini had to reconcile himself to the unpalatable fact that the war was not going to be the short and glorious campaign that he had anticipated. In Dec. 1940 the British counterattacked and drove the Italians out of Egypt into Libya as far as Tobruk. The British navy managed to reassert itself in the Mediterranean, and as a result of an attack on the Taranto naval base in November the Italian fleet for the time being was partially crippled.

These disasters were slight compared with the ignominious defeat of Italian armies in Albania and northern Greece. On Oct. 28, 1940, Mussolini sent his army into Greece with the object of staking out his claims in the Balkan peninsula before Hitler could do likewise. He did not inform Hitler in advance. The views of the Italian general staff were not considered, their objections being overruled as sheer defeatism. Then, to Mussolini's great surprise, the Italians were soon driven back from Greece in retreat through their own colony of Albania. This unprovoked attack provided the Allies with bases in the Balkans and also damaged the Axis in that the Italian defeat persuaded the Spaniards to remain neutral. Furthermore, it compelled Italy to beg German aid. Gradually the Germans took over the Italian war effort, and before long they were exploiting Italy almost as a defeated enemy.

In the spring of 1941 Italian East Africa fell to the British, together mith a large army under Amedeo, duke of Aosta (son and successor of Emanuele Filiberto). Abyssinia regained its independence. The Italian troops in North Africa had lost two-thirds of their strength in casualties and prisoners, and the history of Italy as an African power seemed near its end. In March the battle of Matapan off the southern tip of Greece resulted in the loss or serious damage of one Italian battleship and three heavy cruisers.

At this point the Germans came to the aid of their ally. Gen. Erwin Rommel took over responsibility for the Libyan campaign. Nazi troops in the Balkans forced the British to transfer the bulk of their army from Africa to Athens and Salonika. The German and Italian forces by-passed Tobruk and, in April, crossed once again into Egypt. In the same month Yugoslavia was invaded from the north, and the Greeks were speedily compelled to surrender. Mussolini hardly dared announce the fact to his people. Although the Italian contribution to the conquest of the Balkans had been slight, the Germans rewarded their allies with a small segment of Yugoslavia and certain Adriatic islands. Aimone, duke of Spoleto, the second son of Emanuele Filiberto, was allowed to call himself king of Croatia. Mussolini made the most of this; but he became increasingly impatient of infiltration by the Germans and began to talk of fortifying the northern frontier of Italy for the not-so-distant day when he would be fighting them.

The war extended eastward when the Germans opened hostilities against the Soviet Union—once again without warning their ally. Mussolini, in the folly of desperation, insisted against German advice that Italian units should fight on the new Russian front, as if they had not already more than enough to do elsewhere. At the end of 1941 Japan brought the United States into the battle. and Italy cheerfully declared war on this new enemy. A British offensive in the Egyptian Western desert in Nov. 1941 was followed by a second German counterattack in the spring of 1942, which took the front as far into Egypt as El Alamein.

But the longer the war continued, the more Italy was outdistanced in the field of provision and munitions. British convoys found it as easy to reach Malta as did Italian convoys to cross the narrow straits of Sicily. In the autumn of 1942, at the same time as the Russians won the defensive battle of Stalingrad, the Anglo-American landings in Algeria and Morocco, together mith Gen. Sir Bernard (later Viscount) Montgomery's sweep from El Alamein, loosened the Axis.' hold on North Africa, all of which was to be in Allied hands by the middle of May of the next year.

Civilian morale in Italy now sank disastrously. The king, some of the army leaders, some of the surviving liberals like Orlando, Bonomi and Croce, the Socialist underground and even *frondeurs* inside the Fascist party all began to cast about for some way of extricating the country from the war without too much physical damage or loss of face. It was the dissident Fascists who first had the courage to move, seeing that the uncontrollable Mussolini was losing everything for which they had struggled. The Allied invasion of Sicily on July 10, 1943, followed by the bombing of Rome which had hitherto been inviolable, at last brought home to

Italians some of the realities of war. On the night of July 24–25 the Fascist Grand council supported by 19 votes against 7 a motion of no confidence in the government. Among those who voted against Mussolini were De Bono, De Vecchi, Ciano, Grandi, Federzoni and Giuseppe Bottai.

Badoglio.—The king now took advantage of this division inside fascism and, instead of allowing the rebels to take over the government, arrested Mussolini when he came to report. Nor was there much protest when Marshal Badoglio was charged to form a new ministry. Fascism in fact had fallen, even though the war continued. Badoglio took some time to evade German vigilance and make the first secret overtures for peace. Only toward the end of August did his envoy meet the British and the Americans in Lisbon, and by that time the Germans had been strongly reinforced. The Italian armistice was signed early in September. At the same time the Allies landed in Calabria. But all Italy north of Naples passed at once into German hands; and though the Italian fleet sailed to Malta, the Italian army was for the most part easily disarmed by its former allies. In September a German parachute band carried out a brilliant escapade to recapture illussolini, and a Republican-Fascist government mas set up in northern Italy at Salò. Meanwhile Badoglio reconstituted the king's government at Brindisi and, in October, declared war on Germany.

Debates soon began on the nature of Italy's future government, especially on whether the king had become too far compromised with fascism to stay. But for the moment the six anti-Fascist parties of the liberation movement agreed on suspending this issue and joining a coalition. Palmiro Togliatti. returned from Russia, realistically joined the Liberals and Christian Democrats round Benedetto Croce and Alcide de Gasperi. The Maximalist Socialists reformed themselves under Pietro Nenni. and the milder Reformists under Giuseppe Saragat. A coalition government thus took shape under Badoglio in April 1944.

Bonomi, 1944–45.—When in June 1944 Rome fell to the Allies, Bonomi took over from Badoglio with another broad coalition. The country was allowed the status of a cobelligerent but not of an ally in the war against Germany. Italians played a considerable part in the liberation. and the Allies gradually relaxed their control of civil administration as the front line moved farther north. Great physical destruction, as well as inflation and the bitterness of civil war. left the country in a terrible state.

In April 1945 the Allies opened a general offensive in northern Italy. Italian partisans often seized power in advance of this offensive. and hence the extreme left emerged in control of much local administration. A partisan force intercepted illussolini and his mistress Clara Petacci near the Lago di Como and executed both near Dongo after a summary trial. Ciano and De Bono had already been executed by Mussolini. Grandi and Bottai survived, but most of the other gerarchi were dead. Germany capitulated in May.

Post-World War 11.—In June 1945 Bonomi gave way in the premiership to Ferruccio Parri, a former partisan and a member of the radical Partito d'Azione. Just after his accession to power the dispute with Marshal Tito over Trieste was temporarily settled by a compromise agreement under which Allied and Yugoslav troops partitioned Venezia Giulia. At home, famine conditions were widespread, inflation reached new heights and banditry received a new impetus from deserters, who could arm themselves mith the weapons that littered the countryside. The Allied occupation, however, was accompanied by substantial food shipments and other forms of ,economic aid from the United States. The introduction of DDT against the malarial mosquitoes by itself effected a major revolution for the good.

De Gasperi, *1945–53.*—Unable to solve domestic problems, Parri was succeeded by De Gasperi in Dec. 1945 with another coalition, including Communists and Socialists as well as Christian Democrats. De Gasperi was to prove himself the ablest Italian politician since Cavour. In a period of exceptional difficulty he managed to preserve a working majority through eight successive administrations until 1953. usually with the aid of the Liberals, the Republicans and the Reformist Socialists.

In May 1946 Victor Emmanuel III tried to save the monarchy by abdicating just before a referendum was held on the issue of republicanism. But the vote was 12.71 7,923 against the monarchy as opposed to 10,719,284 for it, and Humbert II went into exile after a month's reign. The voting confirmed, however, that southern Italy was stoutly monarchical, and this constituted one more dangerous division between north and south. A Neapolitan. Enrico de Nicola, was chosen as provisional head of the state by the constituent assembly now elected. This assembly comprised 207 Christian Democrats, 11 j Socialists, 104 Communists. 23 Republicans and only 19 Liberals. But the Socialist party divided itself once again in Jan. 1947, when Saragat formed a separate group and Nenni made common front with the Communists. The Communists left the government coalition in May 1947. The task of the constituent assembly was to devise a constitution to replace that granted by Charles Albert in 1848. In Jan. 1948 this new constitution came into force. It provided for an elected senate? for some regional autonomy in Sicily. Sardinia! Trentino and Aosta, and for the institution of a president of the republic. De Nicola became the first president and was succeeded by Luigi Einaudi in May 1948. Elections for the first parliament. held on April 18–19, gave 307 seats to the Christian Democrats and 182 to the Popular Front of Communists and Nenni Socialists combined. This was a majority such as Italy had never previously known in democratic elections, yet De Gasperi wisely persevered with a broad coalition program and even began to give land to the southern peasants by expropriating the larger estates. There was. however, a growing conflict between left and right wings of the Democristiani (Luigi Gedda. leader of Catholic Action. on the right. Giuseppe Dossetti and Giulio Pastore of the Catholic unions on the left). which weakened the government and held up social reform.

The treaty of peace was ratified in 1947. Yugoslavia received Fiume. Zara. Pola and Istria, while the future of Trieste was left still doubtful. France also obtained small portions of former Italian territory along the frontier. The Dodecanese Islands went to Greece. and the Italian colonies remained at the disposition of the United Nations. Italy's inclusion among the United Nations was vetoed by the U.S.S.R.. but the western nations soon needed Italy's support and so made substantial revisions of the treaty in its favour. In internal politics De Gasperi's coalition was weakened in 19jo–ji by the defection of the Saragat Socialists and the Liberals on its two extreme wings, but both groups continued to give general support to the government. Reconstruction proceeded well. and Giuseppe Pella's deflationary policy brought some good results. The discovery of oil in several areas and of very large supplies of methane gas opened prospects of an industrial revolution.

An unfavourable trade balance was also partially covered by a remarkable increase in tourism.

Pella, Scelba and *Segni.*—In the general elections of June 7–8, 1953, the Christian Democrats won 10,859,554 votes (40.1%) as compared with 12,741,292 (48.4%) in 1948; the number of their seats was reduced to 262. Their associates, Social Democrats (*i.e.,* Saragat Socialists). Republicans and Liberals, also suffered, their seats being reduced from 33 to 19, from 10 to 5 and from 19 to 14, respectively. Communists and Nenni Socialists this time went to the polls separately and won together 9.562,860 votes (35.3%) as compared with 8,151,529 (31.0%); they obtained 218 seats (143 Communists and 75 Nennists). The right-ning parties also increased their votes: the Monarchists had 40 seats instead of 14 and the neo-Fascist Movimento Sociale Italiano had 29 instead of 5. A period of relative government stability was over, as the two extremes gained at the expense of the centre, and the centre itself became less cohesive. The 2,500,000 Communists were contained only by stringent police measures enforced by a vigorous minister from Sicily. Mario Scelba. De Gasperi's ill-advised attempt to rig the electoral law had turned many moderates against him in this election. He resigned, and Pella took over for six months of caretaker government mith a coalition of Monarchists and Liberals. But this move to the right disturbed those who believed in agrarian reform. Amintore Fanfani tried in Jan. 1954 to find an alternative coalition more to the left, but could win neither the *saragatiani* nor the Monarchist party of Achille Lauro. It was Scelba who, in

February, restored De Gasperi's precarious equilibrium with Liberals and Socialists in the cabinet. De Gasperi died in August, and the secretaryship of the Christian Democrats went to Fanfani, thus posing once again the difficult problem of party unity. In April 1955, when Luigi Einaudi's term of office as president came to an end, the official Christian Democrat candidate stood down and Giovanni Gronchi, a left-wing Christian Democrat. mas elected at the fourth ballot. In June, dissensions within his own party forced Scelba to resign. On July 6 a moderate coalition government took office under Antonio Segni, former minister of agriculture and a strong advocate of land reform.

In foreign affairs, Italy supported the European Defense Community, and, after its collapse in Aug. 1954. Western European union.

In Oct. 1954 an agreement was made with Yugoslavia to divide the territory of Trieste. The Allied troops withdrew, and thus one great stumbling block for world peace was at least temporarily removed. (D. M. SH.)

BIBLIOGRAPHY.--For general surveys: L. Muratori, *Annali d'Italia,* 12 vol. (Monaco, 1760–64), covering history up to 1750; P. Villari (ed.), *Storia politica d'Italia,* 11 parts (Milan, 1875 *ff.*); A. Solmi, *Storia politica d'Italia dalle origini ai giorni nostri,* 3rd ed. (Milan, 1937); Janet Trevelyan, *A Short History of the Italian People,* 3rd ed. (1929); Luigi Salvatorelli, *A Concise History of Italy; From Prehistoric Times to Our Own Day* (1940); *H.* Jenkinson and H. E. Bell, *Italian Archives During the War and at Its Close* (London, 1948). *See* also works cited under PAPACY and in the articles on the several Italian cities, states and dynasties.

For ancient and mediaeval Italy: H. Nissen, *Italische Landeskunde,* 2 vol. (Berlin, 1883–1902); R. Thomsen, *The Italic Regions from Augustus to the Lombard Invasion* (Copenhagen, 1947); T. Hodgkin, *Italy and Her Invaders,* 8 vol. (Oxford, 1880–99); L. Hartmann, *Geschichte Italiens im Mittelalter,* 4 vol. (Gotha, 1897–1911); H. W. C. Davis (ed.), *Italy, Mediaeval and Modern* (Oxford, 1917); L. Salvatorelli, *L'Italia medievale* (Milan, 1938) and *L'Italia comunale* (Milan, 1940); N. Valeri, *L'Italia nell' età dei principati* (Milan, 1949); L. Simeoni, *Le Signorie,* 2 vol. (Milan, 1950).

For the 16th, 17th and 18th centuries: K. D. Ewart, *Italy From 1494 to 1790* (Cambridge, 1909); F. Ercole, *Da Carlo VIII a Carlo V* (Florence, 1932); A. Cosci, *L'Italia durante le preponderanze straniere dal 1530 al 1789,* vol. 5 of Villari's *Storia politica* (Milan, 1875).

For the French Revolutionary period and the Risorgimento: R. Albrecht-Carrié, *Italy From Napoleon to Mussolini* (1950); Bolton King, *History of Italian Unity,* 2 vol. (London, 1899); A. Solmi, *The Making of Modern Italy,* Eng. trans. (London, 1925); A. J. Whyte, *The Evolution of Modern Italy* (Oxford, 1944); A. Ferrari, *L'Esplozione rivoluzionaria del Risorgimento, 1789–1815* (Milan, 1925); A. Ghisalberti, *Cospirazioni del Risorgimento* (Palermo. 1938); I. Raulich, *Storia del risorgimento politico d'Italia,* 5 vol. (Bologna, 1920–26); G. M. Trevelyan, *Garibaldi,* 3 parts, new ed. (1933); A. Oriani, *La Lotta politica in Italia,* 3 vol., 4th ed. (Florence, 1921). *See* also F. Lemmi, *Il Risorgimento: guide bibliografiche* (Rome, 1926).

For history after 1870: Ivanoe Bonorni, *La Politica italiarta da Porta Pia a Vittorio Veneto* (Turin, 1944); V. Bersezio, *Il Regno di Vittorio Emanuele II,* 8 vol. (Turin, 1889); G. Gallavresi, *Italia ed Austria 1859–1914* (Milan, 1922); L. Salvatorelli, *La Triplice Alleanza: storia diplomatica, 1877–1912* (Milan, 1939); L. Bissolati, *La Politica estera dell'Italia dal 1897 al 1920* (Milan, 1923); G. Natale, *Giolitti e gli Italiani* (Rome, 1950); G. Perticone, *Gruppi e partiti politici nella vita pubblica italiana* (Modena, 1938); F. Mcda, *Il Partito socialista italiano dalla prima alla terza Internazionale* (Milan, 1921); W. Hilton-Young, *The Italian Left* (1949); M. Rossi, *L'Italia odierna* (Turin, 1916); *Storia contemporanea* (1917), and *L'Italia di ieri,* 2 vol. (1925); E. Corradini, *Discorsi politici* (Florence, 1923); B. Mussolini, *Discorsi,* etc. (Milan, *1921 ff.*), and *Scritti e discorsi,* definitive ed. (Rome, 1934 *ff.*); R. Farinacci, *Storia della rivoluzione fascista,* 3 vol. (Cremona, 1937–39); Don Luigi Sturzo, *Italy and Fascismo,* Eng. trans. (1926); Gaetano Salvemini, *Under the Axe oj Fascism* (1936); Count Galeazzo Ciano, *Ciano's Diary, 1937–1938,* Enp. trans. ed. by A. Mayor (London, 1952). *Ciano Diaries, 1939–1943,* Eng. trans. ed. by Hugh Gibson (1946) and by M. Muggeridge (London, 1947), and *Ciano Diplomatic Papers . . . 1936–42,* Eng. trans. ed. by M. Muggeridge (London, 1948); E. Wiskemann. *The Rome-Berlin Axis* (1949); D. A. Binchy, *Church and State in Fascist Italy* (1941); A. C. Jemolo, *Stato e chiesa negli ultimi cent'anni* (1949); L. Salvatorelli and G. Mira. *Storia del fascismo* (Rome, 1953); P. Monelli, *Mussolini: An Intimate Life* (London, 1953); H. S. Hughes, *The United States and Italy* (Cambridge, Mass., 1953). (X.)

POPULATION AND SOCIAL CONDITIONS

In the 75 years from 1861 to 1936, when the last census before World War II was held. the population of Italy rose from 25,000,000 to 42,127,123 (de *jure*). The *de jure* population at the 19jr census, within the new boundaries laid down by the treaty of Paris (1947) and including zone A of Trieste, was 47,515,537. The preliminary 1961 de *jure* population figure was 50,463,762, The birth rate declined between 1861 and 1951, but so did the death rate. particularly the infant mortality rate; and between 1946 and 1951 the natural increase in population averaged considerably more than 400,000 annually. as it did in the 1930s. The density figure for the whole country rose from 139 per square kilometre (359 per square mile) in 1936 to 159 per square kilometre (408 per square mile) in 1951. A density of 159 per square kilometre does not appear high when compared with 196 in the German Federal Republic, 207 in Great Britain and 284 in Belgium (all figures for 1951), but two factors must be taken into account: the hilly and mountainous nature of a great part of the country: and the fact that about 41% of the people are engaged in agriculture and the density of the farming population on agricultural land is high in Italy, about 170 per square kilometre for the country as a whole, rising to over 300 in Liguria, Lombardy and Campania (440 per square mile rising to over 777).

Table I gives population figures for the different regions (*regioni*). In 1951 nearly 21,000,000 persons lived in the eight northern regions, which include the great industrial areas of Turin, Genoa. Milan and the other big towns of the Po valley; nearly 8,700,000 in the four central regions, Tuscany (Toscana), Umbria, the Marches (le Marche) and Latium (Lazio); more than 11,900,000 in the five southern regions; more than 4,490,000 in Sicily; and about 1,280,000 in Sardinia. Within these main divisions of Italy the density per square mile varied in the north from 75 in the Valle d'Aosta and 139 in Trentino-Alto Adige to 751 in Liguria, in the centre from 246 in Umbria to 504 in Latium and in the south from 163 in Basilicata to 828 in Campania and was 452 in Sicily and only 137 in Sardinia.

Italian statistics take account of a marked characteristic of the distribution of the Italian population, the distinction between the scattered and the concentrated population, the latter being the population residing in the town or village that forms the centre of a commune. According to the census of 1936. the scattered population, nhich is mainly the rural population, amounted to 26% of the total for the country generally. No figures were available in the decade following World War II, but there had been little change in the general situation, although a movement auay from the centres had begun in the south. In Lombardy and Liguria the scattered population only amounted to 18.7% and 17.5% respectively. because of the concentration of the population in the great industrial toans. but still lower figures were found in the mainly rural areas of the south and islands—13.1% in Basilicata, 6 7% in Apulia, 10% in Sicily, 8% in Sardinia. In these regions conditions of climate, security and land distribution have caused the agricultural population to live in towns of varying sizes whence they go to work in fields often lying a considerable distance away.

The great industrial towns are mainly in the northern plain, particularly in Lombardy; in central Italy the towns are smaller but often historically important; in the south, with the exception of the ports and notably Naples, the majority of the towns are

TABLE I.—*Area, Communes and Population*

Regions	Area* in sq. mi.	Number* of communes	Population in ooos		
			1936	1951	1954†
Piedmont (Piemonte)	9,806	1,180	3,439	3,518	3,602
Valle d'Aosta	1,260	73	85	94	97
Liguria	2,087	231	1,483	1,567	1,602
Lombardy (Lombardia)	9,191	1,476	5,805	6,567	6,722
Veneto	7,095	581	3,546	3,918	3,911
Trentino-Alto Adige	5,256	285	693	729	750
Friuli-Venezia Giulia	2,947	206	850	929	937
Emilia-Romagna	8,542	334	3,327	3,544	3,586
Tuscany (Toscano)	8,876	280	2,966	3,159	3,209
Marches (Marche)	3,742	245	1,262	1,364	1,370
Umbria	3,267	91	721	804	814
Latium (Lazio)	6,635	366	2,684	3,341	3,502
Abruzzi e Molise	5,881	435	1,555	1,684	1,699
Campania	5,250	538	3,679	4,346	4,509
Apulia (Puglia)	7,470	247	2,643	3,220	3,341
Basilicata (Lucania)	3,856	126	538	628	647
Calabria	5,821	406	1,742	2,044	2,104
Sicily (Sicilia)	9,925	370	3,971	4,487	4,624
Sardinia (Sardegna)	9,301	334	1,036	1,276	1,343
Territory of Triestef	86	6	...	297	292
Italy	116,294	7,810	42,025	47,516	48,661

*1951 census †Estimate ‡Formerly Zone A of the former Free Territory of Trieste.

agricultural centres. Table II shows the growth between 1911 and 1954 of principal cities.

*TABLE 11.— Population of Major Cities**

Cities	1911†	1936†		1951†	1954‡
		City	commune		
Rome	519,829	1,089,996	1,150,589	1,555,773	1,750,707
Milan	701,571	1,068,079	1,115,848	1,260,609	1,305,407
Saples	751,211	739,349	865,913	887,327	1,059,121
Turin	415,667	608,211	620,115	717,245	783,119
Genoa	465,496	512,313	634,646	648,078	711,515
Palermo	339,462	339,497	411,879	434,502	528,125
Florence	258,057	271,975	321,176	342,300	392,635
Bologna	179,311	226,771	281,162	316,074	364,064
Venice	208,461	170,830	264,027	174,632	327,743
Catania	207,848	241,462	244,972	294,199	320,951
Bari	121,724	162,238	197,918	250,189	287,683
Messina	128,178	121,605	192,051	168,497	231,620
Verona	116,623	84,862	153,708	134,636	186,865
Taranto	65,234	103,306	117,722	146,745	180,511
Padua	96,118	90,325	138,709	138,951	176,851
Leghorn	103,973	109,188	124,963	131,174	148,343
Brescia	87,210	92,583	123,332	110,224	146,812

*Cities or communes, with more than 145,000 inhabitants in 1954. †Census. ‡Estimate.

The consequence of the great and continuing increase of population and the high density, particularly in the poor agricultural districts of the south and islands, is a condition of grave overpopulation. which presents every Italian government with the difficult problem of how to absorb this annual increase of about 400,000 in a country with practically no mineral resources and with a great deal of hilly or even mountainous land. Before 191j the solution was found in emigration, but after 1945 Italy's governments realized that emigration could provide at best only a partial solution and that relief must be found in increased industrialization and in improved methods of farming.

There are great differences of character, dialect and customs in the different parts of Italy. In northern and in most of central Italy industrialization and comparative prosperity have resulted in an assimilation of habits and culture close to those of other western European countries. In the south, however, extreme poverty and widespread malarial conditions and centuries of misgovernment produced a low standard of living. which in some places approximates more closely to that of North Africa than to that of northern Italy. Lack of communications. except between the larger centres, has meant the retention of primitive ways of life as well as methods of agriculture, and in parts of southern Italy and Sicily habits formed during the Moorish and Spanish occupations still persist. This is well marked in regard to the position of women. In northern Italy, for instance, the women members of the farm household share in the work on the land, whereas in Sicily and parts of the south the woman scarcely ever leaves the house. Many south Italians were still in the latter 1950s physically unable to do a hard day's work; although malaria, a cause of incapacity in the past, had greatly declined, they were still often living close to starvation level. In many parts of the south, moreover, it is impossible for an agricultural labourer to find employment for more than from 100 to 150 days a year and. when he has mork, a man often has to walk from j to 10 mi. from his home to the fields before starting work. Although Italy was politically united from 1870, the differences betneen north and south continued to exist; even politically the enforcement of a system of centralized government. which had worked reasonably well in the small kingdom of Piedmont but was not suited to the different conditions of Sicily and the south, accentuated the diiferences. In view of this, a system of regional government, with an emphasis on some degree of local self-government, was planned by the constitution of 1948 but had not been brought into force by 1955 except in the four regions of Sicily, Sardinia, Valle d'Aosta and Trentino-Alto Adige. Economically, the north continued to tend to regard the south as a millstone around its neck. while the south maintained that it was taxed for the benefit of the north and that the north suppressed any movement to establish industry in the south. After 1945 Italian statesmen endeavoured to make their countrymen realize that Italy could only prosper if all its parts were to share in economic development. But the south, though it had produced some of Italy's most eminent thinkers, was still regarded by many northerners as barbarous.

Births, Deaths, Marriages.— The birth rate fell from 36.8 per 1,000 of the population in 1872–75 to 23.7 in 1938 and to 17.5 per 1,000 in 19jj. but the death rate also fell from 30.j in 1872–7 j to 14.0 in 1938 and to 9.1 per 1.000 in 19jj. The rate of natural increase, therefore, went up from 6.3 per 1,000 of the population in 1872–75 to 9.7 in 1938 and was 8.4 in 1955, the absolute increase being more than 400,000 a year both before and after World War II.

The birth rate varied greatly in different parts of the country. In 1954 it varied from 10.3 per 1.000 in Liguria, 11.2 in Piedmont and 12.8 in Tuscany to 24.4 in Apulia, aj.8 in Calabria and 25.5 in Basilicata. In some of the large northern towns the natural increase was small in spite of a low infant mortality. In 1953 the communes of Genoa, Florence and Bologna showed an excess of deaths over births. as did the regions of Piedmont and Liguria. Thus the rate of growth was greatest in the districts which were the poorest, the most overpopulated and the most exclusively dependent on agriculture. The number of male births remained about 6% above that of female. but there was a greater male mortality. In 1936 women constituted 51.5% of the population; in 1951 the numbers were 24,092,316 (or 51.0%) women and 23,126.218 men. The number of illegitimate births decreased from jo per 1,000 births in 1925 to 41 in 1938 and 34 in 1953.

Although the birth rate fell, Italy maintained a net reproduction rate above unity. In 1935–37 it was 1.131 for the whole country, but as with the birth rate there were startling contrasts between north and south. In five of the seven northern regions the net reproduction rate was below unity nhereas in the south and in the islands it was well above, rising from 1.434 in the Abruzzi to 1.635 in Basilicata. There was a steady decline in the death rate after 1946, when it was 12.1 per 1.000 of the population as compared with 14.1 in 1938; it fell to 11.5 in 1947, to 10.6 in 1948, to 10.5 in 1949 and to 9.2 in 1954, the last figure being comparable with the lowest norld rates. This decline was undoubtedly the result of progress in health measures, the effect of which was particularly marked in the great fall in infant mortality.

The greatest fall in infant mortality took place during the first 50 years of Italian unity, when the rate dropped from 219 per 1,000 live births in 1872–7j to 128 in 1922. After that it continued to drop—to 106 in 1938, to 74 in 1949 and to 58.5 in 1953, though this was still high compared with rates (1952) in Great Britain (28.6), the Netherlands (22.5) and Sweden (20.1). The figure for the whole country, moreover, concealed great variations within Italy. In 1953 the rate was as low as 39.6 in Tuscany but was still 100.8 in Basilicata (but even this last figure was a great improvement on that of 1938, when it was 157).

Table III shows the changes in the rates of deaths caused by diseases in 1949 and 1950 compared with 1937–39.

TABLE III.—Deaths per 1,000,000 Inhabitants

Cause of death	1937–39	1949	1950
Infectious and parasitic diseases	1,606	948	693
Tuberculosis	808	496	42j
Malignant tumours	862	1,030	1,071
Diseases of the nervous and digestive system	1,676	1,473	1,491
Pneumonia	2,055	978	746
Diseases of the circulation	2,036	2,107	2,02j
Diseases of early iniancy	585	447	246*
Childbirth	24*	16*	15*

*Deaths per 10,000 births.

The decrease in deaths from all forms of tuberculosis fell steadily from an annual average of 1,362 per 1,000,000 inhabitants in 1924–30 to 808 in 1937–39. It rose to 983 during the war years 1943–45, but by 1953 it was 232 or less than one-third of the rate for 1937–39.

Among parasitic diseases the great improvement was the decline of deaths from malaria. the scourge of the south and of the islands. From 1931 to 1936 the average annual number of deaths from malaria was 2,242; by 1937–39 it had fallen to 799; and, as a result largely of the determined onslaught on the *Anopheles* mosquito with DDT the number of deaths fell to 102 in 1949 and to 53 in 1950. All the regions where malaria was rampant profited (*e.g.*, in the Veneto 23 people died in 1938 and only 3 in 1950), but the chief improvement was in the south and in the islands. The number of

deaths in Latium fell from 25 in 1938 to 1 in 1950, in Campania from 3j to 9. in Apulia from 105 to 3, in Basilicata from 44 to 4, in Calabria from 13j to j and in Sicily from 170 to 11. In Sardinia, where a joint Italo-American attack on the mosquito took place in 1947–48, instead of 159 deaths as in 1938 there were none in 1950.

The marriage rate averaged about 7.5 per 1,000 of the population before 1939. It rose to 9.2 in 1946 but was back at 7.6 by 1949 and fell to 7.3 in 195j. Divorce is forbidden by the Roman Catholic Church, but the number of judicial separations was considerably larger after World War II than before it: 2,002 judicial separations were obtained out of 5,287 suits brought in 1939; 6,302 out of 10,275 in 1948; 5,506 out of 8,702 in 1949; and 4,695 out of 8,134 in 1953.

Table IV gives vital statistics.

Emigration. — Before World War I and again between 1919 and 192j the problem of Italian overpopulation was kept in abeyance, though not solved, by mass emigration from the worst overpopulated districts. There were two main streams of emigration: one overseas which tended to be permanent (though many Italians went even to the United States and Argentina expecting to return); the other to European countries which was mainly temporary and often seasonal (although there were considerable permanent settlements of Italians in France).

Before 1914 the Italian government encouraged emigration and held the view that it was of great value to the country. The emigrants raised both their own standard of living and, by means of remittances, the standard of their families at home; and the remittances also helped to balance Italy's foreign trade. Between 1900 and 1914, 9~000,000emigrants left Italy, of whom about 5,400,000 returned; the peak year was 1913, uhen 873,000 persons (1 in every 50 inhabitants) emigrated. These were the years of mass emigration of unskilled agricultural labour from central and southern Italy; and 64% of the emigration in 1913 was overseas. From 1902 to 1915 the natural increase in population averaged 388,180 annually. net annual emigration overseas (*i.e.*, emigrants less those who returned to Italy) averaged 159,990 or 41% of the increase in population. After World War I emigration soared again, rising to more than 600,000 in 1920. of which total 409,200 went overseas. The value of the remittances for that year was estimated at between 3,000,000 and 4 250,000 gold lire.

The United States was overwhelmingly important as a country of Italian immigration. Between 1901 and 1914 tno-thirds of the Italian immigrants to the new world went to the United States, and the average annual immigration into the United States from 1906 to 1910 was 266,000 while in 1920 it was considerably more than 300,000. The effect on the Italian economy of the United States Immigration acts of 1921 and 1924, the latter of which gave Italy a quota of only 3.845 immigrants a year, is easy to understand. The other most important immigration country overseas was Argentina. In 1913 and 1923 more than 100,000 Italians went there. The size of the emigration to the United States tended to overshadoa emigration to Europe. There are no figures for the return of emigrant Italians from Europe before 1921, but gross emigration from 1906 to 1910 averaged 1,288,000 yearly as compared aith 1,968,000 overseas. After 1918 emigration to Europe recovered rapidly; average gross emigration for 1921–25 was 172,-000, net emigration 93,000 annually.

After 1924 emigration dropped steadily, partly because of alterations in the attitudes of the countries of immigration, notably the United States, but also because of a change in the policy of the Italian Fascist government, which restricted emigration as causing an injurious political and military loss of subjects, however great the economic gain from their remittances. This attitude may have been unreasonable but it is understandable in view of the fact that in 1927 there were about 9,000,000 Italians resident abroad, 7,500,000 in North and South America and 1,250,000 in Europe, of whom 75% were in France.

The overriding economic problem of Italy after World War II was overpopulation, particularly in the south. The number of unemployed varied between 1,500,000 and 2,000,000 in spite of reconstruction work and European aid. The government sought to promote emigration, which would provide at least a partial solution of the problem for some time to come, since agrarian reform and increased industrialization could only take effect slowly. From early in 1946 various agreements mere made with European and South American countries for the reception of emigrants, the most important being those with France and Argentina. But progress was inevitably slow for several important reasons. In the days of mass emigration to Europe it had proved difficult for immigrant countries to satisfy their own people that Italians or other immigrants would not lower the standard of living. This difficulty arose again after 1945 in France; nor were the Italians satisfied with the arrangements for transfer of wages and family allowances in spite of agreements made between the two governments. Mass emigration to Latin America in the early years of the century had often produced unsatisfactory conditions for Italian labour, and the Italian government was consequently chary of encouraging emigration to Latin America without securing specific pledges from the immigrant countries. Also. though governments felt responsible for establishing their citizens in reasonable conditions, this admirable intention was not always practicable on any large scale for a poor country like Italy.

Another obstacle to Italian emigration was the fact that while the main demand of the immigrant countries was for skilled labour, Italy did not have enough skilled workers to meet the demands of increased Italian industrialization required to counteract agrarian overpopulation. Most of the skilled workers emerging from the training schools set up by the government were likely to be needed by the country itself. On the other hand, Latin America needed agricultural labour to develop large new areas, but conditions of life in these remote regions did not appeal to Italian emigrants.

Table V shows the overseas emigration figures for 1947–50 and for 1953.

Employment **and** Unemployment. — The distribution of the employed population, according to figures for 1936 and to those of the official sample survey of 1952, is shown in Table VI.

One of Italy's most valuable assets is its labour force. Only centuries of skilled labour could have made such a barren and mountainous country produce

TABLE IV.—*Marriages, Births, Deaths and Natural Increase, by Regions*

Region	1938				1953			
	Marriages per 1,000	Live births per 1,000	Deaths per 1,000	Natural increase per 1,000	Marriages per 1,000	Live births per 1,000	Deaths per 1,000	Natural increase per 1,000
Piedmont*	7.6	15.8	13.9	1.9	6.5	10.8	12.1	−1.3
Valle d'Aosta*		—	—	—	6.8	15.3	12.1	3.2
Liguria	7.2	15.3	12.7	2.6	6.2	10.2	10.6	−0.4
Lombardy	7.8	21.7	14.1	7.6	6.7	14.4	10.7	3.7
Trentino-Alto Adige	6.9	22.2	14.7	7.4	6.4	18.1	10.8	7.3
Veneto	7.4	24.7	12.2	12.5	7.5	17.3	9.6	7.7
Friuli-Venezia Giulia†	7.2	20.3	13.9	6.4	6.6	13.8	10.4	3.4
Emilia-Romagna	7.5	20.3	12.0	8.3	7.3	13.0	9.7	3.3
Tuscany	7.6	18 7	12.5	6.2	6.9	12.4	10.2	2.2
Marches	7.9	23.9	12.4	11.5	7.9	15.7	9.3	6.4
Umbria	7.3	23.2	12.9	10.3	8.2	15.0	9.3	5.7
Latium	7.4	24.5	12.4	12.1	7.2	17.7	8.5	9.2
Abruzzi e Molise	7.2	25.1	15.9	9.2	7.9	18.1	9.9	8.2
Campania	6.6	28.9	16.7	12.2	7.9	23.7	9.6	14.1
Apulia	7.7	31.1	15.8	15.3	6.8	24.0	9.5	14.5
Basilicata	7.7	31.7	16.7	15.0	7.5	24.8	10.6	14.2
Calabria	7.6	30.1	15.0	15.1	7.4	25.4	8.9	16.5
Sicily	7.5	27.0	15.3	11.6	7.3	21.7	9.5	12.2
Sardinia	6.7	28.3	14.0	14.3	6.1	24.9	8.4	16.j
Italy	7.4	23.7	14.0	9.7	7.1	17.4	0.8	7.6

*In 1938 Valle d'Aosta was included in Piedmont.
†In 1938 Venezia Giulia included Trieste and Istria.

TABLE V.—*Emigration*

Year	Canada	United States	Brazil	Argentina	Other countries	Total	Per 100,000 of the population
1947	58	23,251	4,097	27,234	5,070	59,710	131.3
1948	2,349	16,723	4,709	69,589	17,661	111,031	242.0
1949	5,991	11,465	6,949	98,260	32,393	155,058	336.2
1950	7,086	8,949	8,824	78,261	35,131	138,251	297.7
1953	21,236	7,605	13,266	18,801	36,715*	97,623	202.3

*Including 20,534 to Venezuela and 12,250 to Australia.

as much as it did. while the work of Italy's skilled artisans has long been prized. But this plentiful supply of labour was painfully obvious after 1945. The devastation of roads. bridges and railways caused by the war meant that as soon as the war ended there was work temporarily for a great many labourers, and in fact this work of reconstruction mas carried out with speed and efficiency. But raw materials for Italy's skilled and semiskilled workers in engineering and textiles were in short supply for a long time, and unemployment was a heavy burden on the Italian economy after 1945.

The lack of any exact figures for unemployment, much of it partial and some of it seasonal, led to the appointment of a parliamentary commission of inquiry, which in 1952 produced a remarkable report on social conditions generally as a basis for its conclusions on employment and unemployment. The commissioners reported that in Sept. 1952 there were about 1.500,000 unemployed, 67% men and 33% women. This figure covered only persons formerly employed and young people in search of their first job; it took no account of housewives and pensioners hoping to find work to supplement their own or the family income, or of people trying to get better jobs. The number of young people in search of their first job varied from 500,000 to 670,000 according to various estimates, but even at the lower figure the country's failure to absorb its young people caused great concern to the commissioners. The worst features suspected before and confirmed by the inquiry were the large ertent of underemployment, particularly in agriculture, and the lack of any special qualifications by the vast majority of the unemployed. Only about 5% had had any kind of professional training, a lack acknonledged to be one of the chief obstacles to employment inside or outside the country.

TABLE VI.—*Employment*

figures for 1950 and 1953 were 48.5 and 56.54 respectively (1938 = 1). The main improvement in wages after World War II was, as elsewhere in western Europe, in the wages of the lowest paid workers.

Table VIII, which is based on calculations by Confindustria (the Confederation of Industrialists). demonstrates the change in the wage structure between 1938 and 1949. The rising cost of social contributions was often cited by employers as a stumbling block in the way of industrial development, with its consequent increase in the numbers employed.

For a comparison of wages and prices *see* below, *Finance*, Table XXV.

TABLE VIII.—*Average Daily Cost of an Industrial Labourer*
(In lire)

Year	A	Additional payments	Social contributions	Total
1938	18.40	1.01	2.03	21.44
	85.8%	4.7%	9.5%	100%
1947	741	131.64	213.35	1,085.99
	68.2%	12.1%	19.7%	100%
1948	966	179.68	328.67	1,474.35
	65.5%	12.2%	22.3%	100%
1949	982	182.65	397.12	1,561.77
	62.9%	11.7%	25.4%	100%

Social Insurance and Welfare Services.—Social insurances fall roughly into four groups: family allowances, much the most important; insurance for periods of difficulty (unemployment, accidents at work, illness in general and tuberculosis in particular); insurance for special occasions involving extra expenditure (marriages and births); insurance for the time when work is no longer possible (old age. disability and dependents after a worker's death). The legislation involved was begun early in the 20th century; enactments comprised workers' compensation (accidents), 1904; maternity benefits, 1910; unemployment, disability. old age. 1919; tuberculosis, 1927; family allowances, 1934; and sickness, 1939 and 1943. All these insurances were made applicable to workers and employees in industry, commerce and banking; all but unemployment insurance applied to agricultural workers. All were put on a contributory basis, plus treasury grants, but after June 1946 contributions were paid only by employers.

There is a great tradition of charity in Italy and there are a large number of charitable foundations. They include such institutions as day nurseries, orphanages, homes for beggars and homes for old people. Since 1862 all these foundations have been incorporated as juridical persons by the state, which has the right to inspect them, to audit accounts and to reorganize the foundations. There is a lack of co-ordination among the charitable institutions and between them and the more modern welfare services supplied by social insurance. Administration is in the hands of various independent agencies, some of them nation-aide (*enti* parastatali—semiofficial bodies), others provincial or local.

The Ente Comunale di Assistenza (the Commune's Institution for Relief) is the body which provides general assistance throughout Italy. Its general function is legally defined as that of giving direct and temporary assistance, including aid in money or in kind or in services. Specifically, it provides legal assistance, shelter and food for the homeless poor, help for minors and for the aged in institutions and emergency cash relief to people in temporary need.

Child welfare throughout the country is in the hands of the Opera Nazionale per la Protezione della Maternità e dell'Infanzia (National Association for the Protection of Mothers and Babies), founded in 1925. Its main work lies with expectant and nursing mothers and with babies under 6 years of age, and its methods are up-to-date and progressive. In 1952–53 it employed 7,320 consultant doctors and had under its control 317 nursery homes, 1.020 feeding centres for mothers and 35; homes for mothers and babies. Help was given to 351,000 women and to 1,548,000 babies and children.

Housing and Water Supply.—Many houses were damaged or destroyed by bombing and by the passage of the armies during World War II, and in the first years after the war practically nothing was done for working-class housing. In the large towns a certain number of luxury flats were built, but it was not until 1948 that a start with working people's houses was made on a small scale with the Fanfani plan, so called after Amintore Fanfani. the minister who introduced it. Many more homes were built thereafter by the government and by private enterprise, but a grave shortage still existed in the latter 1950s. Rural housing remained one of the urgent problems of southern Italy, where any scheme of agrarian reform involved the building of new houses for the

peasants settled on new holdings. The provisional housing figures given by the general census of 1951 showed a general figure for the whole country of 1.4 persons per room and 3.2 persons per house. The highest figure for regional capitals was found in the southern cities with their high birth rate and low standard of living; the number of persons per room was 2.2 in Naples and Bari, 2.5 in Matera and 2.; in Foggia.

Some of the most remarkable engineering feats by Italians, beginning in Roman times, are connected with water supplies. The remains of the aqueducts in the Roman Campagna are among the finest Roman monuments that survive. Northern Italy is in general reasonably well supplied from the rivers and from springs and deep wells, but great labour has been expended for centuries on a complicated system of irrigation. Rome is supplied by various aqueducts; the main one, the Marcia, is the successor of various older aqueducts and brings most of the city's drinking water from springs in the Aniene valley. It is in the southern regions of Apulia. Basilicata and Calabria and in Sicily and Sardinia that supply constitutes a grave problem. The rainfall in Apulia is meagre, and the limestone structure of the region lets most of the water percolate deep underground. where it cannot be reached. In Calabria, where the rocks of the high ground are impervious and the rain water runs off rapidly, there is severe summer drought and consequent water shortage. In Basilicata conditions are not quite so difficult, since there are fair springs; but there too the summer drought is severe. There are various important aqueducts in Basilicata, of which the chief is the Agri. In Apulia the problem has been largely overcome by the construction of the Apulian aqueduct, the largest in Europe; it nas begun in 1906, but the main duct was not completed until 1926 and the construction of branches and extensions nas still in progress in 1953. Water is brought from springs at Caposele, the source of the Sele river, on the Tyrrhenian side of the Apennines, and is carried by tunnels through to the Adriatic side. The main aqueduct is about 150 mi. long and is designed to supply about 2,000,000 people with 33 gal. of water a head per day.

In Sicily the water shortage is severe, and the problem of its supply is one of the first to be faced by land reformers. There are springs near the more permeable rocks, and tonns and villages grew up near them. But many villages are dependent on shallow wells worked by primitive methods, and in some districts drinking water has to be carried miles. Plans to increase the number of aqueducts could not be implemented without heavy expenditure.

Sardinia is even worse supplied. There is no spring rainfall, very little rain at all, and severe summer droughts when even the few considerable rivers nearly dry up. There are no large lakes except coastal lagoons and only three large reservoirs, one on each of the main rivers. (M. M. C.)

RELIGION

No inquiry about religious belief was made in the census of Nov. 4, 1951. In that of 1931, however, 41,014,096 Italians, or 99.6% of the population, described themselves as Roman Catholics. This must be assumed to be the total of those baptized into the Roman Catholic Church. Only about one-third of them attend Mass with any regularity, however. and only about one-tenth receive the sacraments at Easter; about 33% were still ready to vote at election time for Communist or Communist-supported candidates after they had been warned by the Holy Office, on June 30. 1949, that to do so was to incur excommunication *ipso* facto. Pet the almost universal admission of religious belief on the census forms of 1931 remained the best testimony to the profound attachment of the Italian people to the Catholic faith.

Legal Position of the Catholic Church. — The Lateran treaty of Feb. 11, 1929, which was confirmed by article 7 of the constitution of the Italian republic (see below), recognizes the Vatican City State as an independent and sovereign state and provides for its relations nith the Italian state, establishing an Italian embassy at the Holy See and a nunciature at the Quirinal. But the position of Catholics in Italy, as distinct from the position of the church,-still rests on Charles Albert's laws of 1848, as does the position of members of other religious communions. Article 1 of the Statute of the Kingdom of Sardinia, dated March 4, 1848, is reaffirmed in article 1 of the Lateran treaty, "by which the Catholic Apostolic and Roman religion is the sole religion of the State." By the same statute other cults were given the freedom which they still enjoy. The particular position of the Waldenses dates from the Edict of Toleration of Feb. 17, 1848, and that of the Jews from March 29 of that year. The position of the Catholic Church is regulated by the concordat which accompanied the Lateran treaty in 1929, of which article 1 gives the city of Rome a special character as the "centre of the Catholic world and place of pilgrimage," where the Italian government is obliged to prevent "whatsoever may be in opposition with its said character." Save in Rome and the suburbicarian dioceses (article 23), the names of those chosen by the Holy See for appointment as archbishops or bishops in Italy must by article 19 of the concordat be submitted in advance to the Italian government, in strict confidence, "so as to be assured by the same that it has no reason of a political character to offer against the nomination." Similar notice is given of parochial appointments, when the government has 30 days in which to lodge objection (article 21). All bishops take an oath of loyalty to the state (article 20) and must be Italian subjects speaking the Italian language.

The concordat restored to ecclesiastical institutions — that is, to all churches open for public worship and to all religious orders and congregations approved by the Holy See — the power of acquiring legal personality and made it possible again for them to be the owners of immovable property. By article 29 the state pledged itself to impose no special tax or levy on church property, and article 30 provided for the subsidy of clerical stipends by the state, to supplement deficiencies in ecclesiastical endowments.

Articles 3 and 4 give all priests and religious under vows exemption from military service (except that those not doing parish work may be required to act as chaplains in time of general mobilizationj and exemption also from jury service. Article 7 secures the seal of the confessional, article 11 gives state recognition to the major feasts of the church, and article 12 provides that there shall be prayers for the state in the churches on those days. Article 8 governs the position of priests offending against the civil law, articles 9 and 10 prevent the requisitioning or demolition of churches by the state and articles 13, 14 and 15 provide for the appointment of peacetime military chaplains.

By article 34 of the concordat the state recognizes the validity of Catholic marriage and its subjection to the provisions of canon law; nullity cases arc therefore reserved to the ecclesiastical courts, and there can be no divorce; but on the other hand marriages may also be celebrated before a registrar or by the recognized minister of some other religion, in which case they are not subject to canon lam.

"Considering the teaching of Christian doctrine according to the form received by Catholic tradition as the foundation and the crown of public instruction," the state agrees by article 36 of the concordat to permit religious instruction in the public primary and secondary schools and concedes to the bishops the right to appoint or dismiss those who impart such instruction and to approve the textbooks which they use. By article 5, no priest may be employed by the state, whether as a teacher or in any other capacity, without the permission of his bishop: and apostate priests and those subject to ecclesiastical censure cannot be so appointed or continued in their appointments; this official stigmatizing of former priests, who sometimes announce their adherence to another religion, is the legal background to incidents sometimes construed as acts of intolerance toward Protestants, whether on the part of the church, as in Milan in 1952, or on the part of the state. as in Naples in 1953.

Article 8 of the Lateran treaty provides not only that physical attempts against the person of the pope or provocation to such attempts but also "offenses and public injuries committed on Italian territory against the person of the Supreme Pontiff by discourses, acts and writings" shall be punished as they would be if directed against the head of the Italian state.

Administration of the Catholic Church in Italy. — As well

as being the head on earth of the Roman Catholic Church throughout the world, the pope is primate of the church in Italy and metropolitan archbishop of the Roman province. By recent custom, but not hy invariable rule, the archbishops of Bologna, Florence. Genoa, Milan, Naples. Palermo. Turin and Venice are members of the College of Cardinals; the last-named has had the title of patriarch since 1451. The dioceses were reduced in number in 1818, during the period of reform which followed the recovery of the papal states at the congress of Vienna, but they remain much more numerous than in any other country of the world. They were grouped into 18 *regioni conciliari* by a decree of the Consistorial congregation dated Feb. 15 and March 22, 1919, confirmed on Sept. 23. 1933.

Catholic Action. — Catholic Action, in Italy as elsewhere, dates from the pontificate of Pius XI (1922–39). Through it Catholics are increasingly encouraged to seek to influence public affairs, whereas before World War I the ruling advice for Italians was *non expedit (see* above, *History)*. The Italian state, by article 43 of the concordat, "recognizes the organizations dependent from Catholic Action, in so far as the Holy See has disposed that they carry out their activity outside any political party and under the immediate dependence of the Hierarchy of the Church, for the diffusion and exercise of Catholic principles." All Catholic priests are excluded by this article from "belonging to and fighting for any political party whatsoever."

Catholic Action, nevertheless, soon came into conflict with the Fascist regime, as described by Pius XI in the encyclical *Non abbiamo bisogno* of June 29, 1931; but a settlement was reached in the following September. After World War II the position was radically changed, with the emergence on the one hand of the Communists and on the other hand of the Christian Democratic party; and Catholic Action, while still formally nonpolitical, in fact played, under the leadership of Luigi Gedda, an increasing part in supporting the Christian Democrats. Its *contitati civici* were especially active in the months before the elections of May 1948. Before the elections of 1953 it broadened its approach somewhat, promoting the interests of certain other political groups as well as of the Christian Democrats.

Religious Minorities. — In parts of Calabria and Sicily there are local Catholic populations following the Greek or Byzantine rite, while remaining in communion with the see of Rome. They are the descendants partly of Albanian refugees of the 15th and 16th centuries (whence they are known as the Italo-Xlbanesi) and partly of Greek colonists of much earlier date. They have bishops of their own rite at Lungro in Calabria and at Piana dei Greci in Sicily. The title of *archimandritato del Santissimo Salvatore,* still held by the Latin archbishop of Messina, commemorates the greater importance which these groups had in the past. The Greek-rite monastery of Grottaferrata, in the Alban hills outside Rome, dates from the latter part of the 10th century and is the only monastery of the Eastern Church which has been continuously in communion with Rome through all the centuries of schism. In 1931, according to the census, there were 6,801 Greek Orthodox ("dissidents") in Italy and 83.618 Protestants; more than one-third of the total of Protestants were foreigners domiciled in Italy. The Waldenses (less correctly written as "Waldensians") are the most considerable element among the indigenous Protestants! although even they are French in origin and conducted their services in French until the latter part of the 19th century. Their church is Calvinist in character and counts about 30,000 adherents: mostly living in certain valleys of Piedmont to the west of Turin. At Torre Pellice, their headquarters, they maintain a college; they have a theological school and two churches in Rome. The Baptists number about 17,500, and the Methodists of the Chiesa Evangelica Metodista d'Italia (formed after World War II by the union of communities of British and American missionary origin) about 7,000. There is a small Lutheran community in Lombardy, largely of Swiss origin, and the Seventh Day Adventists and the Salvation Army are present on a small scale. It was estimated that there were about 30,000 Jews in Italy at the close of 1952; in 1931 there were 47,82j. About one-third of the Jewish community lived in Rome, and the remainder were concentrated in the industrial cities of the north.

The constitution of the Italian republic gave comprehensive juridical assurances to these religious minorities Religious confession does not affect the equality of all citizens before the law (article 3), and liberty of association (articles 2 and 18) and of assembly (17) covers religious purposes. The following provisions in particular are relevant. "All religious denominations are equally free before the law. Religious denominations other than the Catholic are entitled to organize themselves according to their own statutes, in so far as these do not conflict with the Italian legal order. Their relations with the State are governed by law on the basis of agreements with the respective representatives" (article 8); "Everyone has the right to make free profession of his own religious convictions in any form whatsoever, personally or as a member of an association, to advocate the doctrines thereof, and to practise its worship in private or in public, provided they are not rites which offend public morality" (19); and "The ecclesiastical character and the religious or ritual aims of an association or institution may not be the grounds for special legislative restrictions or special fiscal burdens imposed by reason of its constitution or legal capacity or any form of its activities" (20). Some members of Protestant bodies maintained that these guarantees were not always effectively implemented: but the fact that. for example, the Protestants were given broadcasting time on the state radio on Sunday mornings, even though they constituted a small minority, mas cited as evidence of an intention on the part of the state to treat them fairly. (M. DK.)

EDUCATION

The Italian educational system has always been highly centralized under the control of the minister of education. The state provides schools of every grade, and most of the universities are state universities with rectors appointed by the minister. Elementary schools are administered by the commune. which maintains them sometimes with help from the state; but for educational purposes even the elementary schools come under the district representative of the ministry, the *provveditore agli studi.* Secondary schools are directly under the ministry.

During the period of Fascist government from 1922 to 1943 two important education acts were put in force: the Gentile reform of 1923–24, so called after the chairman of the commission on education, the philosopher Giovanni Gentile; and the Bottai act or *Carta dellu scuola* (school charter), introduced in 1939 by the minister of education. Giuseppe Bottai. The Gentile reform laid donn the general lines of education; the Bottai act was largely concerned with the organization of different types of school and with the inculcation of Fascist ideas, particularly through the use of compulsory "readers." After 1945 much of this last act was swept away, but the general framework of schools, not unlike that of Great Britain, was retained.

Education from 6 to 14 years of age is compulsory; elementary education is free. But, though school attendance is legally compulsory, in some cases it is very irregular. The children are officially enrolled but sometimes only go to school for three or four months in the year, particularly in the country districts. This is true even in northern Italy in the mountainous areas, but it is much more marked in the south. nhere the teachers are badly paid and, above all, the housing problem often presents extreme difficulties. In the more remote villages of Calabria, where one small room with no windows may represent the school, the teacher may be unable to find lodging of any kind in the village and so may have to spend two hours travelling each way by the one bus in the day, nhich only allows the teacher to spend a short time with the pupils.

Elementary and Secondary Schools. — Elementary education proper begins at 6 years of age, but for younger children there are preparatory schools variously known as *asili infantili* (nursery schools). *scuole materne,* etc. These schools are not compulsory and are run by various private bodies and by the communes. The elementary schools consist of five classes and include some of the most interesting and progressive schools in Italy. Secondary education begins at 11 years of age and is not free though cheap,

but school books are expensive. Although schooling is legally compulsory until 14, the great majority of children (67% in 1952) leave school at 11 to start work. Those who continue go either into the *scuola media unica* where for three years they get a general education on academic lines. or into the *scuole di avviamento professionale,* schools with a professional bias, industrial, commercial, agricultural or nautical. From these professional schools the pupils can only go on to technical institutes. From the *scuola media* the pupils pass on to higher secondary schools. where the education lasts for five years (from 14 to 19 years of age). There are four main types of higher school: the *liceo classico* for classical and humanistic subjects; the *liceo scientifico* for mainly scientific study; the *istituto magistrale* for training teachers; and the *istituto tecnico-commerciale* for training students for technical and commercial posts. There are various other institutes which give special professional training; *e.g.,* agrarian and marine schools.

In addition to the state schools there are a large number of private schools, mostly Catholic schools run by the Jesuits, Benedictines, Salesians and other orders, to which most well-to-do children go. Private elementary schools can. by agreement with the *provveditore agli studi* of their area. obtain a form of state recognition and a subsidy from the education authorities, if they follow the state program of education. Private secondary schools can obtain state recognition known as *parificazione* (equalization) if they teach the subjects prescribed for the corresponding state schools. *(See* Table IX.)

TABLE IX.—*Elementary and Secondary Education, 1954–55*

Type	Schools	Pupils	Teachers
Nursery schools	14,875	1,052,050	27,828
Operated by the communes	4,018	313,659	8,122
Operated by religious bodies	4,658	350,133	9,337
Operated by private bodies	6,199	388,258	10,369
Elementary schools	41,943	4,655,992	178,591
State	35,764	4,299,561	164,593
Non-state (recognized, private, subsidized).	6,179	356,431	13,998
Secondaryschools	2,361	468,988	40,273
State	1,127	351,974	28,319
Non-state	1,234	117,014	11,954
Vocationalschools	2,460	490,553	41,339
State	2,038	449,632	36,384
Non-state	422	40,921	4,955
Higher classical, scientific and teacher's training schools	1,514	289,973	26,702
State	673	214,367	18,132
Eon-state	841	75,606	8,570
Technical institutes and institutes for girls	570	193,288	15,474
State	346	161,649	11,744
Non-state	224	31,639	3,730

Scuole **Popolari.**—Illiteracy has long been a sore point with progressive Italians. Although it had decreased steadily between 1871 and the illiteracy census of 1931, it was then still high in the southern regions and even in some of the central ones. Illiterates constituted 26% of the population in Umbria and the Marches, 39% in Apulia, 46% in Basilicata, 48% in Calabria and 40% in Sicily, with a total of about 7,500,000 (or 34% of the population), including 6,700,000 over school age. There was a serious increase in illiteracy as a result of World War II, but the desire to get rid of it was strong, not only among educationalists and politicians but among the people themselves. The so-called *scuole popolari* (schools for the people) set up in Dec. 1947, consisting of day and evening classes, were at first largely attended, particularly in southern Italy where the need for them was greatest. Unfortunately in the south suitable teachers were seldom forthcoming and for this and other reasons classes were not as well attended as had been hoped.

The Universities.— There are 21 state (excluding Trieste) and 5 "free" universities in Italy, besides the state university for foreigners (at Perugia) and a number of higher institutes which are reckoned to be of university standard. The state universities are those of Bari, Bologna. Cagliari, Catania. Florence, Genoa, Macerata, Messina, Milan, Modena, Naples. Padua, Palermo. Parma, Pavia, Perugia, Pisa, Rome, Sassari, Siena and Turin; the free are those of Camerino, Ferrara and Crbino. the Roman Catholic University of the Sacred Heart in Milan and the Commercial university of Milan. The number of university students was always large, and an enormous increase took place between 1930 and 1940. The number increased again after 1945. In the academic year 1947–48 there were nearly 180,000 students. But by 1954–55 the number was down to about 136,000 *(sc.* 136,458 in all, of whom 1.552 were at Trieste). Students enter the universities from the *licei* or *istituti tecnici-commerciali;* from the *istituti magistrali* they pass into the faculty of *magistero* (education) of the universities. In 1954–55 the students were divided among the various faculties and subjects as, follows: law, 28,863; economics and politics, 22,029; letters. including education, 23,203; medicine and surgery. 20,468; engineering and architecture, 15,731; science and mathematics, 20,861; pharmacy, 8,930; veterinary studies, 1,969; agriculture and forestry, 2.366; industrial chemistry, 2,075; various. 1,968.

The university course lasts from four to six years, and the student has to undergo a large number of examinations. Even when he has obtained his degree, he has to take the *esame di stato* (state examination) before entering any profession.

The universities are under rectors. There are four grades of teachers in the Italian as in other continental European universities. The lowest grade is that of the *assistenti* (assistants) appointed year by year by national competition or by the professors. The next grade, the *liberi docenti,* lecture and receive practically no pay. *Professori incaricati (i.e.,* entrusted with teaching) are appointed for one year by the universities with a low rate of pay. Full professors, *professori titulari,* are appointed by state competition on production of published work.

Academies. — The 15th, 16th and 17th centuries saw the foundation of many academies. where groups of students and patrons of the sciences discussed the new art and learning. The most famous, the Accademia dei Lincei, was founded in 1603 by Federico Cesi of Rome and tno other young men, Francesco Stelluti of Fabriano and Anastasio de Filiis of Terni, for the study of the mathematical physical and natural sciences. It included among its members most of the great scientists of the time, both Italian and foreign, prominent among them Galileo. Cesi's death in 1630 put an end to the academy's activities; various attempts were made to revive it, but none were successful until 1847, when Pope Pius IX restored it as the Pontificia Accademia delle Scienze — Nuovi Lincei. In 1870 a separate branch was established under the patronage of the crown, the Reale Accademia Nazionale dei Lincei. In 1875 the Reale Accademia established a second class of membership for the study of the moral sciences, history and philology. In 1929 the Fascist government set up a new academy, the Reale Accademia d'Italia, with magnificent premises in the Palazzo Farnesina The aim of the new academy was to supplant the old academies. especially the Lincei. which had shown signs of independence. In 1939 the Lincei were fused with the Reale Accademia d'Italia. On Sept. 28, 1944, the Reale Accademia d'Italia was suppressed by Bonomi's government and on the same date the Accademia Nazionale dei Lincei was re-established. It established two classes of members as before (72 Italian members, 72 corresponding members. with 72 foreign members). and possessed a valuable library; its headquarters at mid-century were in the Palazzo Corsini in Rome.

Libraries and Museums. — These are numerous in Italy, those even of small cities being often rich in manuscripts and valuable works. Statistics collected in 1893–94 and 1896 revealed the existence of 1,831 libraries. either private (but open to the public) or completely public. The public libraries were enormously increased after 1870 by the incorporation of the treasures of suppressed monastic institutions, but suffered seriously from lack of funds during and immediately after World War I The richest in manuscripts is that of the Vatican, especially since the purchase of the Barberini library in 1902; it contained about 53.000 manuscripts at mid-20th century. The Vatican archives are also of great importance. Most large towns contain important state or communal archives; the various societies for local history in the various regions of Italy (Società di Storia Patriaj do good work and issue valuable publications. The treasures of the archives were by no means exhausted in the early 1950s. The private archives of the great families often contain documents of the highest interest. Li-

braries and public archives were placed under the superintendence of the ministry of public instruction. A separate department of this ministry under a director-general was given charge of antiquities and fine arts, making archaeological excavations and supervising those undertaken by private persons (permission to foreigners, even to foreign schools. to excavate in Italy was rarely granted) and maintaining the numerous state museums and picture galleries. The exportation of works of art and antiquities from Italy without leave of the ministry was forbidden. An inventory of those objects, the exportation of which could in no case be permitted. was prepared. The ministry had at its disposal a fund for the purchase of important works of art of all kinds. (See also LIBRARIES.)

GOVERNMENT, LAW AND DEFENSE

On June 2. 1936, the Italians voted by 12,718,641 against 10,-718.502 in favour of replacing the monarchy by a republic. and on June 28 Enrico de Nicola became the provisional president of the Italian republic. A constituent assembly drew up a new constitution to replace the old constitutional statute of 1848 which had been amended almost out of recognition but never abolished by Mussolini, and on Dec. 22 adopted the new constitution by 452 to 62 votes. It was promulgated on Dec. 27, 1947, and came into force on Jan. 1. 1948.

Constitution. — The Italian constitution is a rigid one which can only be revised by a lengthy procedure. The drafting commission was determined to secure a system of parliamentary democracy and to prevent unconstitutional developments of the Fascist type. Also, like many modern constitutions. the Italian constitution includes provisions which cannot strictly be considered as constitutional, particularly those covering social and labour legislation. The revulsion against interference with individual liberty resulted in the large number of articles which lay donn fundamental principles regarding the rights of man, equality of all men before the law, the inviolability of personal liberty and of the home and freedom of speech, of assembly, of religion and of the press. Two of the general provisions are of special interest when viened in the light of the history of Italy. Article 6 states that the republic will protect linguistic minorities and Italian constitutional jurists maintain that the term republic covers not only the state or central authority but also the regions, provinces and communes This is an important undertaking in a country where the German and Yugoslav minorities mere badly treated between 1919 and 1939. Articles 7 and 8 define relations betueen church and state. Article 7 says: "The State and the Catholic Church are each, in its own order, independent and sovereign. Their relations are regulated by the Lateran Pacts [of 1929]. Modifications of the Pacts which are accepted by both parties do not require the procedure of constitutional amendment" So other modern constitution contains any similar provision, which involves a revision of the constitution if church or state desires to repudiate the concordat. Article 8 states that all religious confessions are equally free before the law and that confessions other than the Catholic have the right to be organized according to their own statutes insofar as they do not conflict with the Italian legal order. By the early 1950s the Protestant churches of Italy had already complained that their rights under this clause were being ignored.

The constitution can be revised but only by a constitutional law adopted by each chamber of parliament in two successive meetings at intervals of not less than three months. An absolute majority is required in each chamber on the second vote. Revision can be subject to a referendum like other laws. But one thing is not subject to constitutional amendment — the republican form of government.

Article 1 of the constitution affirms the principle of popular sovereignty: "Italy is a democratic republic based on work. Sovereignty belongs to the people. who will exercise it in the forms and within the limits prescribed by the Constitution." The sovereignty of the people is secured by the establishment of universal, adult suffrage, exercised both in elections to parliament and in the referendum, this last being one of the new features of the constitution. The centre of the constitution is parliament, which consists of tn-o chambers with equal powers: the chamber of deputies and the senate. These meet in joint session in certain cases provided for by the constitution: for the election or impeachment of the president of the republic; for the impeachment of ministers; and for the election of one-third of the members of the supreme council of the judiciary.

Legislative power belongs to the two houses collectively; legislation can be initiated by the government. by members of either house and by bodies on which it is conferred by constitutional law (this provision was regarded by the drafting commission as applying to the national economic council and to the regional councils which were to be set up). The people may also promote legislation by presenting a draft bill supported by at least 50,000 electors. Bills can be initiated in either chamber and must be approved by both before being promulgated by the president of the republic. who has the right to request a fresh deliberation by the chambers but must promulgate the law if it is approved a second time. A referendum for the abrogation of a law (other than laws dealing with taxation! the budget, amnesties or the ratification of international treaties) must be held if it is asked for by 500,000 electors or by five regional councils. Special attention is paid by the constitution to the subject of decree laws. It was largely by the use of decree laws that the Fascists imposed a totalitarian system on Italy within the framework of the constitution of 1848. Under the constitution of 1948 the government map not issue decree laws without the previous consent of parliament; if in case of extraordinary necessity the government adopts measures having the force of lam, it must on the same day present them for conversion into law by the chambers. which must be specially convened for the purpose if they have been dissolved. Parliament authorizes the ratification of international treaties and approves the national budget.

The position and powers of the president of the republic are carefully defined. The makers of the constitution were conscious of the danger of conferring executive power on the president, but at the same time they felt the need for a stabilizing and unifying influence and did not wish to make the president a mere figurehead. The president is elected for seven years by secret ballot at a joint session of both chambers and must obtain a two-thirds majority of the votes. He is head of the state and commander of its armed forces; he announces the holding of new elections and can dissolve one or both chambers; and he promulgates laws, declares war, has the right of pardon and presides over the supreme council of the judiciary. Rut the president does not govern. No act of his is valid unless confirmed by the ministers proposing it, who assume responsibility for it, and he cannot be held responsible for any act taken as president — except in a case of high treason or attack on the constitution. in which case he must be impeached before a joint session of parliament.

Executive power lies with the government which consists of the president of the council and of the ministers, who together constitute that council. The president of the republic nominates the president of the council and, on his advice. the ministers. The government must have the confidence of both chambers, and comment by Italian constitutional lawyers on this provision indicates that they regarded this requirement as establishing the responsibility of ministers to parliament. One of the weaknesses of the constitution of 1848 was its failure to establish responsibility to parliament. It merely said that ministers were responsible, not to whom they were responsible.

The president of the council decides on the general line of policy and is responsible for it; the ministers are collectively responsible for the acts of the council and individually for those of their own ministries.

Provision is made for what are called auxiliary organs: the national council for economic affairs and labour; the council of state for questions of law and administration; and the court of finance. All of these are advisory bodies, though the first has also the power to initiate legislation.

One important new organ of government set up in 1948 was the constitutional court, empowered to give decisions on the constitu-

tional character of laws and of acts having the force of law emanating from the state and the regions. The court decides in cases of conflict between the powers of state and region and between region and region and also in cases of impeachment of the president of the republic or of a minister. It consists of 1j judges. one-third nominated by the president of the republic, one-third by parliament sitting jointly and one-third by the supreme judicial bodies. The judges are to be nominated for 12 years, being chosen from the magistrates of the higher courts, professors of law and lawyers who have practised for 20 years.

Electoral Law.—According to the constitution both houses, the chamber of deputies and the senate, are elected by universal, direct suffrage. The chamber of deputies has one deputy for every 80,000 inhabitants, the senate (elected on a regional basis) one senator for every 200.000. Men and women of 21 and more years of age may vote for the chamber, those over 2j for the senate; deputies must be 25 years of age, senators 40; the chamber is elected for five years, the senate for six. Former presidents of the republic become senators for life, as do five senators nominated by the president of the republic for their outstanding contributions to the social. scientific, artistic and literary life of Italy.

The decree of Feb. 5, 1948. adopted for election to the chamber a system of proportional representation with voting for a party list. There were 32 multiseat constituencies, and every voter could indicate his preferences regarding individual candidates within that list; 530 deputies were to be elected in constituencies and 22 seats would be divided among the parties under a national pooling system (*collegio* unzco *nazionale*).

The decree of Feb. 6, 1948, concerned with election for the senate, combined proportional representation with uninominal constituencies. Besides the 237 elected senators the first senate of the republic was to include, exceptionally. 107 senators by right (senatori di dtritto), their qualifications being that they were former prime ministers. former presidents of the chamber or former deputies who suffered more than five years' imprisonment for their opinions under the Fascist regime.

The electoral law promulgated on March 31, 1953, revised the decree of Feb. 6. 1948, by stipulating that a party or a group of allied parties receiving an absolute majority of 50.1% of the poll would be allotted 65% of the seats in the chamber. The electoral system for the senate remained unchanged, but the senators by right disappeared after the election of June 7, 1953.

Local Government.— The republic is divided into regions, provinces and communes. The most important innovation introduced in 1948 into the structure of the state was the establishment of self-governing regions. "autonomous bodies (*enti*) nith powers and functions of their own in accordance with the principles laid down by the Constitution." In 1861, when Camillo Cavour died, his successors were absorbed by the difficulty of securing the recently non unity of Italy and were afraid to venture to introduce any measure of local autonomy. The French system of rigid central control of local government through the prefects of the provinces, which had not worked too badly in the small kingdom of Piedmont-Sardinia, was ill-adapted to the varying needs of the different districts of united Italy. Mussolini, however, found this centralized system admirably adapted for securing a stranglehold over the country. In consequence the opponents of fascism were determined to secure a large measure of decentralization and of local self-government.

The Region.—The name region (regione) is not new: certain statistical and other information had always been given under the headings of the various regions—Piedmont, Tuscany, Sicily, etc. It had been, however, merely a convenient name for a group of provinces carrying no implication of administrative or legislative functions. Under the constitution of 1948, 19 regions were established—Piedmont, Valle d'Aosta, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria, the Marches, Latium, Abruzzi e Molise, Campania, Apulia, Basilicata, Calabria, Sicily and Sardinia Five of these regions, Sicily. Sardinia, Trentino-Alto Adige, Valle d'Aosta and Friuli-Venezia Giulia, belong to a different category from the rest. Each of the other 14 regions was intended to have a statute of its own containing regulations to bring into force a system of government on the general lines laid down in the constitution; and these statutes were to be approved by an ordinary law of the republic. The statutes of the five special regions are less restricted and had therefore to be adopted by the passing of a constitutional law; they can only be amended by the procedure laid down in the constitution for constitutional revision. The first four special regions obtained their statutes on Feb 26. 1948; but since the future of Friuli-Venezia Giulia was felt to depend on that of Trieste. this region was treated as an ordinary region in the years following 1948.

The constitution gave the regions power to promulgate statutory legislation on definite subjects of local interest; *e.g.*, the organization of local police, the provision of public assistance and medical services, town planning and local communications. Their power to administer this legislation was limited, for there was no desire to have local administration centralized in the region any more than in the state. In cases of exclusively local interest national legislation could confer administrative power on the provinces. communes or other local bodies; and in all cases the region was normally intended to function administratively through the provinces and communes. It was also intended that the regions should have financial autonomy, and the constitution made special provision for the needs of the poor regions by laying down that the regions would not only have certain taxes assigned to them but would receive a quota of the general national taxation in proportion to their needs. In addition the constitution specifically provided for additional financial help in cases involving extraordinary expenditure, such as the development of the south and of the islands.

The official bodies of all regions were to be a regional council to exercise legislative and administrative powers; a giunta or executive committee; and a president to represent the region, promulgate its laws and direct administration. A commissioner of the government was to reside in each region and co-ordinate the administrative functions of the state with those of the region. By the end of 195j no elections to regional councils had been held, so that the regions as autonomous bodies with legislative and administrative functions still only existed on paper. Local government continued to be carried on by the smaller autonomous bodies, the provinces and the communes. which were described in the constitution as being also (*i.e.*, as well as the regions) "areas of national and regional decentralization."

The Commune.—According to the 1951 census there were 7,810 communes. Every square inch of Italy forms part of a commune, which may vary in size from a tiny village to a great city with more than 1,000,000 inhabitants. such as Rome or Milan. All, whatever their size, have the same administrative bodies and all are responsible for certain services: local police, public health, lighting, fire precautions and local public works. The funds of the commune come either from the possession of land and buildings or from various taxes, the chief of which is the *imposta di consumo* (commodity tax). All citizens 21 and more years of age living within the commune can vote in both communal and provincial elections. After Jan. 1946 elections were based on proportional representation in communes with a population of more than 30.000 and in provincial capitals even if their population was less than 30.000; in other communes election is by majority vote with certain special provisions intended to secure representation of minority groups. The organs of government are the mayor (sindaco), a council and an executive committee (giunta), all elected.

Tlze Province.—In 1951 there were go provinces, artificial creations of united Italy, which did not correspond to the old areas existing before 1861. The province has a dual character: it is an area of the state and, as such, the seat of various local administrative agencies of the central government; and it is also an autonomous local body with the duty of providing for local interests. Each province therefore has two sets of officials and administrative bodies. The prefect, the chief government official, is a high-ranking, salaried civil servant. appointed by a decree of the president of the republic on the recommendation of the min-

ister of the interior with the approval of the whole cabinet. He is charged with administering national legislation and the decrees of the ministries and, although primarily responsible to the minister of the interior, is also the local representative of all other ministries. He also has the task of supervising everything which concerns public security and enjoys the right to use the police and to call upon the help of the armed forces of the state. Justice, the armed forces and the railways are exempt from his direct control. All deliberations of the communal council and executive are submitted to the prefect, who can annul any decision of the commune or the province that he may judge to be contrary to the law. The prefect is assisted by a council *(consiglio di prefettura)* of three members, paid officials, presided over by himself or his deputy. They also preside over a committee (*giunta provinciale amministrativa)* consisting of two members of the council and four members elected by the provincial council *(see* below). All contracts entered into by the communes or provinces involving more than a small sum are supervised by the council, and the administration of their real property is watched over by the committee.

The local provincial organs of government are the provincial council (*consiglio provinciale*), an elected body varying in size according to the size of the province, and its executive committee (*deputazione provinciale).* The council has charge of public buildings and other property belonging to the province and must provide for poor relief and public health. for provincial roads and bridges and their upkeep and for certain public works. The funds of the province come partly from property in land and buildings, partly from taxation, partly from loans.

Justice.—Italian law is fundamentally based on Roman lam; but it also owes much to French law, and Italian lawyers have been greatly influenced by French juristic literature and by the decisions of the French court of cassation. The development of a unified system of justice was not easy in a country where the administration of justice had been so varied before 1870. but the influence of France, exerted through Piedmont, was a strong unifying element in the late 19th-century codes, on which the Italian system of justice was based. Immediately after World War I a group of distinguished Italian lawyers was appointed to draw up new codes, which were issued as the Codici Mussoliniani. New codes for criminal law and procedure came into force in June 1931; the new civil code. which included commercial law (formerly incorporated in a separate code), the code of court procedure and the navy code came into force only in April 1942. In theory the new codes were supposed to further "Fascist justice"; in fact they were the outcome of years of work by eminent Italians. Certain articles, such as those which had made strikes and lockouts illegal, were deleted after the destruction of the Fascist regime, and the Italian parliament continued to discuss various other reforms; but by the latter 1950s it seemed likely that, with some amendments, the codes would remain.

The main lines of the theory and practice of the administration of justice are laid down by the constitution of 1948. which devotes a whole chapter to the subject. Experiences under Fascist government showed how important it nas that the judiciary should be independent. The constitution accordingly states that "justice is administered in the name of the people; the judges are subject only to the law." The judiciary is an autonomous order independent of all others. and the judges cannot be removed. Judicial functions can only be exercised by ordinary magistrates. No extraordinary or special courts can be set up, as they were under Fascist rule.

Italian lawyers and politicians are divided on the question of the desirability of trial by jury. The constitution provides (article 102) for the creation of special sections of the ordinary courts to deal with particular subjects, in which sections ordinary citizens not belonging to the magistracy can take part; and for the definition by law of this direct share by the people in the administration of justice. Some lawyers hold that the provision makes it possible to introduce juries. but the minister of justice maintained in 1950 that the later article of the constitution (article 111), which states that the reasons for all jurisdictional decisions must be given *(motivati),* implies the rejection of the jury system with its plain decision of yes or no.

The Legal Profession.—There are two separate branches of the legal profession in Italy, and they are not interchangeable. The one branch is strictly legal and consists of *avvocati* (advocates) and *procuratori* (agents). Except in the lowest courts the *procuratore* is in charge only of the preliminary procedure and pleading is done by the *avvocato.* Both act as solicitors or barristers and a professional lawyer may be both a *procuratore* and an *avvocato.*

The other branch of the profession is the judicial. The magistracy is a part of the civil service, and advancement in the career is by competitive examination, although seniority is taken into account for some of the highest posts. The magistrates rise in rank from the *giudici conciliatori,* who correspond roughly to the British local justices of the peace, through the *pretori* and the judges of the *tribunali* and the *corti d'appello* to those of the supreme court, the *corte di cassazione;* the highest post is that of the first president of the *corte di cassazione.* Responsibility for the administration of justice belongs to the minister of justice, and for this purpose the country was divided into 17 judicial divisions and subdivisions, which differ from the ordinary areas of communal and provincial administration.

Courts.—The lowest civil courts are the local *uffici di conciliazione* (offices of conciliation), each presided over by a *giudice conciliatore* (local justice of the peace) who deals with minor cases involving sums of not more than 10,000 lire. Much stress is laid in Italy on the importance of conciliation. and normally 80% of disputes are settled in these courts or in those of the next grade, the *preture.* These courts are held in each large district or *mandamento* (there are more than goo) and are each presided over by a single *pretore* (corresponding to a British stipendiary magistrate), whose competence extends to cases involving sums not exceeding 100,000 lire. The next highest courts are the *tribunali,* each of them with a bench of three judges; and above them are the *corti d'appello* (courts of appeal), each nith a bench of five judges. These *corti* usually deal with appeals from the *tribunali,* but they may also sit as courts of first instance. There are *corti d'appello* in 22 large towns: Genoa, Turin. Milan, Brescia, Trento, Venice, Bologna, Florence, Ancona. Perugia, Rome. Aquila, Naples, Bari, Lecce, Potenza. Catanzaro, Messina, Catania, Caltanissetta, Palermo and Cagliari, and a subsidiary court in Reggio di Calabria.

The decisions of these *corti d'appello* are final on points of fact, but appeals on points of law may be taken from the *preture,* the *tribunali* and the *corti d'appello* to the supreme court, the *corte di cassazione* in Rome.

Minor criminal offenses involving imprisonment or restriction of the personal liberty of the offender for a period of less than three years are dealt with by the *pretore* sitting as a single judge in his court. The *tribunali* have a bench consisting of a president and two judges and consider appeals from the *preture;* the *corti d'appello* have a bench of four judges and have appellate jurisdiction to review sentences pronounced by the criminal divisions of the *tribunali.* In addition there are the *corti d'assise* which act as courts of first instance in cases of major crimes and felonies involving life sentences or long terms of imprisonment. They consist of a mixed bench of three professional and five lay judges, these last being chosen from a panel of men nho possess certain educational qualifications. Appeals from sentences delivered by the *tribunali* and the *corfi d'assise* can be taken to one of the two criminal divisions of the *corte di cassazione,* nhich, as in civil cases, acts as the supreme court in cases involving points of law but not of fact. Each division has a bench of seven judges, and they can combine to form a *sezione unita.*

Penalties and Crime.-The death penalty was abolished in 1877 but restored by the Fascists in 1926 for certain crimes against the safety of the state (in particular for attempts on the life of the king or of Mussolini). It was again abolished by article 27 of the constitution of 1948. In Jan. 1948, in consequence of this decision. death sentences mere altered to life sentences, and life sentences to imprisonment for 30 years. The practice of *confino,* or confinement to remote places on the mainland or to small is-

lands like the Lipari, which was used for political prisoners, was abolished in Dec. 1948.

There are various kinds of prisons as in other western countries. *Carceri* giudiziarie (judiciary prisons) are used for persons awaiting examination or under arrest and for prisoners undergoing short sentences. Persons serving sentences up to six months are usually in district prisons (*carceri* giudiziarie *mandamentali*), those serving sentences up to two years in central prisons. The other large class of prisons are knonn as *stabilmenti* di *pena* ordinari (ordinary places of punishment) and *stabilmenti* speciali The first include convict prisons (ergasfoli); the special prisons are those for habitual offenders and for prisoners sentenced to hard labour, as well as prisons for minors under 18. In addition there are the *stabilmenti* per *le misure amministrative* di *sicurezza detentive* (places for administrative security measures), nhich include agricultural colonies, institutions for criminal lunatics. etc.

Table X shows the prison population, from 1947 to 1953.

TABLE X.—*Prison Population*

Type of prison	1947	1949	1951	1953
Carceri giudiziarie	50,104	39,410	32,545	16,866
Stabilmenti di pena ordinari e speciali	13,287	16,178	14,527	11,394
Stabilmenti per. le misure amministrative di sicurezza detentive .	2,782	3,127	2,987	2,993
Total	66,173	58,715	50,059	31,253

Statistics show that the incidence of crime was considerably higher after World War II than in 1939. The biggest increase was in crimes of personal violence, which numbered 153,813 in 1948 and 167,002 in 1949 as compared with 119,037 in 1939. Cases of theft amounted to 369,891 in 1948 and to 312.481 in 1949, as compared with 230,890 in 1939. Murder figures for 1949 were double those of 1939. But crimes of violence had always been common and years of underground warfare encouraged the tendency.

Defense.—The Italian army grew out of the old Piedmontese army, which had played a major part in the unification of Italy. The law of 1875 introduced conscription for every able-bodied Italian but, chiefly for financial reasons, only a proportion of the available recruits were drafted; in 1906, for instance, of 475,737 liable for service, 122,557 were physically unfit and only 87.493 were conscripted. Under the law of July 17, 1910, the Italian army mas organized in 2j divisions, each consisting of four regiments of infantry; there were also three divisions of cavalry. The army comprised 96 three-battalion regiments of infantry, 12 of bersaglieri (riflemen) and 8 of *alpini;* 29 regiments of cavalry; and 51 regiments of artillery, including two of mountain and 10 of fortress artillery. At the beginning of 1914 the peace strength of the army was 15,123 officers and 289.910 other ranks. By the end of World War I, in which Italy participated from May 24, 1915, it mas estimated that 5,068,000 men had been mobilized. The navy, which in 1914 had a peacetime strength of 1,987 officers and 38,000 other ranks, had 114,000 men mobilized at the end of World War I.

Between World Wars I and II five new infantry and two new alpine regiments were formed and new three-regiment divisions created. The artillery was reorganized and expanded, and by 1938 there were 72 regiments including j of mountain and 5 of anti-aircraft artillery. In May 1940 the army comprised 20 divisions with about two-thirds of the necessary armament and training and another 20 divisions at half strength. The air force, created by the royal decree of Jan. 24, 1923, comprised about 1,200 aircraft in May 1940, one-sixth of them out of date. The navy at the beginning of World War II had 6 battleships. 22 cruisers, 61 destroyers, 71 torpedo boats and 105 submarines. The period of compulsory service was 18 months but, as before, there were frequent reductions of service and exemptions. The total of efiectives budgeted for in 1935, for instance. was: in the army. 17,500 officers and 234,300 other ranks in the home country and 2,500 officers and 65,600 other ranks in the colonies; in the air force, 25,800 officers and airmen; in the navy, 64,000 officers and sailors.

After World War II Italy's military position was strictly defined by the treaty of Paris in 1947. The treaty compelled Italy to destroy or remove all frontier fortifications within a distance of about 12 mi. of the French and Yugoslav frontiers; ordered the demilitarization of Pantelleria and the Pelagie Islands (Lampedusa. Lampione and Linosa) between Sicily and Tunisia and of Pianosa in the Adriatic; and strictly limited the maintenance of naval installations and fortifications in Sicily and Sardinia.

The strength of the armed forces was limited by the treaty to 300.000. as follows: army, 250,000, including frontier guards and 65,000 carabinieri (police); navy, 25,000; air force, 25,000, including combat, service and overhead personnel.

Strict limits were also imposed on Italy's possession or construction of war matériel. The number of heavy and medium tanks nas limited to 200, the air force was limited to 200 fighter and reconnaissance aircraft and to 1jo transport. air-sea rescue, training (school type) and liaison aircraft. Naval armaments were also limited. The total displacement of vessels held by Italy might not exceed 67,500 tons. and only the folloning units were allowed to be retained. 2 battleships (the "Andrea Doria" and the "Caio Duilio"), 4 cruisers, 4 destroyers, 16 torpedo boats, 20 corvettes. 35 mine sweepers, 8 vedettes and a number of small auxiliary vessels.

The radical postwar changes in the alignment of powers quickly transformed the former enemy into an ally of the western democracies. Italy became in 1949 a founder member of the North Atlantic Treaty organization. The military clauses of the Paris treaty nere not formally revised because the U.S.S.R. refused its consent; but they were actually alloned to lapse, and the only limit to Italian rearmament was determined by finance.

By 1955 Italy mas divided into 11 military regions (the so-called *Comiliter*) and had 10 infantry divisions, 5 *alpini* brigades and 3 armoured divisions. The air force territorial organization comprised four zones (Milan, Padua. Rome and Bari) with tno additional commands for Sardinia and Sicily. There were about 400 first-line aircraft; 15 squadrons were assigned to the 56th NATO tactical air force. The navy had 2 battleships (disarmed), 3 cruisers, j destroyers, 17 frigates and escort vessels, 23 corvettes, 59 mine sweepers. 52 motor torpedo boats. 6 gunboats, 2 submarines and 163 small auxiliary vessels. There were seven territorial navy commands. Military service was compulsory for a period of 18 months. Total effectives of the armed forces amounted in Jan. 1955 to 433,000; *i.e.,* 353,000 in the army (including 60,000 carabinieri or military police), 38,000 in the navy and 42,000 in the air force. Expenditure on defense increased from $482,000,000 in 1949 to $835,000 000 in 1953, but the proportion of the total budget expenditure remained about 24%.

ECONOMY

Italy's natural resources are scanty both for agricultural and for industrial purposes. Much of the country is rocky and mountainous or marshy, and soil fertility is mainly the result of the laborious work of centuries. Industrial resources are limited, and the absence of coal and iron in any quantity was particularly hampering in the early stages of industrialization.

Italy has only two important assets: an abundance of cheap labour and of skilled craftsmen and a reasonable amount of hydroelectric power. For employment and unemployment see under Population above.

AGRICULTURE AND FISHERIES

In spite of the growth of industrialization agriculture remains by far the most important Italian economic activity. According to the census of 1936 Italy had a rural population of about 18,500,000 out of a total population of 43,000,000, and 47% of the employed population were engaged in agriculture. (The sample inquiry made by the Italian Institute of Statistics in 1952 showed about 42.5% still engaged in agriculture.) These figures for the whole country show neither the high proportion of agricultural workers in the south (*e.g.,* 74.5% of the employed population in the Abruzzi and 75.4% in Basilicata) and even in central Italy (64.7% in Umbria and 66.7% in the Marches) nor the much loner proportion in Lombardy (only 28.6%) with its fertile land and high yields.

A great part of Italy is either arid and mountainous or marshy and hitherto malarial, but even so more than two-thirds of the land is under cultivation or pasture, and less than 8% is considered to be totally unproductive. In spite of a dearth of good land Italian farmers supply the greater part of the country's food requirements and contribute largely to its exports (approximately one-third before 1940 and one-quarter in 1953). Table XI shows agricultural land use between 1929 and 1954.

TABLE XI.—*Land Use*
(In hectares)

	1929	1948	1950	1954
Arable	12,752,977	12,954,100	13,050,000	13,186,905
permanent grassland	6,016,718	5,404,400	5,147,000	5,166,554
Specialized tree and bush	2,279,949	2,329,000	2,405,000	2,515,675
Forests*	5,563,398	5,503,200	5,620,000	5,745,506
Productive but uncultivated	1,925,598	1,566,700	1,535,000	1,101,083
Otheruaes	2,469,592	2,345,200	2,346,000	2,342,841
Total	31,008,232†	30,102,600	30,103,000	30,119,164

*Including sweet chestnut. †1931.

Land reclamation has gone on for centuries in Italy. where large areas of mountainous or hilly land have been made reasonably productive by the industry of the Italian farming population. Great parts of the Po valley were reclaimed in the 19th century, and the nork was still going on in the second half of the 20th. After World War I plans were made for co-ordinating public and private reclamation works. *Bonifica integrale* (integral reclamation) was the name given to land-reclamation plans under nhich owners were obliged to improve land reclaimed with state aid and a rural population was to be settled on it. By 1940 some progress had been made with reclamation in the Po delta. in Tuscany (in the coastal plain known as the Maremma) and in the Pontine marshes. Cnder the much-publicized scheme for the Pontine marshes an area of about 80.000 ha. (300 sq.mi.) was drained, roads. farms and villages mere built and about 3.000 peasant families brought from all over Italy and settled on farms of from 10 to 20 ha. (from 25 to 50 ac.).

Land Tenure and Farming Methods.—Italian farming displays great variety of method and tenure. It includes at one end the industrialized farming on a large scale of the Lombard plain and the Apulian tableland, which uses agricultural machinery and large numbers of paid employees, and at the other the primitive village economy of Sicily and the Abruzzi, where the hoe and sickle are the chief tools used, the traditional rotation of crops is still practised and the corn is threshed by animals. In the main, the chief characteristic of Italian farming is its intensive nature both on small holdings and on large commercial estates; but extensive farming still prevails in the Roman Campagna, in Basilicata, Calabria and Sicily.

About one-third of the 8,000,000 persons engaged in agriculture own their land, and more than 90% of the owners work the land themselves. Italy is therefore sometimes described as a land of peasant proprietors, but the description is misleading. About 8.000.000 holdings (or 83% of the total number of 9,700,000) are less than 2 ha. (5 ac.) and in all only occupy 13.7% of the agricultural land, while 53.7% are under ½ ha. and occupy only 3.2% of the land. These dwarf holdings are found all over the country but particularly in the mountainous districts, where their miserably poor owners eke out a wretched living by working as day labourers on the larger farms. At the other end of the scale farms of more than 50 ha. (125 ac.), which number only 0.6% of the total, occupy nearly half of the agricultural land of Italy. Altogether only about 3.4% or 333,000 farms are of more than 10 ha. (2 j ac.), but they cover about two-thirds of the farmland.

Large *Farms*.—Large farms of 100 ha. (250 ac.) and more are found chiefly in the Po valley, in Xpulia and in Sicily. In the Po valley farming is industrialized, machinery is used and large numbers of day labourers (*braccianti*) and labourers with yearly contracts (salariati) are employed. Irrigation, particularly in the lower valley of the Po, is of extreme importance. The chief products are maize, rice and dairy produce. The big industrialized farms of Apulia produce great quantities of wheat and olives grown as specialized crops. Farming there is precarious and requires a considerable amount of capital. Apulia is a limestone country with scarcity of water? and arable farming is something of a gamble. Specialized olive growing also needs capital. for the trees often produce nothing for several years at a time. besides taking about 30 years to mature. Many of the Apulian farms are owned by absentee landlords who employ a large number of day labourers; unemployment and temporary migration to other regions are common. The large properties of Sicily had not been industrialized by the middle of the 20th century. These are the famous *latifondi,* the subject of complaints since Roman times. They are mainly owned by absentee landlords who either let them out in tiny plots at high rents or have them worked by labourers. Extensive cultivation was long the rule all over the interior of Sicily, but after 1945 great schemes of agrarian reform were put forward for Sicily as for Italy as a whole.

The Mezzadria Tenancy.—There are cash-tenancy farms, especially in northern Italy, but the most common form of tenancy is the *mezzadria* (share tenancy), which is found almost everywhere but is prevalent in Emilia. Tuscany, Umbria and the Marches. Rather more than one-fifth of those engaged in agriculture are share tenants. The tenancy is based on a yearly contract; though in practice the same family has often farmed a particular piece of land for generations. The landlord provides the house, the seed and other things as fixed in the varying contracts and receives in return a share of the crop; this used to be a half, as the name mezzadria implies, but in 1946 the shares of landlord and tenant were fixed at 47% and 53% respectively. The tenant's position was made more secure by legislation after World War II. However, he is not a responsible tenant farmer, but cultivates his land in accordance with the orders of the landlord, who also decides when crops and livestock should be sold.

Agrarian *Reform*.—After World War II agrarian reform was one of the main concerns of the Italian government, particularly reform in southern Italy. where social and political conditions made prompt action as distinguished from planning essential. A large general measure of reform came under the consideration of the Italian parliament in 1948. and work was begun under a special law in the Sila (the high plateau in Calabria) and the adjoining lands on the Ionian sea coast and in certain of the most depressed agricultural areas of Italy where unemployment was severe (*e.g.,* in the Po delta, in the Maremma in Tuscany and in large parts of Apulia and Basilicata) under what is known as the *stralcio* (interim) law, whereby action could be taken while the slow process of discussing the general reform went on. Under the stralcio law about 500.000 ha. (1,235,000 ac.) were to be confiscated (compensation being paid to owners). reclamation was to be carried out where required and the land divided into peasant holdings. By 195j this measure of reform was well under way and was proving to be one of the most interesting social experiments ever undertaken. For the first time the peasants of the south saw practical measures to help them being started by the central government.

Cereals.—Cereals are Italy's chief crops, and wheat is the most important. Wheat is a staple crop, on every type of farm and in every kind of soil and climate, both in the hills and on the plains. It is the primary foodstuff of the people, being used for pasta (macaroni, etc.) as well as bread. Both financial and political reasons Icd Mussolini to encourage wheat production and so to reduce the burden of an import of nearly 2,500,000 metric tons a year; and by 1939, as a result of great effort, production had reached his goal of 8,000,000 metric tons. The area under wheat rose slightly, but the increase was attained largely by the use of more intensive methods of cultivation, particularly by deep plowing. seed selection and the use of fertilizers. Italian governments after World War II were especially anxious to encourage wheat growing in view of the heavy dollar cost of imported wheat, and one of the difficulties of putting into effect agrarian reforms was the unjustified fear of reducing production. The chief wheat-growing regions are Emilia. the Veneto, Lombardy, Apulia and Sicily. About one-seventh of the whole wheat area is in Sicily, but Sicily's annual production is about. 440,000 metric tons less than that of Emilia because of the low yield. The average wheat yield for the whole country—1.95 metric tons per hectare in 195j—is lower

than that of France or of Great Britain, but much of the wheat is grown in mountainous areas and in combination with vines or olives.

The other two important cereals grown are maize and rice. The two chief maize-growing regions are Lombardy and the Veneto, which together produce half the country's maize. Rice is grown in Piedmont and Lombardy, where the Po and its tributaries make it possible to flood the fields; before 1940 these regions produced more than three-quarters of Italy's total average of nearly 800,000 tons. which was more than two-thirds of all the rice grown in Europe. Rice production in 1953 had risen to more than 900,000 metric tons, and 242,000 were exported as compared with an average annual export for 1936–39 of about 150,000. See Table XII.

TABLE XII.—*Main Crops*

Crops	Area sown (000 hectares)			Production (000 metric tons)		
	1934–38	1948–52	1953–55	1934–38	1948–52	1953–55
Wheat	5,040	4,705	4,797	7,254	7,170	8,604
Maize	1,458	1,253	1,258	3,000	2,306	3,121
Rice	142	149	175	753	725	898
Oats	428	469	448	539	495	559
Barley	193	251	247	212	253	294
Rye	105	97	87	141	133	133
Potatoes	400	392	394	2,626	2,732	3,238
Sugar beets	115	168	224	2,879	4,590	7,159

Citrus Fruit, Olives and Vines.—More than 2,500,000 ha. (more than 6,000,000 ac.) are given over to tree and bush crops, which constitute an important element in Italy's domestic economy, both for domestic food supplies and as a valuable item in the export trade. Citrus fruits, particularly lemons, are a valuable source of foreign exchange and are mainly grown in the south and in Sicily. The average production of Sicily for 1953–55 was 362,500 metric tons of oranges and 286,400 metric tons of lemons. The other most valuable tree crop is the olive, since the oil largely takes the place of other fats in the Italian diet; little butter is eaten except in the north.

Olives grow everywhere, but particularly in Apulia, which produces more than twice as much olive oil as any other region. Italy, with an average of 274,280 metric tons for 1951–55, was second only to Spain as a producer of olive oil. Vines are also grown everywhere, sometimes alone but frequently in combination with other crops (particularly in Emilia, the Veneto and Tuscany, where wheat or other cereals are grown under the vines). In Italy wine is not a luxury but an essential item in the diet of the people. There are many varieties of wine, but the only ones exported in any quantity are Marsala (from Sicily), Chianti (from Tuscany) and vermouth. See Table XIII.

TABLE XIII.—*Miscellaneous Agricultural Production*

(In 000 metric tons)

Crops	1934–38	1948–50	1953	1954	1955
Wine*	58,090†	40,830	52,540	50,474	58,581
Olives	1,267	1,280‡	2,011	1,720	1,150
Olive oil	213	217‡	346	284	181
Citrus fruit	748	814	1,011	862§	1,070
Tobacco	43.8	75	68.3	66.1	72.3
Hemp fibre	89.6	71.2	63.5	41.8	34.0

*000 hectolitres. †Average of three years. ‡1947–52 average. §Excluding limes.

Vegetables.—Potatoes are grown all over the country but especially in the Po valley, in Campania and in the Abruzzi (though the yield in the last two regions is much lower than that in the north). There is a considerable production of early potatoes. Other vegetables are also grown everyhere and thanks to the seasonal varieties of climate in different parts of Italy, can be produced profitably throughout the year. The leguminous vegetable crop for 1953 amounted to 363,300 metric tons from 100,000 ha. (250,000 ac.). Tomatoes are one of the most important vegetable crops and are grown particularly in Emilia, Campania and Sicily; 1,617,400 metric tons were produced from 97,000 ha. (241,000 ac.) in 1955. Attention, however, had to be given to the improvement of methods of production. packing and transport, since out-of-date methods kept costs high and stultified Italy's natural advantages as an exporter.

Industrial Crops.—Sugar beets are grown in northern and central Italy, particularly in the Veneto and in Emilia (see Table XII). Italy is self-sufficient but the per capita consumption is one of the lowest in Europe. Tobacco is cultivated in every region except Liguria and the Valle d'Aosta; production rose greatly after World War II (see Table XIII), leaving a large quantity for export. Hemp of a fine quality is grown mainly in Emilia and Campania and is exported in considerable quantities; after the G.S.S.R.. Italy is by far the biggest European producer. Before 1940 Italy was the largest producer of ram silk in Europe. Large numbers of mulberry trees, on which the silkworm feeds, are grown in the northern plain (about 76% of the raw silk came from Lombardy and the Veneto), along the Adriatic coast in Tuscany and in Calabria. Low wages, Japanese competition and, above all, the competition of artificial fibres led to a decline of 25% in the number of mulberry trees and of 30% in the output of silk between 1028 and 1938. Production of cocoons dropped from about 45,000,000 kg. in 1928 to an annual average of 38,000,000 for 1936–39 and remained at a still lower figure after 1945, amounting to only 9,639,000 kg. in 1955.

Livestock.—The mountainous districts all over Italy provide great stretches of rather poor pasture, suitable mainly for sheep and goats; *e.g.*, in Calabria, Apulia, Basilicata and particularly Sardinia, where 63% of the farmland is rough pasture. In Trentino-Alto Adige, the Veneto and Piedmont there are fine alpine pastures suitable for cattle, which are there bred mainly for milk and cheese. The country is desperately short of fodder. Practically all the good meadowland is in the north, and the only regions producing fodder in any quantity are Lombardy, the Veneto and Emilia.

The shortage of fodder accounts in part for the small number of cattle in Italy, and their distribution provides a good example of the great differences in the agriculture between region and region. In 1953 about 61% of the cattle were to be found in Piedmont, Lombardy, the Veneto and Emilia, and only in these four regions mas there a reasonably high density of cattle to agricultural land, averaging 70 cattle to 100 ha. (247 ac.). The average density for the whole country was 32 per 100 hectares (247 ac.), but the average for the southern regions was only 13, with a maximum of 19 in Campania and a minimum of 5 in Apulia. In the north there are large herds of dairy cows; in the south before the coming of the land reform cattle were bred primarily for work, not for milk or meats. One of the chief features of the reform is the introduction of milk cows.

There are sheep all over the south and in the islands; in Sardinia there are nearly 2,400,000, approximately one-quarter of the total for Italy. Sheer, are bred mainly for meat and also for milk, from which large quantities of cheese (Pecorino) are made. They are an important element in the rural economy, but in some cases their prevalence is an obstacle to agrarian reform. There are large numbers of goats in Sicily and Sardinia, but they were fewer in 1950, for example, than they had been 30 years before. Horses, mules and asses are bred chiefly in the south, though Lombardy has far more horses than any other region. Italian agronomists are well aware of the need to increase the country's livestock and supplies of fodder. Despite the serious depredation of livestock that Italy suffered in World War II, the numbers of livestock, except horses, asses and mules, were in 1953 well above those of

TABLE XIV.—*Livestock*

Livestock				1954
Cattle	9,875,000	10,141,700	10,002,000	9,746,400
	7,879,000	8,381,200	8,694,200	9,032,600
	3,303,000	3,512,200	4,215,100	3,744,800
	1,867,000	2,254,600	2,113,000	1,797,500
Asses		773,200	760,100	724,100
Horses		768,600	733,800	669,300
Mules		393,200	397,900	401,900

Livestock	1939	1951	1952	1954
Sheep	9,875,000	10,141,700	10,002,000	9,746,400
Cattle	7,879,000	8,381,200	8,694,200	9,032,600
Pigs	3,303,000	3,512,200	4,215,100	3,744,800
Goats	1,867,000	2,254,600	2,113,000	1,797,500
Asses	789,000	773,200	760,100	724,100
Horses	781,000	768,600	733,800	669,300
Mules	432,000	393,200	397,900	401,900

countries bordering the North Atlantic. In 1952, for instance, Italy's fisheries (including fresh-water fish) produced 192,000

metric tons. as compared with France's 468,000, Germany's 663,000 and the United Kingdom's 1,106,000. But among Mediterranean countries Italy has the largest fisheries. Landings in 1955 were 194.748 metric tons (*cf.*, 181.200 in 1938).

The proportion of the population dependent on fishing is. however, comparatively high. The 1937–39 industrial census gave 93.891 persons (including 6.389 in Venezia Giulia and Zara), or 0.47% of the occupied population. as engaged in the fishing industry, uhich comprised 53,194 establishments. The industry is on a small scale, equipment is somewhat primitive and the return for labour expended small. Fishing is mainly confined to a narrow coastal zone seldom more than ten miles wide, except in the northern Adriatic and off Sicily. Sardinia and Tuscany. The most important catches consist of small fish. particularly sardines and anchovies, caught chiefly off Istria and Sicily. except for the tuna or tunny fish, which is caught in considerable quantities, mostly off the coasts of Sicily and Sardinia, though also on the Tuscan and Campanian coasts. Some tuna is eaten fresh locally but the bulk is preserved in oil. The Italian fisheries do not supply all the needs of the home market; from 1950 to 1953 about 24,000 metric tons of fish were imported annually, mostly salt cod and stockfish.

The Italian fishing fleet in 1954 comprised 47,094 vessels. with a tonnage of 149,102, as follows: 2.800 steam and motor vessels (73,141 tons); 5,868 sail and auxiliary motor vessels (20,948 tons); and 38,426 sailing vessels (55,013 tons).

POWER AND MINERAL RESOURCES

Electricity. — Hydroelectric power, Italy's "white coal," is by far its most important natural industrial resource, and it was the development of hydroelectric technique that made the expansion of Italian industrialization possible. An unusually high proportion of the power used in industry is electrically applied, and 81% of the electric energy generated comes from water, about three-quarters of it from the Xlps.

The power system is based on an exchange of current between the different regions. In the north the water supply is most abundant during the summer months, nhen the snow melts in the Xlps; in central and southern Italy. where the rivers are smelled by the winter rains, the supply is greatest in the winter. These fluctuations are met partly by the use of reservoirs, partly by the widespread use of long-distance high-tension transmission.

Having acquired the province of Alto Adige (South Tirol) under the peace treaty of 1919, Italy invested a large amount of capital in the development of the hydroelectric capacity there. By 1940 nearly one-eighth of Italy's total production of hydroelectric poaer came from the region of Trentino-Alto Adige. the poner station at Cardano near Bolzano being the largest in the country (the importance of this power to the industry of the northern plain was one of the main arguments put forward in favour of the retention of the province of Bolzano by Italy during the Paris conference of 1946). A great increase in the number of power stations and in the production both of hydroelectric poner and thermoelectric power took place from 1948. See Table XV.

TABLE XV.—*Electricity: Installed Power and Production**

Item	1929	1938	1948	1950	1953	1954
Installed capacity						
Hydroelectric (000 kw.) .	3,350	4,900	6,307	7,168	8,874	9,330
Thermoelectric (000 kw.) .	738	980	1,201	1,395	2,398	2,465
Productinn (000,000 kw.hr.) .	10,380	15,544	22,694	24,681	32,619	35,574†

*Including that of industrial establishments. †38,124,000,000 kw.hr. in 1935.

As is the case with other industries, the south falls far behind the rest of the country. Geographical conditions, made worse by deforestation and by the failure to systematize the torrential rivers, have largely deprived it of hydroelectric power. The Italian government was, however, well aware of this deficiency, and a comparison of the 1948 and 1954 figures for the southern regions showed that considerable progress had been made. While 75% of all power stations and 75% of the installed power were still in the north (compared with 11% and 13% respectively in the south), the number of power stations in the south was nearly three times as great in 1954 as in 1948 and the amount of installed power had increased from 618,701 kw. in 1948 to 1,242,003 kw. in 1954.

The total amount of electricity consumed in 1952 was distributed as follows: to manufacturing, mining and building industries, 65.7%; to traction, 8.6%; to lighting, 9.3%; to agriculture, 1.3%; to domestic and public use other than lighting, 7.7%; other, including industrial heating, 7.4%.

The electric-power industry is mainly in private hands. Concessions for the development of water power, over which the state claims domain, were granted to companies for fixed terms of years; all power stations are subject to state regulation. The majority of stations are in the hands of large combines, such as the Società Edison and the Società Meridionale, and the monopoly thus created is one of those most bitterly attacked in Italy.

Minerals. — Italy's mineral resources are small; the only important deposits are those of bauxite, mercury. sulphur and iron pyrites. The contribution made by mercury and sulphur to Italy's economy is not of the highest importance since the quantities, values and amount of employment involved are small. Italy's chief lack is coal. A small amount of anthracite is mined in the Valle d'Aosta and about 1,000,000 tons of low-grade coal are produced annually in Sardinia. The Arsa coal field in Istria. which by 1940 was producing 2,000,000 tons of poor coal every year, was taken from Italy under the treaty of 1947. Lignite output, mostly from Tuscany, amounted to about 2~000,000tons a year by 1940. In 1953 the output of coal and lignite together came to about 1,900,000 tons. Italy imported about 12,000,000 tons of coal before World War II and about 9,000,000 in 1953.

The most important mineral is probably bauxite. Under the peace treaty of 1947 Italy lost the valuable bauxite and mercury mines in Istria, but there are large bauxite deposits at Gargano (Apulia) and in the Abruzzi, in Latium and in Campania; average output before 1940 amounted to about 370,000 tons annually (*i.e.*, about 9% of the world total), and, though in 1949 output was only about one-third of that quantity, it was increasing steadily and by 1953 had reached over 272,000 tons. The important mines in Monte Amiata, south of Siena, produced about 45% of the world's total output of mercury before 1940; and by 1953 production amounted to 1,769 tons, about three-quarters of that of 1938 and 36.5% of world output. Before 1940 the sulphur mines of Sicily and Emilia had a European monopoly of sulphur, when production amounted to about 13% of the total world output; later the cost of production and the need to modernize the mines limited output, which in 1953 was not much more than three-quarters of that of 1938.

Iron pyrites are mined in Tuscany, and before 1940 annual production amounted to nearly 1,000,000 tons. Besides supplying the Italian sulphuric acid and iron industries, pyrites before 1940 provided a valuable contribution to the export trade, chiefly to Germany and the Netherlands. By 1950 the home demand was greater than before World War II and although nearly 85,000 tons were exported 123,000 tons were imported. Production increased steadily after 1946 and reached 1,225,368 tons in 1953. The zinc and lead ores of Sardinia are of some importance. Most of the lead is smelted in Italy, but before 1940 more than half the zinc ore was exported, chiefly to Belgium. Small quantities of iron ore are mined in Elba and at Cogne in the Valle d'Aosta.

Before 1940 some authorities held that considerable quantities of mineral oil existed in Italy's subsoil, and after 1945 work went on in the Po valley; some oil was found, but by the latter 1950s output was still negligible, though experts were hopeful that the Sicilian deposits might prove valuable. Important developments, however, took place during and after World War II in Italy's output of methane gas; 17,000,000 cu.m. of gas were produced in 1938; the amount had risen to 117,000,000 cu.m. by 1948 and to 3,624,000,000 cu.m. by 1955. Almost all the gas was produced in the Po valley, uhere a network of methane ducts was constructed.

Italy is well supplied with stone for all building requirements; the quarries of white and coloured marble are famous, especially the Carrara quarries. But the demand for marble for export declined greatly after 1929 and remained low after World War II.

According to the industrial census of Nov. 1951, 96,439 persons, were employed in 6,196 mining and quarrying establishments.

TABLE XVI.—*Mineral Production*
(In metric tons)

Year	Coal and lignite	Iron ore	Pyrites	Zinc and lead	Bauxite	Mercury (mineral)	Sulphur
1938	2,358,514	990,043	930,312	268,341	360,837	195,523	380,345
1948	2,092,506	548,717	836,245	193,763	153,711	103,952	173,646
1951	2,054,923	552,851	898,186	277,922	174,014	174,662	200,549
1952	1,945,740	812,066	1,140,790	300,114	265,546	184,990	236,439
1953	1,905,898	933,375	1,225,368	275,442	272,228	197,498	227,757
1954	1,712,400	1,065,183	1,231,700	309,927	295,082	232,055	226,596
1955	1,551,600	1,348,579	1,289,187	323,326	325,962	232,013	201,661

Table XVI shows the output of Italy's mines before and after World War II.

MANUFACTURING INDUSTRIES

The census of 1936 showed that 5,375,152 persons, 29.3% of the employed population, were engaged in industry (including mining, building and certain occupations such as entertainment). The sample inquiry of 1952 showed nearly 6,000,000 or 30% of the employed population engaged in industry. The most important industrial area is the northern plain, where the supply of electric power is good. transport easy and capital readily available; moreover, communications with western Europe are less difficult than from other parts of the country and the people are skilful and open to new ideas. There are other important industrial centres in Tuscany, in Campania around Naples and in Apulia around Bari. The numbers employed in industry in the various regions differed greatly; e g, in Lombardy 47.5% of the employed population as compared with less than 20% in the Marches and Calabria. In 1936 the average for the eight northern regions was 35%, for the four central, 25%, for the five southern, 22%, and for the islands, 23%.

The industrial census of 1951 gave the number of industrial establishments (including mining, quarrying, building, electricity and the distribution of gas and water, and also fishing) as 711,554 (including 58j.657 artisan establishments) and the number of persons employed in them as 4,830,479 (92j.222 in artisan establishments). A large amount of industry was always carried on in small workshops and the census showed that in 1951 the proportion of firms employing less than 50 persons was 98% and that of those employing less than 10 persons 94%. The number of joint-stock companies rose from 6,850 in 1922 to 20,809 in 1938; nevertheless, they constituted only about one-thirtieth of Italian firms (employing about one-sixth of the total of workers in industry, commerce, transport and finance); by 1951 their number had increased to 26.731 employing 2,210,000 workers.

Table XVII gives details of the manufacturing industries according to the industrial census of 1937–39 and that of Nov. 1951.

TABLE XVII.—*Size of Manufacturing Industries*

Industries	Establishments		Persons employed (000s)		Installed power (in 000 h.p.)	
	1937–39	1951	1937–39	1951	1937–39	1951
Food	292,906	69,355	574.5	358.0	948.2	1,494.8
Tobacco	...	541	...	55.8	...	14.6
Leather and skins	123,804	6,352	215.5	37.8	66.1	110.4
Textiles	36,789	36,359	628.6	647.6	869.3	1,213.7
Clothing	168,451	216,712	308.7	413.7	30.3	76.6
Wood	123,162	110,744	283.6	287.2	210.0	541.5
Paper	1,992	1,817	56.1	59.1	219.3	419.9
Printing	11,510	6,996	70.1	76.6	42.5	75.9
Motion picture and phonograph	64	5,415	2.1	10.7	5.4	5.7
Metallurgy	549	694	103.6	150.4	984.0	1,792.7
Metalworking	100,128	124,523	823.0	920.2	1,161.7	2,074.7
Manufacture of nonmetallic minerals	19,417	15,852	206.8	201.2	389.0	727.3
Chemical	6,981	5,434	127.9	219.6	548.3	1,261.5
Rubber	...	1,618	...	43.9	...	198.2
Miscellaneous	3,401	3,681	117.4	52.9	121.2	80.7
Total	...	606,093	...	3,534.5	...	10,088.2

Metallurgy and Metalworking.— The iron and steel industry is severely handicapped by lack of fuel and raw materials. About one-third of the steel output in 1938 came from Italian-produced pig iron and ferroalloys, the remainder from scrap, of which again only about one-third was home-produced and the rest imported either already broken or in the form of ships for breaking up. Recovery of the industry after 1945 was slow (see Table XVIII). The main steel-manufacturing centres are Genoa. Turin. Milan, Cogne (in the Valle d'Aosta, where local iron ores and anthracite are. used), Piombino (opposite Elba), Portoferraio (Elba), Terni (Umbria) and Naples. The chief producing firms are Ansaldo, Ilva, Terni and Fiat.

The aluminum industry, based on Italian bauxite, is the only considerable exporter among the metallurgical industries. By 1939 output amounted to 34,000 tons (about 5% of the world's total). By 1953 it was up to 55,500 tons, but the high cost kept both home consumption and export low. The chief smelting centres are at Porto Marghera (Venice), Bolzano and Mori (Lake Garda).

The chief branches of the metalworking industry before 1940 were concerned with motor vehicles, shipbuilding, armaments and electrical engineering. The general trend of the industry was toward amalgamation and high-quality production, and great parts of the industry mere under the control of two firms—Ansaldo of Genoa on the heavier side (for shipbuilding and armaments) and Fiat of Turin (for motor vehicles, agricultural machinery and aircraft). The motor industry was much the most important and showed great power of recovery after 1945; in 1953 production amounted to 709,418 vehicles, or nearly ten times the highest pre-war figure of 75,106 vehicles (1937). See Table XVIII.

In 1938 Italy had the fourth largest European merchant fleet —the sixth in the world (see under *Transport and Communications,* below)—and most of its ships had been built in its own yards, but much of the shipping was obsolete, as Italian shipbuilding never recovered after the economic crisis of 1931. The gross tonnage of merchant ships built in 1938 mas only 94,000 (after several years of still lower output); cf., 165,000 tons in 1931. Italy lost about three-quarters of its merchant shipping during World War II, and great damage was done to the shipyards, but by the end of 1949 much had been done to restore and modernize the shipyards and 87,043 tons of shipping had been launched during the year (see also Table XVIII). By that time, moreover: partly as a result of the receipt of Liberty ships from the U.S., the tonnage of mechanically propelled shipping mas only about 500,000 less than in 1941, and that of sailing vessels 20,000 less. By 19j3 the tonnage of mechanically propelled shipping had risen to 3,611,500, a 24% increase on that of 1945.

The production of electrical equipment was important before 1940 in view of the steady development of hydroelectric power. By 1949 the industry was again well under way and general prospects were good because, apart from the growing home market, there mas a considerable foreign demand; about 50% of the rotary machines and high-power transformers produced were exported.

The 1950s saw a rapid growth of light engineering. Index numbers of the output in 1948 of typewriters, sewing machines and calculating machines were 131,140 and 567 respectively (1938=100) and for 1951 they mere 254, 245 and 1,144. See also Table XVIII.

In general, however, the metalworking industry as a whole was still suffering in the 1950s from the disorganization caused by the cessation of arms production (particularly that of military aircraft) and from high-production costs.

The Chemical Industry.— The chemical industry has been largely influenced in its development by the abundance of hydroelectric power and by domestic supplies of salt and sulphur and is closely linked with the development of agriculture. Artificial fertilizers, which are among the industry's main products, have played an important part in the improvement of agriculture, and after 1945 efforts were made to step up their output; by 1953 they had reached 3,170,200 tons, an increase of 60% on 1938. Another important product is sulphuric acid, for which the main ram materials, pyrites, zinc blende and sulphur, are found in Italy. See Table XVIII. Most of the industry was under the control of the Montecatini combine.

Textiles.— The textile industry is, as it has been for centuries,

important, but there has been a change in the relative importance of the different textiles. The silk industry, which used to be the most important, suffered a rapid decline after World War I; the output of raw silk was nearly halved between 1920 and 1929. The dependence of silk production on cheap labour and the competition of Japan and, above all, of artificial fibres brought this about in spite of a government subsidy. The same tendency was visible after World War II. In 1949 only about 1,000,000 kg. of raw silk were produced; cf., more than 3,000,000 kg. in 1939. It is an industry of small firms and the chief centres are Milan and Como.

Cotton is quantitatively the most important of the Italian textile industries. Before 1940 the number of spindles—approximately 5,500,000—was only about one-seventh of that of Great Britain, but a higher proportion of the product was exported. Italian exports of cotton yarn and piece goods were equal to about one-third of those of Great Britain by weight, and Italy was the greatest producer and exporter of cotton goods in Europe after Great Britain. Most of the raw cotton is imported; a small amount is grown in Sicily. It is an industry mostly of small firms supervised by the Istituto Cotoniero Italiano. The main areas of manufacture are Piedmont, Lombardy and Naples, and in 1937–39 about 250,000 workers were einployed in the industry. By 1950 the industry had recovered from the effects of World War II, the output of yarns was higher and of piece goods not much lower than in 1938 and the export of both was higher; but it must be noted that in 1938 both production and export were much less than they had been in the period 1926–29.

The woollen industry is widely distributed over the country, but the big factories are at Biella in Piedmont and at Prato in Tuscany near Florence. About 70% of the raw material is imported, and most of the output is used in the home market. By 1950, though there was great need of modernization, the industry was rapidly recovering its prewar efficiency; the number of spindles had risen from 1,200,000 in 1938 to more than 1,500,000 and the number of power looms was much the same as in 1938, about 22,000. By specializing in fashion goods of imaginative design, a large quantity of which was exported by the latter 19jos (60%–70% of the output at Prato). the woollen industry adapted itself to changing needs better than the cotton and silk industries. Fine-quality cloth, comparable with the best Bradford worsteds though not competitive in price, was increasingly in demand both abroad and by the developing Italian fashion houses. The latter also relied largely on the techniques of hand weaving, the produce of small, specialized firms.

The artificial-fibre industry advanced rapidly during the 1930s, and by 1939 Italy's output of cellulose fibres was about 14% of world output. Italy was the third largest producer of staple fibre, coming next to Germany and Japan, and the fourth largest producer of continuous filament. About half the production was exported. The industry recovered rapidly after 1945, and in 1950 output of fibres amounted to about 103,000 tons (cf., 123,000 tons in 1938) and was equal to 6.3% of world output. The export of artificial fibres and textiles in 1949 was still only about two-thirds of that of 1938; but by 1950 it had surpassed it, and the contribution so made to the country's commercial balance was important. Ownership of the industry was concentrated in a few firms, the most important being that of Snia Viscosa.

TABLE XVIII.—*Industrial Production*
(In ooo metric tons, unless otherwise indicated)

Item	1934	1938	1948	1953	1954	1955
Pig iron	582	929	526	1,309	1,345	1,734
Crude steel	1,832	2,323	2,101	3,594	4,212	5,388
Aluminum	12.8	25.8	32.6		57.6	68.4
Cement	4,092	4,608	3,353	7,836*	8,760*	10,584
Sulphuric acid	774	1,076	975	1,549	...	...
Textiles:						
Cotton yarn	171	139	178	166.8	169	...
Cotton fabrics	103	93.8	112.6	107.9	115	...
Rayon filament yarn	38.9	46.0	47.7	53.2	63.2	64.2
Rayon staple fibre	9.8	73.5	17.9	53.1	61.7	67.0
Motor vehicles:						
Passenger (000 units)	...	59.0	43.1	143.0	180.7	230.9
Commercial (000 units)	...	10.0	16.3	31.6	36.2	38.5
Scooters, etc. (000 units)	...	...	...	385	420	440
Light engineering:						
Sewing machines (000 units)	...	...	...	410	430	443
Typewriters (000 units)	...	...	...	183	223	280
Calculating machines (000 units)	...	...	...	83	98	129
Ball bearings (000 metric tons)	...	...	5.7	10.6	9	10.9
Shipbuilding. (000 gross registered tons)	27	94	112	262	162	167

*90%–93% of total production.

TRANSPORT AND COMMUNICATIONS

Roads.—The road system of Italy is based on the system of roads built by the Romans in the latter part of the republican period and under the early principate. Many of the modern roads (*e.g.,* much of the Via Emilia and the Via Appia) are built on the line of the old roads, and many others follow the same general course. During the middle ages many of the Roman roads fell into disuse, and the development of the modern system took place, as in other countries, only with the coming of motor traffic, which increased so rapidly after 1920.

There are three categories of roads, state, provincial and communal, apart from the new motor highways, the autostrade, which were copied by the German *Autobahnen.* In 1954 the length of the state roads was 24.811 km., of the provincial 40.996 km., and of the communal 105,395 km., making a total of 171,202 km. This total gives an average of j69 km. to 1,000 sq.km. of land and 354 km. to 100,000 inhabitants. The provincial and communal roads are the responsibility of the provinces and communes respectively, though contributions may be made by the state for construction or upkeep. The cost of roads is largely met by taxes on road users. The *autostrade* were built, owned and operated by private companies, whose revenue mas derived from tolls and advertisements.

On the whole, main road communications are good. Many of the roads pass through difficult country; but even secondary roads are well engineered though the surface may be poor. The quality of the roads and the extent of the network deteriorates from north to south of the country. Whereas the length per 1,000 square kilometres in 1954 was 848 km. in Piedmont. 868 in Lombardy and 1,023 in the Veneto, it was only 364 in Apulia, 279 in Basilicata, 337 in Sicily and 196 in Sardinia. In the regions of the south and islands there was great need of more local roads in the early 1950s; the main roads were generally adequate but many of the smaller places were almost inaccessible. (In Basilicata, for instance, there were 1,213 km. of state roads, but only 417 of communal roads.)

After World War II road repairs were a heavy burden, particularly in the regions where actual fighting took place. The Italians showed great capacity and energy in facing the problem, so that 7,182 km. of damaged or destroyed state roads had been repaired and 2,968 bridges rebuilt or repaired by the end of 19j1.

Vehicles.—The number of motor vehicles registered, still small by British standards. nas nevertheless higher by 1954 than it had been before World War II. There were in circulation 744,299 motorcars, 2,271,136 motor bicycles. 9,175 buses and 329,588 trucks, besides tractors of various kinds. The bus services were greatly developed after 1945, both the ordinary country bus services and the so-called services of *gran turismo,* which by 1950 covered about 81.000 km., using comfortable long-distance buses.

Railways.— The labour of restoring the Italian railway system after World War II was immense. In 1938 the total length of track was 22,955 km.; by 1945 one-quarter of this length had been destroyed. Honever, 21.852 km. of line were in use by 1954, of which 16,570 belonged to the state railways and 5,282 to private companies. The most vital repairs needed were those to an enormous number of bridges and viaducts; the damage to iron bridges alone was estimated to cover about 3j km., including the total destruction of the great bridges over the Po at Piacenza. Pontelagoscuro. Borgoforte and Mezzanacorti. In addition about 59 km. of tunnels had been blocked and 90% of the electrified lines destroyed. By 1954, however, 7,723 km. or one-third of the nhole system had been electrified (cf , 6,640 km. in 1938), and more electrification was promised. The loss of engines. signal arms and signal-box levers was also great during the war: 56% of the steam locomotives, 67% of the electric locomotives and 85% of light self-

contained units such as electric rail cars. By 1953 prewar standards had been nearly reached, but there was not enough equipment for the needs of the 12,800,000 more passengers carried per kilometre than before 1940. In 1954, 59,010,000 tons of goods (excluding cattle) were transported by the railways (12,981,000 tons per kilometre) as compared with 63,100,000 tons (11,400,000 tons per kilometre) in 1939. Costs were kept low in comparison with the cost of living and with those of other European countries, and the old differential tariffs which gave reductions for long-distance travel were retained. These reductions were important for the economic development of southern Italy, with its few ports and indifferent roads.

Merchant Marine. — Shipping occupies an important position in the Italian economy partly because of the country's central position in the Mediterranean and partly because of the long coast line which encourages local trading by sea. By 1939 the Italian merchant marine, excluding its considerable tonnage of sailing vessels, ranked sixth among the world's merchant navies, being surpassed only by those of Great Britain, the United States, Japan, Norway and Germany. It consisted of 1,293 ships of more than 100 tons totalling 3,290,484 tons. This fleet had been reduced by the end of World War II to about 300,000 tons, mainly small vessels engaged in the coastal carrying trade. Reconstruction started nith the United States' offer of Liberty ships, 50 of which were made available in 1947; damaged ships were repaired, wrecks were salvaged new ships were built and by the end of 1950 the tonnage of mechanically propelled ships of more than 100 tons had risen to 3,600,640 (including those of Trieste) and the total merchant marine, including sailing ships. to 3,722.471 tons. Italy again held sixth place among the world's merchant navies with 3.7% of the shipping. There was a change in the composition of the fleet. liner tonnage amounted to 25% of the total before 1940, to 15.5% in 1950; and ordinary cargo boats, which accounted for 50% of the tonnage before 1940, accounted for 65% in 1950. By Jan. 1, 1956. the total tonnage of mechanically propelled vessels of 100 gross tons and over had risen to 4,040,476, and that of the total merchant marine, including sailing ships. to 4,108,809.

Great damage was done to the docks between 1943 and 1945. But nith the help of large government grants reconstruction went rapidly ahead, and 40,598 ships, totalling 85,059,000 tons, entered and cleared Italian ports in 1953; *cf.*, 38,755 ships (75,400,000 tons) in 1938. By 1955, 45,000,000,000 lire had been spent in this way. In 1953, moreover, 29,000,000 tons of goods entered Italian ports and 5,700,000 tons were cleared; cf., 17,200,000 and 1,600,000 tons in 1938. The goods traffic at the most important ports in 1938. 1953 and 1954 is shown in Table XIX.

TABLE XIX.—*Goods Traffic at Major Ports*
(In 000,000 metric tons)

Year	Genoa	Naples	Venice	Savona	Leghorn	Bari	Palermo	Trieste
1954		2.4 4.3 6.2			4.0	3.0		3.6

Inland Navigation. — The navigable rivers and canals of Italy have a total length of about 1,350 mi., but inland navigation is of little importance. Apart from the lower reaches of the Arno and the Tiber, the navigable waterways are chiefly in the northern plain. Navigable canals are mainly north of the Po in Lombardy and at the head of the Adriatic in the Veneto. The freight transported on the waterways, including the lakes, amounted normally before 1940 to only 5,000,000 tons a year; in 1953 it was only 1,900,000 tons.

Air Transport. — In 1938 Italy had 51 air lines in commercial service. 10 of which served the interior of the country and 41 external territories (24 of them the Italian colonies of that time). In 1949 the total had risen to 57 lines, 28 working inside and 29 outside the country. One important postwar change was the development of the services south of Rome and to the islands. Before 1940 there were only three home services that went south of Rome or to the islands; in 1949 there were 19. There was a considerable increase in passenger traffic after 1946, but Italy still lagged behind other countries in goods traffic by air. Ciampino, the airfield outside Rome, became an important European airport thanks to its central position in the Mediterranean.

Posts, Telegraphs, Telephones and Radio. — Posts and telegraphs are government services. Telephones are partly controlled by the state, partly by five companies to which concessions were granted. The service nas improved greatly after World War II: 76% of the Italian communes had telephones in 1939; 87% in 1950. But for every 1.000 persons there were only, on an average, 24 telephone instruments, as against 182 in Switzerland, 132 in Norway, 102 in Great Britain and 69 in the Netherlands. In northern and central Italy, indeed. there mere more than 40 telephones for every 1,000 of the population; but in the south the figure was only 7.j. All radio services in Italy belong to the state, but the state directly controls only a few services, the rest being entrusted to concessionaires. The ministry of posts and telecommunications has direct control of wireless communication with merchant shipping at sea through its own coastal stations; it also controls wireless communication with the islands. Radio and television transmission is entrusted to the company known as Radio Audizioni Italia; international radiotelegrams and telephones are handled by Italcable and Radiostampa; the establishment and working of wireless transmission and receiving stations on board merchant vessels are controlled by two companies, the Società Italiana Radio Marittima and Telemar. Great damage was done during World War II to all Italian radio stations; those directly controlled by the government were nearly all destroyed. By 1945, moreover, short-wave transmission equipment scarcely existed; but radio transmissions to foreign countries were regarded in Italy as important, and the work of restoration was rapidly put in operation, with the result that 70 programs in 35 languages were being put out daily by 1952.

Television was entrusted to Radio Xudizioni Italia in 1948. and with the help of the European Recovery program the company imported a complete television plant from the United States.

(M. M. C.)

FINANCE

Italy's national income is derived in almost equal proportions from agriculture and from industry. Before World War II estimates of its magnitude were made from time to time by private students, but the varying methods of calculation used and the lack of sufficient data made them generally unreliable; we may nevertheless cite Jacopo Tivaroni's estimates of 6,000,000,000 current lire for 1860, of 13,000,000,000 current lire for the beginning of the 20th century and of 20~000,000,000current lire for 1914. After World War II, however, the official Istituto Centrale di Statistica evolved a method of calculating the national income, and it is to the Istituto's data that the following paragraphs refer. The term current lire signifies lire of the purchasing power that they had in the year cited in connection with them.

Table XX shows the Gross National Product (G.N.P.) and the economic balance sheet for 1938, 1953 and 1954. The figures therein given for the net value of private undertakings are analyzed in Table XXI, whence it appears that in 1954 agriculture, forestry and fisheries contributed about 27% and industry 45% to the net total, the remaining 28% being divided between trade, transport and communications and banking. In 1954 the largest contributions from the manufacturing industries were made by the engineering industry (20%), the food industry (19%), the textile industry (15%) and the chemical industry (14%).

TABLE XX.—*Gross National Product, 1938, 1953 and 1954*
(In 000,000,000 current lire)

Item	1938	1953	1954
Net value of private undertakings*	101.9	7,669	8,068
Net value of public undertakings	15.8	998	1,086
Net value at cost of production	117.7	8,667	9,154
Indirecttaxation.	18.4	1,439	1,604
Net value at market price	136.1	10,106	10,758
Net income from abroad	0.3	29	23
Net national income	136.4	10,135	10,781
Sinking funds	14.0	958	1,016
Gross national product	150.4	11,093	11,797

**See* Table XXI.

TABLE XXI.—*Net Value of Private Economic Activities*
(In 000,000,000 current lire)

Item	1938	1953	1954
Agriculture, forestry and fisheries	38.2	2,479	2,430
Mining industries	10.8	82	88
Manufacturing industries	23.7	2,947	3,119
Construction industries	2.7	478	550
Electricity, gas and water	3.4	209	220
Transport and communications	7.1	531	598
Trade and miscellaneous services	21.1	1,290	1,410
Banking and insurance	3.8	307	336
Buildings	8.3	125	138
Total	119.1	8,448	8,889
Less rectifications	17.2	770	821
Net value of private undertakings	101.9	7,669	8,068
Set value of public undertakings	15.8	998	1,086
Ket value at cost of production	117.7	8,667	

Per capita income expressed in terms of lire of 1954 amounted to 193,000 lire in 1938 and to 246,000 lire (£141) in 1954 itself, account being taken of the changes in population that took place.

Trade and the Balance of Payments.—Foreign trade has always been extremely important to the Italian economy. Its structure is planned on the basis of the main characteristics of agricultural and industrial production. Imports consist mainly of raw materials, chiefly corn, oilseeds, coffee, cotton, wool, jute, wood, skins, iron and steel, copper, coal, mineral oils and rubber, to be worked with a view partly to producing finished goods for export, partly to supplying the primary needs of the population. Exports consist to a great extent of finished goods made from imported raw materials and of high-quality foodstuffs, the chief exports being cotton thread and woven goods. artificial fibres and woven goods, machines, garden produce, citrus fruits, rice and cheese.

TABLE XXII.—*Foreign* Trade
(Value in 000,000 lire)

Item	1934	1938	1946	1948	1950	1953	1954	1955
Imports*	7,675	11,273	91,484	844,266	900,303	1,512,686	1,524,439	1,691,164
Exports†	5,224	10,502	64,578	575,886	746,863	941,789	1,023,909	1,159,669

*1946–53: including foreign-aid shipments. †Including ships' stores.

The value of imports has almost always been considerably greater than that of exports: in the five years 1871–75 the average annual value of imports was 1,305,000,000 current lire, that of exports 1,197,000,000 current lire; in the years 1901–05 imports were valued at 1,903,000,000 lire, exports at 1.582,000,000 lire and in the years 1936–40 imports amounted to 11,294,000,000 lire and exports to 10,156,000,000 lire. It was only in 1941 and 1942, during World War II, when it was supplying Germany with large quantities of goods, that Italy had a favourable trade balance. See Table XXII.

In the years preceding World War II the deficit in the trade balance was always covered by the so-called invisible items: *i.e.*, by remittances from emigrants, by the proceeds of tourist traffic, by shipping freights, etc. It should, however, be remembered that between World Wars I and II, as more and more customs barriers were put up and as emigration was steadily made more difficult, both income from the export of finished goods and the value of remittances received were greatly reduced.

TABLE XXIII.—*Balance of Payments*
(In 000,000,000 current lire)

Item	1938			1953			1954		
	Credits	Debits	Balance	Credits	Debits	Balance	Credits	Debits	Balance
Goods and services									
Goods (f.o.b.)	8.5	10.8	−2.3	921	1,383	−462	987	1,386	−399
Transport	1.2	1.3	−0.1	154	179	− 25	162	162	—
Insurance	1.3	1.2	+0.1	8	12	− 4	9	12	− 3
Tourist travel	1.6	0.3	+1.3	92	11	+ 81	98	11	+ 87
Revenue from capital	0.1	0.5	−0.4	16	19	− 3	14	19	− 5
Various	0.3	0.6	−0.3	114	73	+ 41	121	60	+ 61
Unilateral transfers									
Remittances from emigrants	0.7	...	−0.7	79	—	+ 79	71	—	+ 71
Other gifts	...	...	...	26	—	+ 26	23	—	+ 23
Reparations	—	—	—	—	14	− 14	—	6	− 6
Government aid									
Military commitments and services	—	—	—	69	1	+ 68	93	—	+ 93
Grants	—	—	—	84	7	+ 77	64	7	+ 57
Grand total	13.7	14.7	−1.0	1,563	1,699	−136	1,642	1,663	− 21

After World War II the natural deficiencies of the Italian economy. which had been much aggravated, were largely countered by free help from abroad. It was estimated that Italy received about $2, 500,000,000 from the European Recovery program and Mutual Security agency aid. Table XXIII, which shows Italy's balance of payments in 1938, 1953 and 1954, indicates the importance of the invisible exports. New difficulties in the balance of payments, meanwhile, were created when other countries imposed various currency regulations, which prevented the transfer of imports paid for by the sale of goods and services in certain monetary areas in order to acquire goods and services in other areas. As Italy was importing more than it was exporting in the dollar area and exporting more than it was importing in the sterling and European currency area, the relation between currencies became dislocated. This situation affected the reserve of currency, which could not be spent, held by the Foreign Exchange bureau; and the disequilibrium had to be financed by the issue of lire by the Bank of Italy.

The zonal distribution of the foreign trade of Italy was quite different in 1954 from the pre-World War II period. Before the war more than 50% of Italian foreign trade was concentrated in Europe. In 1954 68% of imports came from countries of the European Payments union (E.P.U.) (25% from the sterling area); 13% came from the United States and Canada. In 1954, too, 67% of exports went to countries of the E.P.C. (20% to countries of the sterling area); 9% of exports was directed to the United States and Canada.

The need to keep a steady currency balance with the countries belonging to the E.P.U. led Italy to adopt a free-trade policy for goods and services coming from that area. About 100% of the goods entered Italy free. Italy was a party to the General Agreement on Tariffs and Trade with comparatively low customs duties. In 1951, in order to help to stabilize the currency balance, Italy reduced customs dues by a further 10%.

Banking and Credit.— The banking system is regulated by a law of 1936, with various later additions of minor importance. This law controls banking activities in such a may as to safeguard the solvency and liquidity of the banks and to direct their business and investments. Special bodies keep an eye on the banks' observance of the regulations and prevent the adoption of policies harmful to the country's interests. The system is based on a few general rules, not on numerous minute regulations which would hamper action; and the central authority has power to lay down at its own discretion and within reasonably wide limits technical rules to which the banks must conform.

The Bank of Italy is the only bank of issue and holds the gold and currency reserves. It has financial relations with the state, not with private persons, being a bankers' bank. It rediscounts bills of exchange, advances loans against merchandise, issues bills of exchange, makes loans to the treasury, accepts deposits from the banks, etc.

In the period immediately after World War II the Bank of Italy was chiefly concerned with financing the deficit on the national budget; but later the financing of private business took pride of place, either by means of discounting and loans or by financing foreign trade through the Foreign Exchange bureau (Ufficio dei Cambij, which has the monopoly of buying and selling foreign exchange at the official rate. The Bank of Italy financed the excess of purchase of currency over sale that arose from Italy's favourable position in the balance of payments with regard to the sterling area and to other European and non-European currencies. The note circulation of the Bank of Italy amounted to 19,000,000,000 lire at the end of 1938 and to 1,538,000,000,000 lire at the end of 1954. The state's circulation in notes and metal money rose from 3,000,000,000 lire at the end of 1938

to 55,000,000,000 lire at the end of 1954.

The banking system draws a sharp distinction between short-term commercial credit and money credit whether medium or long term. Commercial credit is handled by five chartered public banks (*istituti* di diritto *pubblico*)—the Banco di Napoli, the Banco di Sicilia, the Banca Nazionale del Lavoro, the Istituto di San Paolo a Torino and the Monte dei Paschi di Siena—which carry on non-profitmaking banking business; by three national banks with branches throughout the country—the Banca Commerciale Italiana, the Credito Italiano and the Banco di Roma; by 146 large banking institutions organized on national lines; by 211 "people's co-operative" banks; by 57 private banks; and by two branches of foreign banks. In 1954 a committee of the various banks was set up to prescribe rules and to fix rates of interest and of discount governing the operation of credit and debit accounts.

The 80 savings banks and 17 pledge offices (*monti* di credito *su pegno*), while separately organized, are included among institutions which accept short-term deposits and make short-term investments; and the post-office savings banks carry out operations similar to those of the savings banks regarding acceptance of deposits. The post-office banks pay over their funds to the Bank for Deposits and Loans (Cassa Depositi e Prestiti) which, besides financing the treasury, makes long-term loans to local authorities and to bodies (consorzi) carrying out public works.

Altogether, including 697 rural and artisan banks. 1 j small banking institutions and 4 consorzi with a limited guarantee, there were in Italy 1,237 banking institutions with 7,910 branches in 1954; *cf.,* 1.849 institutions nith 7,384 branches in 1938.

Table XXIV gives figures for the amount of deposits in the 365 more important credit institutions and post-office savings banks. which handle 99% of the total number of deposits. Private credit,

TABLE XXIV.—*Deposits in the Credit Institutions and the Post-Ofice Savings Banks*
(In 000,000,000s of current lire)

End of Year	In credit institutions			In the post office			Grand Total
	On deposit account	On current account	Total	On deposit account	On current account	Total	
1938 . .	38	18	56	29	1	30	86
1951 . .	1,364	1,324	2,688	796	160	956	3,644
1952 . .	1,689	1,647	3,336	962	197	1,159	4,495
1953 . .	2,021	1,894	3,915	1,146	276	1,422	5,337
1954 . .	2,341	2,132	4,473	1,263	252	1,515	5,988
1955 . .	2,722	2,432	5,154	1,363	277	1,640	6,794

both medium and long term, is handled by the chartered public banks and by private bodies controlled by special regulations. These include: the Istituto Mobiliare Italiano, which finances business and takes up shares in private businesses; the Consorzio per Sovvenzioni sui Valori Industriali, for granting subventions on the basis of industrial values; the Consorzio di Credito per le Opere Pubbliche, for financing public works; and the Istituto di Credito per le Imprese di Pubblica Utilita, for financing public utilities. There are in addition special branches of the Banca Nazionale del Lavoro, of the Banco di Napoli, of the Banco di Sicilia, of the Banco di Sardegna and of the Istituto di Credito Fondiario delle Venezie, which provide medium- and long-term credit to smaller industries, to hotels and tourist enterprises, to co-operatives and to mines. Other private credit organizations are the Mediobanca set up by three national banks; the Ente Finanziamenti Industriali, for the financing of industry (in which the main interest is that of the Banca Nazionale del Lavoro); the Centrobanca, the credit institute of the people's co-operative banks; and the Cassa per il Credito alle Imprese Artigiane, the credit institute for artisan undertakings. The state set up regional institutes for granting medium-term credit in 1950 and established the Mediocredito in 1951 to unite the available funds of all organizations authorized to give medium-term credit to undertakings employing labour in the localities where unemployment was most severe. For the economic development of the south the state set up Isveimer in south Italy and Irfis in Sicily.

The Istituto per la Ricostruzione Industriale, for industrial reconstruction, and the Fondo Industrie Meccaniche, or engineering industries fund. are controlled by special regulations and are responsible for management of the state-owned "key industries"; viz., iron and steel, engineering, shipping, electricity, banking, etc.

The Monetary Regime.—From the unification of Italy to World War I the Italian monetary regime was based on gold, though a nonconvertible paper currency was occasionally adopted in consequence of particular economic and political conditions. During and after World War I paper currency was adopted, with consequent deterioration in the exchange value of the lira in relation to the high-priced currencies, until in 1927 the value of the lira was fixed by law at 0.079191 gr. of fine gold. 19 lire being equal to $1 and 92.46 lire to £1 sterling. After the devaluation of the chief world currencies, the value of the lira was reduced to 0.04677 gr. of fine gold in 1936. its relation to the dollar and to the pound sterling being re-established as it was in 1927. The law of 1936 was still technically in force in 1954 although the changes of World War II and the following years had made its provisions inoperative.

Before World War II, legislation was introduced to put foreign exchange entirely under the control of the Ufficio dei Cambi (Foreign Exchange bureau), an organ of the Bank of Italy, which has a monopoly of control over dealings in means of payments abroad, over all trade in gold and over the management of foreign credits and bonds and of all other currency coming from tourists, emigrants, etc.

In 1943, as soon as the occupation of Italy started, the Allied military government fixed a rate of exchange of 100 lire to the dollar and 400 lire to the pound. In 1946 the official rates of exchange nere raised, bringing them to 225 lire to the dollar and 907 lire to the pound. In addition exporters were allowed to dispose of 50% of the currency that they obtained from sales abroad on the open market at a rate of exchange about double that of the official rate. In 1948 the official rate and the export rate of exchange became one for all practical purposes on a basis of 575 lire to the dollar and 2,317 lire to the pound. When the pound was devalued in 1949 the value of the Italian lira fell less in relation to the dollar than did the pound and other European currencies and went to about 62j lire to the dollar and about 1,750 lire to the pound.

Italy joined the International Monetary fund, but had not by 19jj announced its official parity with the fund. However, as a result of U.S. aid and of the home policy of defending the lira, the stability of the lira-dollar exchange after 1949 made it possible for Italy to respect the substance if not the letter of the main principles of the Bretton Woods agreements.

The Bank of Italy acquires gold on the basis of the official dollar exchange. At the end of 1954 the price of fine gold was 703 lire per gram. Besides the official market for currencies and gold, however. there is another one that the financial authorities tolerate but do not recognize. Currencies and gold dealt with on this market are used for buying a few types of goods that may be imported free of exchange control, for personal expenditure abroad and for movements of capital. At the end of 1954 the rates on this market stood at 635 lire to the dollar and 1,710 lire to the pound and at 72j lire per gram of fine gold.

Prices.—Prices on the Italian market have followed the changes in international prices with a slight time lag. The first notable disturbance took place during and after World War I. After readjustment they again folloned international prices, being affected accordingly by the great crisis of 1929–35 (the lowest level was reached in 1934; by 1938, wholesale prices were again approximately where they had been in 1929).

In the first years of World War II all kinds of measures were taken to stabilize prices and to control consumption in order to secure more and more of the national income for investments connected with war activities. As the war went on, this policy lost most of its effect, and the characteristics of inflation became more obvious after the armistice of 1943 when German and Allied troops occupied Italy.

In 1945, at the end of the war, prices were already up 25 times, with the national income halved in terms of real money and note circulation increased roughly tenfold. Open inflation had begun. Despite a rapid increase in production the inflationary process went

on, and in the course of a year prices doubled. In the spring and summer of 1947 the index numbers of wholesale prices reached a point 62 times greater than the prewar figure and the cost-of-living index numbers were up 53 times even though the cost of certain items in the domestic budget such as rent, gas and electricity had been restricted. Then, in the autumn, Luigi Einaudi, later president of the republic, was made minister for the budget. Measures were taken to control the banking system's reserves so as to achieve a due proportion between investments and what was really available in order to fill up the inflationary gap; and at the same time provision was made for reducing the deficit in the national budget. Prices reacted immediately; at first they stood still. then they fell—uholesale prices quickly, cost-of-living prices more slowly and less. Between 1948 and 1954 the wholesale prices were steady but the cost of living advanced slowly. The decrease in prices on the stock exchange was remarkable. Whereas by the summer of 1947 they had risen to be 3j times as great as they had been before the war, they now gradually fell to be only 17 times as great. Later shares quotations improved and at the end of 1954 were 36 times the prewar level. Because of the disinflationary policy it was possible to stabilize the purchasing poner of the lira and thus in the long run promote a more healthy development of economic activity as a whole.

TABLE XXV.—*Prices, Wages and Rates of Exchange*

Year	Index numbers				Lira-dollar rate	Lira-pound rate
	Wholesale prices	Cost of living	Industrial wages	Agricultural wages		
1938	1.00	1.00	1.00	1.00	19.00	88.76
1951	55.81	53.20	63.86	71.01	624.88	1,749.66
1952	52.70	55.46	70.90	74.64	624.91	1,749.74
1953	52.50	56.54	75.45	82.62	624.90	1,749.71
1954	52.93	58.06	77.77	86.84	624.83	1,749.53
1955	53.20	59.69	80.92	89.61	624.90*	1,759.93*

*As of Dec. 31, 1955.

Table XXV indicates the course followed by wholesale prices, the cost of living, wages and the changes in the exchange value of the lira in dollars and pounds sterling from 1938 to 1954. For further analysis of wages, *see* above, *Population and Social Conditions,* Tables VII and VIII.

The State Budget.—The state budget has only shown a favourable balance for brief periods. A deficit is the rule either because of the expense of necessary public works or because of periods of crisis. Between World Wars I and 11 there was a credit balance only for the years from 1923–24 to 1929–30. Residuary deficits from previous budgets were estimated at the end of the financial year 1955 to exceed the credits by 1,325,000,000,000 lire.

TABLE XXVI.—*Budgets*
(In 000,000,000 lire)

Year*	1938–39	1945–46	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56†
Revenue	28	1	1	1,720	1	1,990	2,263	2,446
Expenditure	40	509	1,853	2,206	2,340	2,381	2,674	2,726

*Ending July 30. †Estimate.

Public Debt.—The deficits of the state budget and the need to maintain a modern standard in public works led to a steady increase in the public debt. World War I reduced the purchasing power of the lira to one-fifth of what it had been and so reduced also the real burden of the debt, nhich grew in terms of money from 16,000,000.000 lire in 1914 to 90,000,000,000 lire in 1919–20. Table XXVII shows the public debt in 1938–39 and after 1952.

TABLE XXVII.—*The Public* Debt
(In 000,000,000 current lire)

Type	1938–39	1952–53	1953–54	1954–55
Consolidated	53	53	53	53
Redeemable	49	1,025	1,212	1,498
State notes	2	38	48	56
Total long-term	104	1,116	1,313	1,607
Ordinary treasury bonds	12	908	993	1,064
Loans from the Bank of Italy	5	450	538	570
Otherdebts	25	998	1,062	1,016
Total floating	42	2,356	2,593	2,650
Grand 1	146	3,472	3,906	4,257

Taxation.—During the 19th century taxes on real estate were more important in Italy than were those on personal property.

TABLE XXVIII.—*Taxation*
(In 000,000,000 current lire)

Type	1938–39	1952–53	1953–54	1954–55
Taxes on incomes and estates	7.5	383	440	451
Taxes on business	2.4	145	175	215
Taxes on movements and exchanges of goods and services	6.6	631	737	797
Taxes on luxury consumption goods	3.6	308	334	362
Taxes on essential consumption goods	2.9	145	154	177
Lotteries	0.5	30	32	32
Total	23.5	1,642	1,872	2,034

More recently taxes on income and indirect taxes on business acquired greater importance. Table XXVIII gives figures regarding the incidence of taxation in 1938–39 and after 1952.

Uniform legislation controls the imposition of taxes for local authorities (communes, provinces and regions). In 1938 the effective revenue of the communes amounted to 6,000,000,000 lire as against an expenditure of 6,300,000,000 lire; in 1954 their revenue had jumped to 414,000,000,000 lire but their expenditure had reached 557,000,000,000 lire. In 1938 the budgets of the provinces were balanced with revenue and expenditure each at 1,400,000,000 lire; but in 1954 they showed a deficit with revenue at 108,000,000,000 lire and expenditure at 126,000,000,000 lire. In 1954 the autonomous regions—Sicily, Sardinia. Trentino-Alto Adige and Valle d'Aosta—had a revenue of 57,000,000,000 lire and an expenditure of 56,000,000,000 lire.

Furthermore, it is necessary to take into account that in Italy the contingency and assistance charges fall almost wholly on the employers, meaning therefore a real taxation. In 1938 the taxation burden (state, provinces, municipalities, etc.) was 28,600,000,000 lire and the contingency charge 3,300,000,000 lire, an amount of 31,900,000,000 lire. In 1954 the taxation burden was 2,351,000,000 lire and the contingency charge 1,016,000,000 lire, an amount of 3,367,000,000 lire. The aggregate taxation pressure, estimated in terms of net national income, was 23.39% in 1938 and 31.23% in 1954.

Savings.—The Italian economy shows a low level of savings related to the low level of per capita income, and as a result Italy has always imported capital. The huge losses of World War II demanded an extra effort, ahich was made easier by U.S. aid more than by anything else, so that the relation between gross investments and national income stands at about 21%. Figures for money savings, whether deposited in the banks or in the post-office savings banks, have been given in Table XXIV. The self-financing of businesses by the employment of profits not distributed to shareholders and also by the issue of shares and bonds is, however, important. The value of issues of public and private shares and bonds amounted to 306,000,000,000 lire in 1952, to 365,000,000,000 lire in 1953 and to 309,000,000,000 lire in 1954 (cf., 2,100,000,000,000 lire in 1938).

Insurances provide another form of savings. There are various private insurance companies and the Istituto Xazionale di Assicurazioni, which is a public body. Whereas in 1938 premiums on life insurance amounted to 1,152,000,000 lire, by 1952 they had risen to 37,969,000,000 lire and by 1953 to 42,764,000,000 lire. Social and providential insurances are reasonably well developed *(see* above. *Population and Social Conditions).* In 1953 the Istituto Nazionale per la Previdenza Sociale banked 612,000,000,000 lire received in contributions and paid out 563,000,000,000 lire. Numerous other companies dealt in sickness insurance; their contributions amounted to 247,000,000,000 lire and payments to 203,000,000,000, lire in 1953. (L. L.)

BIBLIOGRAPHY.—For population and social conditions: Repubblica Italiana, Commissione Parlamentare di Inchiesta sulla Disoccupazione, *La disoccupazione in Italia* (Rome. 1953); M. Parasassi and G. Ruffolo, *La disoccupazione* in *Italia* (a summary of the commission's findings) (Bologna, 1954); Camera dei Deputati, *Atti della Commissione Parlamentare di Inchiesta sulla Miseria in Italia e sui Mezzi per Combatterla* (Rome, 1953). For church and state: A. C. Jemolo, *Chiesa e Stato in Italia negli ultimi cento anni* (Rome, 1948); D. A. Binchy, Church *and State in Fascist Italy* (London, 1941). For government: B. Croce, *Storia d'Italia dal 1871 al 1915* (Bari, 1927), trans. by C. Ady,

A History of Italy, 1871–1915 (London, 1928); Cecil J. S. Sprigge, *The Development of Modern Italy* (London, 1943; New Haven, 1944); A. J. B. Whyte, *The Evolution of Modern Italy* (Oxford, 1941); V. Falzone, F. Palermo, F. Cosentino, *La costituzione della Repubblica italiana illustrata con i lavori preparativi* (Rome, 1948); P. Calamandrei and A. Levi (ed.), *Commentario sistematico alla costituzione italiana,* (Florence, 1950). For defense: P. Badoglio, *Italy in the Second World War* (London, 1948); M. Roatta, *Otto millioni di baionette* (Milan, 1946). For economics: G. Medici, *La distribuzione della proprieta fondiarta in Italia* (Rome, 1948); Manlio Rossi-Doria, *Riforma agraria e azione meridionalista* (Bologna, 1948); R. Tremelloni, *Storia dell' industria italiana contemporanea* (Rome, 1947); W. G. Welk, *Fascist Economic Policy* (Cambridge, Mass., London, 1938); Istituto per gli Studi di Economia, *Annuario della congiuntura economica italiana 1938–47, 1948, 1949, 1950–51, 1952–53* (Milan, 1952); Ministero per la Costituente, *Rapporto della Commissione Economica* (Rome, 1946); Libero Lenti, *Problemi economici d'oggi* (Milan, 1955); Leo Diena, *Sindacalismo italiano d'oggi* (Milan, 1946); Ministero del Tesoro, *Relazione generale salla situasione economica del Paese* (Rome, 1954).

ITAPÚA, the southeasternmost department of Paraguay, is separated from Argentine Misiones by the Paraná river which is the boundary for 173 mi. Area 6,380 sq.mi.; pop. (1950) 111,424. Like Argentine Misiones, it was settled by the Jesuits who established missions to convert the Indians. After their expulsion in 1767 the settlements were abandoned, but in the Trinidad district several churches and ruins survive as relics of the period. Encarnación (*q.v.;* pop. 13,321) is the departmental capital, providing the principal exit and entrance to the country. It is a saw-milling and processing centre for the forested and agricultural Paraná lowland. (G. J. B.)

ITASCA, LAKE, the main source of the Mississippi river, is located approximately 25 mi. S.W. of Bemidji, Minn., in Itasca State park, where the state maintains Douglas Lodge and other recreational facilities. It is a glacial lake that has an altitude of 1,475 ft., an approximate depth of 35 ft., and an irregular shoreline that encloses a surface of 1.75 sq.mi. From it, the Mississippi river flows southward 2,348 mi. to reach the Gulf of Mexico. Its shores are lined with virgin pine.

Although a fur trader employed by Astor's American Fur company, William Morrison (1785–1866), claimed to have visited the lake in 1803, Henry Rowe Schoolcraft, the United States superintendent of Indian affairs for Michigan in 1832, is considered by most authorities to be the man who proved that the lake is the main source of the Mississippi river. Many geologists, however, believe that a number of glacial lakes in the region supply the headwaters of the river. Schoolcraft is also credited as being the originator of the name "Itasca." By combining syllables of the Latin words *veritas* (truth) and *caput* (head or source), he formed the name Itasca.

BIBLIOGRAPHY.—John Dobie, *The Itasca Story* (1959); Henry Rowe Schoolcrait, *Expedition to Lake Itasca: the Discovery of the Source of tlze Mississippi,* ed. by Philip P. Mason (1958); J. V. Brower, *The Mississippi River and Its Source,* vol. vii, Minnesota Historical Collections (1893); Joseph N. Nicollet, *Report Intended to Illustrate a Map of the Hydvographical Basin of the Upper Mississippi River* (1843). (W. D. MR.)

ITCHING (PRURITUS) is a symptom of many skin conditions, particularly dermatitis and eczema, insect bites, hives, scabies and pediculosis (lice), prickly heat and some superficial fungous infections. It may be almost entirely psychic in origin (localized neurodermatitis), and in generalized form is sometimes a symptom of internal diseases such as jaundice, diabetes and leukemia. Itching is probably a modified form of pain (*q.v.*). Symptomatic treatment in the long run is unsatisfactory, though local applications or aspirin may be immediately helpful; relief of the underlying cause is essential. The application of complex chemicals to the skin in an effort to control itching may produce allergic reactions.

See also SKIN DISEASES. (D. M. P.; X.)

ITENEZ: see GUAPORÉ.

ITHACA (ITHAKI, THIAKI). next to Paxo the smallest of the seven Ionian islands, with an area of 33 sq.mi.; an eparchy of the nomos of Cephalonia in Greece whose population in 1951 was 5.830. It consists of two mountain masses, connected by a narrow isthmus of hills, west of a wide inlet, the Gulf of Molo. The northern culminates in Anoi (2,650 ft.), the southern in Hagios Stephanos (Merovigli) (2,100 ft.).

Vathy, the chief town and port of the island, lies at the northern foot of Mt. Stephanos, its whitewashed houses stretching for about a mile round the deep bay, to which it owes its name. As there is little arable land in Ithaca, the inhabitants are dependent on commerce for their grain supply; olive oil, wine and currants are the principal products. Goats are fed on the brushwood of the hills, and hares are exceptionally abundant.

The island is divided into four districts: Vathy, Aeto (or Eagle's Cliff), Anoge (Anoi) or Upland and Exoge (Exoi) or Outland.

The name has remained attached to the island from the earliest historical times with but little interruption of the tradition, though in Brompton's travels (12th century) and in the old Venetian maps it is called Fale or Val de Compar, and at a later date it not infrequently appears as Little Cephalonia. This last name indicates the general character of Ithacan history in modern and in ancient times; for the fame of the island is almost solely attributable to the Homeric story of Odysseus, its king in the heroic age. In the Odyssey the island is incidentally described with picturesque topographical detail. The Homeric localities for which counterparts have been sought are Mt. Neritos, Mt. Neion, the harbour of Phorcys, the town and palace of Odysseus, the fountain of Arethusa, the cave of the Naiads, the stalls of the swineherd Eumaeus, the orchard of Laertes, the Raven Cliff Korax and the island Asteris, where the suitors lay in ambush for Telemachus. There are two schools of identification, one placing the town at Polis on the west coast in the northern half of the island (Leake, Gladstone, etc.) and the other at Aeto on the isthmus. The latter site, advocated by Sir William Gell, was supported by H. Schliemann, who carried on excavations in 1873 and 1878. But no amount of ingenuity can fully reconcile the descriptions in the Odyssey with the actual topography.

Above all, the passage in the Odyssey in which the position of Ithaca is described offers great difficulties:

"Now Ithaca lies low, farthest up the sea line towards the darkness, but those others face the dawning and the sun" (Butcher and Lang).

Such a passage fits very ill an island lying, as Ithaca does, just to the east of Cephalonia. Accordingly, W. Dörpfeld suggested that the Homeric Ithaca is not the island that was called Ithaca by the later Greeks, but must be identified with Leucas (Santa Maura; *q.v.*). He succeeded in fitting the Homeric topography to this latter island, and suggested that the name may have been transferred in consequence of a migration of the inhabitants. There is no doubt that Leucas fits the Homeric descriptions much better than Ithaca; but, on the other hand, many scholars maintain that it is a mistake to treat the imaginary descriptions of a poet as if they were portions of a guidebook or to look, in the author of the Odyssey, for a close familiarity with the geography of the Ionian islands.

BIBLIOGRAPHY.—Sir W. Gell, *Topography and Antiquities of Ithaca* (1807); Hercher, in *Hermes* (1866); Leake, *Northern Greece;* Mure, *Tour in Greece;* Bursian's *Geogr. von Griechenland; . . . Macmillan's Magazine* (1877); Partsch, *Kephallenia und Ithaka* (1890). For the controversy, report of excavations and full bibliography, W. Dorpield, *Alt Ithaka* (1927). *H.* Schliemann, *Itlzaque, la Péloponnése, Troie* (1869); The *Times* (London) (Sept. 26, 1878); *Ilios* (preface) (1880).

ITHACA, a city of New York, U.S., 56 mi. S.S.W. of Syracuse, at the southern end of Cayuga lake; the seat of Tompkins county. Ithaca is situated in rolling hill land of the Finger lakes country. Recreational opportunities are provided by neighbouring lakes and excellent state parks nhich are maintained in the area: Buttermilk falls, Fillmore glen. Robert H. Treman State park. Taughannock falls (215 ft, high) and Watkins glen.

Among the leading manufactures of Ithaca are adding machines, power-drive chains and shotguns. while nearby Groton is a significant manufacturer of typewriters. Surrounding agricultural lands are important chiefly for sales of dairy products, poultry and poultry products. Ithaca is the southern terminal of the New York Barge Canal system. (For comparative population figures see table in NEW YORK: Population.)

History.— The site of Ithaca. formerly in the Cayuga nation territory of the Iroquois confederation, was visited by a Continental raiding party during the Sullivan-Clinton campaign of 1779. In 1782 the area was included within the Military tract given to veterans of the American Revolution and the land was acquired by Simeon De Witt, surveyor general of New York, who in 1806 named the community Ithaca. Settlement commenced in 1789. Development of the community was fairly rapid, and was early based upon availability of water transportation and power, in addition to accessibility of lumber, salt. gypsum and products of fertile agricultural lands. Ithaca was incorporated as a village in 1821 and as a city in 1888. The city, with its vicinity, was once a location for silent motion pictures.

Education.— An outstanding educational centre, Ithaca is the home of Ithaca college and Cornell university. Ithaca college'is a private liberal arts college established in 1892; its students specialize mainly in physical education. music or drama.

Cornell university, situated on a hill commanding a wide view of Ithaca and Cayuga lake and occupying over 7,000 ac. of campus, farm, conservation and recreation land. is an unusual combination of endowed and public-supported institution. It was founded as a result of the Morrill act of 1862, under which New York received a substantial grant of public land for support of colleges teaching "agriculture and the mechanic arts.!' Ezra Cornell (*q.v.*) established the foundations and Andrew D. White determined the form of the new university; both were members of the New Tork legislature. Cornell, a citizen of Ithaca who had come into a fortune from his holdings in the Western Union Telegraph company. contributed an initial grant of $500.000 and 200 ac. on the condition that the college be located at Ithaca and that the state endow the institution with all its proceeds from the federal grant. Cornell himself took an active part in supervising the sale and allocation of these lands. and more than $3.000.000 was realized in profits. Cornell later gave the university an additional $400,000 of his own money.

A charter was granted April 27, 1365. White prepared the scheme of internal organization and the trustees elected him president in 1866. On Oct. 7, 1868. the university began operation. It was nonsectarian and coeducational and was to embrace any instruction and investigation deemed useful and proper by the trustees in addition to those branches of learning specified by the Morrill act. In the latter part of the 20th century the university comprised 15 colleges and schools, including the medical college (1898) and school of nursing (1942) in New York city and four university colleges supported by legislative appropriation, which have been part of the State University of New Tork since its creation in 1948. .

The four colleges in the state university system. with their dates of foundings, are the veterinary college (1894), college of agriculture (1904), college of home economics (1925) and school of industrial and labor relations (1915). Other divisions are the college of architecture (1871), law school (1887; became a graduate school in 1925), college of arts and sciences (1868), graduate school (1909), college of engineering (1868), school of hotel administration (1922), school of education (1931), graduate school of nutrition (1941) and graduate school of business and public administration (1945). (R. C. HE.)

ITINERARIUM, a term applied to the extant descriptions of the ancient Roman roads and routes of traffic! with the stations and distances (Lat. *iter,* "road"). Earlier than these, and therefore to be treated as an original source! are the silver cups found at Vicarello. on the lake of Bracciano (*q.v.*), which belong to the time of Trajan. and give the stations from Gades (Cadiz) to Rome overland through Spain, southern Gaul and Italy. There are a few inscriptions which give shorter stretches, but for the rest we are dependent on the written itineraries. According to one view, all the extant sources are derived from a lost official map; one descendant of this is the *Antonine Itinerary,* a somewhat unskillful excerpt from it of the stations and distances along the various roads of the Roman empire; ahile from another map (also lost) are derived the *Ravenna Itinerary* and the *Tabula Peutingeriana.*

Another view (Miller's) is that the maps arose from the itineraries uhich were kept at the main posting centres, and brought up to date from information given by travelers. Thus, he mould hold, the *Antonine Itinerary* is made up from material collected from these itineraries and from travelers in various parts of the norld. It belongs to the time of Diocletian but is of private origin.

The *Tabula Peutingeriana* is a 12th-century copy of Castorius' map of the norld (4th century), which was intended to be rolled and was also unofficial. From it is derived the *Ravenna Itinerary.*

The *Itinerarium Hierosolymitanum,* made by an unknonn pilgrim IN A D. 333, records the stations and distances from Bordeaux overland to Jerusalem and back by Valona and Rome to Milan. The *Iiinerarium Maritimum* (generally but wrongly regarded as the second part of the *Itinerarium Antonini*) is independent.

BIBLIOGRAPHY.—R. Miller, Itineraria *Romana* (1916); T. Codrington, *Roman* Roads in *Britain;* O. G. S. Crawford in Antiquity, i, 195 (1927).

ITO HIROBUMI, PRINCE (1841–1909), Japanese statesman who played a leading role in the making of modern Japan. He was born Sept. 2, 1841. in southwestern Japan, where he attended the school of the patriot Yoshida Shoin. Inflamed with a desire to rescue the country from the foreign danger which seemed to be pressing in from all sides. he made an attempt to burn the British embassy in 1862. The following year, with fellow clansman Inoue Kaoru and three other men. he took passage to England. This was done secretly, because at that time visiting a foreign country was a capital offense in Japan. It6 saw conditions abroad at first hand and understood for the first time the impossibility of driving foreigners out of Japan. Upon receiving news of his clan's attack on a British ship, he hastened back to Japan to urge moderation and compromise.

It6 became one of the major figures in the new government after the overthrow of the shogunate in 1868 (see JAPAN: History). He went with government missions to Europe and the United States in 1871 and 1872 and then returned to work with Okubo Toshimichi (*q.v.*) for the modernization of the country. After the death of Okubo in 1878, It6 succeeded him as minister of the interior and became the leading member of the government. A cabinet system was established in 1881 and It6 became Japan's first prime minister.

When a popular demand arose in the 1880s for a constitution and the establishment of a parliament, It6 showed that genius which characterized his entire political career: he could see when compromise was necessary. He therefore urged the government to give the country a constitution. On a mission abroad to study European governments he found that of Prussia congenial to his ideas of monarchy. Upon his return he became the chairman of a drafting committee which formulated a constitution that included many Prussian ideas; it was proclaimed by the emperor in 1889. It6 was the dominant figure in the ministry during the next decade. which was a period of adjustment to the new constitutional government.

He saw that the government could not expect the co-operation of parliament unless it made some effort at organizing political support. He therefore left the government to form the *Seiyukai* or Constitutional Political Friends' party, which became one of the dominant conservative parties and remained so until the outbreak of World War II. After the Russo-Japanese War, Itō was the first resident general in Korea and as a result became the target of Korean patriots.

In 1909 It6 was assassinated on Oct. 26 by a Korean while on a visit to Harbin, Manchuria.

No statesman of the Meiji period contributed more to the making of modern Japan. It6 was a realistic and enthusiastic modernizer; he was also profoundly Japanese and sought to adapt Japanese tradition to the modern world rather than to destroy it. Like his colleagues, he believed in the personal rule of the emperor, and sought to accomplish his means through the throne. But more quickly than most of his colleagues, he understood popular aspirations for a less autocratic form of government; he was one of the first to recognize the need for a constitution and for a parliament

as an organ of public opinion; he was also one of the first to see the potentialities of political parties.

BIBLIOGRAPHY.—E. Herbert Norman, *Japan's Emergence as a Modern State* (1946); Sir George Bailey Sansom, *Western World and Japan* (1950); Hugh Borton, *Japan's Modern Century (1955).*

(T. C. SH.)

ITONAMAN, a small group of tribes of South American Indians, supposed on meagre evidence to constitute an independent linguistic stock. The stock gets its name from the Itonama, the best-known tribe of the group, which occupies a small area in northeastern Bolivia along the Itonama river (a tributary of the Guaporé) from its mouth up as far as the large lake of the same name in lat. 14° S.

The Itonama are a sedentary, agricultural people, good canoemen and makers of excellent cotton textiles.

The Itonama followed the custom of sealing up the eyes, mouth and nose of a dying person in order to prevent death from escaping from the body and striking another person. Another custom of their aboriginal culture was betrothal of children soon after they were born.

BIBLIOGRAPHY.—A. d'Orbigny, *L'Homme américain* (1839); A. Landi, "Appunti sulle condizioni," etc., *Arch per Antropologia e Etnologza,* vol xxxvi, pp. 219–228; J. H Steward (ed), *Handbook of South American Indians,* Bur, Amer. Ethnol., vol. iii (1948).

ITURBIDE, AUGUSTÍN DE (1783–1824), emperor of Mexico from May 1822 to March 1823, was born on Sept. 27. 1783, at Valladolid, now Morelia, in Mexico. He joined the provincial regiment of his native city in 1797. In 1810 Hidalgo offered him a flattering post in his revolutionary army. but he refused and joined the royalists. In Dec. 1813, Iturbide, now a colonel. and Gen. Llano defeated Morelos, the successor of Hidalgo, in the battle of Valladolid, thereby dealing a crushing blow to the revolt. In consideration of his services. the government placed him in command of the military district of Guanajuato and Michoacán, but in 1816 grave charges of extortion and violence led to his recall.

In 1820, when Ferdinand VII of Spain was compelled to acknowledge once more the constitution of 1812, Iturbide became associated with the conservatives in Mexico in a revolutionary movement. Iturbide issued Feb. 24, 1821, the famous *Plan de Iguala* for a Mexican empire. His plan conciliated all classes of society as Hidalgo's had never done. The military leaders Santa Anna, Nicolás Bravo and Vicente Filisola supported him. In March 1821, Veracruz acknowledged his leadership, Valladolid was captured in May, and in June, Querétaro. In July the viceroy was withdrawn and on Aug. 24, 1821. Gen. Juan O'Donojú, the new representative of the king, seeing the futility of struggle, signed the treaty of Córdoba that gave Mexico its independence. In September Iturbide entered Mexico City; in Feh. 1822, the Spanish Cortes refused to sanction the treaty of Córdoba; and on May 19, congress proclaimed Iturbide Augustín I of Mexico. His regime proved arbitrary and extravagant, and in Dec. 1822, Santa Anna issued a *pronunciamiento* against him.

On March 19. 1823, Iturbide abdicated. and on May 11 sailed for Leghorn, Italy. Congress declared all matters appertaining to the election, coronation and administration of the late emperor null and void. In Dec. 1823 Iturbide moved to London; in Feb. 1824 he offered his services to the Mexican congress; and on May 11, ignorant of a decree of death awaiting his reappearance in Mexico, sailed from England, landing near Soto la Marina on July 15. He was recognized, captured and shot, by order of the state of Tamaulipas, at Padilla, on July 19, 1824. In 1838 congress ordered his body moved to Mexico City where it lies in the cathedral with those of Hidalgo and other leaders.

See *Statement of Some of the Principal Events in the Public Life of Augustín de Iturbide,* written by himself (Eng. trans., 1824); also W. S. Robertson, *Rise of the Spanish-American Republics* (1918).

(W. B. P.)

ITZA, an American Indian people of Mayan stock, inhabiting the country around Lake Petén in northern Guatemala. Chichén Itzá, among the most wonderful of the ruined cities of Yucatán, was the capital of the Itzas.

According to tradition, they moved, on the breaking up of the Mayan kingdom in 1420, to an island in the lake and built another city. In 1697 the Spaniards destroyed the city and temples, and a library of sacred books, written in hieroglyphics on bark fibre.

ITZEHOE, a town in the Land of Schleswig-Holstein, on the Stör, 32 mi. N.W. of Hamburg and 15 mi. N. of Glückstadt. Pop. (1950) 37,153.

Itzehoe, the oldest town in Holstein, had as its nucleus a castle, built in 809. In 1201 the town was destroyed, but it was restored in 1224. Liibeck rights were granted to the new town in 1238, and to the old town in 1303. It passed to Prussia in 1866, with the duchy of Schleswig-Holstein. Ancient buildings include the church of St. Laurence (12th century), and a convent founded in 1256. Manufactures include machinery, tobacco, fishing nets, soap, cement and beer. Iron founding, shipbuilding and wool spinning are carried on.

IUTURNA, previously **DIUTURNA,** an Italian goddess of springs. Her original home was on the Kumicius river near Lavinium, where there was a spring named for her, supposed to possess healing qualities. Her worship was early transferred to Rome, localized by the Lacus Iuturnae near the Temple of Vesta, at which Castor and Pollux, after announcing the victory of Lake Regillus, were said to have washed the sweat from their horses. At the end of the First Punic War, Lutatius Catulus erected a temple in her honour on the Campus Martius, subsequently restored by Augustus.

Iuturna was associated with two festivals: the Iuturnalia on Jan. 11, probably a dedication festival of a temple built by Augustus, and celebrated by the college of the *fontani,* workmen employed in the construction and maintenance of aqueducts and fountains; and the Volcanalia on Aug. 23, at which sacrifice was offered to Volcanus, the nymphs and Iuturna, as protectors against outbreaks of fire.

In Vergil, Iuturna appears as the sister of Turnus (probably because of the partial similarity of the names), on whom Jupiter, to console her for the loss of her chastity, bestowed immortality and control of all the lakes and rivers of Latium. For the statement that she was the wife of Janus and mother of Fontus (or Fons), the god of fountains, the early Christian writer Arnobius is alone responsible.

IVAN VI (1740–1764), emperor of Russia, was the son of Prince Antony Ulrich of Brunswick and the princess Anna Leopoldovna of Mecklenburg, and grandnephew of the empress Anne, who adopted him and declared him her successor on Oct. 5, 1740, when he was only eight weeks old. On the death of Anne (Oct. 17) he was proclaimed emperor, and on the following day Biren, duke of Courland, was appointed regent. With the fall of Biren (Nov. 8, 1740), the regency passed to the baby tsar's mother, though the government was in the hands of the vice-chancellor, Andrei Osterman. *A coup d'état* placed the tsarevna Elizabeth on the throne (Dec. 6, 1741), and Ivan and his family were imprisoned in the fortress of Diinamiinde (Dec. 13, 1742). In June 1744 they were transferred to Kholmogory on the White sea, where Ivan, seeing nobody but his jailer, remained for the next 12 years.

Ivan was then secretly transferred to the fortress of Schlüsselburg (1756), where even the commandant of the fortress was left in ignorance of his identity. In the few weeks' reign of Peter III his condition was improved, but later instructions were given to chain him up. On the accession of Catherine orders were given that the prisoner was not to be delivered alive into any one's hands, even if his deliverers produced the empress' own sign manual authorizing his release. By this time, 20 years of solitary confinement had disturbed Ivan's mental equilibrium, though he does not seem to have been actually insane. A sub-lieutenant of the garrison, Vasily Mirovich, learned his identity, and formed a plan for freeing and proclaiming him emperor. At midnight on July 5, 1764, Mirovich won over some of the garrison, arrested the commandant, Berednikov, and demanded the delivery of Ivan, who immediately was murdered by his jailers in obedience to their instructions.

See R. Nisbet Bain, *The Pupils* of *Peter the Great* (London, 1897); M. Semevsky, *Ivan VI. Antonovich* (Rus.) (St Petersburg, 1866); *A.* Bruckner, *The Emperor Ivan VI. and his Family* (Rus.) (Moscow, 1874); V. A. Bilbasov, *Geschichte Catherine II.* (vol. ii., Berlin, 1891–93).

IVAN IV., called "the Terrible" (1530–1584), tsar of Muscovy. was the son of Vasily [Basil] III. Ivanovich, grand duke of Muscovy, by his second wife, Helena Glinska. Born on Aug. 25, 1530, he was proclaimed grand duke on the death of his father (1533), and took the government into his own hands in 1544, being then 14 years old. Ivan IV. had a neurotic strain in his character. His father died when he was three, his mother when he was only seven, and he grew up in a brutal and degrading environment where he learnt to hold human life and human dignity in contempt. He was maltreated by the leading boyars whom successive revolutions placed at the head of affairs, and he conceived an inextinguishable hatred of their whole order and a liking for the merchant class, their natural enemies. He threw to his dogs the last of his boyar tyrants, and announced his intention of assuming the title of tsar, a title which his father and grandfather had not dared to assume. On Jan. 16, 1547, he was crowned the first Russian tsar by the metropolitan of Moscow; on Feb. 3 in the same year he selected as his wife from among the virgins gathered from all parts of Russia for his inspection, Anastasia Zakharina-Koshkina, the scion of an ancient and noble family better known by its later name of Romanov.

Hitherto, by his own showing, the private life of the young tsar had been abominable, but in 1550 he summoned a *Zemsky Sobor* or national assembly, the first of its kind, to which he made public confession of the sins of his youth, and at the same time promised that the realm of Russia (for whose dilapidation he blamed the boyar regents) should henceforth be governed justly and mercifully In 1551 the tsar submitted to a synod of prelates a hundred questions as to the best mode of remedying existing evils, for which reason the decrees of this synod are generally called *stoglav* or *centuria.* At this time Ivan deliberately broke with his disreputable past and surrounded himself with good men of lowly origin. The chief of these were Alexis Adashev and the monk Sylvester, men of obscure origin, and the best Muscovites of their day. The period of their administration coincides with the most glorious period of Ivan's reign—the period of the conquest of Kazan and Astrakhan.

In 1551 one of the factions of Kazan offered the whole khanate to the young tsar, and on Aug. 20, 1552 he began the siege with an army of 150,000 men and 50 guns. On Oct. 2 the fortress, which had been heroically defended, was taken by assault. The conquest of Kazan was the first territorial conquest from the Tatars, before whom Muscovy had humbled herself for generations; at Kazan Asia, in the name of Mohammed, had fought behind its last trench against Christian Europe marshalled beneath the banner of the tsar of Muscovy. For the first time the Volga became a Russian river. Nothing could now retard the natural advance of the young Russian state towards the east and the south-east. In 1556 Astrakhan fell almost without a blow. By 1560 all the Finnic and Tatar tribes between the Oka and the Kama had become Russian subjects. Ivan was also the first tsar who dared to attack the Crimea. In 1555 he sent Ivan Sheremetev against Perekop, and Sheremetev routed the Tatars in a great two days' battle at Sudbishenska. Some of Ivan's advisers, including both Sylvester and Adashev, now advised him to make an end of the Crimean khanate, as he had already made an end of the khanates of Kazan and Astrakhan But Ivan recognized the difficulties involved. He coveted Livonia, which was comparatively near at hand and promised him a seaboard and direct communication with western Europe. Ivan IV. desired to raise Muscovy to the level of her neighbours. He proposed immigration into his tsardom of master-workmen and skilled artificers. But his neighbours combined to thwart him. Charles V. dispersed 123 skilled Germans whom Ivan's agent had collected and brought to Liibeck for shipment to a Baltic port. Therefore, when Sweden, Poland and Denmark were contesting the possession of Livonia, Ivan intervened in 1558. He captured Narva, Dorpat and a dozen smaller fortresses; then, in 1560, Livonia placed herself beneath the protection of Poland, and King Sigismund II. warned Ivan off.

Ivan now entered upon the second and evil portion of his reign. As early as 1553 he had ceased to trust Sylvester and Adashev, owing to their backwardness in supporting the claims of his infant son to the throne while he himself lay at the point of death. On his recovery he overlooked their ambiguous conduct, and they continued to direct affairs for six years longer. Then the dispute about the Crimea'arose, and Ivan began to distrust their intelligence as well as their loyalty. In 1560 both of them disappeared from the scene, Sylvester into a monastery at his own request, while Adashev died the same year, in honourable exile as a general in Livonia. The death of his wife Anastasia and his son Demetrius, and the desertion of his one bosom friend Prince Kurbsky, about the same time, seem to have infuriated Ivan against God and man. During the next ten years (1560–1570) terrible and horrible things happened in Muscovy. The tsar imagined that every man's hand was against him. On Dec. 3, 1564 he quitted Moscow with his whole family. On Jan. 3, 1565, he declared his intention to abdicate. The common people, whom he had always favoured at the expense of the boyars implored him to come back on his own terms. He consented to do so, but entrenched himself within a peculiar institution, the *oprichina* or "separate estate." Certain towns and districts all over Russia were separated from the rest of the realm, and their revenues were assigned to the maintenance of the tsar's new court and household, which was to consist of 1,000 carefully selected boyars and lower dignitaries, with their families and suites, in the midst of whom Ivan henceforth lived exclusively. The *duma,* or council, still attended to the administration; the old boyars still retained their ancient offices and dignities. But the tsar had cut himself off from all communication with them except on extraordinary occasions. The *oprichniki* trampled with impunity upon every one beyond the charmed circle. Their first victim was Philip, the saintly metropolitan of Moscow, who was strangled for condemning the *oprichina* as an unchristian institution, and refusing to bless the tsar (1569). Ivan had stopped at Tver, to murder St. Philip, while on his way to destroy the second wealthiest city in his tsardom—Great Novgorod. A delator of infamous character, one Peter, had accused the authorities of the city to the tsar of conspiracy; Ivan, without even confronting the Novgorodians with their accuser, proceeded at the end of 1569 to punish them. After ravaging the land he entered the city on Jan. 8, 1570, and for the next five weeks, day after day, massacred batches of every class of the population. Every monastery, church, manor-house, warehouse and farm within a circuit of 100 m. was plundered and left roofless, all goods were pillaged, all cattle destroyed. Not till Feb. 13 were the miserable remnants of the population permitted to rebuild their houses.

An intermittent and desultory war, with Sweden and Poland simultaneously, for the possession of Livonia and Estonia, went on from 1560 to 1582. Ivan's generals bore down their enemies by sheer numbers, capturing scores of fortresses and towns. But in the end the superior military efficiency of the Swedes and Poles invariably prevailed. Ivan had as his chief antagonist Stephen Báthory, one of the greatest captains of the age. The West was too strong for him. By the peace of Zapoli (Jan. 15, 1582) he surrendered Livonia with Polotsk to Báthory, and by the truce of Ilyusa he at the same time abandoned Ingria to the Swedes. The Baltic seaboard was lost to Muscovy for another century and a half. In his latter years Ivan cultivated friendly relations with England; he wished to marry Mary Hastings, one of Elizabeth's ladies, though his fifth wife, Martha Nagaya, was still alive. Towards the end of his life Ivan acquired Siberia, which was first subdued by the Cossack hetman Ermak or Yermak in 1581.

In November 1580 Ivan in a fit of ungovernable fury struck his eldest surviving son Ivan, whom he passionately loved, a blow which proved fatal. In an agony of remorse, he would now have abdicated, but the boyars absolutely refused his abdication. Three years later, on March 18, 1584, he died. During the last moments of his life he assumed the hood of the strictest order of

hermits, and died as the monk Jonah.

Ivan IV. possessed extraordinary political foresight. He anticipated the ideals of Peter the Great, but the resources for their realization were lacking. His brutal and vicious manners prepared the way for the horrors of "the Great Anarchy." Personally, Ivan was tall and well-made, with high shoulders and a broad chest. His face had a sinister, troubled expression, but an enigmatical smile played perpetually around his lips. He was the best educated and the hardest worked man of his age. His memory was astonishing, his energy indefatigable. As far as possible he saw to everything personally, and never sent away a petitioner of the lower orders.

See S. M. Soiov'ev, *History of Russia* (Rus.) vol. v. (St. Petersburg, 1895); A. Briickner, *Geschichte Russlands bis zum Ende des 18ten Jahrhunderts* (Gotha, 1896); E. Tikhomirov, *The first Tsar of Moscovy, Ivan IV.* (Rus.) (Moscow, 1888); L. G. T. Tidander, *Kriget mellan Sverige och Ryssland åren 1555–1557* (Vesterås, 1888); P. Pierling, *Un Arbitrage pontifical au XVIe siècle entre la Pologne et* la *Russie* (Bruxelles, 1890); V. V. Novodvorsky, *The Struggle for Livonia, 1570–1582* (Rus.) (St. Petersburg, 1904); K. Waliszewski, *Ivan le terrible* (Paris, 1904); R. N. Bain, *Slavonic Europe*, ch. 5 (Cambridge, 1907). (R. N. B.; X.)

IVAN V.[1] (1666–1696), tsar of Russia, was the son of Tsar Alexius Mikhailovich and his first consort Miloslavzkoya. Physically and mentally deficient, Ivan was the mere tool of the party in Muscovy who would have kept the children of the tsar Alexis, by his second consort Natalia Naryshkina, from the throne. In 1682 the party of progress, headed by Artamon Matveyev and the tsaritsa Natalia, passed Ivan over and placed his half-brother, the vigorous and promising little tsarevich Peter, on the throne. On May 23, however, the Naryshkin faction was overthrown by the *stryeltsi* (musketeers), secretly worked upon by Ivan's half-sister Sophia, and Ivan was associated as tsar with Peter. Three days later he was proclaimed "first tsar," in order still further to depress the Naryshkins, and place the government in the hands of Sophia exclusively. In 1689 the name of Ivan was used as a pretext by Sophia in her attempt to oust Peter from the throne altogether. During the reign of his colleague Peter, Ivan V. took no part whatever in affairs, but devoted himself to religious exercises. On Jan. 9, 1684, he married Praskovia Saltuikova, who bore him five daughters, one of whom, Anne, ultimately became empress. He died on Jan. 29, 1696.

See R. Nisbet Bain, *The First Romanovs* (London, 1905); M. P. Pogodin, *The First Seventeen Years of the Life of Peter the Great* (Rus.) (Moscow, 1875).

IVAN III. (1440–1505), grand duke of Muscovy, son of Vasily (Basil) Vasilievich the Blind, grand duke of Moscow, and Maria Yaroslavovna, was born in 1440. He was co-regent with his father during the latter years of his life, and succeeded him in 1462. Ivan III.'s first enterprise was a war with the republic of Novgorod, which, alarmed at the growing dominance of Muscovy, had sought the protection of Casimir IV., king of Poland, an alliance regarded at Moscow as an act of apostasy from orthodoxy. Ivan took the field against Novgorod in 1470; during the summer of 1471, the Novgorodians sued for peace, which they obtained on engaging to abandon for ever the Polish alliance, ceding a considerable portion of their northern colonies, and paying a war indemnity of 15,500 roubles. Ivan sought continually a pretext for destroying Novgorod altogether; he found his opportunity in 1477. In that year the ambassadors of Novgorod addressed him in public audience as "Gosudar" (sovereign) instead of "Gospodin" ("Sir") as heretofore. Ivan seized upon this as a recognition of his sovereignty, and when the Novgorodians repudiated their ambassadors, he marched against them. Deserted by Casimir IV., and surrounded on every side by the Muscovite armies, which included a Tatar contingent, the republic recognized Ivan as autocrat, and surrendered (January 14, 1478) all her prerogatives and possessions (the latter including the whole of northern Russia from Lapland to the Urals) into his hands. Subsequent revolts (1479–1488) were punished by the removal en *masse* of the richest and most ancient families of Novgorod to Moscow, Vyatka and other central Russian cities. Novgorod, as an independent state, ceased to exist. The rival republic of Pskov purchased the continuance of its political existence by assisting Ivan against its ancient enemy. The other principalities were virtually absorbed, by conquest, purchase or marriage contract—Yaroslavl in 1463, Rostov in 1474, Tver in 1485.

Ivan's refusal to share his conquests with his brothers, and his interference in their inherited principalities, involved him in several wars, from which, though the princes were assisted by Lithuania, he emerged victorious. Ivan's last will decreeing that the domains of all his kinsfolk, after their deaths, should pass directly to the reigning grand duke instead of reverting to the princes' heirs, destroyed these semi-independent princedoms. Ivan determined to annex part of Lithuania, now governed by his son-in-law Alexander, who was compelled in 1499 to take up arms against his father-in-law. The Lithuanians were routed at Vedrosha (July 14, 1500), and in 1503 Alexander purchased peace by ceding to Ivan, Chernigov, Starodub, Novgorod-Syeversk and sixteen other towns.

In the reign of Ivan III. Muscovy rejected the Tatar yoke. In 1480 Ivan refused to pay the customary tribute to the grand Khan Ahmed. All through the autumn the Russian and Tatar hosts confronted each other on opposite sides of the Ugra, till Nov. 11, when Ahmed retired into the steppe. In the following year the grand khan, while preparing a second expedition against Moscow, was suddenly attacked, routed and slain by Ivak, the khan of the Nogai Tatars, whereupon the Golden Horde suddenly fell to pieces. In 1487 Ivan reduced the khanate of Kazan (one of the offshoots of the Horde) to the condition of a vassal-state, though in his later years it broke away from his suzerainty. With the other Mohammedan powers, the khan of the Crimea and the sultan of Turkey, Ivan's relations were pacific and even amicable. The Crimean khan, Mengli Girai, helped him against Lithuania, and facilitated the opening of diplomatic intercourse between Moscow and Constantinople, where the first Russian embassy appeared in 1495.

The character of the government of Muscovy under Ivan III. took on an autocratic form. This was due to the natural consequence of the hegemony of Moscow over the other Russian lands, and to the simultaneous growth of new and exotic principles falling upon a soil already prepared for them. After the fall of Constantinople, orthodox canonists were inclined to regard the Muscovite grand dukes as the successors of the Byzantine emperors. After the death of his first consort, Maria of Tver (1467), Ivan III. wedded the Catholic Zoe Paleologa (better known by her orthodox name of Sophia), daughter of Thomas, despot of the Morea, who claimed the throne of Constantinople as the nearest relative of the last Greek emperor. Through her influence the ceremonious etiquette of Constantinople with the imperial double-headed eagle was adopted by the court of Moscow. The old patriarchal systems of government vanished. The boyars were no longer consulted on affairs of state. The sovereign became sacrosanct, while the boyars were reduced to the level of slaves absolutely dependent on the will of the sovereign. The boyars naturally resented so insulting a revolution, and struggled against it, at first with some success. But Sophia prevailed in the end, and her son Vasily was ultimately crowned co-regent with his father (April 14, 1502). The first Russian "Law Book," or code, was compiled by the scribe Gusev in Ivan's reign. The grand duke invited many foreign masters and artificers to settle in Muscovy, the most noted of whom was the Italian Ridolfo di Fioravante, nicknamed Aristotle, who built the cathedrals of the Assumption (Uspenski) and of Saint Michael or the Holy Archangels in the Kremlin.

See P. Pierling, *Mariage d'un tsar au Vatican, Ivan III. et Sophie Paléologue* (Paris, 1891); E. I. Kashprovsky, *The Struggle of Ivan III. with Sigismund I.* (Rus.) (Nizhni, 1899); S. M. Solov'ev, *History of Russia* (Rus.), vol. v. (St. Petersburg, 1895).

IVAN I., called *Kalita*, or Money-Bag (d. 1341), grand duke of Vladimir, was first *sobiratel*, or "gatherer" of the scattered Russian lands, thereby laying the foundations of the future

[1] Ivan V., if we count from the first grand duke of that name, as most Russian historians do; Ivan II., if, with the minority, we reckon from Ivan the Terrible as the first Russian tsar.

autocracy as a national institution. He adopted a policy of complete subserviency to the khan of the Golden Horde, who, in return for a liberal and punctual tribute, permitted him to aggrandize himself at the expense of the lesser grand dukes. Moscow and Tver were the first to fall. The latter Ivan received from the hand of the khan, after devastating it with a host of 50,000 Tatars (1327). When Alexander of Tver fled to Pskov, Ivan procured his banishment by the aid of the metropolitan, Theognost, who threatened Pskov with an interdict. In 1330 Ivan extended his influence over Rostov by the drastic methods of blackmail and hanging. But he threatened the republic of Great Novgorod in vain. In 1340 Ivan assisted the khan to ravage the domains of Prince Ivan of Smolensk, who had refused to pay the customary tribute to the Horde. Ivan's own domains remained free from Tatar incursions, and therefore attracted immigrants and their wealth from surrounding principalities. Ivan uas a niggard, keeping an exact account of every village or piece of plate that his moneybags acquired, whence his nickname. During his reign the metropolitan see was transferred from Vladimir to Moscow, which gave Muscovy the preeminence over all the other Russian states. The Metropolitan Peter built the first stone cathedral of Moscow, and his successor, Theognost, followed suit with three more stone churches. Simultaneously Ivan substituted oaken walls for the ancient wooden ones of the Kremlin, or citadel, which made Moscow a still safer place of refuge.

See S M Soloviev, *History of Russia* (Rus.), vol. iii (St. Petersburg, 1895) ; Polezhaev, *The Principality of Moscow in the first half of the 14th Century* (Rus.) (St. Petersburg, 1878).

IVAN II (1326–1359), grand duke of Vladimir, a younger son of Ivan Kalita, succeeded his elder brother Simeon as grand duke in 1353, despite the competition of Prince Constantine of Suzdal, the Khan Hanibek preferring to bestow the *yarluik,* or letter of investiture, upon Ivan rather than upon Constantine. At first the principalities of Suzdal, Ryazan and the republic of Novgorod refused to recognize him as grand duke, and waged war with him until 1354. The surrounding principalities paid little attention to Moscow, and Ivan was ruled to a great extent by the *tuisyatsky,* or chiliarch, Alexis Khvost, and, after his murder by the jealous boyars in 1357, by Bishop Alexis. Ivan, by his last will, divided his dominions among his children.

See Dmitry Ilovaisky, *History* of *Russia* (Rus.), vol. ii (1876–94).

IVANOVO (IVANOVO-VOZNESENSK), (1) an *oblast* of the Central region of the Russian Soviet Federated Socialist Republic. drained by the Volga and its tributary, the Unzha. Population (1956 est.) 1,351,000. Area 9.498 sq.mi. It lies in the pine forest area, and is thickly forested north of the Volga and east of the Unzha, but in the southwestern district the forest remains in patches only. Rye and oats are the main crops. with potatoes. grasses, flax, wheat, barley and buckwheat in much smaller quantities. Sheep, cattle. horses and pigs are reared. A network of electric stations is working on the abundant peat fuel of the district, and the town of Ivanovo is supplied from an electric plant at Teikovo, near Lake Rubsk, on the railway to Moscow via Aleksandrov. (2) A town, the administrative centre of the region, linked by branch lines with the Moscow to Gorky and the Moscow to Yaroslavl railways, and also to Kineshma on the Volga river. It has important cotton and linen factories. equipped with up-to-date machinery, and iron and chemical works connected with its textile industries. Its population is increasing rapidly and was estimated at 319,000 in 1956. Originally it consisted of two villages—Ivanovo, dating from the 16th century, and Voznesensk, of more recent date—united into a town in 1861. Its cathedral and the church of the Intercession of the Virgin were formerly associated with an important monastery founded in 1579 and abandoned in 1754.

IVARR BEINLAUSI (d. 873), son of Ragnar Lothbrok, the great Viking chieftain, is known in English and continental annals as Inuaer, Ingwar or Hingwar. He was one of the Danish leaders in the Sheppey expedition of 855 and was perhaps present at the siege of York in 867. The chief incident in his life was his share in the martyrdom of St. Edmund in 870. He seems to have been the leader of the Danes on that occasion, and by this act he probably gained the epithet "crudelissimus" by which he is usually described. It is probable that he is to be identified with Imhar, king of the Norsemen of all Ireland and Britain, who was active in Ireland between the years 852 and 873, the year of his death.

IVEAGH, EDWARD CECIL GUINNESS, 1ST EARL OF (1847–1927), was born on Nov. 10, 1847, the son of Sir Benjamin Guinness, first baronet. He was educated at Trinity college, Dublin, and after some experience in the business became chairman of the famous Guinness brewery. He retired from the management in 1889, marking his retirement by a gift of £250,000 for the housing of the poor in Dublin and in London. A little later he provided another £250,000 for the clearing of an insanitary area in Dublin and the erection of workmen's dwellings. His other great benefactions included £250,000 to the Lister Institute of Preventive Medicine in London for bacteriological research. Last of all he rescued Ken Wood, north of Hampstead heath, for the benefit of Londoners by purchasing the remaining portion of the estate in 1925 and arranging that Ken Wood with its collection of pictures and the 76 ac. on which it stood should become public property. From 1905 onward when he purchased Elveden hall, Suffolk, most of his time was spent in England, but he never lost touch with his native city, of which he was a constant benefactor, and he did not allow his unionist principles to interfere with his civic patriotism. Guinness received a barony in 1891, a viscounty in 1905 and an earldom in 1919. He died in London on Oct. 7, 1927.

He was succeeded by his son Rupert, Viscount Elveden, M.P. (b. 1874), whose wife (nee Lady Gwendolen Onslow) entered parliament as member for Southend in 1927.

IVES, FREDERIC EUGENE (1856–1937), U.S. inventor, was born on Feb. 17, 1856, on a farm in Litchfield, Conn. He was apprenticed as a printer on the *Litchfield Inquirer,* 1869. He diligently studied photography and it was in those early days he first dreamed of a quick and popular photomechanical process of illustration. So expert a photographer had he become at 19 that he was placed in charge of the Cornell university photographic laboratory. There he developed a new "swell gelatine" line process by which beautiful illustrations were produced for the undergraduate periodical. At Cornell in 1878 Ives invented the first process called "halftone." Although the results were identical with those of today, the process was different. The method now in universal use he invented in 1885–86 in Philadelphia, where, in Feb. 1881, he had begun the first commercial production of half-tone printing plates (by his first method). In 1881 Ives made the world's first set of trichromatic half-tone process printing plates. Among his other important inventions were the half-tone photogravure (anticipating rotogravure) ; the modern short-tube single-objective binocular microscope; the photochromoscope, a device for optically reproducing objects in both full modelling and perfect colour; also photographs and motion pictures in natural colours. Specimens of his early prints are preserved in the Smithsonian institution. Frederic E. Ives was the father of Herbert E. Ives, the outstanding engineer in the development of television and the transmission of pictures by wire. (W. T. I.)

IVIZA, IBIZA or IVIÇA, an island in the Mediterranean sea, belonging to Spain, and forming part of the archipelago knowh as the Balearic Islands (*q.v.*). Pop. (1950) 35,312; area 209 sq.mi. Iviza lies 50 mi. S.W. of Majorca and about 60 mi. from Cape San Martin on the coast of Spain. Its greatest length from northeast to southwest is about 25 mi. and its greatest breadth about 13 mi. The hilly parts which culminate in the Pico de Atalayasa (1,558 ft.), are richly wooded. Oil, corn and fruits (of which the most important are the fig, prickly pear, almond and carob-bean) are the principal products; hemp and flax are also grown. Fruit, salt. charcoal, lead and stockings of native manufacture are exported. The imports are rice, flour, sugar, woollen goods and cotton. The capital of the island and, indeed, the only town of much importance—for the population is remarkably scattered—is Iviza or La Ciudad (11,333), a fortified town on the southeast coast, possessing a good harbour, a 13th-century Gothic

collegiate church and an ancient castle. Iviza was the see of a bishop from 1782 to 1851.

South of Iviza lies the smaller and more irregular island of Formentera, pop. (1950) 2,838; area, 32 sq.mi. With Iviza it agrees both in general appearance and in the character of its products, but it is altogether destitute of streams. Goats and sheep are found in the mountains, and the coasts are greatly frequented by flamingos. Iviza and Formentera are the principal islands of the lesser or western Balearic group, formerly known as the Pityusae or Pine islands.

IVO OF CHARTRES, SAINT (Yvo, Yves) (*c.* 1040–1116), bishop of Chartres, was born of a noble family near Beauvais, and was educated in Paris and at Bec under Lanfranc. About 1080 he became prior of the canons of St. Quentin in Beauvais and 10 years later bishop of Chartres in place of Geoffrey who had been deposed for simony. As bishop he incurred the hostility of Philip I who wished to leave his wife and marry the Countess Bertrada of Anjou. In the Investiture struggle his policy was one of moderation. His importance as a canonist is apparent from his *Decretum* and his *Panormia,* both composed before 1096. His 288 letters throw much light on the political, religious and liturgical questions of his day. In addition to these works, which together with the sermons are printed in Migne's *Patrol. Lat.,* vol. 161 and 162, Ivo wrote an unprinted commentary on the Psalms and a collection of canons, *Tripartita.* His feast is celebrated on May 20.

IVORY, SIR JAMES (1765–1842), a Scottish mathematician, was born in Dundee in 1765, the son of a matchmaker. In 1779 he entered the University of St. Andrews, where he distinguished himself especially in mathematics. From 1804 until 1816, he occupied a chair of mathematics at the Royal Military college (later Sandhurst), at Marlow.

Ivory contributed many memoirs to the *Philosophical Transactions,* the most important was one published in 1809. This paper gave his theorem on the attraction due to a homogenous ellipsoid, which later became known as Ivory's theorem.

In 1814 Ivory received the Copley medal. and in 1815 was elected a fellow of the Royal society. He was connected with several other scientific societies. He died in London on Sept. 21, 1842.

IVORY, a term usually confined to the material represented by the tusk of the elephant, and for commercial purposes almost entirely to that of the male elephant. In Africa both the male and female elephant produce good-sized tusks; in the Indian variety the female is much less bountifully provided, and in Ceylon perhaps not more than 1% of either sex have tusks. Ivory is in substance quite dense. the pores are close, compact and filled with a gelatinous solution which makes it easy to work and contributes to the beautiful polish which may be given to it. It may be classed between bone and horn, but is more fibrous than bone and therefore less easily torn or splintered. A scientific definition is that given by Sir Richard Owen, who said, "The name ivory is now restricted to that modification of dentine or tooth substance which in transverse sections or fractures shows lines of different colours, or striae, proceeding in the arc of a circle and forming by their decussations minute curvilinear lozenge-shaped spaces." These spaces are formed by an immense number of exceedingly minute tubes placed very close together, radiating outward in all directions. It is to this arrangement of structure that ivory owes its fine grain and almost perfect elasticity, and the peculiar marking resembling the engine-turning on the case of a watch, by which many persons are guided in distinguishing it from celluloid or other imitations. Elephants' tusks are the upper incisor teeth, which, starting in earliest youth from a semisolid vascular pulp, grow during the whole of the animal's existence, gathering phosphates and other elements and becoming hardened as in the formation of teeth generally. The tusk is built up in layers, the inside layer being the last produced. A large proportion is embedded in the bone sockets of the skull, and is hollow for some distance up in a conical form, the hollow becoming less and less as it is prolonged into a narrow channel which runs along as a thread or "nerve," toward the point of the tooth. The outer layer, or bark, is enamel of similar density to the central part. Besides the elephant's tooth or tusk, the teeth of the hippopotamus, walrus, narwhal, cachalot or sperm whale and of some animals of the wild boar class. such as the wart hog of South Africa, are recognized as ivory for commercial purposes. However, among these the hippo and walrus tusks proved to be the only ones of importance for large work.

Sources of Ivory. — The supply of ivory imported into Europe generally comes from Africa; some is Asiatic, but much that is shipped from India is really African, coming by way of Zanzibar and Mozambique to Bombay. A certain amount has been furnished in modern times by the vast stores of remains of prehistoric animals existing throughout the U.S.S.R., principally in Siberia in the neighbourhood of the Lena and other rivers discharging into the Arctic ocean. The mammoth and mastodon seem at one time to have been common over the whole surface of the globe. In England tusks were dug up (*e.g.,* at Dungeness) 12 ft. in length and weighing 200 lb. However, little or no mammoth ivory passed through the London market after 1900, but before that, parcels of 10 to 20 tons were not uncommon. Not all of this ivory was good; about half of what came to England was rotten; although specimens mere found as perfect and in as fine a condition as if recently killed, instead of having lain preserved for thousands of years in the icy ground. There is considerable literature on the subject of big game hunting (*q.v.*) which includes that of the elephant, hippopotamus and smaller tusk-bearing animals. Elephants until comparatively recent times roamed over the whole of Africa from the northern deserts to the Cape of Good Hope. They were still abundant in Central Africa and Uganda in modern times, but civilization gradually drove them farther and farther into the wild and impenetrable forests of the interior.

The quality of ivory varies according to the districts where it is obtained, the soft variety of the eastern parts of the continent being the most esteemed. When in perfect condition African ivory should be (if recently cut) of a warm, transparent, mellow tint. with little appearance of grain or mottling. Asiatic ivory is a denser white, more open in texture and softer to work. But it is apt to turn yellow sooner, and is not so easy to polish. Unlike bone, ivory requires no preparation, but is ready for immediate working. That from the neighbourhood of the Cameroons was of good quality but the supply was exhausted early in the 20th century; the ivory from Loango, Congo, Gabun and Ambriz ranked next in quality, followed by that from the Gold Coast (Ghana), Sierra Leone and Cape Coast. That of French Sudan was nearly always "ringy," and some of the Ambriz variety also. Zanzibar and Mozambique varieties were called soft; Angola and Ambriz all hard. Ambriz ivory was at one time much esteemed, but there was comparatively little in modern times. Siam ivory is rarely if ever soft. Abyssinian has its soft side, but Egypt was practically the only place where both types were widely distributed. A drawback to Abyssinian ivory is a prevalence of a rather thick bark. Egyptian was liable to be cracked, from the extreme variations of temperature (when primitive methods of packing and transit were used) since ivory is extremely sensitive to sudden extremes of temperature.

The market terms by which types of ivory are distinguished tend to mislead. As is often the case they generally refer to ports of shipment rather than to places of origin. For instance, "Malta" ivory came to be a well-understood term in the trade, though there are no ivory-producing animals in that island.

Tusks should be regular and tapering in shape, not too curved or twisted, for economy in cutting; the coat, fine, thin, clear and transparent. The substance of ivory is so elastic and flexible that excellent riding whips have been cut longitudinally from whole tusks. The size to which tusks grow and are brought to market depends on the species rather than on the size of elephants. The largest are found in equatorial Africa. Asiatic bull elephant tusks seldom exceed 50 lb., though lengths of 9 ft. and up to 150 lb. in weight are not entirely unknown. Record African tusks included the one presented to George V (then prince of Wales) on his marriage (1893), which measured 8 ft. $7\frac{1}{2}$ in. and weighed 16 j lb., and the pair of tusks which were brought to the Zanzibar market by natives in 1898, the pair weighing more than 450 lb. One of these

was preserved in the Natural History museum at South Kensington and the other in the Rodgers collection at Sheffield. Two tusks were also found measuring 11 ft. and 11 ft. j in. respectively, with a combined weight of 293 lb.

Osteodentine, resulting from the effects of injuries from spear-heads or bullets, is sometimes found in tusks. This formation, resembling stalactites. grows with the tusk, the bullets or iron remaining embedded without trace of their entry.

Hard and Soft Ivory. — The most important commercial distinction of the qualities of ivory is that of the hard and soft varieties. The terms are difficult to define exactly. Generally speaking, hard or bright ivory is glassy and transparent, and is distinctly harder to cut with the saw or other tools. Soft ivory contains more moisture, stands differences of climate and temperature better and does not crack so easily. The expert is guided by the shape of the tooth. by the colour and quality of the bark or skin and by the transparency when cut. or even before, as at the point of the tooth. Roughly, a line might be drawn almost centrally down the map of Africa — on the west the hard quality prevails, on the east the soft. In choosing ivory (*e.g.*, for knife handles) buyers seem to prefer a pretty grain, strongly marked; but the finest quality in the hard variety, which is generally used for such handles, is the closest and freest from grain. The curved or canine teeth of the hippopotamus are valuable hard ivories. Owen described this variety as "an extremely dense, cqmpact kind of dentine, partially defended on the outside by a thin layer of enamel as hard as porcelain; so hard as to strike fire with steel." By reason of this hardness it is not popular with turners and ivory carvers, and before being worked the enamel has to be removed by acid, or sometimes by heating and sudden cooling so it can be scaled off. The texture is slightly curdled. mottled or damasked. Hippo ivory was at one time used for artificial teeth, but later mostly for umbrella and stick handles, and whole (in their natural form) for fancy doorknobs and the like. In the trade the term was not "riverhorse" but "seahorse" teeth. Walrus ivory is less dense and coarser than hippo. but of fine quality (what there is of it) for the oval centre which has more the character of coarse bone unfortunately extends a long way up. Formerly a large supply came to the market. but eventually there was an increasing scarcity, the animals having been almost exterminated by exploitation in their principal haunts in the northern seas. Walrus ivory came to be of minor importance in modern times though it was at one time valued highly. Comparatively large slabs are to be found in mediaeval sculpture of the 11th and 12th centuries, and the grips of many oriental swords, ancient and modern, are made from it. The ivory from the single tusk or horn of the narwhal is not of much

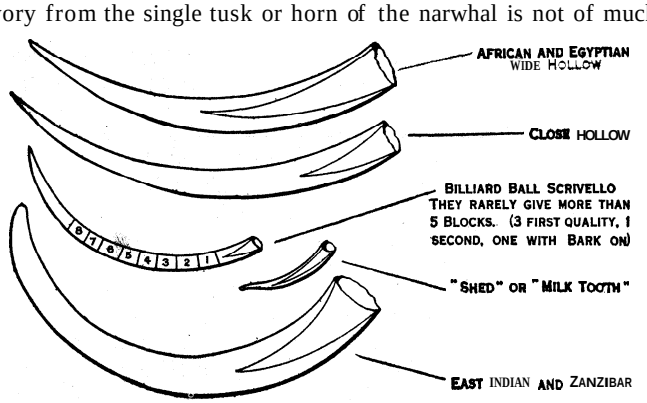


FIG. 1.—TYPES OF TUSKS

commercial value except as an ornament or curiosity. Some horns attain a length of 8 to 10 ft., 4 in. thick at the base. It is dense in substance and of a fair colour, but because of the central cavity there is little of it fit for anything larger than napkin rings.

Ivory in Commerce. — Almost all importation of ivory to Europe was until relatively recent years confined to London, the principal distributing mart of the world. But the opening of the Congo trade placed the port of Antwerp in a position which equalled that of London. Other important markets were developed at Liverpool and Hamburg. Germany, France and Portugal ordinarily imported their supplies from Africa. America also imported ivory for its own requirements.

Every pair of tusks that comes to the market represents a dead elephant, but not necessarily a slain or even a recently killed one, as is popularly supposed. By far the greater portion comes from stores accumulated by natives, a good part from animals which died a natural death. It has been estimated that not 20% is live ivory or recently killed; the remainder is known in the trade as dead ivory.

Mincing lane in London became a centre for ivory sales in the 19th century, and was noted for its interesting and wonderful display of tusks and ivory of all kinds, laid out previously for inspection in the great warehouses known as the "Ivory floor" in the London docks.

Industrial Applications. — In industry little is wasted of this valuable product. The cuttings and shavings and scraps returned by manufacturers after they have used what they require for their particular trade, come to the mart. The dust has been used for polishing and in the preparation of India ink.

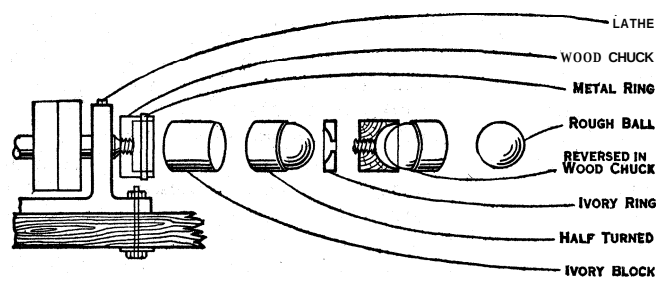


FIG. 2.— TURNINGBILLIARD BALLS FROM IVORY BLOCKS

The scraps of ivory are used for inlaying and for various purposes. such as small domestic and decorative objects. In India, which has been called the backbone of the trade, the rings left in the turning of billiard balls, served as women's bangles, or mere used in making small toys and models and other characteristic Indian work. Chief among recent applications of ivory were the manufacture of billiard balls. cutlery handles, piano keys, brushware and toilet articles. Billiard balls demanded the highest quality of ivory; for the best balls soft ivory was first employed, though later, through the competition of substitutes, the hard was more used in order that the weight might be assimilated to that of artificial ivory (see below). The most valuable tusks of all were those adapted for the billiard ball trade. The term used, "scrivelloes," was applied to teeth proper for the purpose, weighing not over about 7 lb. The division of the tusk into smaller pieces for subsequent manufacture, in order to avoid waste, was a matter of importance.

Figs. 1 and 2 show the method used in making billiard balls. The cuts were made radiating from an imaginary centre of the curve of the tusk. In after processes the various trades had their own particular methods for making the most of the material. In making a billiard ball of the English size the first step was to rough out. from the cylindrical section. a sphere about $2\frac{1}{8}$ in. in diameter, which eventually would be $2\frac{1}{16}$ or sometimes for professional players a little larger. One hemisphere (see fig. 2) was first turned and the resulting ring detached with a parting tool. The diameter was accurately taken and the subsequent removals taken off in other directions. The ball was then fixed in a wooden chuck. the half cylinder reversed, and the operation repeated for the other hemisphere. It was left for five years to season and then turned dead true. The rounder and straighter the tusk selected for ball making the better. Evidently, if the tusk were oval and the ball the size of the least diameter, its sides uhich came nearer to the bark or rind would be coarser and of a different density from those portions further removed from this outer skin. The matching of billiard balls was important, with extreme accuracy in weight essential.

It was usual to bleach the balls, since a dead white was desirable; however, bleaching with chemicals took out the gelatine to some extent, altered the quality and affected the density; it also

made them more liable to crack, and detracted from the appearance. On an average three balls of fine quality could be made from a tooth.

The ivory for piano keys was delivered to the trade in shapes known as heads and tails, the former for the parts which came under the fingers, the latter for that running up between the black keys. The two were joined afterward on the keyboard with extreme accuracy. Piano keys were bleached, but organists for some reason or other preferred unbleached keys. The soft variety, preferably of the Egyptian type, was mostly used for high-quality work.

The great centres of the ivory industry for ordinary objects of common domestic use were established in Great Britain: for cutlery handles, Sheffield; for billiard balls and piano keys, London. For cutlery a typical firm used an average of 20 tons of ivory annually, mostly of the hard variety. For billiard balls and piano keys the U.S. became a large producer, and considerable quantities were made in France and Germany. Dieppe became famous for the numerous little ornaments and useful articles such as statuettes, crucifixes, little book covers, paper cutters, combs and napkin rings. St. Claude in the Jura, Geislingen in Wurttemberg and Erbach in Hesse, Ger., were also among the most important centres of the industry. India and China supplied toys, models, chess and draughtsmen, puzzles, work-box fittings and other curiosities.

Vegetable Ivory and Substitutes.—Some mention may be made of vegetable ivory and artificial substitutes. The plants yielding the vegetable ivory of commerce represent two or more species of an anomalous genus of palms. and are known to botanists as *Phytelephas*. They are native to tropical South America, occurring chiefly on the banks of the Magdalena river, Colombia, always found in damp localities, not only on the lower coast region as in Darien, but also at a considerable elevation above the sea. They mostly grow in separate groves, not mixed with other trees or shrubs. The plant is known as the "tagua" by the Indians on the banks of the Magdalena, as the "anta" on the coasts of Darien and as the "pullipunta" and "homero" in Peru. It is stemless or short-stemmed, and crowned with from 12 to 20 very long pinnatifid leaves. The plants are dioecious, the males forming higher, more erect and robust trunks than the females. The male inflorescence is in the form of a simple, fleshy, cylindrical spadix covered with flowers; the female flowers are also in a single spadix, shorter than in the male. The fruit consists of a conglomerated head composed of six or seven drupes, each containing from six to nine seeds, and the whole being enclosed in a walled woody covering forming altogether a globular head as large as that of a man. A single plant sometimes bears at the same time from six to eight of these large heads of fruit. each weighing from 50 to 25 lb. In its very young state the seed contains a clear insipid fluid, which travellers take advantage of to allay thirst. As it gets older this fluid becomes milky and of a sweet taste, and it gradually continues to change both in taste and consistence until it becomes so hard as to make it valuable as a substitute for animal ivory. In their young and fresh state the fruits are eaten with avidity by bears, hogs and other animals. The mature seeds, or nuts, were used by American Indians for making small ornamental articles and toys, and were imported into Britain in considerable quantities, frequently under the name of "Corozo" nuts, a name by which the fruits of some species of *Attalea* (another palm with hard ivorylike seeds) are known in Central America—their uses being chiefly for small turned articles.

Many artificial compounds have been introduced as substitutes for ivory, among them potatoes treated with sulphuric acid. Celluloid (*q.v.*) was initially developed as an adequate substitute for ivory in making billiard balls; a French substitute—a casein made from milk, called galalith—was developed for piano makers as a substitute for piano keys.

Odontolite is mammoth ivory, which through lapse of time and from surroundings becomes converted into a substance known as fossil or blue ivory, and is used occasionally in jewelry as turquoise, which it very much resembles. It is formed from the tusks of antediluvian mammoths buried in the earth for thousands of years, during which time under certain conditions the ivory becomes slowly penetrated with the metallic salts which give it the peculiar vivid blue colour of turquoise. (*See* also PLASTICS.)

IVORY BILL or **IVORY-BILLED WOODPECKER** (*Campephilus principalis*), the largest North American woodpecker, reaches a length of 20 in. Formerly extending north to Illinois, Indiana and North Carolina, the ivory bill is now very rare everywhere and is almost confined to cypress swamps in a few isolated portions of Florida. The white beak and large size are diagnostic. The plumage is black, with the secondaries and shorter primaries white, and a pair of white stripes down the back. The long crest is scarlet in the male, black in the female. The call is "a sharp, penny trumpetlike *yap-yap.*" The heads were used for ornaments by the Indians. (*See* WOODPECKER.)

IVORY BLACK, a high-grade carbonaceous black sometimes prepared by carbonizing ivory turnings and cuttings, but more often made by the calcination of bone, only the best grades of product being selected. It should have a deep black, velvety tint, It is largely composed of mineral matter, from 65% to 84% being calcium phosphate uith some calcium carbonate. Ivory black is used by copperplate printers in preparing their inks, and also to a decreasing extent as a dzcolourizing agent.

IVORY CARVING. The use of ivory as a material peculiarly adapted for sculpture and decoration has been universal in the history of civilization. In order to treat the subject adequately and give the relative importance of the art in different countries, the following division is made: techniques of ivory carving; western, covering various periods and countries; oriental; North American.

TECHNIQUES

Prehistoric.—Paleolithic man in prehistoric Europe learned to use elephant and mammoth tusks, along with bones and antlers, working them in two characteristic ways. The substance was either worn away to shape simple human or animal figures, or rough pictures were scratched on a flattened surface. The tools were edged implements of chipped flint or quartz. Although the early stone tools ultimately gave way to better ones of other materials and various refinements were gradually learned, the basic methods for carving ivory remained essentially the same down through the ages. First, the heavy outer rind or bark of the tusk had to be removed, then the inner substance was worked—generally in conveniently small sections—with careful attention to the direction of the grain, and finally the result had to be cleaned and polished; after which it might be further painted or stained. The succeeding history of ivory carving techniques largely involves differences in the kinds of ivory used in different areas and local variations in method.

Egypt.—The ancient Egyptians before 3000 B.C. had achieved a high art of figure carving in ivory. The later Egyptians continued to make figures and implements in the round, and incised pictures on flat slabs of ivory. They also developed a third basic technique, the carving of panels in relief. They used elephant tusks from the Sudan and teeth of the hippopotamus from the Nile. The elephant ivory carvings were often stained red, or sometimes dark brown, black or green with dyes now unknown; but hippopotamus ivory would not take a stain.

The Phoenicians.—The ancient Phoenicians, using ivory from Syrian elephants (finally exterminated by Assyrian hunters in the 8th century B.C.), as well as African ivory imported through Egypt, developed an extensive carving industry, probably under Egyptian inspiration. They seem to have specialized in panels, engraved or in relief, for inlays in furniture and woodwork. Specimens recovered from the ruins of Nineveh and other sites show much use of over-all painting and gilding or heavy inlays and encrustations of lapis lazuli, glass, or other substances. Ivory seems to have been considered as an easily worked and rather permanent base material for luxurious art products, rather than of value for its own intrinsic qualities.

Greece.—The Phoenician custom of combining ivory with gold and other precious substances doubtless inspired the colossal chryselephantine statues of the Olympian gods, constructed by Phidias and other Greek artists, on which the faces, hands and feet

were of ivory while the rest was in gold. To procure ivory slabs of sufficient width. it is thought that they must have cut large cylindrical sections from the central portions of the tusk, sawn these part way through, and then softened the ivory by some process which made it possible to flatten it out. The actual method used for softening is not known. However, steeping in vinegar and almond oil makes ivory relatively ductile. and it can be made quite flexible by soaking in a solution of phosphoric acid until it becomes translucent. after which it hardens on exposure to air but assumes flexibility in hot water. The pieces of worked ivory and beaten gold were probably fastened to wooden cores. and the ivory parts were doubtless stained or painted, following the Greek custom for all statues.

Rome and **Byzantium.**—Egyptian, Phoenician and Greek techniques of ivory carving ultimately passed on to the empires of Rome and Byzantium. One of the later developments was a deepened appreciation for the innate qualities of the ivory itself so that the use of gilding and inlays became more sparing, leaving larger areas of the natural substance to be enjoyed for its creamy tone and high gloss. Rome and then Byzantium used elephant ivory from Africa and India. and the later Byzantine carvers also used much walrus ivory imported from the north through Viking traders.

The Islamic World. — The Moslem countries of the near east and north Africa, acquiring both techniques and materials through Byzantium, did extensive work in walrus ivory, particularly for sword and dagger hilts. These nere valued much more than those of elephant ivory because of a belief in the magical healing properties of the former. Working in walrus ivory, the carvers generally deliberately exposed the characteristic mottled core to show clearly what they were using.

India. — Through Moslem influences and trade, walrus ivory was carried to northern India. where it was highly valued for the same magical reasons. Meanwhile, the Indians (after at least 2500 B.C. in the Indus valley) had had a high tradition of superior work in elephant ivory that reached its height in the fine reliefs of the first centuries A.D.; some of which were discovered in Afghanistan in the mid-1930s. This art declined in Mogul times, partly due to orthodox Moslem objection to images of men or animals, but it has continued in some localities. The Indians have tended to work ivory as just another convenient material. using the same patterns as on wood. or brass or silver. To make it easier to carve they sometimes soften ivory artificially by wrapping it in wet cloths for several days. Since the outer portions of the tusk (previously peeled) are preferred by the carvers, the figures of elephants and other animals generally turn out convex on the right side and concave on the left. Much work has been done on lathes in recent years. Hyderabad is noted for its coloured ivories. dyed red from the juice of the bulbul tree and green from an imported dye. African ivory has been used extensively in India because Asian tusks are not as large or as fine in texture.

Burma. — The Burmese ivory carvers of Moulmein evolved a distinctive national tradition, in which uhole tusks or sections of tusks were first intricately carved and pierced on the outside: then the interior was sculptured to show one or more figures — generally religious images — to be seen through an openwork screening of floral designs.

Indonesia. — Java and Bali had a high tradition of ivory carving. at least from medieval times, expressing itself particularly in handles for the kris, the national dagger, which were often carved in the round to show highly conventionalized figures of old Hindu deities. The people of Java and Sumatra were pioneers in the use of hornbill ivory (*angang* gading) which comes from the head of a large bird, the helmeted hornbill. and under Dutch rule there was quite an industry in ornaments for the European trade. It was still being carved in the ancient style by the natives of Sarawak, in northern Borneo in mid-20th century.

China. — In the long history of Chinese ivory carving, which goes back more than 3.000 years, the most distinctive contributions have been in the ancient incised work inlaid with chips of turquoise: in the medieval use of paint on ivory which was then deftly cut away to show the fresh substance, in turn stained with other colours; in the slightly later tinting of ivory with vegetable dyes to produce subtle effects not seen elsewhere; and in the more recent Cantonese balls within balls The balls mere produced by first drilling several wide holes through a sphere of ivory from several directions, then cutting within these holes with small knives set at an angle to their stick handles, releasing one inner ball after another, and finally rotating each in turn so it could be pierced and decorated through the original openings. Some of the best Chinese carving is especially distinguished for its intricate pierced work, accomplished with the use of fine bow drills and delicate wire saws.

Ivory from the Asiatic elephant was used until the Sung dynasty (after 960), when tusks were imported from Africa. In north China, walrus ivory was long valued more than elephant ivory because of its fancied ability to protect against poison. Often, only the distinctive crystalline core was used and objects carved from this were coloured a deep green with dye made from verdigris. Hippopotamus teeth were frequently used in Canton in the 20th century, especially the sharply curved canines. which uere ideally suited for making the elephant bridges and arched landscapes which have been a specialty of that city. Hornbill ivory was first introduced to China from Borneo in 1371, and was worked in China from that time, being highly prized at court. The Ho-a-ching shop in 19th-century Canton developed special techniques for carving this to make handsome jewelry for the foreign trade.

Japan. — The Japanese, having developed their ivory carving quite late, did not introduce any particular novelties except the method of inlaying on ivory with precious metals, coral and mother-of-pearl; but even this may have originated in China. They used walrus and narwhal tusks, whale's teeth and. more recently. vegetable ivory from the nuts of the South American tree *Phytelephas macrocarpa* as substitutes for elephant ivory.

Europe.—Meanwhile, through Byzantine influence from the east and Islamic influences by way of Spain, western Europe developed an ivory carving tradition nhich reached its height in the Gothic period. Especially in the northern countries. including England, great quantities of walrus tusks were utilized. along with some elephant ivory from Africa, for making both figures and panels in relief This tradition of carving persisted down to the 16th century, when new methods of ivory working began to come in. particularly in the use of lathes, as ivory was found to be eminently suitable for turning, and in the extensive use of engraved ivory panels for inlays. However. the commercial arts of turning, and the cutting of ever larger strips for veneer with special saws which were developed in the 19th century, do not properly belong in a discussion of carving as such The use of walrus ivory gradually diminished in Europe, except for Russia, although it was still used for objects of utility. In the late 18th and early 19th century hippopotamus Ivory began to be used in considerable amounts in England and France. especially for carving false teeth. as this ivory is denser and whiter than elephant ivory and is not as easily discoloured Vegetable ivory also came into use, especially for industrial purposes, in the 20th century

Tools. — Regardless of the area or culture and of the distinctive local or national traditions of carving throughout the world, the basic tools as well as the methods of the ivory carvers were much the same down to the end of the 19th century They consisted of. a straight metal rod for testing the depth of the cavity in the tusk; an ax, adze or hammer and chisel, for removing the bark; a bow saw or a bucksaw for cutting a tusk into sections; rasps and files and a special tool called a float for paring the surface; gouges and a mallet (sometimes of deer antler, since metal was considered too heavy and wood too light); hand chisels and scrapers; bow drills of various sizes and delicate fret saws. The polishing in different countries was done by various substances, including rice stalks, sharkskin, ivory dust and jeweler's rouge. The lathe was used only in Europe and India. The great change came with power-driven rotary saws for cutting and peeling the ivory and nith dental drills for carving it easily and quickly. In the 20th century these machine tools soon spread from Europe to Japan and India. and ultimately even to the Alaskan Eskimo, for use on walrus ivory carvings for the tourist trade.

BIBLIOGRAPHY.—Alfred Lucas, *Ancient Egyptian Materials and Industries,* 3rd ed. (1948); R. D. Barrett, "Phoenicia and the Ivory Trade," *Archaeology,* no. ix (1956); George Frederick Kunz, Ivory and *the Elephant* (1916); C. L. Burns, "Monograph on Ivory Carving," T. P. Ellis, "Ivory Carving in the Punjab," J. Donald, "Ivory Carving in Assam" and H. S. Pratt, "Ivory Carving in Burma," *J. of Indian Art and Ind.,* no. ix (1901); W. E. Cox: *Chinese Ivory Sculpture* (1946); S. V. R. Cammann, "Carvings in Walrus Ivory," *Univ. Mus. Bull.,* no. sviii (1954), "The Story of Hornbill Ivory," *Univ. Mus. Bull.,* no. xv (1950). (S. V. R. C.)

WESTERN IVORY CARVING

The history of ivory carving in the west is the history of a minor art which rose in some periods of the middle ages to the level of a great art. It is difficult to speak of any continuity, as great achievements were followed by long periods in which ivory carving seems to have been abandoned for reasons which neither political nor economical causes can entirely explain.

From high antiquity, ivory exercised great fascination because of its rarity and its fantastic origin as the weapon of defense of an almost mythical animal. It was prized as highly as gold. silver and precious stones. was preserved in public treasures, coveted as war booty and considered the most precious material for carving objects of devotion. Gold and silver could be easily recast. stones might be reset. but ivory, once carved. survived unaltered. Being easily transportable. given, exchanged. bought and stolen, it traveled from one country to another to serve (sometimes in a place far distant irom its origin) as a model for a new school of carvers. Early Christian ivories carved on the shores of the Mediterranean inspired the Carolingian Renaissance in northern monasteries. In fact. ivory often spread a new art movement which otherwise would have been confined to one country for a long time. Byzantine ivories inspired Romanesque sculpture in the west, and the extraordinary acceptance of the French Gothic all over Europe was certainly due in some part to its ivories.

I-Iandled by many generations. having acquired an inimitable polish and a beautiful golden patina, many ivories have come to light in the museums of the world after mysterious unrecorded wanderings. From the middle of the 19th century patiently working scholars have made great progress in the listing. classification and dating of the vast material. By careful historical research, comparison with other arts, illuminations of manuscripts, metalwork and even textiles—from which ivory carvers might have taken inspiration—a close dating often has been possible. But still. many fine ivories evade a final classification since they were either produced in a centre of activity unknown to us from any other work or where local traditions of ivory carving outlivrd other arts in which a radical change of style had already taken place. (J. NN.)

ANCIENT HISTORY

Carvings of the Paleolithic Period.— Carvings in ivory, bone and horn are so numerous from certain periods of the Stone Age that one of these, the Aurignacian, has been called the ivory period. Most of the carvings have been found in southern France, in the Dordogne and Arriège districts, though a few come irom the Riviera and Germany. The earlier examples usually take the form of nude female figures. the aesthetic worth of which is usually almost negligible. but a small head of a girl found at Brassempouy (Landes, France) has real artistic value. The animal carvings belong almost entirely to the succeeding Magdalenian period; these are frequently of extraordinary merit. The material is usually reindeer horn or more rarely mammoth ivory; among the objects in the latter is a tusk in two parts carved in the round with reindeer, found at Montastruc (Bruniquel, France) and now in the British museum. In r'eindeer horn is a magnificent dagger handle from Laugerie Basse. France (now in the museum at St. Germain). with a figure of a kneeling reindeer. a fine example of the utilization of the natural form of the material. Though no hard and fast demarcation can be made. engraving is probably rather later than carving in the round. The engravings usually represent animals, often rendered in a masterly manner and combined to forrn scenes. but occasionally human figures are represented in a rudimentary and animallike form.

Egyptian Ivories.— Ivory and bone were worked from a very early period in Egypt. A large number of combs, hairpins and other utensils dating from the predynastic and early dynastic periods have been found at Nakada (Nagada) and other sites. and a fine handle carved with hunting and other scenes found at Gebel el-Arak is now in the Louvre. To the same period belong some of an extensive series of nude female figures, probably worn as amulets to ward off evil or harm, and carved in varying degrees of crudity.

A considerable number of ivory figures of men and women, some in embroidered robes, were found by J. E. Quibell at Hierakonpolis, many of which show considerable aesthetic feeling. But among the masterpieces of early Egyptian carving are two statuettes; hoth found at Abydos: one. a king belonging to the 1st dynasty (now in the British museum) wearing the crown of upper Egypt and a richly embroidered robe; the other, in the Cairo museum, represents the 4th-dynasty king, Cheops or Khufu (c. 2900 B.C.), builder of the Great Pyramid. Later work, though frequently of fine quality, is usually more decorative in intention, largely used for handles. spoons, inlays for caskets and furniture. (*See* also EGYPT: *History: Ancient Civilization and Culture.*)

Babylonian and Assyrian Ivories.— Though only a few examples had been found up to the mid-1950s there is every reason to believe that ivory was carved in Babylonia from a period at least as early as in Egypt. The later work of about the 9th to the 7th centuries B.C. is, however, represented in the British museum by an unrivaled series of ivories from Nimrud (Kalakh) many of which show strong Egyptian influence. These were frequently inlaid with gold and lapis lazuli, a method of decoration which is found elsewhere (*e.g.,* at Mycenae and throughout the Aegean). Apparently contemporary with these are a series of fragments, chiefly heads. more purely indigenous in type. Both groups show an admixture of other influences and it has been plausibly suggested that the carvers were Phoenicians.

Aegean, Etruscan, Greek and Roman Ivories.— Among the earliest Aegean carvings that have any considerable aesthetic value are the small ivory figures of acrobats found at Knossos in Crete, and now in the museum at Candia. These must be rated with the masterpieces of Minoan art and may be dated about the 16th century B.C. The celebrated figure of the snake goddess (now at Boston) has also been ascribed to the same period. A considerable number of ivories of superior workmanship (British museum). which may he assigned to a date between the 14th and the 11th centuries. were found at Enkomi. Cyprus Island. They include a gaming box carved on the sides in low relief with hunting scenes, and two mirror handles depicting combats between human beings and monsters. Ivories similar in style and of about the same period have been found in Greece at Sparta and Mycenae; both groups are in the museum at Athens. It has been suggested that one of the centres of production was perhaps Cyprus, but it is much more probable that they were made in Syria or possibly on the south coast of Asia Minor. In any case the main influence is Asian in derivation.

To a period between the 9th and 6th centuries B.C. belong extensive groups of carvings which seem to derive from the same cultural source as the earlier ivories. These groups, which show close analogies of style both among themselves and with the Nimrud carvings. have been found on various sites—at Ephesus, Rhodes. Sparta and in Italy and Spain. The dominating style is Asian but in some cases there are traces of Egyptian influence. The ivories from Sparta (now in the Athens museum) were excavated in the sanctuary of Artemis Orthia and date mainly from the 8th and 7th centuries: they show traces of Ionic influence and were possibly worked locally. Among them are plaques carved in relief to decorate pins. figures of animals carved in the round, statuettes and a fine relief with a warship, this last inlaid with amber.

The carvings from Ephesus, now in the museum at Istanbul, Turk., were found in the temple of Artcmis and date from about the same period. They consist chiefly of statuettes, the costume of which shows Asian (perhaps Hittite) influence, and some well-conceived animal figures.

The earliest ivories found in Etruscan tombs in Italy belong to

about the same period (700–670 B.C.) and present many difficulties as to origin. Some of the best examples were found in the Barberini tomb at Praeneste. south of Rome; these included a tazza (ornamental cup or vase) on a high foot, and three arms and hands the use of which is not clear; all are decorated nith bands of centaurs, griffins and animals in procession. It has been suggested, with considerable likelihood, that these are importations from Cyprus. probably of Phoenician workmanship but even if they are native Etruscan imitations the motives are derived from an oriental sourcew Slightly later in date is a box found at Chiusi in northern Etruria. now in the Museo Archeologico at Florence.

It is remarkable that no ivories of importance belonging to the earlier classical period of Greek art have survived. though it is kno n from documentary evidence that they existed. To the Greco-Roman period should probably be assigned a beautiful head found in the Roman amphitheatre at Vienne (Isère, France) now in the Musée Archéologique of that town. A fine head of a goddess. together with fragments of arms (in the Vatican) probably belongs to the same period, but it may serve to give an idea of the chryselephantine statuary of Greece known only from the descriptions of classical uriters. A number of smaller ivories of the Roman period have survived, among them a small figure of a tragic actor (in the Dutuit collection in Paris) and a statuette of a hunchback (in the British museum), but they are mostly objects for domestic use. (M. H. L.)

The Middle Ages

Early Christian. — From the period which art historians call either late antique or early Christian, about 200 objects of carved ivory have survived to modern times. Some of them are of great beauty and fine craftsmanship, showing how ivory carving outlived great sculpture for a long period. The style and workmanship, the subjects represented and their treatment are so varied in this accidental collection of preserved work that they elude any attempt to assemble more than a few under a common definition. They could have been made, and probably were, in any important centre of the Roman world; in the west—in Rome itself, in north Italy (Ravenna or Milan) or in Gaul; in the east—in Constantinople, in Syria or in Egypt.

Ivories made in Rome and in north Italy would naturally follow the tradition of official Roman art and the Hellenistic classical survival. As an example we might take a beautiful object, the large casket from Brescia which is the earliest ivory decorated with Christian subjects—scenes from the New and Old Testaments. It was made probably in the second half of the 4th century. Christ is represented as a young, beardless man, and the figures would not be out of place in any bas-relief made more than a century before.

On the other hand, ivories made in Constantinople and in Syria would be more influenced by subclassical elements and hieratic art, which never entirely died out in the east and was prepared to serve the new religion. In Egypt, ivories would follow the impressionistic Alexandrian style from which Coptic art took its energy and liveliness. In this style is the magnificent bishop's chair which belonged to Maximianus. bishop of Ravenna (546–556). It is decorated with scenes from the life of the Virgin and Christ and the story of Joseph, carved with great freedom and boldness in a fluent narrative style and in a manner suggesting the Alexandrian school. On the front of the chair the figures of St. John and the four evangelists appear arrested frontally in a gesture of blessing.

This simplified summary can be developed by a study of consular diptychs, the only certainly datable ivories from the early Christian period.

It was customary in the 4th century for the consul to announce his nomination to important people and to the emperor by sending tablets in the form of a diptych. The outside was decorated with an appropriate subject while the inside, hollowed and covered with a thin layer of wax, contained the message. Since the name of the consul was used as the legal date of the year. these diptychs can be dated accurately providing the name of the consul was not subsequently removed.

About A.D. 400, diptychs were also made to commemorate important private events, such as a marriage uniting two important families (see fig. 1). These ivories are carved in the aristocratic style of the Hellenistic revival. On the contemporary consular diptych of Probus, made in 406, the emperor Honorius is represented in the manner of Roman official portraiture. Carved in a similar style is the diptych in which impassive dignitaries are presiding at a lively race in the hippodrome.

The same craftsmen who served pagan patrons also carved Christian subjects. (By this time the church had adopted diptychs for recording the names of persons for whom special prayers were required) Having to represent scenes unknown to pagan imagery, ivory artists forgot the stale academism of pagan pieces and created clear and dignified compositions in which every figure is true and moving.

By accident or for some reason which history still must explain, all the known consular diptychs of the jth century were made for Roman consuls, while those of the 6th century mere for consuls nominated in Constantinople. All the western diptychs have an individual character. There is an attempt at portraiture and a difference in style that changes as they advance in the century. On the other hand, those made in the east follow fixed patterns of composition. The eastern diptychs were probably prepared before time of purchase with an empty space in which to write the name of the consul. Their composition is conventional. the figure of the consul impersonal, belittled by all the symbols of his power. Only when, in addition. a scene from the circus is depicted, does the artist forget heavy symbolism and introduce a vivid impression of life and movement. This is the narrative style of the east which is so well illustrated on the bishop's chair at Ravenna and which appears on many other reliefs of a religious character when action had to be represented: Christ performing miracles, scenes from the life of the Virgin, to mention the most popular subjects. The same themes are carved in an equally vivacious and almost sketchy way on numerous pyxes (cylindrical boxes made from a segment of tusk, which were jewel boxes in pagan times and later adopted by the church as receptacles for the Eucharist). However, uhen the subject did not depend on action, the composition is set frontally in a more rigid disposition of the figures.

BY COURTESY OF THE VICTORIA AND ALBERT MUSEUM

FIG. 1 — LEAF OF AN IVORY DIPTYCH OF THE SYMMACHI AND NICOMACHI. ROME. ABOUT 390–400

Imperial consular diptychs were composed of five pieces of ivory to each leaf, the figure of the emperor in the centre and above, two winged victories holding within a wreath a symbolic representation of the city, later replaced by the head of Christ. There is almost a complete leaf of this type in the Louvre, the Barberini diptych. From a similar composite diptych, where they probably formed the centre part of each leaf, figures of an empress in two different poses have been preserved.

The church adopted the same composition for Gospel book covers, changing the content without altering its formal appearance. Winged victories without any change became angels (see fig. 2). In the centre, instead of the emperor, Christ or the Virgin is represented, and the long piece at the bottom where, in an imperial diptych, the vanquished brought their tribute in procession, the same movement was preserved with the kings coming to adore the Virgin and Child, or Christ entering Jerusalem.

There are many examples showing how Christian iconography grew naturally from pagan imagery to set patterns of composition which were adopted by the church and used by its artists ever since.

Carolingian. — By the will of Charlemagne, not only a new Roman empire was created beyond the Alps, but also a great revival of culture was atcomplished. In workshops installed at

the palace and in important monasteries, books were produced in great numbers, illustrated with miniatures and bound with ivory plaques. Never was the association between ivory carving and painting more close or the inspiration more in common. Carvers were using the same subjects, compositions and ornamentation as painters. but using them in an entirely sculptural way, a surprising fact in a period without any great sculpture and so distant from its revival in the 11th century.

Since there was no other local tradition except the abstract ornamental art of the north, which could not serve the didactic purposes of Charlemagne and his court, artists naturally looked for figural models to early Christian ivories preserved in churches. There are even instances of close Carolingian copies of 4th- or 5th-century pieces. For example, the magnificent plaques of the Lorsch gospel were obviously copied from an early Christian composite carving that was imitating. in turn, an imperial consular diptych. The parentage is easily traced. Nevertheless, this imitation never leads to academism. Carolingian artists copied subjects, patterns of composition and motives of decoration, but inspired them with a new life. They were less conventional but more observant. Their figures are bursting with personality, the proportions are harmonious, their movements natural and easy. Learning from a period in which so many styles and conventions were mixed, they succeeded in creating a style distinctly their own.

Naturally, this style has different aspects depending on the various centres in which it was created. By comparing ivories with illuminations, or using the cover of a well-known manuscript as a headpiece to a group of closely related ivories, the approximate dating and the place of origin of many carvings have been convincingly stated.

In this way the Ada group, named after a manuscript illuminated for Ada. abbess of Trier (Trèves), Ger., about 800, has been traced to Aix-la-Chapelle (France) or to Trier. The ivories of this group, made probably under the direct influence of the court, show the strictest obedience to Mediterranean models. They are inclined to follow the solemn and the hieratic rather than the narrative trend. The carving is smooth and the relief rather flat, but its surfaces are finely graded. draperies follow the movement of the body in regular folds and the architectural framework is carefully classical.

BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

FIG. 8.— LEAFOF A DIPTYCH REPRESENTING THE ARCHANGEL MICHAEL. CONSTANTINOPLE, ABOUT 518

In contrast to the solemnity of the Ada group, the ivories assembled in the Liuthard group sho great exuberance of expression and originality. They have been named after Liuthard, who between 842 and 869 wrote a psalter for Charles the Bald. Two plaques from the cover of the book and the large Crucifixion from Munich which probably was on the cover of a Gospel written by the same Liuthard, are the masterpieces of this school and seem to have been carved by the same hand. The subjects are taken from the Utrecht psalter made in Reims a generation before and there is reason lo believe that the school which produced the admirable ivories of the group originated also at Reims. The iconography is of extraordinary richness and variety, the composition of unequaled freedom and inventiveness. From wherever they took their inspiration (still preserving from early Christian times some pagan symbols; *e.g.,* personification of sun and moon, sea and earth), ivory carvers transformed this into their own universe made of movement, life and passion. They disliked everything which was static and avoided the straight line. Figures stand on irregular, curling bands which are neither ground nor clouds. They are either closely grouped or floating in space; scenes merge one into another without any formal division. The foliated ornamentation is luxuriant. The energy of the composition is underlined by sharp and precise cutting which gives additional beauty to the surface.

The ivories of the Liuthard group made a decisive contribution to the formation of the Carolingian style. Under their influence even the ivories of the Ada school lose their initial dryness and evolve toward greater expression. In Metz, another group of ivories was located. in style closely related to the Liuthard group, although it is less energetic, the figures are heavier and the compositions are more conventional. The numerous ivories of this group form the current type of production in the Carolingian period. Nevertheless, some of them are of outstanding beauty, such as the plaque of the Annunciation to which the pierced background gives an additional air of delicacy.

Outside the main groups of Carolingian ivories, there are the productions of some provincial schools (Tours is often mentioned) which cannot be located precisely. An exception is the school of St. Gall (Switz.), from which a work signed by Tuotilo and dated about 900 has been preserved. Although the figures are sometimes heavy and without great expression and the composition unimaginative, the floral decoration in regular scrolls is always beautifully carved and of great effect.

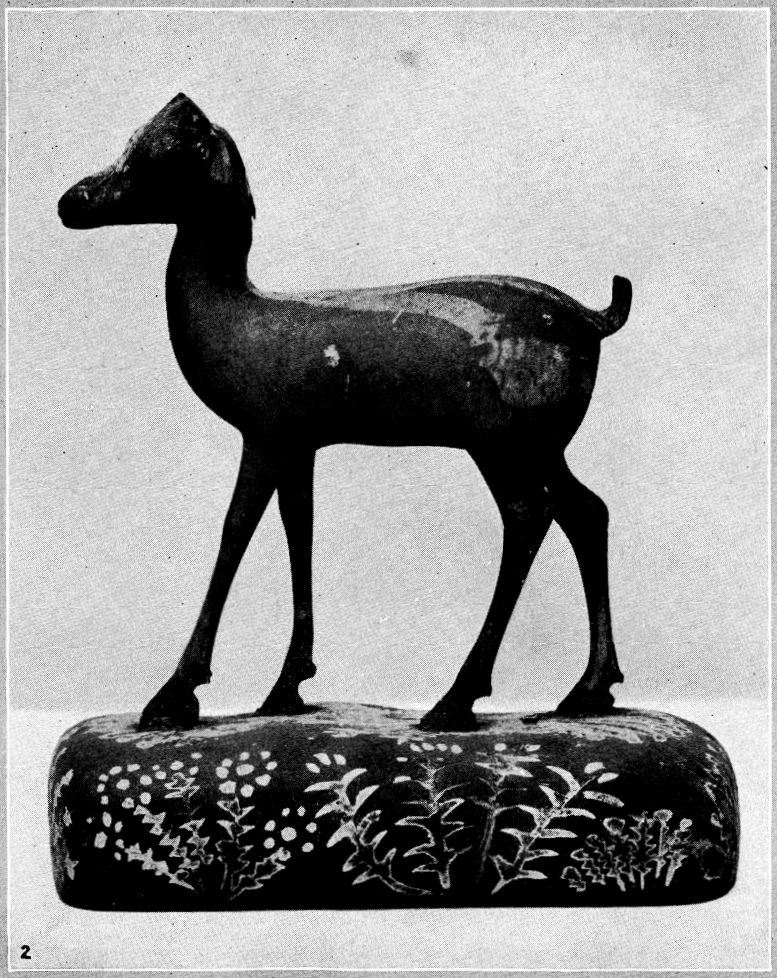
Byzantine.— There is no Byzantine ivory datable from the 7th to the 10th century. It is quite possible that any ivories, if produced during the iconoclastic period, were destroyed (as were all images at that time), the artists dispersed and ivory carving entirely abandoned. Yet, after this apparent eclipse. an art of great maturity and character sprang up and some of the work shows a monumental style unsurpassed before or later. Thus in ivory is found some of the greatest masterpieces produced by Byzantine art in a period often called its golden age.

Most of the carvings are of panels assembled in the form of a triptych, but there are also instances of carving in the round. The subjects are religious, the most popular being Christ enthroned or the Virgin and Child surrounded by saints. But there are also scenes from the life of Christ and the Virgin.

In a group of ivories which has conventionally been called pictorial, the carvers were obviously inspired by paintings— wall paintings from churches or miniatures from books. The figures are carved out sharply without indication of the ground on which they stand, which would have been represented by a line or change of colour in a painting. But, on the other hand, they courageously attempt to picture landscapes or architecture. Softness in the treatment of the body shows an unbroken link with classical art. This connection is even more obvious in a series of caskets closely related in style to the previous group of carvings. Except for a few instances, they are decorated with secular subjects. Surrounded by a border of medallions with rosettes or heads copied from antique coins, the reliefs consist of accidentally assembled groups of figures without respect for sense or continuity of action. The carvers copied paintings and antique reliefs, as well as miniatures taken from Christian books. They were either indifferent to the copied compositions or ignorant of their meaning. In one of the most beautiful examples of such caskets, the 10th-century Veroli casket, figures from the stoning of Achan from the Book of Joshua jostle the Rape of Europa, cupids and centaurs. The same figures assembled in other combinations appear on different caskets showing that the copyists were working from a few haphazardly chosen designs.

Another series of Byzantine ivories has been grouped under the name of Romanus, derived from an ivory representing Christ blessing the emperor Romanus and his wife Eudocia (datable about 945). Some of the most beautiful Byzantine carvings belong to this group including the great triptychs from the Palazzo Venezia and the Vatican, and the Harbaville triptych in the Louvre. The style is severe, the composition monumental, imitating mosaics rather than miniatures; the faces are idealized and the folds of drapery carefully arranged on one plane, yet there is a softness and dignity of movement which gives extraordinary beauty to simple groups of figures.

Another group, named Nicephorus from an ivory which also can be dated (about 965), differs from the Romanus group more in



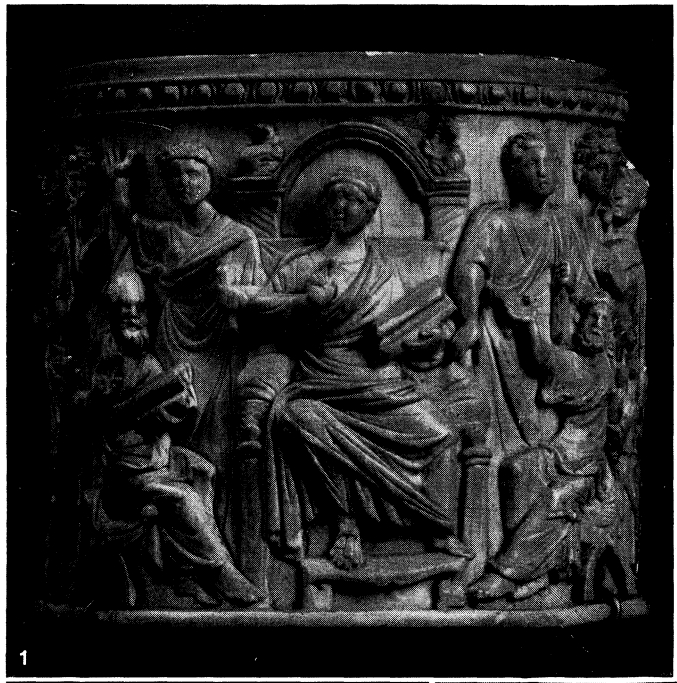
BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, NEW YORK

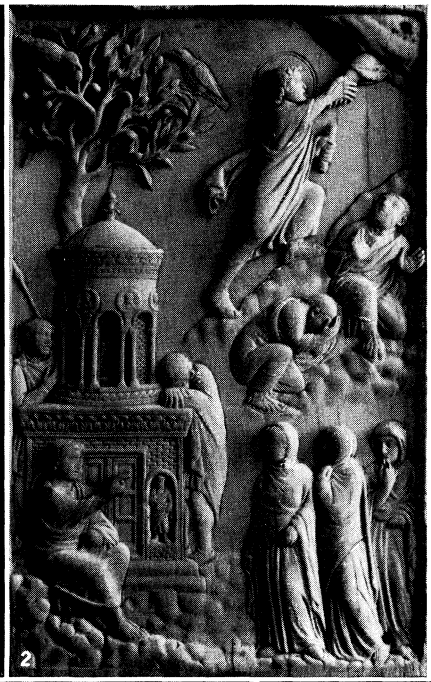
TWO EGYPTIAN IVORIES

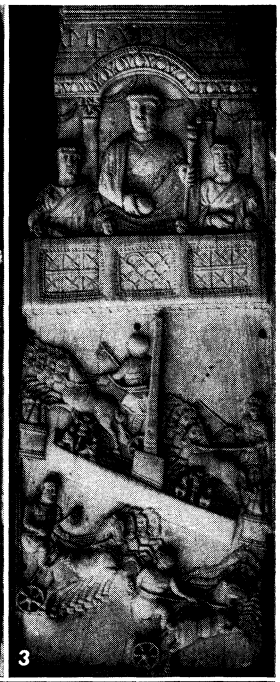
1. Whip handle in the form of a running horse, late 18th dynasty 1375–1350 B.C. Carnarvon collection

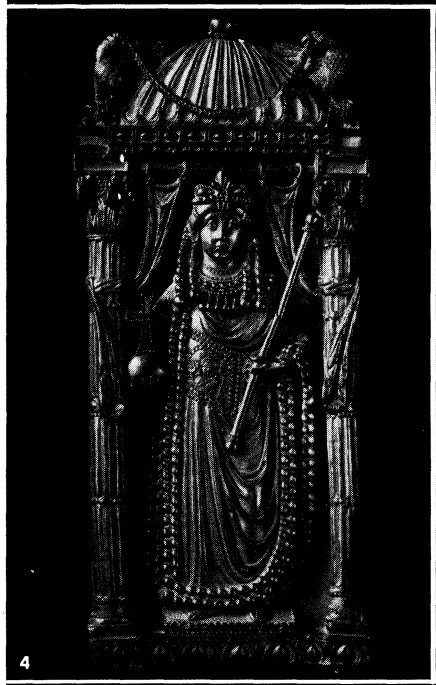
2. Figure of a gazelle, Thebes, late 18th dynasty. The base is painted to depict a desert crag with flowers. Carnarvon collection

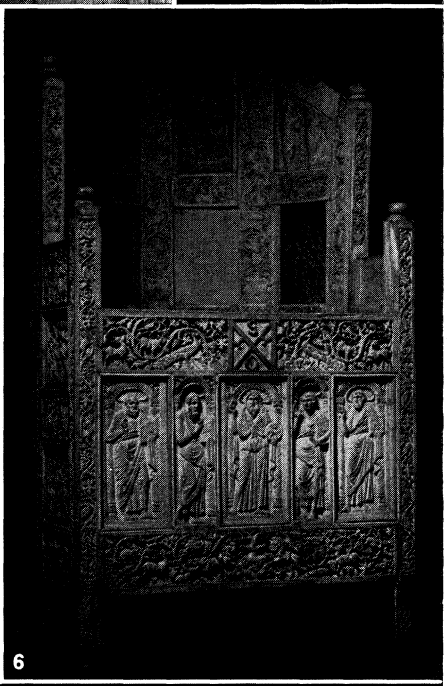
IVORY CARVING







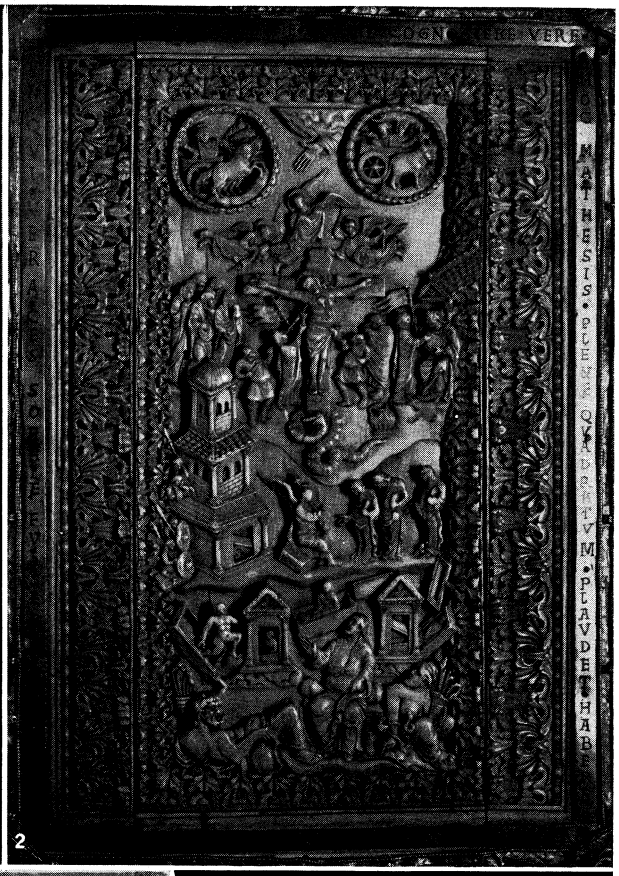


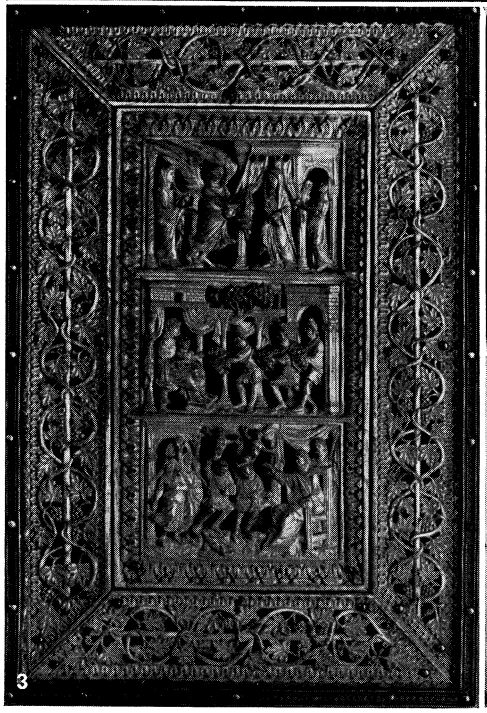


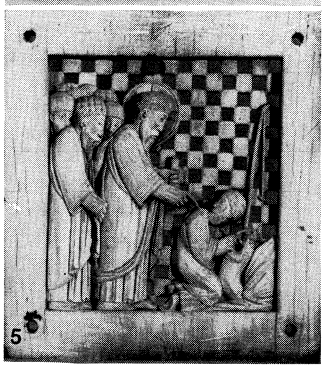
BY COURTESY OF (1) KAISER FRIEDRICH MUSEUM, BERLIN, (2) BAYERISCHES NATIONAL MUSEUM, MUNCHEN, (3) J. NATANSON, (7) VICTORIA AND ALBERT MUSEUM; PHOTOGRAPHS, (4, 6) ALINARI, (5) GIRAUDON

EARLY CHRISTIAN AND COPTIC IVORIES

1. Pyx or cylindrical box, showing Christ and His disciples. East Mediterranean, about 400. Kaiser Friedrich museum, Berlin
2. Panel: the Ascension and the Marys at the Sepulchre. Italian, 5th century. National museum, Munich
3. Leaf of a diptych showing a chariot race in the Hippodrome. Italian, 5th century. Museo Cristiano, Brescia
4. Panel showing an empress. Constantinople, about 500. National museum, Florence
5. Consular diptych of Anastasius. Constantinople, 517. National library, Paris
6. Bishop's chair with the monogram of Maximianus, bishop of Ravenna (546–556). Alexandria, 6th century. Archiepiscopal museum, Ravenna
7. Three bone plaques. Coptic, 3rd or 4th century. Victoria and Albert museum, London





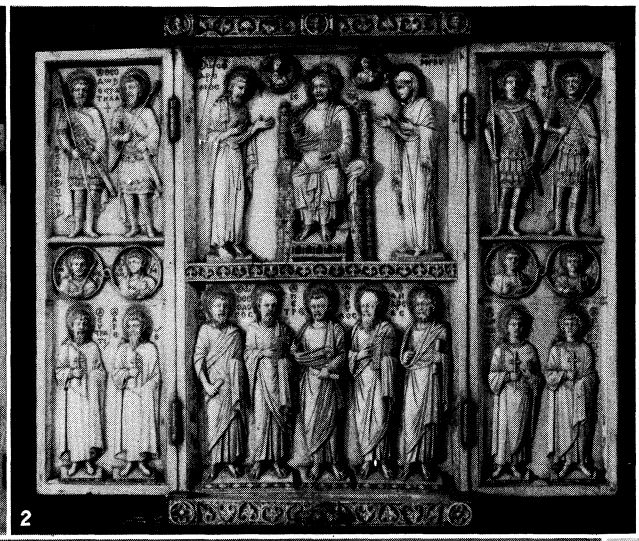


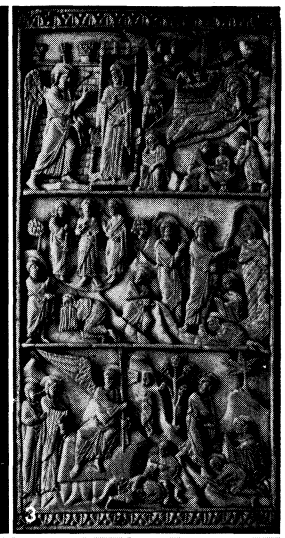
BY COURTESY OF (1, 6) VICTORIA AND ALBERT MUSEUM. (2) BAYERISCHE STAATS-BIBLIOTHEK, (3) BIBLIOTHÈQUE NATIONALE, (4) THE TRUSTEES OF THE BRITISH MUSEUM, (5) LIBRARIES. MUSEUMS AND ARTS COMMITTEE. LIVERPOOL

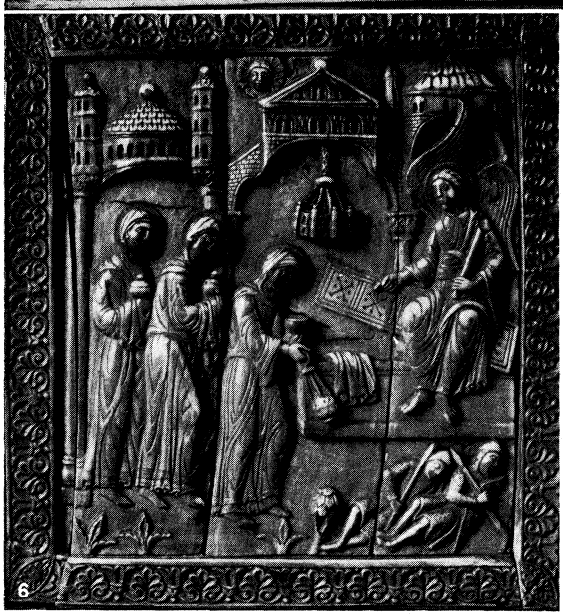
CAROLINGIAN AND OTTONIAN IVORIES

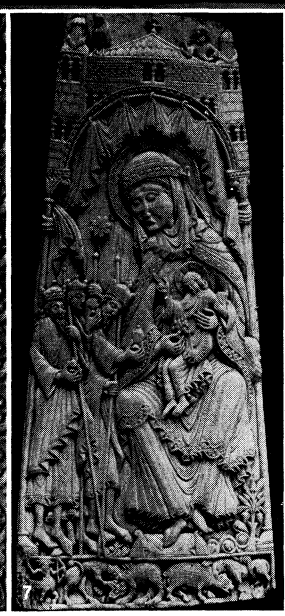
1. Book cover: the Virgin and Child, saints and the Nativity. Carolingian, 9th century. Victoria and Albert museum, London
2. Book cover: the Crucifixion, the Marys at the Sepulchre, the Harrowing of Hell and the Ascension. Carolingian, 9th century. National library, Munich
3. Book cover: the Annunciation, the Adoration of the Kings and the Massacre of the Innocents. Carolingian, 9th century. National library, Paris
4. Panel: the Raising of the Widow's Son. Ottonian, 10th century. British Museum
5. Panel: St. Peter and the Tribute Money. Ottonian, 10th century. Liverpool (Eng.) Public Museums
6. Section of a holy-water bucket. Ottonian, 10th century. Victoria and Albert museum

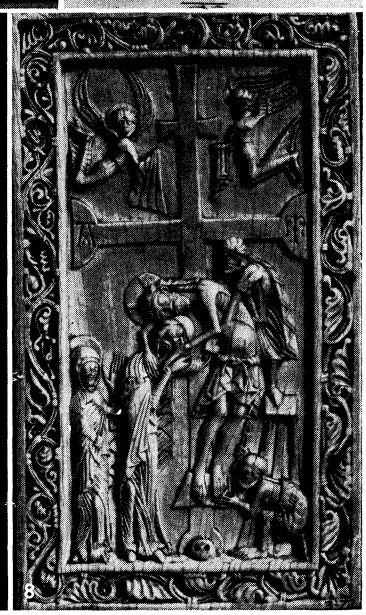
IVORY CARVING









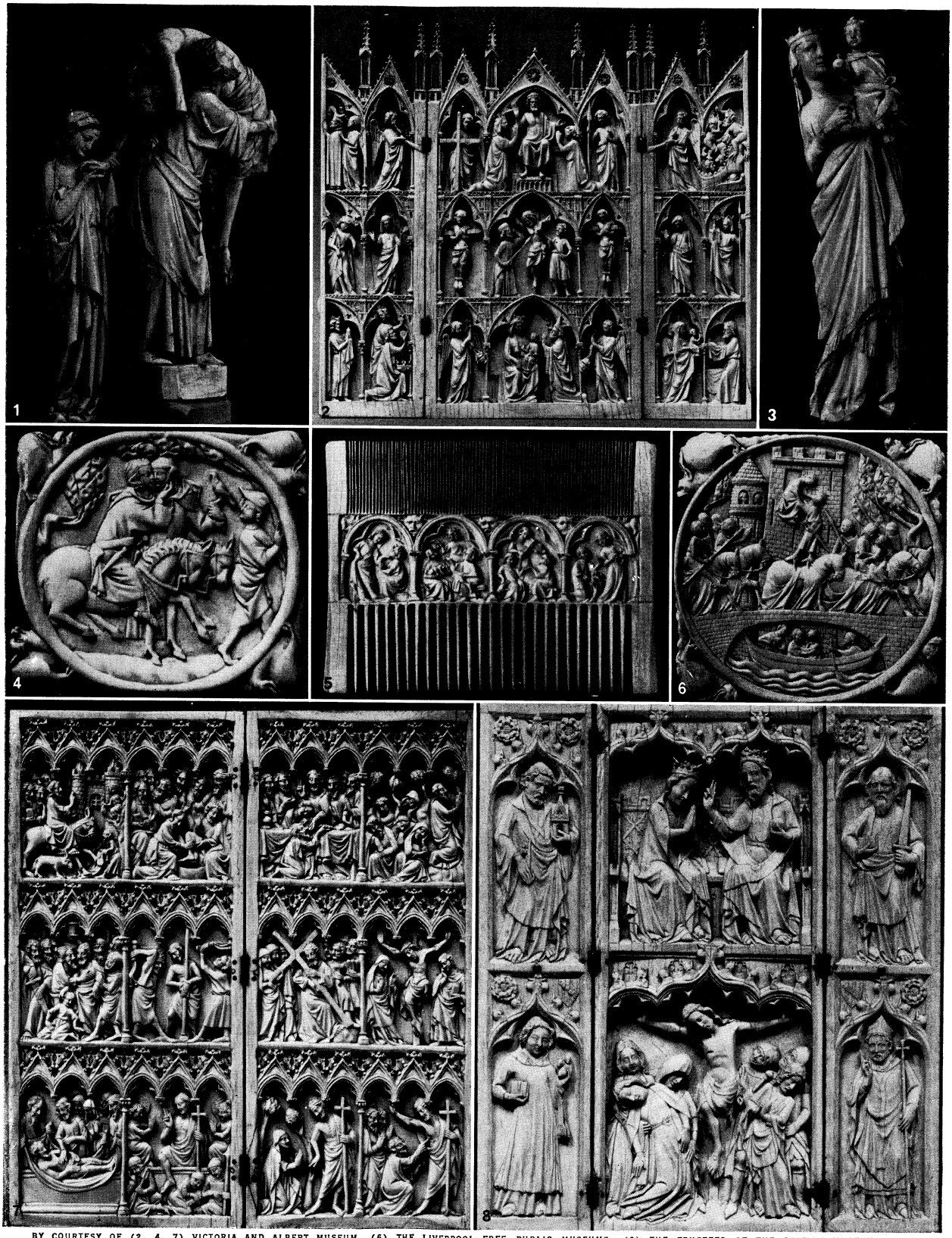


BY COURTESY OF (1) AARTSBISSCHOPPELIJK MUSEUM, UTRECHT, (3, 4, 5, 7, 8) VICTORIA AND ALBERT MUSEUM. (6) GEORGE BLUMENTHAL: PHOTOGRAPH. (2) ALINARI

BYZANTINE, MOHAMMEDAN AND ROMANESQUE IVORIES

1. Panel: the Virgin and Child. Byzantine, 10th century. Archiepiscopal museum, Utrecht
2. Triptych: Christ enthroned, the Virgin and saints. Byzantine, 10th century. Louvre, Paris
3. Panel: scenes from the life of the Virgin and Christ. Byzantine, 11th century. Victoria and Albert museum
4. Casket. Byzantine, 10th century. Victoria and Albert museum
5. Circular casket. Hispano-Moresque, 969–970. Victoria and Albert museum
6. Panel in walrus ivory: the Marys at the Sepulchre. Cologne. 12th century. G. *Blumenthal* collection, New York
7. Panel in whalebone: the Adoration of the Kings. English, 12th century. Victoria and Albert museum
8. Panel: the Deposition. Spanish, 11th–12th centuries. Victoria and Albert museum

IVORY CARVING

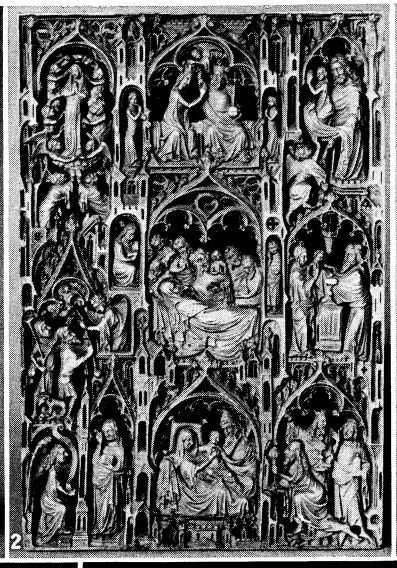


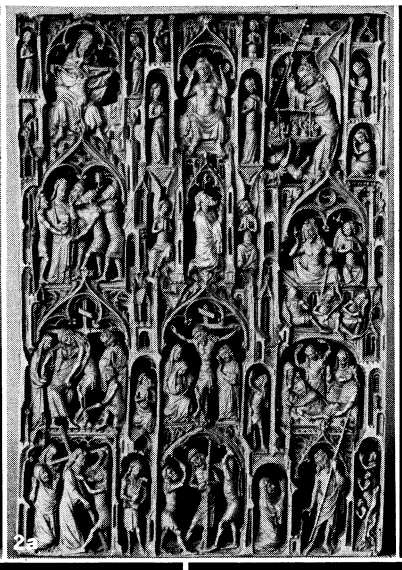
BY COURTESY OF (2, 4, 7) VICTORIA AND ALBERT MUSEUM, (6) THE LIVERPOOL FREE PUBLIC MUSEUMS, (8) THE TRUSTEES OF THE BRITISH MUSEUM; PHOTOGRAPHS, (1, 3, 5) ALINARI

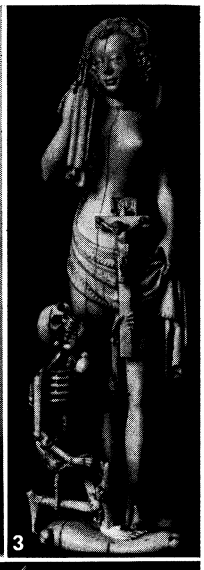
GOTHIC IVORIES

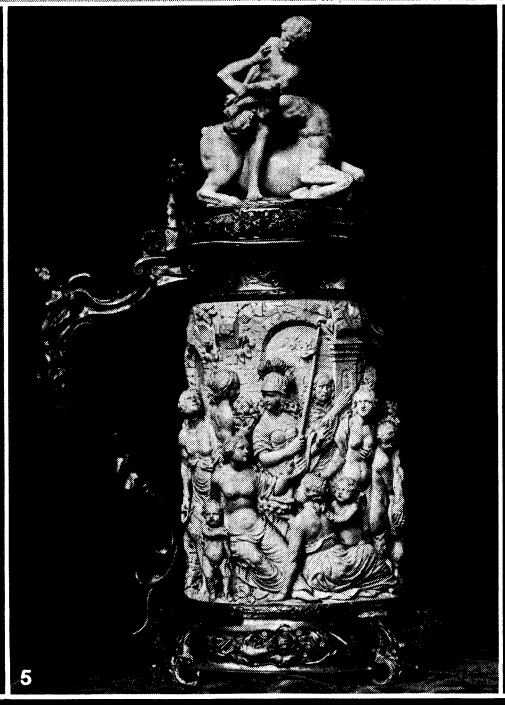
1. The Deposition. French, 13th century. Louvre, Paris
2. Triptych: the Last Judgment, the Crucifixion, the Adoration of the Kings and the Presentation. French, 13th century. Victoria and Albert museum
3. The Virgin and Child by Giovanni Pisano (*c.* 1249–after 1314). Sacristy of the cathedral, Pisa
4. Mirror case showing a hunting scene. French, 14th century. Victoria and Albert museum
5. Comb with courtship scenes. French, 14th century. Louvre
6. Mirror case showing an elopement. French, 14th century. Liverpool Public Museums
7. Diptych: scenes from the Passion. French, 14th century. Victoria and Albert museum
8. Triptych: the Coronation of the Virgin, the Crucifixion and saints. English, 14th century. British Museum

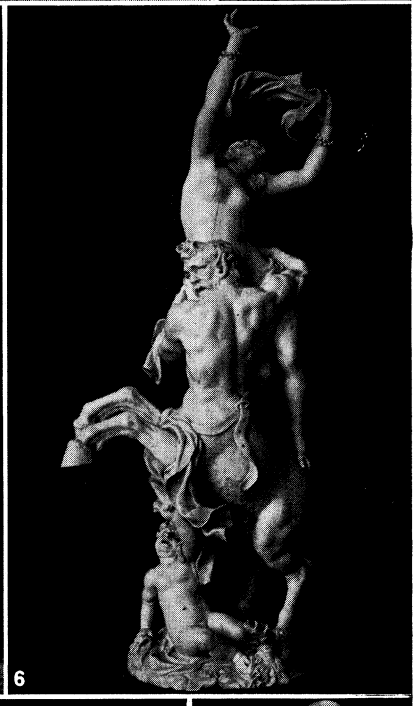
IVORY CARVING

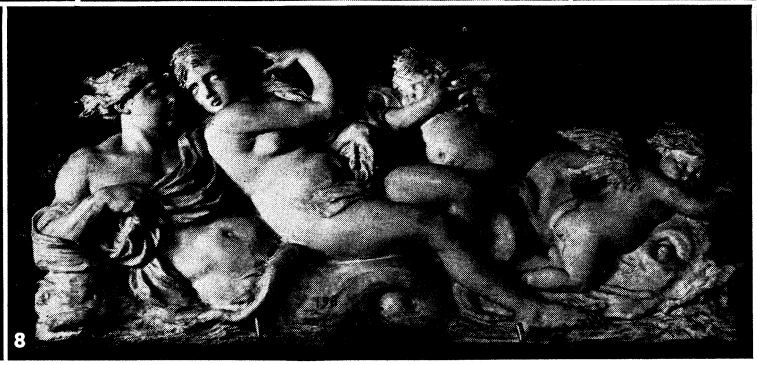








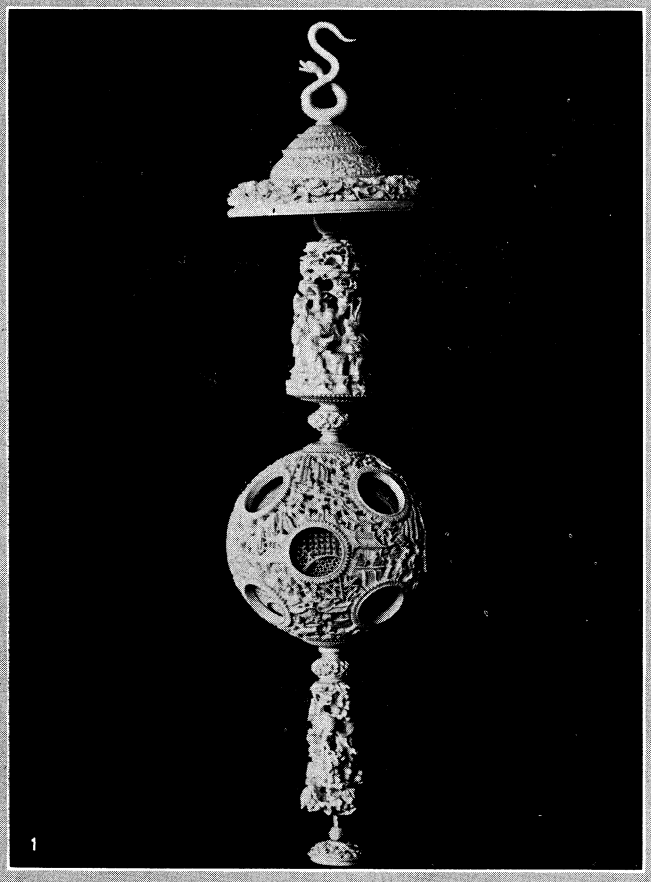




BY COURTESY OF (1, 4, 5, 7) VICTORIA AND ALBERT MUSEUM, (2, 2A) METROPOLITAN MUSEUM OF ART, N.Y., GIFT OF J. PIERPONT MORGAN, 1917, (3, 6) BAYERISCHES NATIONAL MUSEUM, (9) THE GOUPIL GALLERY; PHOTOGRAPH, (8) ALINARI

LATE GOTHIC TO 20TH-CENTURY IVORIES

1. The Virain and Child. French. 16th century. Victoria and Albert museum
2. and 2a. Pierced diptych: scenes of the lives of the Virgin and Christ. English, 15th century. Metropolitan Museum of Art
3. "Death and the Maiden." German, 16th century. National museum, Munich
4. The Virgin and Child. Spanish or Portuguese, 17th century. Victoria and Albert museum
5. Tankard by Bernard Straus. German, 1651. Victoria and Albert museum
6. Nessus and Deianeira (Deijanira). German, 17th century. National museum, Munich
7. Anne Churchill by David le Marchand (1674–1726). French. Victoria and Albert museum
8. Relief by Gerard van Opstal (1597–1668). Flemish. Louvre
9. The Virgin and Child by Eric Gill (1882–1940). English



BY COURTESY OF THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM

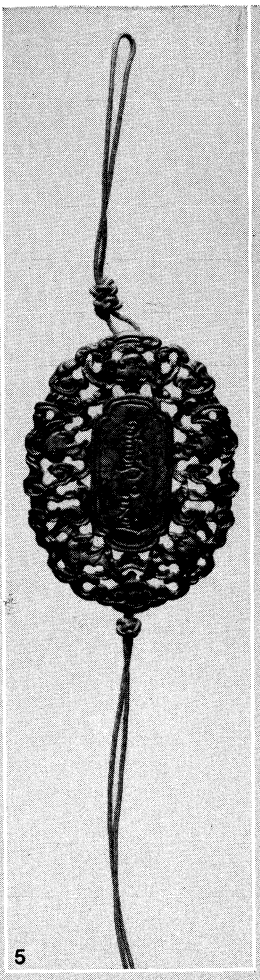
CHINESE IVORY CARVING

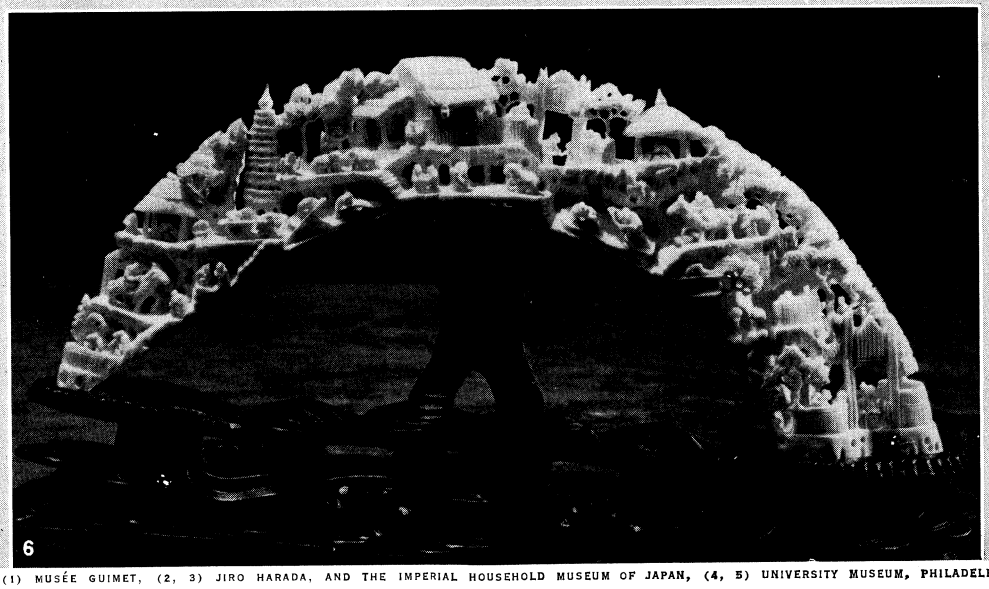
1. Pendant for foreign trade, showing the balls-within-a-ball motif. Canton, 19th century
2. Brush box (*pi tung*) from a section of elephant tusk. Cantonese
3. Box and lid for European patron, with owner's monogram. Canton, 19th century
4. Figure of late Ming or K'ang Hsi period. North China. 16th or 17th century
5. Arm rest for scholar's desk; underside, showing relief carving of the Eighteen Lohan. Peking work, 18th century

IVORY CARVING

1

4

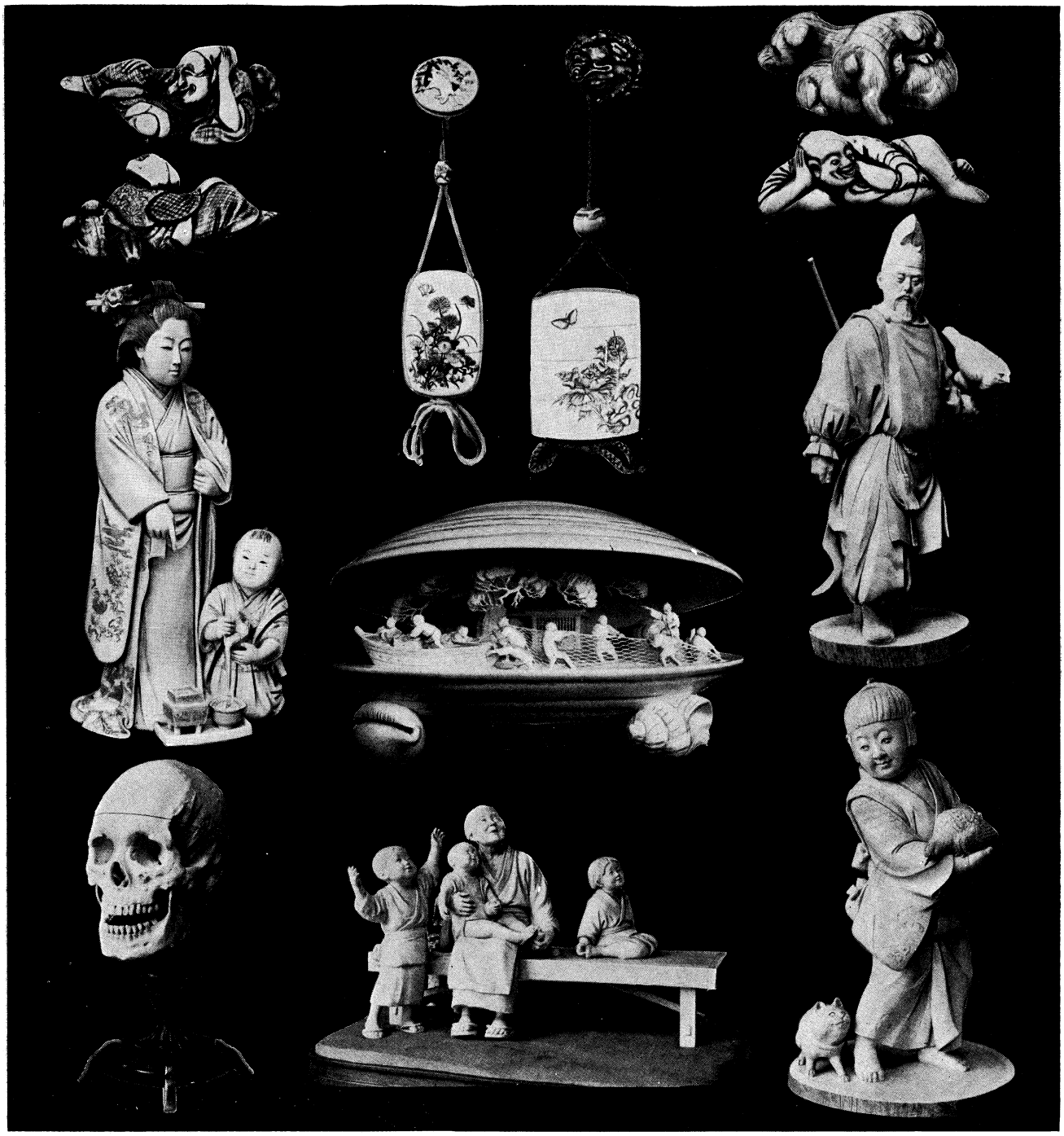

5


6

BY COURTESY OF (1) MUSÉE GUIMET, (2, 3) JIRO HARADA, AND THE IMPERIAL HOUSEHOLD MUSEUM OF JAPAN, (4, 5) UNIVERSITY MUSEUM, PHILADELPHIA, (6) LONG SAN TI CO.; PHOTOGRAPHS, (4, 5) REUBEN GOLDBERG, (6) WIDE WORLD

CHINESE IVORY CARVING

1. Elephant ivory plaque, with pattern similar to those on contemporary bronzes. Shang dynasty, about 1300 B.C. Musée Guimet, Paris
2. and 3. Lacquered ivory rulers. T'ang dynasty, 8th century. Shosoin treasury, Nara, Japan
4. Historical scene in "hornbill ivory" — carved directly into the casque of a bird's skull. 19th century. University museum, Philadelphia
5. Manchu abstinence plaque of walrus ivory. Ch'ing dynasty, 18th century. University museum, Philadelphia
6. Cantonese landscape "bridge" carved in a lower canine tooth of a hippopotamus. 20th century. Long San Ti company, New York



BY COURTESY OF JIRO HARADA, AND THE IMPERIAL HOUSEHOLD MUSEUM, TOKYO, JAPAN

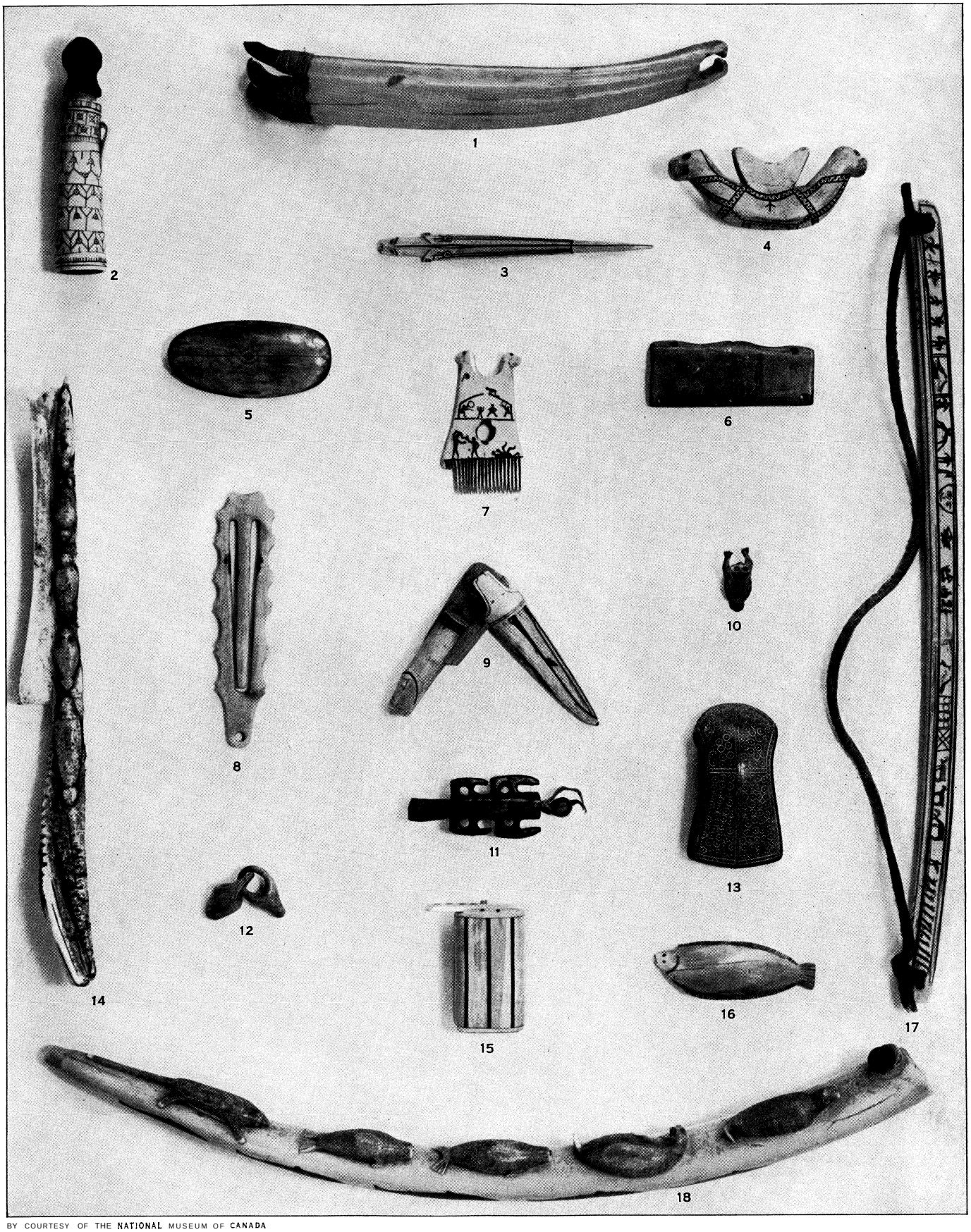
JAPANESE IVORY CARVING

Top left and top right: Netsuke (ornamental pieces attached to purse or tobacco pouch). 18th and 19th centuries

Top centre: Two *inro* (medicine boxes) showing inlay work with ivory. 18th and 19th centuries

Centre and bottom rows: Ornamental carvings (*okimono*) of the late 19th and 20th centuries

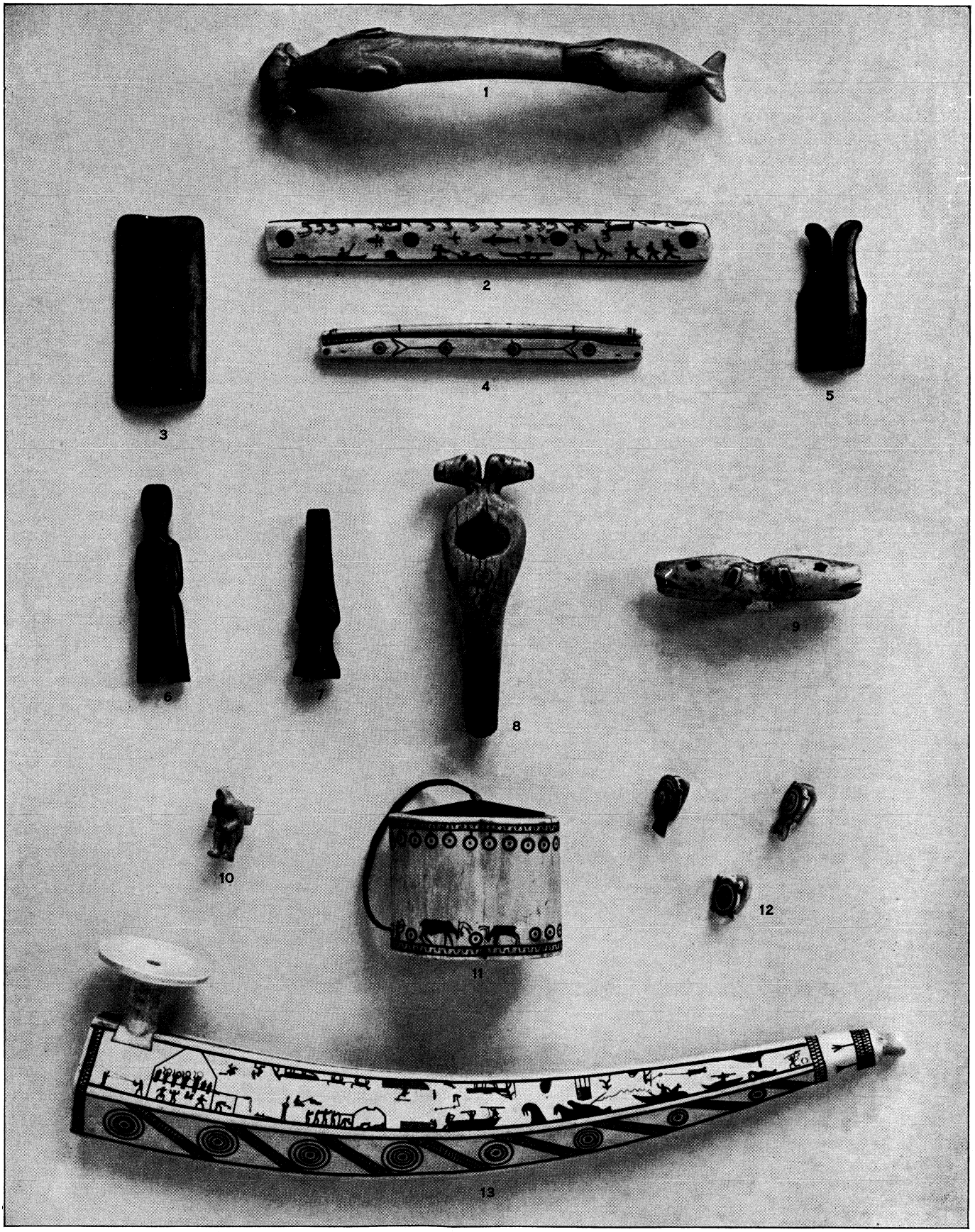
IVORY CARVING



BY COURTESY OF THE NATIONAL MUSEUM OF CANADA

IVORY CARVING OF NORTH AMERICA

1. Scratcher for imitating the clawing of seals on ice. 2. Snuff-box. 3. Bodkin. 4. Mouth-piece of a bow drill. 5 & 6. Archer's wrist guards. 7. Comb. 8. Thimble-holder. 9. Needle-case and thimble-holder. 10. Mythical animal resembling a frog. 11. Needle-case with flanges representing polar bears. 12. Unbroken links representing seal-heads. 13. Handle of a skin scraper. 14. Mesh-gauge with seals carved in relief. 15. Match-box with sliding lid. 16. Fish. 17. Handle of a bow drill. 18. Pipe with walruses and an otter in high relief



BY COURTESY OF THE NATIONAL MUSEUM OF CANADA

IVORY CARVING OF NORTH AMERICA

1. Bucket handle, carved at one end to represent a whale, at the other a monstrous bear attacking a whale. 2. Bucket handle. 3. Archer's wrist guard. 4. Ornament for a bucket. 5. Archer's wrist guard. 6. "Human" needle-case. 7. "Winged" needle-case. 8. Arrow-straightener, surmounted with caribou heads. 9. Toggle for dragging seals, in the shape of two polar bear heads. 10. Figurine of a man carrying a pack. 11. Engraved box with wooden base and lid. 12. Ear-pendants. 13. Pipe with both geometric and realistic engraving

formal details than in general style.

Contemporary with these ivories are a series of carvings of less severe treatment, notable for their vivid composition, good conception of space and the expressive character of the figures. It is believed that many of them were carved in Italy. Chosen from this group is a panel which shows all the qualities of the school—saintly figures appear in motion against architecture, mountains and trees, no longer arrested in monumental repose.

The great period of Byzantine ivories did not survive the 12th century. In the 13th century ivory gave way to steatite (talc or soapstone).

Islamic.—Arab craftsmen brought from Mesopotamia a new style of ivory carving, of which many beautiful objects still remain. It influenced Romanesque art, especially in Spain. The main centre of activity was the court of the caliphs of Córdoba. Circular and oblong caskets were produced decorated with interlaced foliage scrolls enclosing birds and animals and, in rare instances, human figures. The decorative patterns, in which lettering often forms a part, are carved on one plane subtly graded in a manner closer to engraving than sculpture. As contrast, the background is deeply undercut, giving strong emphasis to the decoration.

In Sicily, ivory boxes were not carved but were painted and gilded.

Romanesque.—Carolingian art exercised a considerable influence over the whole period of Romanesque art in ivory carving. The tradition became so strong that even when the great Romanesque sculpture appeared, carvers were not inclined to follow its creative originality, and remained faithful to their own conservative style.

The Ottonian style in Germany is a natural continuation of the Carolingian style, in which some of the characteristics, especially of the Metz school, developed toward a new ideal. The figures are heavy and rigid. To give a more monumental effect, the composition is simple and schematic, with movement arrested. draperies straight, and heads large and globular with stern and fixed expressions. The supernatural is emphasized by a background cut into an abstract pattern.

Important centres of production were Reichenau. an island in Lake Constance, and Milan. 'Both were influenced strongly by Byzantine art as political intercourse between the two empires was quite active at that time.

The magnificent situla (holy water bucket) with scenes from the life of Christ shows the combined attempts of the two schools toward a monumental expression of the transcendental content of divine images.

At the end of the 11th century and in the 12th century, ivory carvers in Cologne and the lower Rhine seem to have been very active. Elephant ivory being scarce at this time, walrus ivory was generally used. It is a conventional art in which too often repeated motives lost their vitality. Perhaps also the close association with metalwork, in which ivory took a decorative part, reduced its individual character.

In England the art of ivory took a different direction. The decorative aspect is dominant. Some heads of pastoral staffs (fig. 3) and tau crosses show formal exuberance tending to the baroque style. Beautifully carved human figures are intermixed with volutes of foliated scrolls. Standing apart from this group are two mysterious reliefs, of which the most important is in London. The disproportion of the figures, geometrical arrangement of folds. minuteness of the carving and the addition of unusual details makes its origin extremely difficult to establish, although it has been generally ascribed to England.

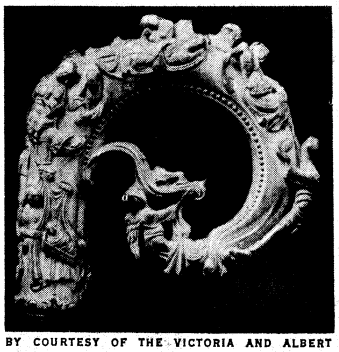
In Italy the Byzantine tradition was strongly established and probably for a long time, even after Byzantine ivories ceased to be made in the east, they were cut in Italy and were undistinguishable from originals made in Constantinople. Venice seems to have been the centre of this production. But at the same time, in some monastery workshops not easily determined, an independent style was created. To these workshops have to be attributed numerous panels which probably formed part of large ensembles, such as retables or altar fronts. The Salerno altarpiece remains as a complete example. This art, often of a provincial aspect, sometimes tinted with Islamic influence, has stronger connections with early Christian style than with the later Byzantine development. Early influence is sometimes so strong that many reliefs, which were for a long time believed to have been made in the 6th or problematically in the 7th century have since been given their rightful place in the 11th and even 12th century.

In Spain the Byzantine influence was never really felt. From the middle of the 11th century there is a rich production of works of great character where Spanish Romanesque art, expressive although often crude, mixes with the refined decorative feeling of Hispano-Moresque art.

As has been seen, in the Romanesque era all sorts of church objects were made in ivory, sometimes in association with metalwork and enamel. In addition, such objects for secular use as draughts or checkers and chess pieces also appear. The draughts pieces are decorated with animals, monsters or figure subjects derived from classical myths or sacred literature surrounded generally by a border of simple geometrical design. They are believed to have been made in various places, mostly in Germany. The chess pieces are rarer.

Some unusual pieces (fig. 4) found on the island of Lewis, Scot., of English or Scandinavian origin, have all the character of Romanesque sculpture; they are heavy and sturdy, but have extraordinary vigour.

Gothic.—An active production of ivories in a completely new style started at the end of the 13th century. Its origin has been located in France and precisely in Paris. There is practically no ivory carving from the first part of the century and the few examples of early Gothic ivories do not foretell a development of such importance. The first carvings in the round are inspired by stone sculpture, translated in a masterly way into ivory idiom. These are the group of the Coronation of the Virgin and the Deposition and other figures remaining from large altarpieces.



BY COURTESY OF THE VICTORIA AND ALBERT MUSEUM

FIG. 3.—HEAD OF A PASTORAL STAFF SHOWING SCENES FROM THE NATIVITY AND PASSION. ENGLISH. 11TH CENTURY

Soon, however, ivory carvers found their proper expression in devotional shrines, diptychs and triptychs in which scenes taken from the life of the Virgin and the Life and Passion of Christ are most often represented in an elaborate architectural setting. In this first group of Gothic ivories, all carved at the end of the 13th century, the character of an art which was to flourish for a century is clearly stated: the role assumed by architectural decoration, the display of figure on one plane against a flat background and a fluent and vivacious narrative style.

With an admirable sense of composition, the Gothic artist knew how to disregard mechanical divisions of scenes and, having established a certain rhythm with columns and arches. he could fill each partition with different actions or spread one scene into several compartments.

Even in a triptych where symmetry naturally imposes formality, each figure is in movement and the story is told with admirable clarity.

Ivory carving at that time was no longer an art produced in monasteries to serve the liturgical needs of the church. Lay craftsmen were carving holy figures and shrines intended for private devotion. In addition they carved a large number of objects entirely secular in character.

In the round. figures of the Virgin holding her Child are numerous. In reliefs, all the forms of diptychs and triptychs are repeated with infinite variations of size, divisions and decoration. Also common are plaquettes (diptychs with a single subject on each leaf) and tabernacles (triptychs or polyptychs) with a cen-

tral figure of the Virgin and Child and single- or double-folded wings in low relief with scenes from the life of the Virgin and the childhood of Christ. Caskets, pastoral staves and a few objects made for liturgical use complete the list of principal devotional objects carved in ivory.

For secular use. caskets, mirror cases, writing tablets and combs are numerous. They are decorated with scenes from well-known romances, from court life, or with figures engaged in gentle love-making. Chivalry and love mingle in the romantic "storming of the castle of love" (see fig. 5). The style of the carving, the treatment of figures and even the architectural decoration is often similar to that of religious objects.

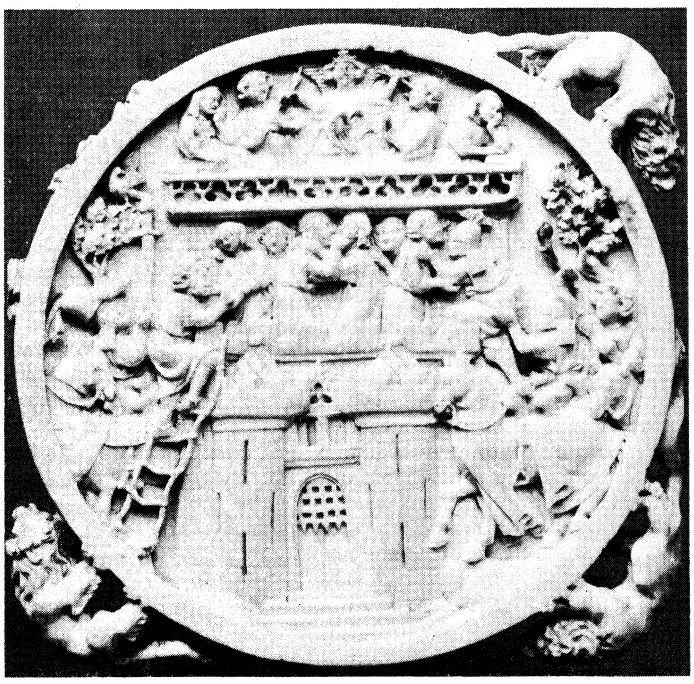
BY COURTESY CF THE TRUSTEES OF THE BRITISH MUSEUM

FIG 4 — CHESSMEN FROM THE ISLAND OF LEWIS SCOT ENGLISH OR SCANDINAVIAN, 12TH CENTURY

In general. the ivory art of the first half of the 14th century is one of imagination, ruled by subtle conventions, often overrefined and elegant, where there is no place for topical subjects, no need for realism, no attempt at psychological insight into the characters represented. In religious subjects there is an obvious tendency to emphasize the glorious and happy episodes in the life of Christ and pass rather briefly over the tragic scenes. Gospel themes are often interwoven nith scenes from pious legends.

It is only in the second half of the 14th century that a more dramatic approach is attempted. It was certainly not a revolution, but the admirable series of Passion diptychs that renewed an art which had already become static in its conventions. The carving in general is more nervous and searching. There is an attempt to set figures in different planes: landscape and architecture appear more freely. The secular objects also follow this variation in style.

Outpaced for a long time by great sculpture and threatened by the appearance of painted panels, ivory artists uere forced to go a step further. But a more naturalistic approach, with individualistic treatment of figures, meant a complete break with conventions established for more than a century—a break from which Gothic ivories could not survive. And indeed, at the beginning of the 1 jth century, a whole series of pierced reliefs were made with minutely carved figures and architecture. From the iconographical point of view. they brought new subjects to ivory carving. but in spite of the ingenuity of the workmanship, they advanced chronologically into more and more pronounced crowding of composition and forced attitudes in the figures. They were probably made in both England and France.



BY COURTESY OF THE VICTORIA AND ALBERT MUSEUM

FIG. 5.— MIRROR CASE. "STORMING OF THE CASTLE OF LOVE." FRENCH. ABOUT 1330–50

Attempts to ascribe some Paris work to foreign studios and to Italy are not too convincing, as the few ivories found in Italy at that time are of an entirely different character. With the exception of the individual nork of one artist, the beautiful Madonna of Giovanni Pisano (*c.* 1249–1314), these ivories show close resemblance to other art objects made in Italy at that period. There is obviously no great activity in ivory carving before the last part of the century.

Then comes the rich production of the Embriachi family in Venice. They adopted bone as a substitute for ivory; their reliefs were composed of narrow, vertical strips assembled side by side. This resulted in a most monotonous fluting all over the surface. and their large and small altarpieces. devotional shrines and innumerable chests and caskets are tedious and without real artistic interest. In contrast, the few examples of Gothic ivories made in England show a technical ability and style which can be compared nith the best French examples. In fact. if less elegant, they show a simplicity of composition and a nobility in the treatment of the figures already unknown to the French mannerists of the mid-14th century.

From Renaissance to Modern Times

In the second half of the 1 jth century, a whole series of objects was made decorated with figures in low relief on hatched backgrounds. They seem to be the work of the last schools of ivory workers surviving from the Gothic period.

With the approach of modern times, ivory assumed the place which it has held subsequently: an attractive material for precious, useful objects and for imitations of great sculpture in a reduced scale, appealing rather to the virtuosity of a clever craftsman than the creative power of a great artist. During the Renaissance, Flanders and Germany produced many of the then fashionable *mementi mori* (reminders of death) in the form of chaplets and small statuettes which were often ingenious and pleasing in spite of the gruesome subject. In Italy, ivory carvers developed great skill in copying famous statues and low reliefs. Sometimes they produced individual work inspired by the style of a great master. France also produced figures imitating great sculpture, but with more feeling for the delicate material.

Though rarely used during the Renaissance, ivory became popular in the 1 jth century and individual artists devoted themselves entirely to its technique. Inspired by baroque sculpture, they developed extraordinary skill, trying to achieve in the delicate but resistant material effects which would be impossible to achieve in any other medium. Extravagant cavalcades, figures and draperies flying in the air, clouds threatening in the sky, smoke rising, spurious mythological divinities playing in the sea, rivers and forests with pedantically carved vegetation, were the most popular subjects. Submerged in technical ability, the personality of the sculptor seems to vanish and an international style prevails in which German craftsmanship is dominant.

Ivories standing by themselves or associated with metalwork, carved in the round or in relief, are the work of the Germans Christoph Angermair, Georg Petel, Mathias Rauchmiller, Ignaz Elhafen and Leonhard Kern, the Italian Antonio Leoni, the Danish Magnus Borg and the Flemish Lucas Fayd'herbe, a pupil of Rubens who executed a number of carvings after the drawings of his master.

Artists distinguished also in other fields of sculpture tried their hands at ivory carving, and their style is often superior to the professional virtuosos. One of the most important sculptors of the reign of Louis XIV, the Flemish Gerard van Opstal, left many ivories in which his favourite subject—children—play vague mythological scenes, following the taste of the period. Similar

in style but less personal was another Flemish artist, François Duquesnoy, called Il Fiammingo, who was more famous for his work in bronze. In Italy there was Alessandro Algardi, the baroque sculptor. In Germany, Andreas Schluter and Balthasar Permoser (who decorated the Zwinger museum, Dresden) also made sculptures in ivory.

In Spain and Portugal devotional art in ivory survived much longer than in other countries of Europe. Saintly figures as well as devotional shrines are numerous. Some of them are of real artistic merit and deserve a closer study which they still awaited at mid-20th century.

In this, an important chapter should be devoted to the active school of carvers in the Portuguese colony of Goa in India, where were made in the 17th century some beautiful figures of mixed European and eastern influence.

At the end of the 17th century portraiture in ivory became popular. In this field two French artists acquired great fame: Jean Cavalier, who traveled widely all over Europe, and David le Marchand, who established himself in London. The latter also made carvings in the round and his portrait of Anne Churchill has a place among the charming 18th-century portrait busts.

At that time ivory was also used to make snuff rasps, snuff boxes, perfume bottles and shuttles, some beautifully decorated with secular and also religious subjects. Made in Dieppe or Paris, these delicate carvings seem to have been a revival of a minor art forgotten for centuries. But these also disappear at the end of the 18th century.

After the beginning of the 19th century the art of ivory carving died out entirely. Devotional figures produced in the 19th and 20th centuries are without artistic value. If ivory was used by clever craftsmen it was often to make forgeries of medieval work which, detected by a greater knowledge of the subject, have little chance to be seen in any important collection, as often happened at the beginning of the 20th century.

Should a modern artist of repute try his hand on this wonderful material, in which so many masterpieces have been made in the past, it is so rare that it only shows how completely the word "ivory" has disappeared from the artistic vocabulary.

BIBLIOGRAPHY.—*General:* O. M. Dalton, *Catalogue of Ivory Carvings of the Christian Era in the British Museum* (1909); *W.* F. Volbach, *Die Elfenbeinbildwerke* (Staatliche Museen zu Berlin) and *Die Bildwerke des Deutschen Museums* (1923); 0. Pelke, *Elfenbein,* 2nd ed. (1923); M. H. Longhurst, *English Ivories* (1926), *Catalogue of Carvings in Ivory* (Victoria and Albert Museum), 2 vol. (1927–29); *Cambridge Ancient History* and *Cambridge Mediaeval History* (under Art and Sculpture, *see* indexes to volumes); R. Berliner, *Die Bildwerke des Bayer. Nat.-Mus.,* "IV. Abteilung: Die Bildwerke in Elfenbein und Steinbockhorn" (1926); C. R. Morey, *Gli oggetti di avorio e di osso, del Museo Sacro Vaticano* (1937); *E.* Kitzinger, *Early Mediaeval Art in the British Museum* (1940); L. Grodecki, *Ivoires français* (1947); C. Cechelli, *Vita di Roma nel Medioevo,* "I. Arti minori e il costume" and "4. Avori" (1951–52); G. Bovini and L. B. Ottolenghi, *Catalogo della mostra degli Avori dell'alto Medioevo* (1956).

Prehistoric: Abbé Breuil in *Revue Archeologique,* 4th series, xiii, pp. 378 ff. (1909); R. A. S. Macalister, *Text-book of European Archaeology,* "I. The Paleolithic Period" (1921); British Museum, *Stone Age Antiquities* (1926); J. Déchelette, *Manuel d'arche'ologie préhistorique* (1908); S. Reinach, *Répertoire de l'art quaternaire* (1913); *M.* Hoernes, *Urgeschichte der bildenden Künste in Europa* (1915).

Egypt: J. Capart, *Primitive Art in Egypt* (1905); *W.* M. Flinders Petrie, *Nagada and Ballas* (1896), *Abydos,* part ii (1903); J. E. Quibell and F. W. Green, *Hierakonpolis,* part i (1902).

Babylonia and Assyria: W. Andrae, *Die archaischen Ischtar-Tempel in Assur* (1922); British Museum, *Guide to the Babylonian and Assyrian Antiquities* (1908).

Aegean, etc.: F. Poulsen, *Der Orient und die Frühgriechische Kunst* (1912); *H.* R. Hall, *Aegean Archaeology* (1915); British School at Athens, *Annual,* no. xiii (1906–07), no. xxv (1921–23); A. S. Murray *et al., Excavations in Cyprus,* British Museum (1900); D. G. Hogarth *et al., Excavations at Ephesus,* British Museum (1908).

Greek and Ronzan: H. Graeven, *Antike Schnitzereien* (1903).

Early Christian and Byzantine: J. Strzygowski, *Koptische Kunst, Catalogue général des antiquités égyptiennes du Musée du Caire* (1904); O. M. Dalton! *Byzantine Art and Archaeology* (1911), *East Christian Art* (1925); E. G. Smith, *Early Christian Iconography and a School of Ivory Carvers in Provence* (1918); *R.* Delbrueck, *Die Consulardiptychen und verwandte Denkmäler* (1929); A. Goldschmidt and K. Weitzmann, *Die byzantin. Elfenbeinskulpturen . . .,* 2 vol. (1930–34); H. Pierce and R. Tyler, *L'Art byzantin* (1932–34); *J.* Kollwitz, *Die Lipsanothek von Brescia* (1933); E. P. de Loos-Dietz, *Vroeg-Christelijke ivoren* (1937); C. Cecchelli, *La Cattedra di Massimiano ed altri ivori romano-orientali* (1936–44); *G.* W. Morath, *Die Maximianskathedra in Ravenna* (1940); K. Weitzmann, *Greek* MY*thology in Byzantine Art* (1951); C. R. Morey, *Early Christian Art* (1942); W. F. Volbach, *Elfenbeinarbeiten der Spätantike und des frühen Mittelalters* (19.52); *J.* Natanson, *Early Christian Ivories* (1953).

Carolingian and Romanesque: A. Goldschmidt, *Die Elfenbeinskulpturen aus der Zeit der karoling. u. sächs. Kaiser . . .,* 4 vol. (1914–26); R. P. Hinks, *Carolingian Art* (1935); G. de Frankovich, *Arte carolinaia ed ottoniana in Lombardia. Romisches Jahrbuch für Kunstgeschichte,* vol. vi (1942–44).

Islamic: E. Kuhnel, *Maurische Kunst* (1924); *G.* Migeon, *Manuel d'art musulman* (1927); *P.* B. Cott, *Siculoarabic ivories* (1939).

Gothic: J. von Schlosser, *Die Werkstatt der Embriacchi in Venedig, Jahrbuch der Kunsthistorischen Sammlungen des A. H. Kaiserhauses,* xx (1899); R. Koechlin, *Les ivoires gothiques français* (1924); *D.* D. Egbert, *North Italian Gothic Ivories in the Museo Cristiano of the Vatican Library,* Art Studies, vol. vii (1929); C. R. Morey, *Italian Gothic Ivories, Mediaeval Studies in Memory of Kingsley Porter* (1939); *J.* Natanson, *Gothic Ivories* (1951).

Renaissance to Modern Times: C. Scherer, *Elfenbeinplastik seit der Renaissance* (1903); A. Milet, *Ivoires et ivoiriers de Dieppe* (1906); A. Julius, *Jean Cavalier* (1926); *G.* van Bever, *Les Tailleurs d'ivoire de la Renaissance au XIX" siècle* (1946). (J. NN.)

ORIENTAL IVORY CARVING

CHINA

Early Chinese. — Ivory carving is one of China's oldest arts. Examples of skillfully carved ivory, together with the earliest of the fine bronzes for which China is famous, have been found in the tombs of the Shang kings at Anyang (north Honan). These Shang dynasty carvings are so handsomely designed and well executed that they suggest a previous long development, probably going back into prehistoric times.

In Shang times elephants still roamed the forests of the Yellow river region, so that the supply of ivory was close at hand, as is known from linguistic, historical and archaeological evidence. Most of the Shang ivories that have been recovered consist of small plaques, ornamental hairpins. or scraps of inlay from the furnishings of the tombs, but the *Book of Songs,* which contains some ancient Chinese odes, also speaks of ivory bow tips, and the last king of the Shang is saidto have invented ivory chopsticks as one of his acts of refined extravagance.

Even at that early date, ivory seems to have been valued on a par with gold and jade.

Only a few rather doubtful pieces of ivory carving have survived from the succeeding Chou dynasty (1122?–256 B.C.), although we read that the substance continued in high favour. Ivory was especially noted as a product of the Yangtze river delta area and of the state of Ch'u, which ruled in the middle Yangtze districts and to the south of that river. By that time the elephant had doubtless been driven south, so the people of Ch'u more or less controlled the supply of ivory. The Chou sovereigns are said to have had chariots of rare substances, one of which was of ivory. and Meng Ch'ang-chun (d. 279 B.C.), an official of the state of Ch'i, is said to have had an ivory bed among the ornate furnishings of his household.

At the Chou court it became fashionable for princes and high officials to carry narrow memorandum tablets of ivory and other substances. Called *hu,* these were generally worn as girdle pendants. In the Han dynasty (206 B.C.–A.D. 221) the ivory ones came to be considered as marks of rank, required for formal dress and were reserved for feudal princes and the highest officials, while the lower officials were restricted to wooden ones. Later, during the T'ang dynasty (A.D. 618–906) and the Sung (960–1279), these tablets were greatly elongated, and were carried by court officials as a kind of sceptre as well as a writing surface for memoranda. These later *hu* tablets were more than a foot long, tapering to conform to the natural narrowing of the tusk toward the tip, and slightly curved to follow the natural arching of the tusk. The tablets continued to be carried as a mark of court rank until the fall of the Ming dynasty in 1622.

A few ivory figurines have survived from the T'ang dynasty: showing the existence of a highly developed art of figure sculpture in ivory. But the T'ang ivory work is best known from the

examples that were sent to Japan for the dedication of the Great Buddha at Nara in 752, and are still preserved there in the Shosoin storehouse.

These represent another tradition of decoration. Instead of deep undercutting such as is usually found in the figures of the time, the work is mostly on flat pieces which were painted or stained a dark colour and then carved to form intricate patterns of birds and animals or geometrical figures, the carvings being stained with other colours or left plain. Among the objects treated in this way are several foot rules in bright blue and red, an ivory plectrum for a stringed instrument in vivid red, numerous red and blue game pieces, a few ivory knife hilts and several scabbards.

Several finely carved ivory figures in occidental collections have been ascribed to the Sung dynasty on stylistic grounds. These, like the T'ang figurines, show traces of colouring, as even the stone sculptures were painted in those days. The colouring matter is not solid and opaque as it was on the earlier flat ivories, preserved in the Shosoin, but was applied in the form of a stain which sank into the natural grain of the ivory to enhance its effect.

By Sung times, the elephant had been driven far into the wilderness areas of the southwest (modern Yunnan), which then belonged to another nation, the kingdom of Nanchao. Accordingly, new sources of ivory were sought overseas, and it was apparently at this time that the first African elephant tusks were brought from Zanzibar to China by Arab traders.

Kublai Khan, whose Mongol armies finally overthrew the Sung Chinese and the kingdom of Nanchao, had a vast stable of elephants, some taken from the Burmese as spoils of war and others presented to him in tribute, and much ivory must have been used at his luxurious court, as we know from allusions by Marco Polo and other European travelers of that time.

When the Mongol dynasty was in turn overthrown by the Ming Chinese in 1368, the new nationalistic-minded native dynasty proceeded to revive the arts, and in ivory carving, as in porcelain making, there was a renaissance of fine craftsmanship. The Ming ivory carvings that have come down to us are mostly in the form of handsomely carved figures. not stained or painted but with the natural colouring of the ivory slightly mellowed by time.

Many imitations have since been made, and the antique tone has been imparted artificially by soaking in infusions of tobacco or tea leaves, but the imitations cannot compare with the originals in graceful lines or sureness of carving.

Peking Work.—The tradition of fine Ming carving seems to have carried over into the first half of the Ch'ing dynasty, after the Manchus came down into China in 1644. The second Manchu emperor, K'ang Hsi, was a generous patron of Chinese arts and industries, and in 1680 he established 27 imperial workshops in the capital at Peking, one being devoted to producing fine carvings in ivory.

These workshops were later abandoned during the Ch'ien Lung reign (1736–96) but this did not mean the end of the work. The Ch'ien Lung period is still noted for its exquisite tinted ivory figures. The art of colouring the ivory was revived at that time, and both stains and lacquers were used to enhance the delicately carved figures, which many connoisseurs have considered the finest productions of the Chinese carvers' art. At this time, the T'ang style of carving through a surface layer of opaque lacquer was also revived, particularly for table screens, brush holders and other appurtenances of the scholar's desk.

Peking continued to be a centre for the finest Chinese ivory carvings until after the fall of the Ch'ing dynasty in 1911. In subsequent years the output declined, resulting from the lack of imperial patronage. From that time on, the industry was devoted chiefly to supplying foreign residents and tourists. Because these buyers were not discriminating, the quality, which had been declining after the mid-19th century, deteriorated at an accelerating pace.

Modern Peking ivory work has been especially noted for minute engravings of poems, scenes, etc., on flat ivory, but these productions, accomplished with the aid of a magnifying glass, would rank as tours de force, not as works of art.

The chief products of the Peking workshops traditionally were figures, singly or in groups, and other ornamental carvings; cylindrical brush boxes (*pi* t'ung), table screens, armrests carved in flat relief on the convex upper surface and in high relief on the concave side below, and other desk fittings; *jui* sceptres, snuff bottles, snuff dishes and accessories for opium smoking; stands for fine porcelains; and perfume boxes, mirror cases and all manner of other things for the court ladies.

Canton Work.—The second great centre of ivory carving in China during the past 300 years has been Canton, which, with nearby Macao, was a centre of occidental trade with China until other ports were forcibly opened by foreign pressure in 1842. Even after that, Canton continued to enjoy an extensive trade with the west. Sailors from Portugal, Spain and the Netherlands, and later from England, France and the United States (after 1790), greatly prized the carvings in ivory which they found in Canton, and an extensive industry in carvings for foreign taste arose to meet their ever-increasing demands.

In addition to card cases, cane heads, lacelike fans and other objects of ornamental utility for the European market, the Cantonese developed the art of making balls within balls, sometimes containing as many as ten concentric spheres, to satisfy the westerners' desires for novelties to amuse or amaze their families at home.

Since these things were being made for a foreign market, the Cantonese craftsmen did not take care to avoid sharp edges, as they would have if they had been working for Chinese patrons. In the orient, tactile values are especially appreciated, and the connoisseurs among the nobles and scholar gentry admired the feel of ivory, stroking it to enjoy its smooth surfaces; hence the figures and ornaments made for them had large expanses of polished areas, with a minimum of sharp angles or edges. In short, the Cantonese work which westerners considered so typical of China was not characteristically Chinese at all.

In addition to its great intricacy and emphasis on small details, the Cantonese work was further distinguished from the Peking products by absence of colour because the Canton ivories were never tinted.

Other Centres.—In addition to Canton and Peking, there were other, less prominent centres of ivory carving, which developed after the opening of the treaty ports in the second half of the 19th century. Of these, Foochow became famous for its artistic productions, especially in the form of architectural models of houses, pagodas and temples.

The Foochow work declined around the turn of the century but revived briefly in the 1930s. After Shanghai rose from a fishing village to a metropolis of world trade, it too became noted for its extensive ivory industry, which manufactured such utilitarian objects as chopsticks, mah-jongg sets, combs and seals on a mass-production basis.

Wenchow was briefly noted for its genre groups illustrating peasant occupations, which were popular with foreign travelers. The old city of Ningpo was long famed for its fine ivory inlay work in redwood furniture, but the decline of Ningpo as a port after the rise of Shanghai, and changes in taste following western influences, caused this to decline by the 1920s.

At the beginning of the Chino-Japanese War in 1937, many of the ivory carvers from Canton's famous Tai Sun street fled to the British colony of Hong Kong and set up new shops there. Other Cantonese ivory workers later followed them to escape the communists. Thus, Hong Kong, which previously had been merely a sales centre for Cantonese work, developed a full-fledged ivory carving industry of its own, in the traditional Cantonese style.

Artists.—Northern Chinese ivory carvings are sometimes dated (usually falsely, to give them a spurious antiquity), but are rarely signed. When the artists did sign them, they usually used only a given name. However, a few names of artists whom the Chinese connoisseurs considered great have been preserved in literary records. Thus we know that Wang Liu-chiu of the Sung dynasty was noted for his skillful carving of religious figures and of covers for Buddhist scriptures (sutras).

In the Ming period the greatest artist was said to have been Hsia Pai-yen, uho gained his skill by carving olive stones. and Pao T'ien-ch'eng. Chu Hsiao-sung. Wang Pai-hu. Chu Hu-yai. Yuan Yu-chu. Chu Lung-ch'uan and Fang Ku-lin, all of nhom carved scent boxes, fan handles and figures of Buddhist saints or Taoist immortals. During the Ch'ing dynasty, Wu Feng-tsu and Tu Shih-yuan attained fame as ivory carvers in the K'ang Hsi reign: while Ch'en Yang-shan, Li Te-Kuang and Chu Hung-chin were noted ivory artists in the Ch'ien Lung reign.

All of these artists were from north China or the Yangtze river delta. In Canton, as a result of the more commercial nature of the work, few individuals stood out. In the second half of the 19th century, two brothers nho operated a shop called Ho-a-ching on Honam Island are said to have done the finest and most original work in that region and their products were highly prized by the foreign residents. In the 1950s Liu Chia was hailed as Canton's foremost ivory carver. In the latter cases. intricacy and dexterity, rather than artistic skill. were the bases for judgment.

BIBLIOGRAPHY.—B. Laufer, *Ivory in China* (1925) ; *A.* de C. Sowerby, *China and Ivory* (1936) ; *S.* E. Lucas, *Catalogue of the Sassoon Chinese Ivories* (1950).

JAPAN

Since it is generally conceded that the ivory objects in the Shosoin storehouse in Nara, dating from the 8th century A.D., were actually products of T'ang China, it is not possible to claim any great antiquity for ivory carving in Japan. However, although they learned the art rather late. the Japanese ivory carvers of the Tokugawa period (1603–1867) quickly developed an astonishing mastery of this medium and created many miniature works of art which still excite admiration. Kyoto was traditionally the first centre of ivory carving, turning out products for the imperial court but eventually the lead was taken by Tokyo, which developed into an important mercantile centre as the capital of the Tokugawa shoguns.

The Japanese ivory carving industry apparently developed along two lines. The first was a purely utilitarian one, devoted to producing such objects as the plectrum for plucking the strings of the samisen, and the ends of the rollers for traditional scroll paintings. The other was the more artistic production of a kind of toggle, called a netsuke, which formed an indispensable item of men's costumes in the Tokugawa period. Netsukes were used to fasten the medicine box (inro) and the pipe and tobacco pouches to a man's sash. Since the members of the newly risen middle class, ranking below the samurai, were not allowed to wear jewelry, netsukes took the place of other personal adornment. Originally carved from boxwood, netsukes soon were made in various kinds of ivory.

Yoshimura Shuzan of Osaka is said to have been the first maker of ivory netsukes, during the Kyoho era in the first half of the 18th century, and others soon followed. In addition to the small netsukes which were seldom more than an inch in diameter, some of these artists also produced larger carvings called *okimono* which depicted the same subjects on a somewhat larger scale and were intended to ornament the alcove (*tokonoma*) in the principal room of a Japanese home. The netsuke makers, in the latter part of the 18th century, devised a method of inlaying, using coral, ivory. pearl-shell, horn and precious metals on lacquer and wood. Some of these other substances also were used for inlaying ivory. Even the very small ivory netsuke carvings were sometimes so inlaid. Rarely was the ivory lacquered.

With the end of the Tokugawa regime in 1867, leading to new customs of dress, and the introduction of the cigarette shortly after, netsukes became obsolete, although some were still carved to supply the demand of foreign residents and tourists who found them amusing. The former carvers, like the Cantonese. gradually turned to making things for foreign trade, dnd eventually they produced jewel boxes, chests, card cases. chessmen, buttons, brooches and other objects to appeal to Victorian tastes. They decorated them by engraving and carving and even by painting designs in gold lacquer, a technique which had been developed for decorating tortoise shell in Nagasaki and Osaka.

There was a parallel trend for the manufacture of figures like the okimono, purely ornamental but depicting animals and people with excessive detail and a sense of realism tending toward the macabre or the ridiculous. In most cases these seemed a sad parody of the miniature figures on the netsuke, unworthy of the old tradition However, an occasional product showed the old taste and artistry.

By about 1900 endless repetition and the use of machine tools for mass production had destroyed the remaining elements of the art. From that time, most Japanese ivory carving seems to have been directed toward the copying of old netsukes. complete with signatures of dead artists. and the forging of Chinese antiquities.

See Yuzuru Okada, *Netsuke: a Miniature Art of Japan* (1951).

(S. V. R. C.)

NORTH AMERICAN IVORY CARVING

To the primitive North American Indian unacquainted with metals except the soft copper found in a pure state in certain isolated places, the gleaming ivory teeth of the animals he hunted always possessed a special attraction. The tooth of the beaver made him an efficient knife or graving tool, the tooth of the bear an admirable fish lure. Often he attached rows of teeth to his clothing, partly to show his success in hunting. partly because he found pleasure in their sheen.

There are three animals, the walrus, the narwhal and the elephant, gifted by nature with a larger share of ivory than the rest. and it so happened that in North America two of these animals were available only in the arctic and subarctic regions where the timber that supplies so many of man's needs was either scarce or lacking. The third animal, the elephant, was extinct in every part of America, but its tusks were easily accessible in certain parts of Alaska, although elsewhere rare and usually deeply buried. Consequently it was among the Eskimo tribes inhabiting the arctic and subarctic regions that the art of carving ivory for both utilitarian and aesthetic purposes attained its highest development.

The ivory in commonest use is walrus ivory, which is densest in structure and easiest to secure. Narwhal tusks are twisted and hollow. which renders them unsuited for engraving or carving, although they served the old Eskimos of Hudson bay for harpoon shafts and other implements. Mammoth ivory is almost as dense as walrus ivory, and hollow only toward the base.

Fossilization (*i.e.*, darkening through long contact with minerals in the soil) gives a variety of soft, deep colours greatly appreciated by curio collectors; hence traders often immerse white ivory in boiling coffee and other liquids to give its surface a spurious fossilization.

The earliest specimens of Eskimo carving seem to come from the Bering sea region. They are not numerous, and are scattered through several museums, their antiquity unrecognized because they were purchased from unlearned Eskimos and not excavated by trained archaeologists. They may be distinguished by two criteria, deepness of colour (an unsafe guide) and the style of ornamentation; and sometimes a third way, the shapes of the specimens, which often differ from the later Eskimo types. There is carving in the round, apparently — heads of seals and other realistic figures quite similar and perhaps not inferior to anything found in more recent Eskimo remains. But still more abundant are finely etched geometric patterns covering surfaces even of utilitarian objects such as snow goggles and harpoon foreshafts that in later periods seldom carried any ornamentation. The artists of this ancient school, unlike their successors, disliked straight lines, preferring the graceful curves, scrolls and concentric circles that are so characteristic of Maori and Melanesian art. Cnlike the Melanesians, however, they did not allow their ornamentation to run riot, but subordinated it in conformity with the shape and purpose of the object so as to produce a natural balance. The freehand drawing on the more carefully worked specimens is admirable; many of the concentric circles with incised dots are so accurate that they seem hardly traceable without compasses (see fig. 6).

The period at which this remarkable art flourished is as obscure as its origin. It surely dates back at least 1,000 years, but how

much more than this cannot be guessed.

The curtain then closes for a period on the early history of the arctic. When it opens again, about ten centuries ago, we find the Eskimos occupying the whole coast line from Bering sea to Labrador and Greenland. Ivory carving flourished in both the west and the east, but the finest specimens come from the west. Even the most everyday objects, such as needle cases, toggles for the dog harness and harpoon heads, underwent ornamentation or were given a decorative form. There are ornaments made of two unbroken links each carrying a representation of an animal's head, sometimes slightly conventionalized but often quite realistic. Some needle cases with thimble holders attached date from post-European times; they were also carved from one unbroken section of a walrus tusk.

BY COURTESY OF THE NATIONAL MUSEUM OF CANADA

FIG. 6.—EXAMPLE OF FREEHAND ESKIMO CARVING

The Eskimo needle case is a hollow cylinder of bone or ivory that contains a sealskin thong carrying the bone or copper needles. The ivory carvers of ancient days could not remain content with a plain undecorated tube, but for some reason not as yet understood. expanded it into what has been called the winged form, which they engraved with their characteristic geometric designs. Ringed needle cases have been found in old ruins from Alaska to the Labrador peninsula, so that the type was established at least 1.000 years ago. In Alaska the artists let their fancy play with the different elements of this conventional form. Sometimes they developed the ends of the needle case. sometimes the flanges or wings and the hardly perceptible knobs below them. Since all their sculpture (as opposed to their engraving) tended toward realism, these elements became elaborated into animal forms.

Attached to the sealskin thong that passed through the tube there was always a toggle of some kind to assist in drawing the needles in and out, and it may be that the round, buttonlike toggle, fitting on top of a winged needle case, suggested the human figure. In any event, we have actually secured from quite early sites many needle cases in human form—always female, for though men were the ivory carvers, women performed all the sewing. In some specimens the head is hollow, in others it is solid and separate from the trunk, serving as the button for the sealskin thong.

Animal heads. usually carved on tools connected with the chase, are nevertheless much commoner than human figures in these old remains. One implement carved in the form of tno polar bear heads joined together at the neck is commonly used as a toggle for dragging the carcasses of seals. In such carvings the detail is skillfully executed; the ears are admirably worked and the eyes represented by plugs of dark coloured antler. Possibly the holes marking the nostrils were originally plugged in the same nay. The heads would be almost identical if the artist had not fancifully depicted one bear with teeth and one without. Specimens of this type are particularly interesting because of the wide deep groove on the underside, which still reveals the Stone Age method of its formation. The workman first drilled a series of holes, side by side, then broke away the intervening walls.

From a somewhat later period, the early Iron Age, comes the arrow straightener which is regularly surmounted nith the heads of what appear to be caribou. Again the artist used plugs of dark ivory to represent the eyes and nostrils, but for the somewhat misplaced ears he contented himself with a conventional design, an engraved dot and circle. This pattern, so widely spread over the globe, makes its appearance fairly frequently in Alaska. even from the earliest times. Ivory boxes with wooden bases, snuff boxes and skin scrapers are common objects decorated in this manner.

The Russian explorations of the Chukchi peninsula in the middle and latter half of the 17th century caused a steady stream of iron to flow across Bering strait. The possession of iron tools immediately brought about a striking development in ivory work, particularly in Alaska. Older implements and ornaments appeared in new forms, as skin scrapers, thimble holders, mouthpieces of bow drills and delicate little ear pendants with concentric circles and holes for suspending glass beads. With more efficient tools the artist could give freer rein to his imagination, and for the first time apparently, he made carvings in the round, or in high relief, arranged to compose a scene. To this postiron period belongs a remarkable Alaskan bucket handle showing a polar bear seizing a fish. The Labrador peninsula has produced some carved ivory tusks, probably recent, that illustrate the same artistic growth.

Far more striking, however, than either of these developments was the sudden emergence of realistic engravings in Alaska, and the birth, nearly full-grown, of a picture writing, that often has been compared by writers too apt to forget its modernity with the scenes painted by Paleolithic man on the walls of French and Spanish caves, and the drawings made on rocks by the Bushmen in south Africa. Actually very little realistic engraving seems to occur before the Eskimos had direct or indirect contact with Europeans, and for some time after this contact realistic designs contested the field with the older geometric patterns without gaining the supremacy. In museum collections the oldest pipes (which were first introduced from Siberia about the same time as iron) seem to be carved in relief, and engraved either with geometric designs or with realistic figures of animals arranged without any relation to each other except a purely spatial one. It was not until the 19th century that picture writing became firmly established and succeeded in relegating the older geometric engraving to the background; and even then it failed to gain a foothold in the Eskimo area except in Alaska.

From about 1750 picture writing in Alaska overshadowed the older engraving of geometric patterns, but by no means superseded it. Nor did it seriously affect the carving of detached figures, nor of figures in high or low relief. Among the many articles produced from ihis time on, the utilitarian form a large and important decorated group. Hunters had for many years employed a scraper with attached claws to simulate the scratching of seals on ice; these, originally without ornament, later attained a delicacy hitherto unequaled. Even the mesh gauges used in making sealing nets were carved in relief; sometimes with conventionalized representations of seals, at others with hunting scenes.

In addition, there regularly would be crude picture writing on the underside. Needles for stitching skin clothing, ornaments for such objects as buckets and pipes, toys and playthings for children and mythical monsters, feared alike by hunters and homemakers, all were executed with great skill and beauty by the Eskimo artists.

In the 20th century, Eskimo ivory carving in Alaska produced the professional carvers who earned their livelihood by supplying the demands of the curio trade. Undoubtedly these modern artists possess as much ability as their ancestors but they failed to apply their skill to the production of objects that mould be acceptable to the civilized world at large. See also SCULPTURE; SCULPTURE TECHNIQUE. (D. J.)

BIBLIOGRAPHY.—F. Boas, "Decorative Designs of Alaskan Needle Cases," in *Proceedings* of the United States National Museum, vol. xxxi (1908); W. J. Hoffman, "The Graphic Art of the Eskimo," Report of the U S National Museum (1897); *Native Arts of the Pacific Northwest,* Portland Art Museum (1949).

IVORY COAST (CÔTE D'IVOIRE), a former overseas territory of French West Africa became an autonomous republic within the French Community in 1958 and an independent state in 1960. It is bounded on the west by Liberia and the republic of Guinea, north by the republics of Mali and Upper Volta, east by Ghana. The area is 124.503 sq.mi. In 1955 the population was 2,485,086, of whom 14,086 were Europeans; (1958 est.) 3,088,000. The coastal and central regions are the most densely populated.

Most of the former colony of Upper Volta was absorbed by Ivory Coast in 1933, but was separated again as a territory in 1947.

Physical Features.— The curved coastline extends from 3° 7 W. to 7° 34' W., and has a length of 315 mi.; neither bay nor promontory breaks its regularity The shore is low, bordered in its eastern half with lagoons. and difficult of access because of sub-

merged bars and the heavy surf. The principal lagoons, from west to east, are those of Lahou, Ebrié, and Assinie or Aby. The low alluvial coastal belt extends inland about 40 mi. Beyond, the land rises gradually to a plateau with an elevation of more than 1,000 ft., with higher hills and mountains. Many valleys cut into the plateau, and in the west the Nimba mountains rise to more than 6,000 ft. The major rivers flow southward, and have rapids where they descend from the plateau to the plain. The Cavally river (c 373 mi.) forms the border with Liberia From west to east. other large streams are the Sassandra (*c.* 404 mi.). the Bandama (*c.* 497 mi) and the Comoé (466 mi.). These rivers drain to the Gulf of Guinea. A few small streams in the northwest of the territory drain to the Niger system, and a few in the northeast to the Volta system. The climate near the coast is always warm and moist, with two rainy seasons separated by less humid periods. On the northern plateaus temperatures are modified by altitude and there is a dry season during the cooler months from November to February. The fauna and flora are similar to those of the Gold Coast and Liberia The tropical rain forest of the coastal areas gives way to semideciduous forest in the central region. North of 8° N. the forest is mixed with lower shrubs of the savanna.

History. — The Ivory Coast is stated to have been visited by Dieppe merchants in the 14th century, and was made known by the Portuguese discoveries toward the end of the 15th century. It was thereafter frequented by traders for ivory, slaves and other commodities. There was a French settlement at Assinie, 1700–04, and a French factory was maintained at Grand-Bassam from 1700 to 1707. In the early part of the 19th century several French traders had established themselves along the coast. In 1830 Adm. (then Cmdt.) Louis Edouard Bouët-Willaumez (1808–71) began a series of surveys and expeditions which yielded valuable results. In 1842 he obtained from the native chiefs cessions of territory at Assinie and Grand-Bassam to France, and the towns named were occupied in 1843 From that time French influence gradually extended along the coast except during a period of temporary withdrawal (1872–83). Between 1887 and 1889 Capt. Louis Gustave Binger traversed the whole region between the coast and the Kiger, visited Bontuku and the Kong country, and signed protectorate treaties with the chiefs. In 1892 Captain Binger made further explorations in the interior of the Ivory Coast, and in 1893 he was appointed the first governor of the colony on its erection into an administration distinct from that of Senegal. Among other famous explorers who helped to make knoun the hinterland was Col. (then Capt.) Jean Baptiste Marchand. The boundary of the colony on the west was settled by Franco-Liberian agreements of 1892 and subsequent dates; that on the east by the Anglo-French agreements of 1893 and 1898. The northern border was pushed toward the interior as additional territory was conquered, and subsequently changed several times.

Native revolts, many of them led by Samory, occurred in the late 19th century. Additional revolts in 1910 and 1916 led to the separation of the troublesome northern country as the colony of Upper Volta. The Abidjan-Niger railway, commenced in 1904, was completed to Bobo-Dioulasso in 1934. The Upper Volta, pacified and linked to the south by rail was largely reabsorbed by the Ivory Coast (decree of 1933). In World War II the Ivory Coast provided troops for France, but remained under the control of the Vichy regime following the defeat of France in 1940. By the constitution of 1946, the Ivory Coast became a territory in the French union, with increased autonomy in financial and administrative affairs. At the request of the inhabitants. and for administrative convenience. Upper Volta uas separated from the Ivory Coast by decree of Sept. 4, 1947, and given equal standing.

Inhabitants.—Among the larger ethnic groups are the Kru (380,000) in the southwest and the Agni (related to the Xshanti, *q.v.*) in the southeast. The Baulé (500,000) in the central part of the colony are of Agni-Ashanti origin. The Senufo (350,000), the Dioula (360,000) and other peoples inhabit the north. The bulk of the inhabitants are fetish worshipers or animists. but several Dioula and Senufo groups are Moslem. Among the indigenous peoples, Christians number only a few thousand

Towns. — The chief towns are (pop. 1955) Abidjan (127.585) (1958 est.) Bouaké (45,000), Grand-Bassam (12,000), Agboville (11,050), Katiola (8,620), Port-Bouet (7,500), Grand-Lahou (2,-930) and Korhogo (14,650).

Abidjan, the capital of the Ivory Coast, has one of the best ports in West Africa. The city is built on a peninsula extending into the Ebrie lagoon, but the lagoon was at first separated from the ocean by a sand bar. Harbour improvements, including the Vridi canal which pierces the bar and joins Abidjan to the ocean, were started in 1937 and completed in 1951. The Vridi canal is almost 2 mi. long, 49 ft. deep, and 400 yds. wide, with an entrance protected by rock breakwaters.

Agriculture and Trade. — The major agricultural products for export are coffee, cocoa and bananas. . Minor products are palm kernels and palm oil, shea-nut butter, peanuts, pineapples, cotton, rubber, kola nuts, sesame, sisal, kapok and vanilla. The subsistence crops are millet, corn (maize), rice: manioc and yams. The natives supplement their diet with fish and game. Stock raising (goats, sheep, cattle) is of but slight importance because of sleeping sickness carried by the tsetse fly. Weaving, pottery making and iron smelting are native industries.

In 1952 the major export by tonnage was hardwood lumber (mahogany) 76,411 metric tons, followed by coffee 61,017 tons, cocoa 51,037 tons, and bananas 17,529 tons. France was the best customer, the United States second. The United States took about half of the exports of mahogany and a fifth of the cocoa. The remaining lumber and cocoa exports, as well as those of coffee and bananas, went mainly to France. Imports of the Ivory Coast consisted primarily of cloth and other manufactured goods from France, England and Europe, and machinery and petroleum products from the United States.

Transportation and Communications. — The rivers of the Ivory Coast are navigable only for about 30 mi. at their mouths and at a few places in the interior, but the coastal lagoons are used by barges and by small steamers with a draft of 4 or 5 ft. There are wharves at Abidjan and at nearby Vridi, Port-Bouet and Grand-Bassam; also farther west at Tabou and Sassandra.

In 1954 the total length of motorable roads was about 9,000 mi., of which 100 mi. were bituminous, 5,400 mi. were unpaved but maintained for all-season usage and 3,500 mi. were usable in the dry 'season only. In addition there are thousands of miles of trails, some of which are used by trucks during the dry season. Road construction and improvement have been especially active since World War II. The Abidjan-Niger railway of metre gauge runs from Port-Bouet and Abidjan through Bouaké and other interior towns to Bobo-Dioulasso in Upper Volta, a distance of 500 mi. In Cpper Volta territory an extension of the railway from Bobo-Dioulasso to Koudougou was opened in 1953.

Air traffic increased greatly after World War II. Local lines connect the larger towns with Abidjan and with adjoining territories. Abidjan is on several trunk lines, with direct flights to Dakar and Paris. Telegraph and telephone lines serve the major towns, and there are several radio stations.

Administration. — The Ivory Coast was an overseas territory with membership in the federation of French West Africa and in the French union. It was administered by a governor ,resident at Abidjan assisted by a territorial assembly of 50 elected members. For administrative purposes the territory was divided into 17 "circles," each with an administrator assisted by a council of notables. The Ivory Coast was represented at Dakar, Sen., by members in the grand council of French West Africa. After independence the capital was Abidjan and the head of government the prime minister.

BIBLIOGRAPHY.—F. J. Clozel and R. Villamur, *Coutumes indigènes de la CGte d'Ivoire* (Paris, 1902); Michellet and Clement, *La CGte d'Ivoire* (Paris, 1906); Augustin Bernard, *Sahara et Afrique Occidentale,* in *Géographie Universelle,* vol. xv, part 2 (Paris, 1939); Georges Spitz, *L'Ouest Africain Français, A.O.F. et Togo,* Societé d'Éditions Géographiques, Maritimes, et Coloniales (Paris, 194'7); Eugène Guernier (ed.), *Afrique Occidentale Française,* 2 vol., Encyclopédie Coloniale et Maritime (Paris, 1949); Emmanuel Avice, *La CGte d'Ivoire,* Societé d'Éditions Géographiques, Maritimes, et Coloniales (Paris, 1951); *Annuaire Statistique de l'Afrique Ociidentale Française,* voi. i and ii (Paris, 1950–51); *Guid' A.O.F., 1953–1954,* Agence de Distribution de Presse (Dakar, 1953). (T. C. WN.; B. E. T.)

IVREA, a town and episcopal see of Piedmont (anc. *Eporedia),* Italy, province of Torino, 38 mi. N.N.E. from the city of Turin by rail and about 27 mi. direct, 770 ft. above sea level, on the Dora Baltea at the point where it leaves the mountains. Pop. (1951) 11,308. The cathedra1 was built between 973 and 1002, but nothing survived from that .period except the ambulatory around the choir and the two bell towers. The cathedral was rebuilt a number of times. The hill above the town was crowned by the imposing Castello delle Quattro Torri (1358). The ancient Eporedia. at the junction of roads from Augusta Taurinorum and Vercellae, at the point where the road to Augusta Praetoria enters the narrow valley of the Duria (Dora Baltea), was a military position of the Salassi who inhabited the whole upper valley of the Duria. The importance of the gold mines of the district led to its seizure by the Romans in 143 B.C. The centre of the mining industry seems to have been Victumulae *(see* TICINUM), until in 100 B.C. a colony of Roman citizens was founded at Eporedia itself; but prosperity was only assured when the Salassi were finally defeated in 25 B.C. and Augusta Praetoria founded. Remains of a theatre of the time of the Antonines survived until modern times, and the Ponte Vecchio was set on Roman foundations. In the middle ages Ivrea was the capital of a Lombard duchy, and later of a marquisate; both Berengar II (950) and Arduin (1002) became kings of Italy for a short period. Later it submitted to the marquises of Monferrato, and in the middle of the 14th century passed to the house of Savoy.

IVRY, BATTLE OF (1590). Ivry. now Ivry-la-Bataille in the modern *départements* of Eure, Fr., gave its name to the battle fought in its vicinity between the forces of Henry of Savarre (Henry IV of France) and those of the Catholic league under Charles of Lorraine, duke of Mayenne, on March 14, 1590.

After the fighting round Arques (Sept. 1589) and an unsuccessful attempt on Paris, Henry had withdrawn via Étampes to his temporary capital Tours (Nov. 21). In the two following months, however, his forces began the reduction of Normandy, till by Jan. 28, 1590, only Rouen was left to the league in that province. Mayenne meanwhile, though he had hoped to spend the winter resting in Paris, had retaliated by taking Vincennes and Pontoise and laying siege to Meulan. Henry then turned south to take Poissy; and Mayenne abandoned Meulan, leaving Henry free to march on Dreux (Feb. 28). At this point, however, Philip II of Spain, incensed by the Venetians' recognition of Henry, decided to give overt help to the league, and the duke of Parma, his governor of the Netherlands, sent Count Egmont with 1,200 Walloon lancers and joo arquebusiers to reinforce Mayenne. Mayenne then advanced on Dreux, and Henry met him on the plain of Saint-André, just after he had crossed the Eure at Ivry.

The marshal Jean d'Aumont, commanding Henry's left-centre, repelled an attack by Mayenne's light cavalry, but Henry's extreme left, shaken by the league's German mercenaries, was thrown into confusion by a charge of the Walloon lancers, who could then turn the flank of Henry's artillery. The advance guard of Henry's centre attacked the Walloons' left flank but was hurled back. The cavalry reserve behind Henry's right, however, was able to reinforce Aumont, who drove the Walloons back. Mayenne rallied them and led them with his carabiniers against Henry himself in the centre. Henry, telling his men to follow his white plume on the road to honour and victory, charged into combat. At one moment he seemed lost, but his left wing attacked to disengage him. The league's cavalry was defeated, falling back on Mantes and Chartres; the Swiss infantry capitulated. saving also the Frenchmen within its ranks; the rest were massacred.

The victory was decided more by personal acts of valour exploiting the enemy's sudden weaknesses than by strategic or tactical superiority. It bore little fruit: Henry marched again on Paris but had insufficient troops and had to raise the siege; and four more years passed before his conversion to Catholicism enabled him, in March 1594, to enter the capital that military success had failed to deliver.

See *Discours ve'ritable de la victoire obtenue par le Roy en la bataille donnée près le village d'Eury, le Mercredi quatorziesme jour de Mars, 1590* (Tours, 1590).

IVRY-SUR-SEINE, a suburb of Paris, France, in the department of Seine. *arrondissement* of Sceaux, near the left bank of the Seine, 6 km. from Notre Dame cathedral. Pop. (1954) 47,509.

It manufactures organs, earthenware, rubber and chocolates, and has engineering works and oil works, its trade being facilitated by a port on the Seine.

IVY, the collective designation of certain species and varieties of *Hedera,* a genus of the ginseng family (Araliaceae). There are 50 species of ivy recorded in modern books, but they may be reduced to two or, at the most, three.

The English ivy, *H. helix,* sometimes called European ivy, with its varieties and many horticultural forms, shows numerous variations in the form and colour of its leaves but tends to produce a three- to five-lobed form when climbing and a regular ovate form when flowering and fruiting. The Algerian ivy, H. *canariensis,* is a native of north Africa, the Azores and the Canary Islands. It is the common large-leaved climbing ivy. It also varies, but in a less degree than H. *helix,* from which its leaves differ in their larger size; rich deep green colour and a prevailing tendency to a five-lobed outline. When in fruit the leaves are usually three-lobed, but they are sometimes entire and broadly ovate. The Colchis ivy, *H. colchica,* considered to be a form of H. *helix,* has ovate, obscurely three-lobed leaves of a coriaceous texture and a deep green colour; in the tree or fruiting form the leaves are narrower than in the climbing form and without any trace of lobes.

WALTER SINGER

IVY (HEDERA CANARIENSIS)

Distinctive characters are also to be found in the appendages of the pedicels and calyx, *H. helix* having 6-rayed stellate hairs, *H. canariensis* 15-rayed hairs and H. *colchica* yellowish 2-lobed scales.

It is important to note the difference of characters of the same species of ivy in its two conditions of climbing and fruiting. The first stage of growth is essentially scandent and the leaves are more or less lobed. This stage is accompanied by a plentiful production of the claspers or modified roots by means of which the plant becomes attached and obtains support. When it has reached the summit of the tree or tower, the stems, being no longer able to maintain a perpendicular attitude, fall over and become horizontal or pendent. Coincidentally with this change they cease to produce claspers and the leaves are strikingly modified in form, being now narrower and less lobed than on the ascending stems. In due time this treelike growth produces terminal umbels of greenish flowers: which have the parts in fives, with the style united into a very short one. These flowers are succeeded by smooth black or yellow berries containing two to five seeds. The yellow-berried ivy is found in northern India and in Italy but elsewhere it is known only as a curiosity of the garden, where, if sufficiently sheltered and nourished, it becomes an exceedingly beautiful and fruitful tree.

A question of practical importance is the relation of the plant to its means of support. A moderate growth of ivy is not injurious to trees; still the tendency is from the first inimical to the prosperity of the tree, and at a certain stage it becomes deadly. Therefore the growth of ivy on trees should be kept within reasonable bounds, more especially in the case of trees that are of special value for their beauty, history, or the quality of their timber. In regard to buildings clothed with ivy, there is nothing to be feared so long as the plant does not penetrate the substance of the wall by means of any fissure. Should it thrust its way in, its natural and continuous expansion hastens the decay of the structure. But a fair'growth of ivy on sound walls that afford no entrance beyond

the superficial attachment of the claspers is beneficial. It promotes dryness and warmth, reduces to a minimum the corrosive action of the atmosphere and is altogether as conservative as it is beautiful. Many varieties are cultivated in gardens. Growing these is an extremely simple matter, as they will thrive in a poor soil and endure a considerable depth of shade, so that they may with advantage be planted under trees.

The common Irish ivy (a variety of *H.* helix) is often used as a ground cover beneath large trees where grass has difficulty in thriving.

Though long cultivated in mild, moist districts, ivy is, on the whole, a scarce plant on the American continent. In the northern Cnited States and southern Canada the winters are not more severe than the ivy can endure, but the summers are too hot and dry. In districts where native ferns abound the ivy will usually thrive, and varieties of H. helix should have the preference. But in the drier districts ivies should be planted on the north side of buildings. and encouraged with water and careful training for three or four years. A strong light is detrimental to the growth of ivy, but there are no hardy plants that may be compared with it for variety and beauty that will endure shade equally well.

The North American poison ivy (*q.v.*), species of *Toxicodendron* (of the cashew family, or Anacardiaceae), is a climber with three-foliate leaves, which are very attractive in their autumn colour.

The ground ivy, Nepeta hederacea (mint family, or Labiatae), is a small creeping plant with rounded crenate leaves and small blue-purple flowers, occurring in hedges and thickets in Great Britain and widely in North America.

For a consideration of the numerous cultivated varieties and forms of *Hedera,* see H *M.* Lawrence and **A. A.** Schulze, "The Cultivated Hederas," Gentes Herb., *Ithaca,* 6:107–173, fig 73–86 (1942).

IWAKURA, TOMOMI, PRINCE (1835–1883), Japanese statesman, was born in Kyoto. He was one of the court nobles (kuge) of Japan, and he traced his descent to the emperor Murakami (A.D. 947–967).

Iwakura took a leading part in the complications preceding the fall of the Tokugawa shogunate, and he was obliged to fly from Kyoto accompanied by his coadjutor, Prince Sanjo. They took refuge with the Daimyo of Choshu and, while there, established relations which contributed greatly to the ultimate union of the two great fiefs, Satsuma and Choshu, for the work of the restoration.

From 1867 until the day of his death Iwakura was one of the most prominent figures on the political stage. In 1871 he proceeded to America and Europe at the head of an embassy of about 50 persons, to explain to foreign governments existing conditions in Japan, and to prepare for negotiating new treaties consistent with its sovereign rights. Little success attended the mission. Returning to Japan in 1873, Iwakura found the cabinet divided as to the manner of dealing with Korea. He advocated peace, and his influence carried the day.

IWASAKI, KOYATA, 2ND BARON (1879–1945), Japanese philanthropist, was born in Tokyo on Aug. 3, 1879, and succeeded to the barony in 1908. Educated at the Imperial university of Tokyo and at Cambridge, Eng., he became president of Mitsubishi and Co., Ltd., succeeding his father as head of the Mitsubishi interest.

His vast wealth was largely expended in experiments and benefactions. His visit to England convinced him of the educational value of public libraries and when the library of G. E. Morrison. for many years the Times (London) correspondent in Peking. came into the market, Baron Iwasaki bought it for the students of Japan.

Iwasaki added to it the bulk of his own collection and, in addition to buying a site and erecting a building to contain it, allotted a sum of money annually to the institution for the purpose of keeping it up-to-date by the purchase of new books. The library is called the *Toyo* Bunko (Oriental library) and is situated in Kamifujimae Cho in Hongo, Tokyo. He died in Tokyo on Dec. 2, 1945.

IWO JIMA, a volcanic island in the North Pacific, was under Japanese control until 1945, when it became the scene of one of the fiercest and most costly battles in U.S. history, measured in terms of the ratio of casualties to the number of men engaged. More than 700 mi. S.E. of Tokyo, it is irregularly shaped, about 5 mi. long, ranging in width from 800 yd. to 2½ mi.

The island was strategically important both for the United States and Japan, since it was the best available air base between Saipan, about 700 mi. S., which U.S. forces had taken in 1944, and Tokyo. Three marine divisions landed on Iwo Jima between Feb. 19 and 21, 1945. The Japanese had entrenched themselves so effectively in caves that weeks of preliminary bombardment failed to weaken appreciably their ability to offer desperate and tenacious resistance, and Japanese fire directed against the beaches was heavy and accurate. The struggle for the possession of the island, fought at close quarters, continued for almost a month before it was officially pronounced captured by the United States. The hardest struggles were for the occupation of Meatgrinder hill, in the northern part of the island. and of Mt. Suribachi, an extinct volcano which rises 546 ft. above sea level in a southern corner of the island. The former position was taken and lost five times before U.S. marines held it permanently.

The raising of the U.S. flag over Mt. Suribachi, which was photographed by Joe Rosenthal of the Associated Press, proved to be one of the most dramatic episodes in the Pacific war. Rosenthal's photograph was widely reprinted, and paintings, a three-cent postage stamp, statues, etc., were based on it.

About 22,000 Japanese troops were killed or captured, and the U.S. casualties totaled more than 21,000, including almost 4,500 men killed. Under the Japanese peace treaty, signed in Sept. 1951, administration of IRO Jima and the other Volcano Islands formally passed to the United States. (See also WORLD WAR II.)

I.W.W.: see INDUSTRIAL WORKERS OF THE WORLD.

IXION, in Greek legend, son of Phlegyas, king of the Lapithae in Thessaly (or of Ares), and husband of Dia. Having treacherously murdered his wife's father Dei'oneus he could find none to purify him until Zeus did so and admitted him as a guest to Qlympus. Ixion abused his pardon by trying to seduce Hera; but the goddess substituted for herself a cloud, by which he became the father of the Centaurs. Zeus bound him on a fiery wheel, which rolls unceasingly through the air or (according to the later version) in the underworld (Pindar, *Pythia,* ii, 21; Ovid, *Metam.,* iv, 461; Virgil, Aeneid, vi, 601). A plausible but by no means certain explanation connects the story with the not uncommon practice of carrying a blazing revolving wheel through fields which needed the heat of the sun, the legend being invented to explain the custom (see Mannhardt, Wald- und Feldkulte, ii, 1905, p. 83).

See Roscher's Lexikon, *s.v.*

IXTACCIHUATL or IZTACCIHUATL ("white woman"), a lofty volcano, 10 mi. N. of Popocatepetl (*q.v.*) and about 40 mi. S.S.E. of Mexico City, forming part of the short spur called the Sierra Nevada. Its elevation is 17,338 ft., making it the sixth highest peak on the North American continent. Its apparent height is dwarfed somewhat by its elongated summit, and the large area covered. It has three summits of different heights standing on a north and south line, the central one being the largest and highest, and all three rising above the permanent snow line. As seen from Mexico City the three summits have the appearance of a shrouded human figure, hence the poetic Aztec appellation of "white woman" and the unsentimental Spanish designation "the fat woman." The ascent is difficult and perilous, and is rarely accomplished. It has no crater and no trace of lingering volcanic heat. It is surmised that its crater, if it had one, was filled in and its cone worn away by erosion.

IXTLILXOCHITL II (c. 1500–1550), chief of the Texcucans. one of the most civilized tribes of ancient Mexico. He became an enemy of Montezuma, emperor of Mexico, because Montezuma aided his brother in the struggle for leadership which followed upon the death of their father, Netzahualpilli. When the Spaniards under Cortés arrived Ixtlilxochitl offered his services against Montezuma, and CortCs in turn aided him in becoming king of Texcuca. Ixtlilxochitl remained faithful to the Spaniards to the last and accompanied Cortés on many expeditions, but in the end

he lost the favour of his own subjects whom he had really helped to conquer.

IYRCAE, an ancient nation on the northeast trade route described by Herodotus (iv, 22) beyond the Thyssagetae (*q.v.*), somewhere about the upper basins of the Tobol and the Irtysh. They were distinguished by their mode of hunting, climbing a tree to survey their game, and then pursuing it with trained horses and dogs. They were almost certainly the ancestors of the modern Magyars, also called Jugra.

IZARD (*Rupicapra* pyrenaica), the chamois of the Pyrenees, differing from the typical Alpine form (see CHAMOIS) in its reddish colour and smaller size. The name is also spelled "isard."

IZHEVSK, administrative centre of the Udmurtsk republic in Soviet Russia on the Izh river, a tributary of the Kama river, in lat. 56° 52' N. and long. 53° 14′ E. Pop. (1956) 252,000. Its steel foundries and ammunition works, established in 1807, increased rapidly in importance. Other industries include brewing, brickmaking, flour milling and sawmilling.

IZMIR (formerly SMYRNA), the capital of the *il* of Izmir and after Ankara the most important town in Asia Minor, is situated at the head of the sheltered Gulf of Izmir on the deeply indented Aegean coast of Turkey. Pop. (1960 cen.) 370,923. The city is built on a plain around the eastern end of the gulf, which varies in width from 1¼ to 5 mi., and on the heights and ridges to the south. The highest point within the city limits is Kadifekale (Mt. Pagus) j40 ft. above sea level. The Yamanlar mountains, to the north, rise to a height of 2,500 ft. The climate is Mediterranean, with warm summers tempered by winds from the west and generally mild winters with occasional snow.

More than three-fifths of the town was destroyed when the Greeks retreated before the advancing Turkish forces in 1922. The reconstruction of the city was planned by René Donje in 1924 and was almost completed in the late 1950s, while subsequent building is on the lines of a project prepared by Kemal Ahmet Ağru of Istanbul university. Izmir's recovered prosperity is apparent from its spacious avenues, modern theatres and stores. Among its public buildings are the Izmir National library (1912) and the Museum of Archaeology (1951). The latter contains a fine collection of the antiquities of Smyrna. Konak remains the business and commercial centre, spreading out to Basmahane and Pasaport. The residential centres are in Karantina and Güzelyali, southwest of the city, and Kadifekale and Tepecik. Alsancak, to the north, is the site of a new harbour, while the main concentration of industry is in Halkapinar. to the northeast.

Izmir is the commercial and industrial centre of a well-defined geographical region, and the port for a rich hinterland producing a variety of agricultural products, including tobacco, grapes, figs, cereals, cotton, olives, valonia and vegetables, as well as carpets and silk. It is the principal export centre of Turkey and second to Istanbul in import trade. Industrially also it is second only to Istanbul, possessing factories and repair shops and processing plants for grapes, figs, tobacco and olives. Industrial products include soap, dyes and cotton textiles. An international trade fair is held annually from Aug. 20 to Sept. 20 in the Kültürpark, north of the district of Basmahane.

Izmir has two railway stations (Basmahane and Alsancak), terminals for lines from the north (Manisa and Balikesir and the main Anatolian system) and from Aydin and Denizli to the southeast. Highways link the city with Balikesir and northwest Anatolia, Aydin and the southeast. the Çeşme peninsula and Menemen and the Aegean coast. Air services to Istanbul and external services to Athens ouerate from Cumaovasi airport.

The chief archaeological sites are the Agora, or ancient market place, Kadifekale (Mt. Pagus) and the aqueducts of Kizilçullu. The site of ancient Ephesus (now Selçuk) and Pergamum (Bergama) are not far from Izmir. (*See* SMYRNA.) (C. Ns.)

IZPARTA, ISPARTA or SPARTA (anc. *Baris*), a town in Turkey, well situated on the edge of a fertile plain at the foot of Aghlasun Dagh. It was once the capital of the Emirate of Hamid. It suffered severely from an earthquake in 1889. It has been an important centre of Greek influence in Anatolia. It is connected by rail with Smyrna and Egerdir. Pop. (1960) 36,201.

IZU-SHICHITO, the "seven isles of Izu," included in the empire of Japan. They stretch in a southerly direction from a point near the rnouth of Tokyo bay, and lie between 33° and 34° 48' N. and between 139° and 140° E. They include six islands of the O-shima group, (Izu-shima, To-shima, Kii-shima, Kozu-shima, Miyake-shima, Mikura-shima) and Hachijo-shima. There are some islets in their immediate vicinity. Izu-shima, 10 mi. long and 5½ mi. wide, is 15 mi. from the nearest point of the Izu promontory. It is known to western cartographers as Vries Island, a name derived from that of Capt. Martin Gerritsz de Vries, a Dutch navigator, who supposedly discovered the island in 1643. But the group was known to the Japanese from a remote period, and was used as a convict settlement from the 12th century. Izu-shima is remarkable for its smoking volcano. Mihara (2,500 ft.).

IZVOLSKY, ALEXANDER PETROVICH (1856–1919), Russian diplomat and foreign minister, was born at Moscow on March 17, 1856. He graduated at the Imperial Lyceum of St. Petersburg (Leningrad) with the highest honours, and entered the diplomatic service. He held appointments at Bucharest, Washington and at the Vatican, where he was charged with the resumption of relations between the tsar's government and the Holy.See.

Izvolsky married Countess Toll, a friend of the dowager Empress Maria Feodorovna, to whose influence he owed much of his professional success. His next posts, as minister plenipotentiary, were in Belgrade, Munich and Tokyo. Before hostilities with Japan broke out Izvolsky was transferred to Copenhagen (1903). In 1906 he succeeded Count Lamsdorff as minister of foreign affairs, a post which he held until 1910. From 1910 to 1917 Izvolsky was Russian ambassador in France. After the revolution he died in Paris Aug. 16, 1919.

When he became foreign secretary, France and Russia were only nominally allies, and the cardinal principle of his policy was to convert that alliance into an effective reality. He also strove to draw Great Britain, Italy, Turkey, Bulgaria and Rumania into the Entente.

Izvolsky's first success was the liquidation of the war with Japan. The next and more difficult task, elimination of the causes of Anglo-Russian rivalry, was begun by the arrangement with Great Britain about Persia, Afghanistan and Tibet (1907). This reconciliation definitely baffled Aehrenthal's scheme which the Russian tsaritza favoured—a renewal of the Three-Kaiser alliance.

Soon after this Izvolsky sounded Vienna unofficially as to Austria's view on an attempt by Russia to obtain the freedom of the straits. Aehrenthal, then minister of foreign affairs, replied unofficially that no objection would be raised if Russia agreed to the annexation of Bosnia and Hercegovina. This question and answer were, however, followed by a marked coolness in the mutual relations of the two empires, and the matter ,dropped. The two states came together again when charged by Europe to draft and execute á scheme for the reform of justice in Macedonia. But Austria secretly obtained from Turkey a railway concession in the sanjak of Novi Bazar. In St. Petersburg, London and Belgrade the news aroused intense indignation. But after King Edward VII's visit to Reval (June 1908), Izvolsky informed Aehrenthal that Russia had no objection to the Sanjak railway if Austria would assent to an Adria railway lor Serbia. At the same time he proposed that the tsardom should obtain the freedom of the straits and Austria promulgate the annexation of Bosnia and Hercegovina. Izvolsky and Aehrenthal then met at Buchlau, the Moravian residence of Count Berchtold (Sept. 15, 1908), and agreed to this arrangement. Izvolsky held that he made the proviso that the two points be referred to a European conference, while Aehrenthal asserted that he announced the annexation as impending. Both were probably right. A few days later the annexation was proclaimed, whereas Russia was kept out of its *quid pro quo* owing to British-French opposition.

The resulting personal and national tension almost brought war within sight, but Russia was unprepared and it was staved off. Izvolsky attempted to draw Italy into the orbit of the Allies; in spite of this 'Russia and Germany seemed for a while to become friends again, and during the tsar's sojourn in Germany Izvolsky was relieved of his office and sent to Paris as ambassador, remaining, however, the real head of his country's policy until the outbreak of World War I, for which his enemies often held him responsible. But the hyperbole is unjustified. His policy, like that of Aehrenthal, was a sequence of cruel illusions for which the people had to pay.

J THIS letter was not differentiated from I until comparatively modern times. It was the custom in medieval manuscripts to lengthen the letter I when it was in a prominent position, notably when it was initial. As initial I usually had consonantal force, the lengthened form came definitely to be regarded as representing the consonant and the short form the vowel in whatever position they occurred. The process of differentiation began about the 14th century but was not complete until the 17th century. For certain purposes, an alphabetical series for example, the letters I and J are not always regarded as distinct, the enumeration passing occasionally from I to K.

The original consonantal sound represented by the letter was the semivowel or spirant *i* (the sound of *y* in the word *yacht).* This passed into dy and later into the sound *dž* which the letter represents today. This sound was already established in the language in words of Romance origin in which it was represented by *g* (*e.g*, in words such as *gesture, ginger),* and these words retain their spelling. J represents the same sound (*dž*) in all positions and deviations from it are extremely rare even in words of foreign origin. In the bird-name *jaeger,* however, the sound *dž* and the sound *y* are both admitted, and in certain personal and local names of Spanish origin, *e.g., Juanita, La Jolla,* the sound of *h* is current in English usage. The minuscule form *j* is the lengthened form, retaining the dot, of minuscule *i.*

See also ALPHABET. (J. W. P.)

JA'ALIN, the largest, most widely distributed and most loosely knit main group of the Arabs of the Sudan. The term is used generally of most of the northern riverain tribes and in a more restricted sense of a large group comprising the Sa'adab, Nifi'at, Kiti'āb and other tribes. They claim to be of the Koreish tribe and even trace descent from Abbas, uncle of the Prophet. They are of Arab origin, but now of very mixed blood. According to tradition they emigrated to Nubia in the 12th century. They are a proud religious people, formerly notorious as slave dealers.

JABIR: *see* GEBER.

JABIRU, an American stork, *Jabiru mycteria,* found from Mexico to the Argentine. It stands between 4 and 5 ft. in height, with a massive black bill and white plumage. The head and neck are bare, and black and red in colour. The old world genera *Xenorhynchus* and *Ephippiorhynchus* are nearly allied to the true jabiru, but the head and neck are feathered. Less closely related are the adjutant birds (*q.v.*). The name is often wrongly applied to the wood ibis *(Mycteria americana),* a smaller but somewhat similar stork rangicg from Argentina to the coasts from Texas to Florida and North Carolina. *See* STORK.

JABLOCHKOV, PAUL (1847–1894), Russian electrical engineer and inventor, a pioneer in electric lighting, was born at Serdobsk, in the government of Saratov, on Sept. 14, 1847. and was educated at St. Petersburg. In 1871 he was appointed director of the telegraph lines between Moscow and Kursk, but in 187j he resigned his position in order to devote himself to research on electric lighting by arc lamps.

In 1876 he settled in Paris, and toward the end of the year he brought out his Jablochkov "candles." These consisted of two carbon parallel rods, separated by a nonconducting partition; alternating currents were employed and the candle was operated by a high-resistance carbon match connecting the tips of the rods, a true arc forming between the parallel carbons when this burned off, and the separators volatilizing as the carbons burned away.

For a few years his system of electric lighting was widely adopted, but it was gradually superseded *(see* LIGHTING). Jablochkov made various other electrical inventions, but he died in poverty in Russia on March 19, 1894.

JABLONEC NAD NISOU (Ger., GABLONZ AN DER NEISSE), manufacturing town in Liberec region, Czech., noted for Gablonz ware; a centre for the glass industry and the preparation of cheap jewelry and imitation stones. Pop. (1930) 23,139.

JABLONSKI, DANIEL ERNST (1660–1741), German theologian who worked for union of Lutherans and Calvinists, was born at Nassenhuben, near Danzig, on Nov. 20, 1660. His father was a minister and his maternal grandfather, Johann Amos Comenius (d. 1670), a bishop of the Moravian Church. Jablonski studied at Frankfurt an der Oder and Oxford, became a preacher at Magdeburg in 1683, and from 1686 to 1691 was head of the Moravian college at Lissa. He was appointed court preacher at Konigsberg in 1691 by the elector of Brandenburg, Frederick III, and soon attained considerable influence in court circles. In 1693 he became court preacher at Berlin, and in 1699 he was consecrated a bishop of the Moravian Church..

The courts of Berlin, Hanover, Brunswick and Gotha were interested in Jablonski's scheme for Lutheran-Calvinist union, and his principal supporter was G. W. Leibnitz. His idea appears to have been to form a general union of German, English and Swiss Protestants. For several years negotiations to this end were carried on, but eventually it was found impossible. Jablonski's next plan was to reform the Church of Prussia by introducing the episcopate and the liturgy of the Church of England, but again he was unsuccessful. He was one of the founders of the Berlin Academy of Sciences, of which he was president in 1733, and he received a degree from the University of Oxford. He died on May 25, 1741.

Correspondence between Jablonski and Leibnitz was published at Leipzig in 1747 and at Dorpat in 1899.

See H. Dalton, *Daniel Ernst Jablonski* (1903).

JABORANDI, a name given in Brazil and South America generally to various plants which increase perspiration and the flow of saliva.

In the year 1875 a drug was introduced under this name, its botanical source being then unknown. *Pilocarpus pennatifolius,* a member of the family Rutaceae, the plant from which it is obtained, is a slightly branched shrub about ten feet high, growing in Paraguay and eastern Brazil.

The leaves are the part of the plant most commonly imported. The active principle is called pilocarpine. It is a liquid alkaloid, freely soluble in water, alcohol and chloroform, and less soluble in ether. It forms crystalline salts of which the nitrate is that chiefly used in medicine. Certain other alkaloids are present in the leaves including the stereoisomer, isopilocarpine and pilocarpidine and isopilocarpidine, all of which are weaker in action than pilocarpine.

Pilocarpine stimulates smooth muscle and gland cells innervated by the parasympathetic nervous system, and by cholinergic fibres of the sympathetic nervous system. It is therefore antagonistic to atropine in its actions. *(See* ATROPINE.) While its actions resemble those of physostigmine, the mechanism of its actions is different in that it stimulates the effector cell directly, whereas physostigmine prevents the destruction of acetylcholine. Its effect on the salivary and sweat glands is more marked, and its chief clinical uses are to increase salivation or as a sweating agent.

JACA, a city of northern Spain, in the province of Huesca, 114 mi. N.W. of Saragossa, on the left bank of the river Aragon, and among the southern slopes of the Pyrenees, 2,380 ft. above the sea. Pop. (1950) 7.754 (mun.). The origin of the city is unknown. The Jaccetani are mentioned as one of the most celebrated of the numerous small tribes inhabiting the basin of the Ebro by Strabo. They are probably identical with the Lacetani of Livy (xxi, 60, 61) and Caesar (*B.C* i. 60). Early in the 8th century Jaca fell into the possession of the Moors, by whose writers it is referred to under the name of Dyaka as one of the chief places in the province of Sarkosta (Saragossa). It was reconquered before the time of Ramiro I of Aragon (1035–63), who gave it

the title of "city," and in 1063 held a council within its walls. During the Peninsular War Jaca surrendered to the French in 1809, and was recaptured in 1814. Jaca is an episcopal see, and was formerly the capital of the Aragonese county of Sobrarbe. Its massive Gothic cathedral dates at least from the 11th century, and possibly from the 9th.

JACAMAR, Brazilian name used for some 15 species of small to medium-sized birds, confined to heavy forests of tropical America, constituting the family Galbulidae (order Piciformes). Jacamars are usually metallic green or bronze above—sometimes across the breast or on the throat—and rufescent below, with a white patch on the lower throat of the male. The bill is long, tapering, sharp-pointed, with stiti bristles about its base, the feet yoked in pairs like a woodpecker (*q.v.*), the tail graduated. They are quite tame, sit quietly on a dead twig as if asleep, suddenly darting forth flycatcherlike to catch large insects on the wing and returning to the perch; in flight and actions they resemble swallows. Jacamars lay two glossy white eggs in holes of old stumps or banks of streams. Most species inhabit tropical forests east of the Andes, especially the Amazon and Orinoco, but the great jacamar (*Jacamerops aurea*), 11 in., extends north to Costa Rica, while the black-chinned jacamar (Galbula melanogenia) reaches southern Mexico. The three-toed jacamar (*Jacamaralcyon* tridactyla) is found in southern Brazil. (G. F. Ss.)

JAÇANA, Amazonian name generally used for some seven species of lily trotters constituting the family Jacanidae, classed with shore birds in order Charadriiformes, but raillike in appearance and habits and sometimes placed near gallinules (*q.v.*) in the Gruiformes. Jaçanas are moderately small, with fairly long legs and extremely long toes (hind claw longer than its toe) adapted for running easily over floating water lily pads or water hyacinths or over soft mud, There is a prominent spur at the bend of the wing, a leaf or plate on the forehead as in gallinules. The plumage is colourful, sometimes glossy; the female is larger than the male. Jaçanas feed on slow-moving streams, ponds, or marshes. on seeds and bits of vegetation, crustaceans and insects, and lay four glossy eggs, usually splotched or lined with brown, on a nest of floating vegetation. The Mexican jaçana (Jacana *spinosa* gymnostoma). 7.5 to 10 in., is chiefly dark chestnut, greenish black above, with apple-green flight feathers, yellow bill, and orange-red wattle; it ranges from Yucatan north to the lower Rio Grande valley of Texas; other races occur in the West Indies and Central and South America, south to Ecuador and northeastern Argentina. The smallest is the African least jaçana (*Microparra* capensis), about 6 in., black, white, reddish-orange, and greenish-yellow. The largest, most extravagant is the pheasant-tailed jaçana (*Hydrophasianus* chirurgus), 12 to 14 in., in winter brownish and white with a black breast band; during breeding, dark brown above and below, black cap, white head and fore neck, and lengthened tail feathers adding 6 or 7 in. to size; it is found in India and southern China to the Philippines and Java. Smaller and duller, without lappet or distinct breeding plumage, is the bronze-winged jaçana (*Metopidius* indicus) of southeastern Asia from India to Sumatra and Java. The larger African jaçana (*Actophilornis africana*), over Africa south of the Sahara, is beautiful in chestnut, black, gold, represented in Madagascar by the white-necked jaçana (A. albinucha). The Australian jaçana (Irediparra *gallinacea*), of eastern and northern Australia, ranges to New Guinea, southeastern Borneo, and Mindanao, southern Philippines. (G. F. Ss.)

JÁCANA or ÁCANA (native West Indian name), a very common timber tree (Lucuma *multiflora*, family Sapotaceae) of the West Indies. The tree grows to a height of 75 to 90 ft. and gives straight logs of very durable timber. The wood is hard, very fine grained, light coloured and very heavy, and used in construction work where great strength is required; formerly used for cane-mill rolls. It is used in afforestation work in Puerto Rico.

JACKAL (*Canis aureus*), a wolflike wild member of the dog family inhabiting southeastern Europe, northern Africa and southern Asia. The name is also applied to a number of allied species. Jackals resemble wolves and dogs in their dentition, the round eye-pupils, the period of gestation, and to a large extent also in habits. The European species grows to a height of 15 in. at the shoulders, and to a length of about 2 ft., exclusive of its bushy tail. The fur is grayish-yellow, darker on the back and lighter beneath. The range of the common jackal extends from eastern Europe to southeast Asia and in northern Africa, from Egypt and Uganda to Senegal. The black-backed jackal (C. *mesomelas*), its sides rusty red, shares most of southern Africa with the side-striped jackal (C. *adustus*), which is grayish with an indistinct stripe of dark and pale on the sides. The Abyssinian red jackal (C, *simensis*) is long-legged and is somewhat wolflike. Jackals are nocturnal, concealing themselves until dusk in jungles and other lurking places, and then sallying forth in packs to visit farmyards, villages and towns in search of food. This consists chiefly of the smaller mammals and poultry, although the association in packs enables these marauders to hunt down antelopes and sheep. When unable to obtain living prey, they feed on carrion and refuse of all kinds, and are thus useful in removing putrescent matter from the streets.

They also follow lions and tigers in order to finish the carcass after the larger animal has eaten its fill. The cry of the jackal is even more appalling than that of the hyena. Like the fox, it has an offensive odour, due to the secretion of a gland at the base of the tail.

JACKDAW or DAW, one of the smallest species of the genus *Corvus* (see CROW), and a well-known inhabitant of Europe, C. monedula. It associates with the rook during a great part of the year; but almost invariably chooses holes for its nest of sticks: sometimes even breeding in rabbit burrows. Many church towers and castles are occupied by daws. Their industry in collecting materials for their nests is marvelous. In some cases the stack of loose sticks piled up by daws in a tower has been known to form a structure 12 ft. in height. The style of architecture practised by the daw thus brings it more than the rook into contact with man, and its familiarity is increased by the boldness of its disposition, which, though tempered by cunning, is hardly surpassed among birds.

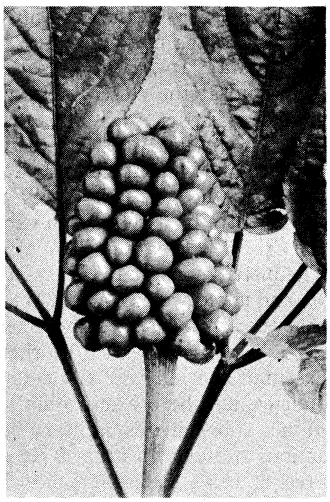
BY COURTESY OF BRITISH INSTRUCTIONAL FILMS, LTD.
ENGLISH JACKDAW

Its pilferings are not to be denied, though its services to the agriculturist are great, for in the destruction of injurious insects it is hardly inferior to the rook, and it has the useful habit of ridding sheep of some of their parasites. The eggs, four to six, bluish white to greenish blue, are spotted and blotched with brown and olive. The daw displays a glossy black plumage in the adult, varied by gray ear coverts and nape and sides of the neck. In birds from the east of Europe and western Asia these parts are much lighter.

In America the name is extended to include the boat-tailed and great-tailed grackles (*Cassidix*) and even the smaller grackles (*Quiscalus*). See GRACKLE.

JACK-IN-THE-PULPIT (*Arisaema* triphyllum), a North American plant of the arum family (Araceae), called also Indian turnip, bog onion, brown dragon and starchwort, native to wet woods and thickets from Nova Scotia to Minnesota and southward to Florida and Texas. It is a stoutish perennial, 1 to 2½ ft. high, rising from an acrid corm and usually bearing two long-stalked, three-parted, dull-green leaves, which overshadow the conspicuous green- and purple-striped flowering spathe that rises on a separate stalk between them. The flowering spathe curves in a broad canopylike portion over the top of a club-shaped spadix, two to three inches long, near the base of which, concealed within the enclosing spathe, are borne the minute flowers, the staminate and pistillate commonly though not always found on different plants. Fertilization is aided by small insects? especially gnats of the genus Mycetophila. The fruit. a handsome cluster of brilliant red berries, ripens in late summer. This aroid, in many respects a North American counterpart of the British cuckoopint (*q.v.*), is one of the best-known late spring wild flowers of the

eastern United States and Canada. The starchy corm is exceedingly irritating, because of the presence of myriads of needlelike crystals of oxalate of lime. It was formerly used for food, after proper treatment by drying and cooking, by the Iroquois and other American Indians. See ARACEAE; GREEN DRAGON.



J HORACE MCFARLAND CO

FRUIT CLUSTER OF JACK-IN-THE-PULPIT (ARISAEMA TRIPHYLLUM)

JACKLING, DANIEL COWAN (1869–1956), U.S. mining engineer and metallurgist, known as the "father of the porphyry coppers," was born on a farm near Appleton City, Mo., Aug 14 1869 Graduated from the Missouri School of Mines (Rolla) in 1892 he taught chemistry and metallurgy there in 1891–93, and in 1894–95 worked as a chemist and metallurgist in the Cripple Creek district, Colorado. While engaged in treating gold ores at Mercur, Utah, he was commissioned to make a report on a copper prospect at Bingham Canyon. His history-making report led a few years later (1905) to the formation of the Utah Copper company for which he exploited copper ore yielding only 25 lb. per ton. Utah was the prototype of porphyry operations that revolutionized copper mining. Jackling was active in operating and executive positions in the Nevada Consolidated Copper company, the Kennecott Copper corporation, for which he directed western operations until his retirement in 1942, and the Mesabi Iron company. For his work in constructing and operating government explosive plants, 1917–19, he received the Distinguished Service medal. He died March 13. 1956, in San Francisco. Calif., where he lived from 1914, leaving an estate of $7,000.000. (A. B. P.)

JACK RABBIT, a name applied to several species of hares—not rabbits—occurring in western Korth America. The commonest species is the black-tailed or California jack rabbit (*Lepus californicus*) which occurs from Washington and South Dakota to central Mexico. Its tail has a wide black stripe which runs onto the back. The white-tailed jack rabbit (L. *townsendii*) is distinguished from it by its all white or buff-marked tail. The latter is found from Alberta to New Mexico, from Illinois to California. Other species of jack rabbits occur as far south as the Isthmus of Tehuantepec in Mexico. Three or four litters of one to six young are produced each year. (K. R. KN.)

JACKSON, ABRAHAM VALENTINE WILLIAMS (1862–1937), U.S. linguist, a specialist in Indo-Iranian languages. was born in New York city, Feb. 9, 1862. He was associated most of his life with Columbia university, both as student and professor. teaching Sanskrit, Avestan. Persian and related subjects. His interest in the orient resulted in repeated trips to Turkey; Iran, Turkistan. Afghanistan and India. In 1903 he made the first photographs of the famous Old Persian inscription of Darius at Behistun. He was a world-renowned authority on Avestan, the language of the sacred writings of Zoroastrianism. and also on the life and religion of Zoroaster himself. His work in comparative linguistics, while sound, was not characterized by great originality, although his comparative study of Xvestan and Sanskrit shows erudition. and his *Avestan Reader* has been an invaluable aid to generations of students. Jackson's numerous books include: *A Hymn of Zoroaster* (1888). *Avestan Alphabet and Its Transcription* (1890), *An Avestan Grammar in Comparison With Sanskrit* (1892), *An Avestan Reader* (1893), *Zoroaster, the Prophet of Ancient Iran* (1899). *Persia, Past and Present* (1906), *From Constantinople to the Home of Omar Khayyam* (1911), *Early Persian Poetry* (1920), *Zoroastrian Studies* (1928). He died in New York city on Aup. 8, 1937. (R. A. Fs.)

JACKSON, ANDREW (1767–1845), U.S. soldier and statesman, seventh president of the United States, was born on March 15, 1767, at the Waxhaw settlement on the frontier of the Carolinas. The area in which he was born was in dispute between North Carolina and South Carolina, and subsequent boundary shifts and a doubt as to the exact house in which he was born have led both states to claim him as a native son. Jackson always maintained that he was born in South Carolina. Although the question can not be answered positively, the weight of evidence appears to support his contention.

The Waxhaw area offered little opportunity for formal education, and such schooling as Jackson did have was interrupted by the British invasion of the western Carolinas in 1780–81. In 1781 he was captured and imprisoned for a time by the British. Shortly after he was captured, he refused to shine the boots of a British officer and was struck across the face n-ith a sabre. His mother and two brothers died during the closing years of the war, direct or indirect casualties of the invasion of the Carolinas. This sequence of tragic experiences fixed in Jackson's mind a lifelong hostility to Great Britain.

Early Career. — After the close of the American Revolution Jackson studied law in an office in Salisbury, N.C., and was admitted to the bar of that state in 1787. In 1788 he went to the Cumberland region as prosecuting attorney of the western district of North Carolina — the region west of the Appalachians which was soon to become the state of Tennessee.

When Jackson arrived in Nashville, the judicial seat of the district, the community was still a frontier settlement exposed to the danger of Indian raids, with a fluid social structure! no well-established political institutions, and a volatile economy in which virtually every investment had the character of a speculation. As prosecuting attorney, Jackson was principally occupied with suits for the collection of debts. In these he was so successful that he soon had a thriving private practice and had gained the friendship of landowners and creditors. For almost 30 years Jackson was allied with this group in the politics of Tennessee.

Jackson boarded in the home of Col. John Donelson and there he met the colonel's daughter, Mrs. Rachel Robards. Her marriage was a stormy one which had seemed destined to end in separation or divorce even before she met Jackson. Jackson was quickly attracted to her. In 1790, Robards sought a divorce by legislative enactment in Virginia, but the legislature would do no more than empower Robards to sue for divorce in the courts. Jackson and Mrs. Robards believed the legislature had granted the divorce and in 1791 they were married. Robards in fact delayed in suing for divorce until 1793 and then obtained it on the grounds of desertion and adultery. When Jackson and his wife learned the true state of affairs, they were remarried quietly in Nashville. Until the death of Mrs. Jackson, nearly 40 years later, political opponents and others who resented Jackson's impetuous manner did not hesitate to make unflattering insinuations about events leading to his marriage. The marriage appears to have been a happy union of a devoted couple but gossip concerning it kept Jackson on the defensive.

Jackson was a successful lawyer, but his spirit was too restless and his interests too versatile to be confined to a career as an attorney. The expanding economy of frontier Tennessee encouraged adventures in trade and in land speculation, and Jackson became involved in both. He invested heavily in land and horses and he raised cotton, but his investments were so diverse that he could not be regarded as primarily a planter. The course of his investments was a series of reversals of fortune. At times he appeared to be financially secure; on other occasions: he was hard pressed by debt.

Tennessee Politics. — Jackson's interest in public affairs and in politics had always been keen. He went to Nashville as a political appointee, and in 1796 he was a member of the convention which drafted a constitution for the new state of Tennessee. In the same year he was elected as the first representative of the state in the nationai house of representatives. He refused to seek reelection and served only until March 4, 1797. These were the closing months of the administration of Pres. George Washington, and the chief event of Jackson's brief service in the house was the debate over the response to Washington's farewell address. Jackson was critical of Washington, resenting the president's support of

Jay's treaty, which Jackson regarded as too favourable to Great Britain, and he was one of 12 representatives who opposed a cordial reply to the farewell address.

Jackson returned to Tennessee vowing not to enter public life again, but before the end of the year he was elected to the United States senate. His willingness to accept the office reflects his emergence as an acknowledged leader of one of the two factions contending for control of the politics of the state. The leader of the opposing faction was John Sevier, the first governor of Tennessee, who was commonly regarded as the most powerful political figure in the state.

Jackson resigned from the senate in 1798 after an uneventful year in that body. Personal financial pressures were the immediate cause of his resignation but Jackson appeared ill at ease in national politics and was unhappy in being separated from his family. Soon after his return to Nashville he was appointed a judge of the superior court (in effect, the supreme court) of the state, serving until 1804, when financial difficulties again forced him out of public life.

War of 1812.—In 1802 Jackson was elected major general of the Tennessee militia, a position he still held when the War of 1812 opened the door to a command in the field and a hero's role. In the intervening years, though he was nominally out of politics, Jackson maintained his old associations with many of the active political leaders of the state. It was during this period that he renewed his acquaintance with Aaron Burr, whom he met and admired when they served together in congress. For a time, Jackson appeared willing to aid Burr in the latter's nebulous scheme for the conquest of Texas. Later, when he began to suspect that Burr entertained treasonable intentions, Jackson withdrew his support. He was not fully convinced of Burr's guilt, however, and he appeared as a defense witness in the trial of Burr in 1807.

In March 1812, when it appeared that war with Great Britain was imminent. Jackson issued a call for 50,000 volunteers from the state to be ready for an invasion of Canada. After the declaration of war, in June 1812, Jackson offered his services and those of his militia to the United States. The government at Washington was slow to accept this offer, and when Jackson finally was given a command in the field, it was as the result of action by Gov. Willie Blount of Tennessee. The enemy against whom he marched was not the British but the Creek Indians, who were allied with the British and who were threatening the southern frontier. In a campaign of about five months, in 1813–14, Jackson crushed the Creeks, the final victory coming in the Battle of Tohopeka (or Horseshoe Bend) in east-central Alabama. The victory was so decisive that the Creeks never again were a menace to the frontier, and Jackson was able to impose upon them a treaty whereby they surrendered to the federal government an estimated 23,000,000 ac. of land, comprising about one-fifth of the state of Georgia and more than three-fifths of the present state of Alabama. The campaign against the Creeks thus opened a vast new area to settlement and established Jackson as the hero of the west.

In Aug. 1814, Jackson moved his army south to Mobile. He was without specific instructions, but his real objective was the Spanish post at Pensacola. The motive was to prepare the way for U.S. occupation of Florida, then a Spanish possession. The justification for this bold move, as Jackson viewed it, was the fact that Spain and Great Britain were allies in the wars in Europe. At Mobile, Jackson received information that the British were planning to invade the southern coast of the United States and were using Pensacola as one base for that operation. In the first week of November he made a hurried march into Florida and on Nov. 7 captured Pensacola. He could not linger, however, for at Pensacola he learned that the British were about to invade Louisiana. He hastened with his little army to New Orleans. There, after a series of skirmishes culminating in a major battle on Jan. 8, 1815, he inflicted a decisive defeat upon an army of British regulars and compelled it to withdraw from Louisiana. The news of this victory reached Washington at a time when morale in the capital was at a low point. A few days later, news of the signing of a peace treaty at Ghent, Belg., reached Washington. The twin tidings of victory and peace brought joy and relief to the American people and made Jackson the hero not only of the west but of a substantial part of the nation.

Florida Campaign.—Jackson retained his commission in the army and at the close of the war was named commander of the southern district. His duties were nominal and the actual command in the field was left to others while Jackson retired to his home at the Hermitage, near Nashville. From that congenial environment he was called back to active service in 1818 when the Seminole Indians refused to vacate a portion of the lands ceded by the Creeks in 1814 and then, after being attacked, fled into Florida. The instructions given Jackson were vague, apparently purposely so, and it was well known in Washington that Jackson still believed that the United States should occupy Florida. As was to be expected, Jackson invaded Florida. He captured two Spanish posts, executed two British subjects who were accused of aiding the Indians, and before returning to the United States appointed one of his subordinates military governor of Florida. These bold actions brought an immediate and sharp protest from Spain and precipitated a cabinet crisis in Washington. The staunch defense of Jackson by Secretary of State John Quincy Adams, both in the cabinet and in a note to Spain, saved Jackson from censure and hastened the acquisition of Florida by the United States.

Presidential Prospects.—Jackson's military triumphs led to suggestions that he become a candidate for president, the earliest of these proposals coming soon after the battle of New Orleans. The aggressive conduct of Jackson in Florida in defense of what he conceived to be the national interest revived discussion of his possible candidacy for high office. Jackson disavowed any interest in seeking the presidency and political leaders in Washington assumed that the flurry of support for Jackson would prove transitory. The campaign to make him president, however, was kept alive by his continued popularity and was carefully nursed by a small group of his friends in Nashville, who combined devotion to the general with a high degree of political astuteness. In 1822 these friends maneuvered the Tennessee legislature into a formal nomination of their hero as a candidate for president. In the following year this same group successfully placed pressure upon the legislature to elect him to the United States senate—a gesture designed to demonstrate the extent of his popularity in his home state. By Dec. 1823 when he reached Washington to assume his new duties, Jackson had become an open and formidable contender for the presidency.

In the election of 1824 four candidates received electoral votes. Jackson received the highest number (99), the other three being John Quincy Adams (84), William H. Crawford (41) and Henry Clay (37). As no one had a majority of the electoral votes, the house of representatives was required to elect a president from the three with the highest number of votes. Crawford was critically ill and the actual choice was between Jackson and Adams. Clay, who was speaker of the house, was in a strategic and perhaps decisive position to determine the outcome. Adams was elected on the first ballot (Feb. 9, 1825). When he appointed Clay secretary of state—then regarded as the second most powerful office in the government—it seemed to admirers of Jackson to confirm rumours of a "corrupt bargain" between Adams and Clay. Jackson had long detested Clay but had hitherto admired Adams. His friends persuaded him that the popular will had been thwarted by intrigues, and he thereupon determined to vindicate himself and his supporters by becoming a candidate again in 1828.

Election of 1828.—The campaign to elect Jackson president was resumed almost as soon as Adams took office. The circumstances under which Adams had been elected did not augur well for the success of his administration; skillful politicians flocked to the support of Jackson, whom they recognized as the man of the future, and the efforts of Adams to provide leadership were frustrated by factional opposition. In 1828 Jackson defeated Adams by an electoral vote of 178 to 83 after a campaign in which personalities and slander played a larger part than in any previous national election in the history of the United States. But Jackson's hour of triumph was soon overshadowed by personal tragedy. During the campaign his opponents had resurrected the charges that his marriage had been irregular and this may have hastened

a decline in his wife's health. Worn-out and defeated in her long effort to avoid the glare of public life, Mrs. Jackson died at the Hermitage on Dec. 22, 1828.

"Jacksonian Democracy."--The election of 1828 is commonly regarded as a turning point in the political history of the United States. Jackson was the first president from west of the Appalachians, but it was at least equally significant that the initiative in launching his candidacy and much of the leadership in the organization of his campaign came also from the west. The victory of Jackson was evidence of a westward movement of the centre of political power. He was also the first man to be elected president through a direct appeal to the mass of the voters rather than through the support of a recognized political organization. His victory nas regarded by contemporaries and by historians as the triumph of political democracy, and the political movement of which he was the central figure is commonly described as the "Jacksonian Democracy."

Jackson was, however, more the beneficiary than the molder of the rising tide of democratic sentiment which was evident in nearly every part of the United States. Between 1815 and the election of 1828, six new states were admitted to the union, and five of these had manhood suffrage. In the same years, four of the older states revised their constitutions, three making provisions for a substantial extension of the suffrage. This trend toward greater political democracy weakened the power of the older political organizations and opened the way for the rise of new political leaders who were sympathetic with the new democracy and skilled in appealing to the mass of voters. This was notably true in New York where Martin Van Buren, after 1824 a supporter of Jackson, became the dominant political figure. It was the new political leadership, thrust forward by the spread of democracy, that furnished much of the momentum which carried key eastern states for Jackson in 1828.

Not the least remarkable triumph of the Jacksonian organization was its success in picturing its candidate as the embodiment of democracy. Jackson had been aligned with the conservative faction in Tennessee politics for 30 years. and in the financial crisis which swept the west after 1819 he had vigorously opposed legislation for the relief of debtors. He had risen to a position of eminence and by contemporary standards in the west had acquired moderate wealth. In terms of personal qualities, however, he was well cast in the role of the champion of democracy. He had been born on the frontier and had risen to fame as the defender of the frontier against its traditional enemies—the Indians, the British and the Spanish. He was a man of limited education and no pretence to inherited social position. He was the epitome of the self-made man, the ideal admired by hundreds of thousands of his fellow citizens and one which they hoped to emulate. In view of these personal qualities, his conservatism in Tennessee politics was ignored and he was accepted by both friend and foe as the appropriate champion of the new democracy.

Jackson's Personal Qualifications for Office.—As the victory of Jackson reflected the emergence of new forces in U.S. politics so Jackson himself brought to the presidency a new set of personal qualifications nhich were to become the standard by which presidential candidates would be judged for the remainder of the 19th century. He was the first president since Washington who had not served a long apprenticeship in public life and had no personal experience in the formulation or conduct of foreign policy. His brief periods of service in congress provided no clue to his stand on the public issues of the day. except perhaps on the tariff. Even there, those who sought to know his stand had to rely on inferences draan from casual statements, such as his assertion that he favoured a "judicious" tariff or that manufactures "properly fostered and protected" were an important asset in the defense of the nation.

There is no evidence that either Jackson or the voters who supported him were disturbed by this absence of any clear guide to his political philosophy. Jackson approached the problems of the presidency as he had approached all other problems in life. He met each issue as it arose, and in the White House he exhibited the same vigour and determination in carrying out decisions which had characterized his conduct as commander of an army in the field. He made it clear from the outset that he would be the master of his own administration, and at times he was so strong-willed and decisive that his enemies referred to him as "King Andrew I" and to his administration as the "reign" of Andrew Jackson. Strong leadership did not guarantee consistency in planning a comprehensive policy. In retrospect, certain fundamental principles which affected his decisions may be discerned, among which were the maintenance of the strength and honour of the union, a distrust of inflation and of paper money, and a conviction that concentrations of power, and particularly of "moneyed power," were dangerous. His practice of acting upon each question as he met it often made it difficult for even his friends to predict the decisions he would make; and on at least one major issue—that of states' rights—his actions on successive problems in which this principle was involved were clearly inconsistent.

In the presidency as in private life Jackson was often influenced by personal feelings, but with advancing years and greater responsibilities he appeared much less impetuous than he had earlier. When the requirements of public policy dictated a forgiveness of former enemies, he was capable of seeking a reconciliation with them. His basis for judging the character of others, however, remained remarkably simple. Those who supported him were his friends; generally, though not universally, those who opposed him were not to be trusted.

The First Term Begins.—When Jackson was inaugurated on March 4, 1829, it was the first time in more than a quarter of a century that the advent of a new president reflected the repudiation of his predecessor. Hundreds who had worked for the election of Jackson hoped this would mean that incumbent officeholders would be replaced by friends of the new president. Jackson and his friends were besieged by office seekers, and within a few weeks the process of removing opponents of Jackson to make way for supporters had begun. Some years later, William L. Marcy defended the principle of "rotation of office" with the aphorism, "To the victors belong the spoils." Critics of Jackson charged that this was the whole motive for the removal of civil servants who had long been employed in federal offices. It is certainly true that among Jackson's closest advisers there were skilled politicians, anxious to build a strong party by attaching the interest of his political friends to the administration through officeholding. Rotation in office, however, did not begin with Jackson. It was an accepted procedure in many states, and Jefferson had set the example by removing a number of unfriendly officeholders after he became president in 1801. Nor did Jackson utilize this practice so extensively as was charged. In eight years as president, Jackson removed fewer than one-fifth of all federal officeholders.

Jackson was in poor health when he became president, and few believed that he would have the strength or inclination to seek a second term. The question of the succession was therefore certain to attract early attention. One obvious candidate was Vice-Pres. John C. Calhoun, from Jackson's native state of South Carolina. Another contender was Martin Van Buren, Jackson's first secretary of state. The harmony of the new administration was threatened by the rivalry between these two men; it was shattered as a result of a social crisis caused by the refusal of Mrs. Calhoun and most of the cabinet wives to associate with Margaret O'Neill Eaton (*q.v.*), the wife of the secretary of war, John H. Eaton. Jackson and Eaton had been close friends for years, and the president was convinced that Mrs. Eaton, like his own wife, was the victim of gossip. Van Buren, also a widower, was conspicuous by his cordiality to the Eatons and thus gained in the confidence of the president. The breach between Jackson and Calhoun became irreparable in 1830 when Jackson learned that Calhoun had favoured a censure of Jackson in the cabinet debates of 1818 over the invasion of Florida. With Calhoun completely discredited in the judgment of Jackson, Van Buren became the probable successor to the presidency.

Threats to Federal Authority.— The feud between Jackson and Calhoun, which began over personal issues, became of crucial importance in national policy in 1830 when Calhoun openly espoused the cause of South Carolina in its opposition to a high pro-

tective tariff. Feeling in South Carolina was so intense that there were covert threats that the state would attempt to prevent collection of the tariff within the state. This danger was quickly recognized by the advisers of Jackson; to make his own position clear, Jackson used the occasion of a Jefferson Day dinner (April 13, 1830) to offer the toast, "Our federal union, it must be preserved." When Calhoun followed with a toast to liberty and states' rights, the position of the two antagonists was clear. The situation drifted until 1832, when congressional leaders sought a compromise in the form of a moderate reduction of the tariff. South Carolina was not satisfied, and in reply adopted a resolution declaring the tariff of 1832 null and void and prohibiting its enforcement within its borders. Jackson accepted the challenge, denounced the theory of nullification, and asked congress for authority to send troops into South Carolina to enforce the law. The president believed the tariff to be too high, however, and urged congress to reduce the new rates. In March 1833 congress both granted the authority which he had requested and reduced the offending tariff. Public opinion outside South Carolina appeared to back the president, and South Carolina withdrew its offending resolution but declared Jackson's Force act null and void. There can be little doubt that the vehemence with which Jackson met this threat to federal supremacy was prompted, in part, by his dislike of Calhoun, but personalities alone do not explain the position of either man. Jackson was devoted to the union, Calhoun to South Carolina.

Whatever the motives, Jackson had preserved the integrity of the union against the most serious threat it had yet faced. In contrast, he was remarkably complacent when Georgia defied the federal government. In 1829, Georgia extended its jurisdiction to about 9,000,000 ac. of land within its boundaries but still occupied by Indians, whose title to the land had been guaranteed by treaty between them and the United States. The Indians appealed to the federal courts, and Jackson was on the horns of a dilemma. He did not wish to condone defiance of federal authority but his sympathies were with Georgia and he held the frontier view that the removal of the Indians was inevitable. Jackson intervened to bring pressure on the Indians to accept lands west of the Mississippi in lieu of those they were asked to abandon, but in this he was only partly succcessful. The supreme court, in two separate cases, ruled against Georgia, but when Jackson refused to use force to compel Georgia to obey those rulings the Indians capitulated and moved westward. The president appeared to have condoned in Georgia a defiance of federal authority which he had condemned in South Carolina. It is possible that personal antipathy influenced Jackson, for it was well known that he disliked Chief Justice John Marshall. It is also true that he was convinced it would be futile to attempt to protect the Indians against the inevitable march of the frontier.

Election of **1832** and the Bank issue.—In the meantime, Jackson acquiesced in the pressure of friends to seek a second term as president. As the election of 1832 approached, a new issue mas introduced by Jackson's opponents with the hope of embarrassing him. The charter of the Bank of the United States was due to expire in 1836. The president had not clearly defined his position respecting the bank, but there was growing evidence that he was uneasy about the bank as then organized. More significant in an election year was the iact that large blocs of voters who favoured Jackson were openly hostile to the bank. In the summer of 1832, Jackson's opponents rushed through congress a bill to recharter the bank, thus forcing Jackson either to sign the measure and alienate many of his supporters or to veto it and appear as a foe of sound banking. Jackson's cabinet was divided between friends and critics of the bank but the obviously political motives of the recharter bill reconciled all of them to the necessity of a veto. The question before Jackson actually was whether the veto message should leave the door open to future compromise.

Few presidential vetoes have caused as much controversy in their own time or later as the one Jackson sent to congress on July 10, 1832. It was a long document of more than 7,000 words. Much of it was devoted to the argument that the bill was premature or was directed to certain details in the legal status of the bank. At the opening of the message and again near the end, Jackson conceded the value of a national bank, "so organized as not to infringe on our delegated powers or the reserved rights of the states." Judged by comments made prior to the introduction of this bill in congress, there were many friends of the bank who could have agreed with a large part of the veto message. Portions of the message, however, took more controversial ground. Jackson began with the charge that the stockholders would gain a windfall of $7,000,000 through increased value of their stock if the bill became law. In a closing paragraph, he revealed the basic cause for his opposition to the existing bank, asserting that "the rich and powerful too often bend the acts of government to their selfish purpose." In a sentence he had summarized and accepted the widespread fear of the growth of a "moneyed power" which, if unchecked, would in time be able to dictate to the government itself.

As was anticipated, the veto was upheld in the senate. Political opponents of Jackson rejoiced that he had given them an issue, and the conservative press, seldom restrained in its attacks on the president, showered him with abuse. The mass of the people, however, rallied behind Jackson. In November he was re-elected by an even more decisive margin than in 1828.

Subsequent Financial Policy.—The veto of the bill to recharter the bank was the prelude to a conflict over financial policy which continued through Jackson's second term. After the reelection of Jackson, Nicholas Biddle, president of the bank, initiated a policy of calling in loans and contracting the volume of notes issued by the bank, ostensibly because it was necessary to prepare for the time when the charter would expire. Jackson and his associates were convinced that Biddle was seeking to create a panic in order to force congress to recharter the bank. The administration met this threat by refusing to deposit funds of the federal government in the bank, an action which Jackson believed would minimize any effort by the bank to control the volume of bank notes in circulation. Friends of the bank countered with congressional resolutions affirming belief in the solvency of the bank and censuring Jackson; but these had no other effect than to persuade Jackson that Biddle was using political influence to preserve the bank.

Beginning in the autumn of 1833, federal funds were deposited in selected banks in various parts of the country. The banks thus selected had been investigated for assurance that they were well managed, but critics immediately described them as "pet banks." It was in keeping with the spirit of the times that funds should be placed with bankers who had been politically friendly to the administration. The country was already on the threshold of an inflationary era when the "bank war" began; the dispersion of government funds throughout the country gave a further stimulus to this inflationary trend.

In the meantime, Jackson and his advisers had developed a theory of business cycles, in which paper money was the villain which caused alternate periods of inflation and depression. If the circulation of paper could be restricted and the proportion of gold and silver to paper increased, the cycle could be brought under some measure of control. Wage earners and those with fixed incomes would then receive some protection against periodic disaster. These were the very groups which, Jackson believed, usually were not adequately represented in the government and whose champion he should be.

Efforts to persuade congress to enact legislation limiting the circulation of bank notes failed, but there was one critical point at which Jackson was free to apply his theories. Nearly all purchasers of public lands paid with bank notes, many of which had to be discounted because of doubts as to the continuing solvency of the banks which issued them. Partly to protect federal revenues against loss and partly to advance his concept of a sound currency, Jackson issued the Specie Circular (July 11, 1836), requiring payment in gold or silver for all public lands. This measure created a demand for specie which many of the banks could not meet; the effect of bank failures in the west spread to the east, and in the spring of 1837 the entire country was gripped by a financial panic. However, the panic did not come until after Jackson had had the pleasure of seeing Van Buren inaugurated as president on March 4, 1837.

Jackson's Influence on **U.S.** Politics.—Jackson retired from office more popular than when he entered. The widespread approval of his actions exercised a profound effect on the character of U.S. politics for half a century. The success of Jackson appeared to be a vindication of the new democracy. Powerful voices still questioned the wisdom and even the morality of democracy in 1829; there were few who would question it openly in 1837. Jackson had likewise established a pattern which future candidates for the presidency attempted to imitate. Birth in humble circumstances, experience on the frontier, evidence of being close to the mass of the people, a devotion to democracy, and if possible, some military exploits were all valuable assets for any candidate who hoped to succeed.

The intensity of the political struggles from 1825 to 1837 led to the revival of the two-party system, which had been in abeyance since 1817. Jackson never thought of himself as a master politician, but he and his associates proved themselves the most skillful political leaders of that generation. When Jackson was elected president in 1828 he was the candidate of a faction rather than of a party. When he retired from the presidency he left a vigorous and well-organized Democratic party as one of his legacies to the future. His opponents were less well organized; in the elections of 1832 and 1836 they were more a coalition than a party. It was clear, however, that if they were to prevail they must have an organization and by 1840 they had been transformed into the Whig party. The two-party system has ever since been one of the accepted features of U.S. politics.

Later Years.—Upon leaving the presidency, Jackson retired to his home, the Hermitage. He was virtually an invalid during the remaining eight years of his life, but he continued to have a lively interest in public affairs. Friends of earlier years, party leaders and aspiring young men made the Hermitage a mecca where they hoped to renew friendships or to receive the counsel and blessings of the former president. His last years, however, were generally uneventful, and he died at the Hermitage on June 8, 1845.

BIBLIOGRAPHY.—The standard biographies of Jackson are J. S. Bassett, *The Life of Andrew Jackson,* 2 vol. (1911), rev. ed. (1916), 2 vol. in 1 (1931); and a two-volume work by Marquis James, with separate titles. *Andrew Jackson: the Border Captain* (1933) and *Andrew Jackson: Portrait of a President* (1937). Two particularly thoughtful and provocative evaluations of the influence of Jackson and of the forces which sustained him in power are Arthur M. Schlesinger, Jr., *The Age of Jackson* (1945), and Marvin Meyers, *The Jacksonian Persuasion* (1957). *See* also Glyndon G. Van Deusen, *The Jacksonian Era, 1828–1848* (1959), in the "New American Nation Series," and Leonard D. White, *The Jacksonians: a Study in Administrative History, 1829–1861* (1954). (H. W. BY)

JACKSON, CYRIL (1746–1819), dean of Christ Church, Oxford, was born in Yorkshire, and educated at Westminster and Oxford.

From 1771 to 1776 he was subpreceptor to the two eldest sons of George III. He then took holy orders, and after holding (1779–83) the preachership at Lincoln's Inn, became dean of Christ Church. In this position he showed a genius for government, and maintained a strict discipline. He had a large share in the framing of the Public Examinations statute (1802) and alnays encouraged his pupils to compete for scholarships.

In 1799 he refused the offer of the bishopric of Oxford, and in 1800 the primacy of Ireland, preferring to remain at his college. where many afterward famous men studied under him, including Canning and Sir Robert Peel, whom he is reported to have advised to "work like a tiger." Jackson resigned his deanery in 1809, and retired to Felpham, near Bognor, where he died on Aug. 31, 1819.

JACKSON, FREDERICK GEORGE (1860–1938), British arctic explorer who led the Jackson-Harmsworth expedition of 1894–97 to Franz Josef Land. was born at Alcester, Warwickshire. on March 6, 1860, and was educated at Edinburgh university. His first arctic voyage was a whaling cruise in 1886. In 1893–94, to gain experience and to test equipment for the projected Franz Josef expedition, he sledged across 3,000 mi. of Siberian tundra from the Kara sea westward to the White sea and through Lapland to Kirkenes in north Norway. He set out for Franz Josef Land only a few months after finishing this journey. In *The Great Frozen Land* (1895) he describes his Siberian trip, not without humour. *A Thousand Days in the Arctic* (2 vol., 1899) is an account of the Jackson-Harmsmorth expedition, and records the many scientific observations made. Jackson served in the South African War and in World War I, and later explored in central Africa. He died in London on March 13, 1938.

JACKSON, HELEN (MARIA) HUNT (1831–1885), U.S. poet and novelist best known for *Ramona,* was born in Amherst, Mass., Oct. 18, 1831, the daughter of Nathan Fiske, a professor at Amherst college. After the tragic deaths of her first husband, Capt. Edward Hunt, and her two sons, she turned to writing. She married William Jackson in 1875. A prolific writer, she is remembered primarily for her efforts on behalf of the American Indians. *A Century of Dishonor* (1881) arraigned government Indian policy, and the novel *Ramona* (1884) depicted the injustices suffered by the mission Indians. *Ramona* aroused public sentiment for improving the conditions described, but has been admired chiefly for its romantic picture of old California. She died in San Francisco, Aug. 12, 1885.

BIBLIOGRAPHY.—"Helen Jackson ('H. H.')" in T. W. Higginson, *Contemporaries* (1899); G. W. James, *Through Ramona's Country* (1908); C. C. Davis and W. A. Alderson, *The True Story of "Ramona"* (1914).

JACKSON, JOHN HUGHLINGS (1835–1911), English neurologist who excelled in the observation and minute description of neurological phenomena, was born at Green Hammerton, Yorkshire, on April 4. 1835. He worked mostly in London, being appointed to the National hospital, Queen square, in 1862 and to the London hospital in 1863. His physiological and philosophical interpretations of his findings illuminated the problems of mental and nervous diseases and provided the foundation for much modern research upon the nervous system. In his own day he was known chiefly for his work on language disorders (aphasia). From Jackson's studies on epilepsy and especially "convulsions starting unilaterally" (Jacksonian fit) were developed the modern methods of clinical localization of lesions of the nervous system and, less certainly, the experimental investigation of localization of functions. Jackson's definition (1873) of epilepsy as "a sudden, excessive and rapid discharge" of brain cells has never been bettered and is fully confirmed by electroencephalography. From the wide range of clinical manifestations of epilepsy (positive) and paralysis (negative), he concluded that sensation and movements are represented in the nervous system at several levels of complexity. He was among the first to proclaim that abnormal mental states might result from structural brain damage. In 1878 Jackson was elected a fellow of the Royal society. He died in London on Oct. 7, 1911.

His more important writings are collected in *Selected Writings of John Hughlings Jackson,* edited by James Taylor (1931). (W. GY.)

JACKSON, SHELDON (1834–1909), U.S. Presbyterian minister and educator, generally regarded as the foremost apostle of Presbyterianism in America, was born at Minaville, N.Y., on May 18, 1834, the son of Samuel Clinton and Delia (Sheldon) Jackson. Educated at Union college, Schenectady, N.Y., and Princeton seminary, he was ordained by the Albany presbytery following his graduation in 1858.

After a year among the Choctaws (Indian Territory), Jackson shattered all records as a missionary superintendent by founding (1859–83) over 100 churches in Minnesota, Wisconsin, Iowa, Nebraska, Wyoming, Montana, Colorado, Utah, Idaho and Nevada, besides opening native schools in New Mexico and Arizona. Yet his greatest work was performed after 1883 in Alaska where, in addition to organizing churches and schools, he developed an important and much-needed food resource by introducing domesticated reindeer from Siberia. As general agent of education in Alaska (1885–1908) he was instrumental in laying foundations for Alaska's eventual admission into the union. Jackson mas elected moderator of the general assembly in 1897. He died on May 2, 1909.

BIBLIOGRAPHY.—The Sheldon Jackson Papers (manuscripts) are in the Department of History, United Presbyterian Church in the U.S.A., Philadelphia, Pa. *See* also Sheldon Jackson, *Alaska, and Mis-*

sions on the North Pacific Coast (1880); Robert Laird Stewart, *Sheldon Jackson: Pathfinder and Prospector of the Missionary Vanguard in the Rocky Mountains and Alaska,* 2nd ed. (1908); Clifford M. Drury, *Presbyterian Panorama* (1952). (F. *I.* Ks.)

JACKSON, THOMAS JONATHAN (STONEWALL) (1824–1863), outstanding Confederate general of the American Civil War, was born at Clarksburg. Va. (now W. Va), on Jan. 21, 1824 The early death of his father, who left little support for the family. folloned by the death of his mother shortly after a second marriage, left the son to grow up in the homes of relatives. He had little opportunity for formal education in his early years but received an appointment to the U.S. Military academy at West Point in 1842. After a slow start he graduated 14th in his class and was commissioned as a second lieutenant of artillery. He joined his regiment in Mexico, where the United States was then at mar and soon showed some of the qualities of resourcefulness, coolness and bravery in action for which he was later to become famous.

Finding service in the peacetime army tedious and unrewarding, he became professor of artillery tactics and natural philosophy at the Virginia Military institute in 1851 and resigned his commission. Jackson worked hard but never became a popular or highly successful teacher; he won a reputation for eccentricity that folloued him to the end of his career. In the ten years at V.M.I. he experienced the death of his first wife, Eleanor, daughter of the Rev. George Junkin, president of Washington college, and three years later married Mary Anna Morrison. daughter of a North Carolina minister. Meanwhile he had taken a trip to Europe, become more deeply religious and allied himself with the Presbyterian church. His strong sense of duty and moral righteousness. coupled with great devotion to the cause in which he was engaged, earned for him the derisive title "Deacon Jackson" and comparison with Oliver Cromwell.

On the outbreak of the Civil War he offered his services to his state of Virginia and was ordered to bring his cadets to Richmond. He shortly became a colonel of volunteers in the Confederate army and rapidly gained fame and promotion. His untimely death only tno years later cut him down at the height of an increasingly successful career, leaving unanswered the question of his capacity for independent command which his rapid rise suggests he might have achieved. That he was the ablest of Gen Robert E. Lee's generals is rarely questioned. The qualities of the two generals complemented each other, and Jackson obeyed and co-operated most effectively. In him were combined a deep religious fervour and a fiercely aggressive fighting spirit. He was a stern disciplinarian, but his subordinates and men trusted him and fought well under his leadership He was a master of rapid movement and surprise tactics. His intentions were so veiled in secrecy that often his own officers did not fully know his plans until ordered to execute them.

Jackson's first assignment in the Confederate cause was the small command at Harpers Ferry, where the Shenandoah river flons into the Potomac, which he was to fortify and hold if possible. When Gen. Joseph E. Johnston (q *v.*) took over the Confederate forces in the valley, nith Jackson commanding one of the brigades, he withdrew to a more defensible position at Winchester.

In July 1861 the Federal invasion of Virginia began and Jackson's brigade moved with others of Johnston's army to unite with Gen. P. G. Beauregard on the field of Bull Run (*q.v.;* battle of Manassas) in time to meet the advance of Gen. Irvin McDowell's Union army and nin for himself the famous "Stonewall" title. The spring of 1862 found him again in the Shenandoah valley where his diversionary tactics prevented reinforcements being sent to Gen. George B. McClellan in the peninsula campaign against Richmond and possibly accounted for its failure. Lee, who had assumed command of the army of northern Virginia, threatened Washington by sending reinforcements to Jackson in the valley, which thus became a veritable cannon pointed at Washington. By rapid movement he met several Federal forces and defeated them separately. In April he struck in the mountains of western Virginia, then on May 24–25 turned on Gen. N. P. Banks and drove him out of Winchester and back on the Potomac. He then as quickly turned his attention to the southern end of the valley, defeating the Federals at Cross Keys on June 8, and at Port Republic on the next day. Lee then brought Jackson by road and railroad to Richmond to envelop the right wing of McClellan's army. Jackson arrived a day late and lost some of his reputation for effectiveness, possibly because of lack of experience in such a large-scale action, but McClellan was beaten back and was ordered to evacuate the peninsula.

Lee at once joined Jackson against Federal forces regrouping under Gen. John Pope (*q.v.*). He sent Jackson by a wide encircling movement to attack Pope's rear and bring on the second battle of Bull Run in which Pope was soundly beaten. Lee next crossed the Potomac for the "liberation" of Maryland. To protect Richmond he detached Jackson to capture Harpers Ferry, which he did in time (Sept. 13–15) to rejoin Lee at Antietam. After his return to Virginia, Lee divided his army into two corps, Gen. James Longstreet commanding the 1st and Jackson, now a lieutenant general, the 2nd. At Fredericksburg, Va., in December, Jackson was in command of the Confederate right when Gen. A. E. Burnside's rash attack was easily repulsed.

In April, Gen. Joseph Hooker, Burnside's successor, attempted to turn the Confederate position on the Rappahannock. There the seemingly invincible team of Lee and Jackson made its boldest move. Leaving a small detachment to meet the Federals on the Rappahannock. Lee moved his main body, including Jackson's corps, to meet Hooker's threatened envelopment in the woods of Chancellorsville. He then divided his army again, keeping only 10,000 men to demonstrate against Hooker's front, and he sent Jackson with his whole corps to move secretly around Hooker's right. The maneuver nas completely successful. On the evening of May 2, Jackson rolled up the flank of the unsuspecting Federals. Then, in the moment of victory, tragedy struck. Jackson, aho had ridden forward to organize the pursuit, was shot down in the dusk by his own men and mortally wounded. He died on May 10 and his place was never filled. Lee had indeed lost his right arm. *See* also AMERICAN CIVIL WAR.

BIBLIOGRAPHY.—G. F. R. Henderson, *Stonewall Jackson and the American Civil War* (1919); M. A. Jackson, *Memoirs of Stonewall Jackson* (1895); R. L. Dabney, *Life and Campaigns of T. J. Jackson (Stonewall Jackson)* (1866); W. Allan, *Jackson's Valley Campaigns* (1880); *A.* Tate, *Stonewall Jackson, the Good Soldier* (1928); Burke Davis, *They Called Him Stonewall* (1954); *H.* K. Douglas, I *Rode With Stonewall* (1957); F. E. Vandiver, *The Mighty Stonewall* (1957). (C. W. TE.)

JACKSON, WILLIAM (1730–1803), English musician. was born at Exeter on May 29, 1730. He published many norks during his lifetime, the most famous of which was *Twelve Songs* (1755), which deserved its great popularity. But he is remembered only for his *Te Deum* (Jackson in F), which was a popular favourite in church music for more than a century. Jackson died at Exeter on July 5, 1803.

JACKSON, a city of Michigan. U.S., on the Grand river, 37 mi. S. of Lansing and 73 mi. W. of Detroit; the seat of Jackson county. Population (1960) city 50,720; standard metropolitan statistical area (Jackson county) 131.994. (For comparative population figures *see* table in *MICHIGAN* : *Population.)*

The site of Jackson was crossed by nine Indian trails, including the famous St. Joseph trail. Settlement began in 1829, the village being called Jacksonburgh after Andrew Jackson; the name was changed to Jacksonopolis and finally to Jackson in 1833. It mas chartered as a city in 1857 and in 1915 adopted a commission-manager form of government. The Republican party nas organized at a mass meeting "under the oaks" in Jackson on July 6. 1854.

The growth of Jackson was spurred by the automotive industry. At one time the Hayes Wheel company produced 75% of the wood wheels made for automobiles. In the latter part of the 20th century the more than 200 industrial firms in the Jackson area manufactured, among other products, automotive parts, tires, brakes, garments, toys. lawn moners, water heaters, grinding wheels, candy, air conditioning equipment, aircraft parts. extracts and flavouring. The New York Central railway has diesel light repair shops and its headquarters for all off-track equipment

maintenance in Jackson. The general offices of the Consumers Power company, which provides electric and gas service for much of the state of Michigan, are located in the city.

The State Prison of Southern Michigan, one of the largest walled prisons in the world, is 5 mi. N. of the city. Jackson junior college, a community college. was established in 1928. Jackson is the home of the Illuminated cascades, man-made waterfalls located in the Sparks Foundation park, that annually attracts thousands of visitors throughout the summer.

(J. B. DA.)

JACKSON, the capital of Mississippi, U.S., and one of the two seats of Hinds county, is on the Pearl river about 35 mi. S.W. of the centre of the state. Pop. (1960) city, 144,422; standard metropolitan statistical area (which includes all of Hinds county) 187,045. (For comparative population figures see table in MISSISSIPPI: *Population.*)

The city was named for Andrew Jackson, who had been instrumental in negotiating with the Choctaw Indians for the portion of Mississippi where the capital came to be located. Originally a trading post known as LeFleur's Bluff, the site was picked in 1821 by a special commission appointed by the legislature. It was laid out in 1822 by Peter A. Van Dorn, using a plan of Thomas Jefferson, a checkerboard arrangement with alternate squares designated as parks or greens. These spots were reserved for churches, a cemetery and public buildings. The legislature began to meet in Jackson in 1822. In the 1830s two of the state's best architectural treasures were constructed, the governor's mansion and the old capitol, now a state historical museum.

The city was chartered in 1823 but it mas 1833 before a city government was set up. At first there was a board of five selectmen; then in 1839, a mayor and six aldermen were authorized; finally in 1912 the city adopted a commission form of government: The city hall, a beautiful Ionic structure, dates from 1353.

During the American Civil War, Jackson was captured by Gen. Ulysses S. Grant on May 14, 1863, and many of its buildings were burned. After the war. Jackson recovered slowly. and did not begin to emerge as the state's leading city until the 20th century. Because of excellent advantages as a railroad junction and the discovery of natural gas in the late 1920s, Jackson recovered rapidly from the depression years. During and after World War II its growth was phenomenal. Formerly a white-collar city, it began to attract industries but wisely avoided the evil of industrial slums; its wide streets bordered with crepe myrtle, its modern skyscrapers and its smoke-free air give it the clean and spacious appearance of a western city. Much of the population increase was the result of an influx of people from the surrounding countryside. In the 1950s about 45% of the population was Negro. Major industrial items are glass. tile, cans, textiles, electronic equipment and meat and dairy products.

Jackson's educational facilities include Millsaps college, a Methodist institution founded in 1891; Belhaven, a Presbyterian college founded in 1894; Campbell college, a junior college founded in 1890 and controlled by the African Methodist Episcopal Church; the Jackson School of Law, private, founded 1930; Jackson State college, founded 1877; and a school of medicine. a department of nursing and an evening division of the University of Mississippi. The city has two major city libraries, a municipal art gallery, a little theatre, an opera guild and a symphony orchestra. More than 850 ac. of city parks are supplemented by the nearby Satchez Trace parkway. (J. K. B.)

JACKSON, a city of western Tennessee, U.S., seat of Madison county, is 85 mi. S.E. of Memphis. Settled in the early 1820s as a river town on the Forked Deer, it soon became an inland cotton centre. Its economy in the 20th century is based on agriculture, trades and services, and industries producing textiles, store, church and office furniture, barrel staves, hardwood lumber, toys, batteries, offset printing plates, food products and aluminum foil.

Jackson has three 4-year coeducational colleges: Union university, established in 1825 and controlled by the Tennessee Baptist association; Lambuth college, a Methodist institution founded in 1843; and Lane college, founded in 1882 and controlled by the Colored Methodist Episcopal Church. Health facilities include two hospitals, a speech and hearing clinic, a mental health clinic, several private clinics and a central blood bank.

Originally known as Alexandria, Jackson mas given its present name on Aug. 17, 1823, in honour of Andrew Jackson, the uncle of the founding fathers. Among the town's famous citizens were the railroad presidents, Milton Brown and Isaac Tigrett; Adam Huntsman, who defeated David Crockett so badly that Crockett is said to have told his constituents that they could go to hell but he was going to Texas; John Luther "Casey" Jones, the famed railroad engineer. Incorporated as a city in 1845. Jackson uses Tennessce Valley authority power. For comparative population figures see table in TENNESSEE: *Population.* (E. I. WI.)

JACKSONVILLE, a city of extreme northeastern Florida, U.S., and the seat of Duval county. Pop. (1960) city 201,030; standard metropolitan statistical area (Duval county) 455,411. Located on the St. Johns river, 15 mi. from the Atlantic ocean, 22 mi. from the Georgia line and 350 mi. from Miami. The deep-water port of entry and its situation at the hub of federal and state highways, trunk-line railroads, commercial airlines, and motor bus and truck carrier routes have made the city one of the foremost distributing and manufacturing centres of southeastern Cnited States. The importance of the port has attracted many foreign and domestic vessels which support three major shipyards and make the city an important Atlantic harbour. The city has a virtual monopoly on domestic distribution throughout Florida and 75 counties in southern Georgia and South Carolina.

hfuch of the industrial activity of the area involves the transformation of raw materials into finished products. These industries include food and kindred products, transportation equipment, printing and publishing, lumber and paper products, machinery and tobacco products. Because of its location the city has been chosen as the state and regional headquarters of many national businesses; it is the financial centre of the state, its financial and banking institutions including a branch of the Federal Reserve bank. After the passage of favourable insurance tax laws in 1953, several home or regional offices of national insurance companies were established in the city.

In 1940 the U.S. navy commissioned the Jacksonville naval air station at Yukon on the west bank of the St. Johns river, 12 mi. S. of the city. Later, the navy commissioned Cecil field, an auxiliary air station 10 mi. W. of the city. During this time an aircraft carrier base and auxiliary air station were constructed at hlayport, just inside the St. Johns river jetties at the Atlantic ocean. A destroyer base was added to the other facilities at Mayport. Many thousands of aircraft pilots and air crewmen were trzined in the Jacksonville area during World War II and these installations continue to be an important segment in the national defense.

In 1957 the city floated a $30,000,000 bond issue to finance a 15-story city hall, auditorium, sports coliseum, sewage construction and treatment plant, and street improvement and drainage program. The Jacksonville expressway authority supervises a $100,000.000 system of motor traffic freeways through the city.

Jacksonville is also a tourist centre? its attractions including sports activities in the Gator bowl, pari-mutuel dog racing and the beaches. The Jacksonville beaches are five'adjacent communities: Atlantic beach, Neptune beach, Jacksonville beach and Ponte Vedra on the ocean and Mayport on the St. johns river. Lying 16 mi. E. of the city, the beaches ofier water sports and driving on a strand 600 ft. wide at low tide.

The first European settlement in Florida was made at the site of the Fort Caroline National monument, 10 mi. E. of the city on the St. Johns river, by the French in 1564. Later, the Spanish placed a small fort within the present limits of the city, which during the English period (1763–83) was called Comford. After U.S. acquisition in 1821, the settlement was named for the first governor. Andrew Jackson. (J. E. D.)

JACKSONVILLE, a city of west central Illinois, U.S., the seat of Morgan county. is 35 mi. W. of Springfield and 85 mi. N. of St. Louis, Mo. Plotted in 1825, and named in honour of Andrew Jackson, the town soon acquired a distinctive educational character which it has to a large degree retained. The establish-

ment of Illinois college in 1829, the first in the state, brought a large group of New Englanders into an area predominantly southern in outlook; the first president was Edward Beecher, brother of Henry Ward Beecher. Other educational institutions were soon started: the Jacksonville Female academy (1830) and the Athenaeum (1864); both later became part of Illinois college, which is affiliated with the Presbyterian and Congregational-Christian Churches. The Illinois Conference Female academy (1846) later became MacMurray College for Women and in 1957 began a co-ordinate college for men; the institutions are controlled by the Methodist Church. The Illinois School for the Deaf. the Illinois Braille and Sight Saving school and the Jacksonville State hospital are also located in the city. While Jacksonville serves as the trading centre for a rich agricultural area, manufacturing has also developed, chiefly in the fabrication of men's clothing, the processing of vegetable oils and plastics; a ferris wheel factory is also there. For comparative population figures see table in ILLINOIS: *Population.* (E. G. HI.)

JACKSTONES (KNUCKLEBONES), also called Jacks or Dibs, a game of great antiquity and world-wide distribution, played currently with stones, bones, seeds, filled cloth bags and metal "men" (the jacks), sometimes with and sometimes without a ball. The name derives from "chuckstones"—stones to be tossed. The knucklebones, wrist or ankle bones of goats, sheep or other animals also have been used in play. These objects have been found in prehistoric caves in Kiev, and pictures of the game are depicted on jars from ancient Greece.

In the classic game, five or more counters are thrown into the air singlehandedly, the object being to catch them either on the palm or the back of the hand. Those so caught count for the player and those missed count against him.

In contemporary games, there have been two developments: one emphasizing skill (as in the modern game of jackstones or jacks) and the other, the accumulation of as many men as possible.

In the U.S. and Canada, jacks is primarily a girls' game, played with 6 to 12 or more six-pronged iron or plastic jacks and a small rubber ball. After the jacks are strewn on the floor, the player tosses the ball into the air and then tries to pick up the jacks and catch the ball, usually before it bounces. If the player fails in this she loses her turn. The game becomes increasingly difficult; first, one jack has to be picked up, followed by two at a time, then three, and finally all of them must be grasped in the hand before the ball is caught. Then the movements change. The player may have to push a jack or jacks into the other hand. Ten to twelve or more increasingly complex moves are often encountered, one of which includes bouncing the jacks off the back of the hand, or catching them there as in the classic game. The player who completes the series in the shortest time wins.

In Czechoslovakia, girls play the classic game using six seeds, and perform each maneuver first with the right, then with the left hand. In parts of the middle east there developed a game in which four to ten may play: each places four or more knucklebones in a straight line on the ground, the lines close to each other. Players stand at a distance from the lines, and toss a bone at the knucklebones, winning those that are knocked over.

In Egypt. children use apricot seeds, no more than ten to each player, everyone putting up the same number. The first player, chosen by lot, gathers all the seeds together and tosses them into the air; as they fall, he catches as many as possible on the back of his hand; the number caught determines the number of throws to which he then is entitled. The player then scatters all but one of the seeds, tosses that one into the air and snatches as many as possible from the ground before catching the falling seed. If he fails to catch the pit or to pick up any, he loses his turn. The winner is the one who has amassed the most seeds.

Jewish girls of eastern Europe traditionally played "Ghop Bagi" with five bones. On the first play, all were scattered on the ground or carpet, one tossed up and the other four garnered before it fell. In the second play of the set, three were on the floor and two in the air; in the third, two on the carpet and three in the air; and in the last, one on the floor and four in the air. The sets following became increasingly complex as in jacks.

In Japan and in China, a similar game is played using cloth bags filled with rice, sand or beans. The player drops the bags on a table, picks up one and tosses it aloft; while it is aloft he tries to pick up a bag from the table. He then holds this in his hand and repeats the play in an attempt to pick up and retain all the bags. Dib, dibstones or dabs is a game similar to jackstones, using either pebbles or sheep knucklebones. This game was played in ancient Rome using bones marked like dice, but only on four sides.

BIBLIOGRAPHY.—P. G. Brewster, *American Nonsinging Games* (1953); Jessie H. Bancroft, *Games for the Playground, Home, School and Gymnasium* (1937); E. O. Harbin, *Games of* Many *Nations* (1954).
(N. F. J.)

JACK THE RIPPER, the pseudonym applied to the perpetrator of a series of gruesome murders committed in or near the sordid Whitechapel district of London in 1888. At least seven killings may be attributed to the unknown assailant with reasonable certainty. All of the victims were prostitutes, and all except one were killed while plying their trade on the public streets. The methods of killing were not in every instance identical, but in each case the throat was cut and in most the bodies were mutilated by someone obviously possessing considerable knowledge of human anatomy. Unusual though futile efforts were made to trap the killer. Hundreds of suspects were interviewed. Bloodhounds were put into service. Even the eyes of one of the victims were photographed on the theory (not then discredited) that the image of the murderer might be recorded on the retinas of the murdered woman. Throughout the investigation the authorities received taunting notes from one purporting to be the murderer. On one occasion half a human kidney, which may have been removed from the body of a victim by the killer, mas mailed to the police.

Few cases have so captured the attention and imagination of the public, both in England and America. Jack the Ripper has provided themes for literary and dramatic productions, perhaps the most notable being Mrs. Belloc Lowndes' classic horror novel, The Lodger (1913). The identity of Jack the Ripper and the motivation for his crimes have proved tempting subjects for speculation. Although many hypotheses have been advanced, none has been generally accepted. The case remains one of the great unsolved mysteries of English crime.

BIBLIOGRAPHY.—A. Barnard (ed.), *The Harlot Killer* (1953), a useful anthology of factual and fictional material relating to the case. *See* also G. *B.* H. Logan, *Masters of Crime* (1928); *E.* L. Pearson, *More Studies* in *Murder* (1936).
(F. A. A.)

JACOB was the son of Isaac and Rebecca, the grandson of Abraham and the traditional ancestor of the people of Israel. He is represented as the twin brother of Esau, the ancestor of Edom, and the two are representatives of two grades of social order, Jacob being a pastoral nomad, and Esau the typical Bedouin hunter and raider. While Esau is actually the elder, Jacob by a double artifice (Gen. xxv, 28–34, and xxvii) obtains the rights and privileges of seniority. He then goes to the Aramaean tribe from which his ancestry had sprung, and on the way receives a special revelation from God at Bethel. He marries two of his cousins, Leah and Rachel, and after serving Laban seven years for each of them, and an additional six years during which he amasses a large property in small cattle, he returns to Palestine. He receives a second revelation at Peniel, meets and is reconciled to Esau and settles in Canaan. Twelve sons are born to him, six by Leah, and two each by Rachel and the female slaves of his wives. The story of his later years belongs rather to the life of Joseph, and it was as a result of the latter's success in Egypt that Jacob and his sons migrated there in time of famine and took up their residence on the northeastern border—the land of Goshen. There Jacob died; he was buried in Palestine. These narratives are full of much valuable evidence regarding marriage customs, pastoral life and duties, popular beliefs and traditions, and are evidently typical of what was currently retailed.

Their historical value has been variously estimated. The name existed long before the traditional date of Jacob, and the Egyptian phonetic equivalent of Jacob-el *(cf.* Isra-el, Ishma-el) appears to be the name of a district of central Palestine (or

possibly east of Jordan) about 1500 B.C. But the stories in their present form are very much later. The close relation between Jacob and Aramaeans confirms the view that some of the tribes of Israel were partly of Aramaean origin; his entrance into Palestine from beyond the Jordan is parallel to Joshua's invasion at the head of the Israelites; and his previous journey from the south finds independent support in traditions of another distinct movement from this quarter. Consequently, it would appear that these extremely elevated and richly developed narratives of Jacob-Israel embody, among a number of other features, a recollection of two distinct traditions of migration which became fused among the Israelites. *See* GENESIS; JEWS. (S. A. C.; T. H. R.)

JACOB OF EDESSA (c. 640–708), a distinguished Jacobite theologian, historian, philosopher, exegete and grammarian, was born at 'En-deba and became bishop of Edessa (c. 684). His strict disciyline giving offense,he retired and devoted himself to study and teaching. He composed Syriac homilies in prose and verse, canons, liturgies, commentaries on the Old and New Testaments and a chronicle, designed to continue that of Eusebius, of which only fragments remain. He revised the Peshitta Old Testament on the basis of Greek and Syriac versions. He translated from the Greek, notably the *Homiliae cathedrales* of Severus of Antioch. He produced the earliest extant Syriac grammar and introduced Greek letters to represent the Syriac vowels.

See A. Baumstark, *Geschichte der syrischen Literatur (1922).* (W. D. McH.)

JACOB OF SERUGH or SARUG (451–521), a Syriac writer described for his learning and holiness as "the flute of the Holy Spirit and the harp of the believing church," was born at Kurtam on the Euphrates. Like his father he was ordained priest, and by jog he was episcopal visitor of Haura in Serugh. In 519 he was made bishop of Batnan in Serugh. He died in Nov. 521. By his contemporaries and some moderns Jacob has been regarded as orthodox. but four of his letters edited by P. Martin prove his monophysitism. His prose writings include discourses, six festal homilies and many letters. He is the reputed author of a liturgy and order of baptism. He wrote also 760 homiletic poems, mostly in dodecasyllabic metre, treating mainly of Old and New Testament incidents and of apostles, saints and martyrs.

See A. Baumstark, *Geschichte der syrischen Literatur* (1922); J. B. Abbeloos, *De vita et scriptis S. Jacobi (1867).* (W. D. McH.)

JACOBA or **JACQUELINE** (1401–1436) was the only daughter and heiress of William IV, duke of Bavaria and count of Hoiland, Zeeland and Hainaut. Born on July 25, 1401, she was married as a child to John of Touraine, second son of Charles VI, king of France, who on the death of his elder brother Louis became dauphin. John of Touraine died in April 1417, and within two months Jacqueline lost her father. In 1416 the emperor Sigismund had refused to accept her as heiress, and he now supported the claims of her uncle, John of Bavaria, bishop of Liège. Jacqueline's marriage to her cousin John IV, duke of Brabant, was arranged in 1418 by their uncle, John the Fearless, duke of Burgundy. His mediation secured a treaty of partition with John of Bavaria in 1419; but it was merely a truce and the contest soon began again.

Dissatisfied with her feeble husband, Jacqueline fled to England in 1421 and was welcomed by Henry V. There she repudiated her marriage with John of Brabant, and, before Feb. 1423, she married Humphrey, duke of Gloucester (*q.v.*). In the autumn of 1424, Humphrey and Jacqueline invaded Hainaut and were opposed by John of Brabant, who had Burgundian help. In April 1425 Humphrey returned to England, abandoning his wife. who had to submit to her cousin, Philip V, duke of Burgundy; she was imprisoned at Ghent. John of Bavaria had died in Jan. 1425, and John of Brabant now mortgaged the two counties of Holland and Zeeland to Philip, who assumed their protectorate. However, Jacqueline escaped to Holland in Sept. 1425 and for three years struggled gallantly to maintain herself against the united efforts of Philip of Burgundy and John of Brabant. At first she had some success, for in Holland she mas supported by the Hook faction of nobles, but the towns were Burgundian in sympathy. The death of John of Brabant (April 1427) freed the countess from her quondam husband; but nevertheless the pope pronounced her marriage with Humphrey illegal, and Philip, putting out his full strength, broke down all opposition.

By the treaty of Delft (July 3, 1428) Jacqueline was left nominally countess, but Philip was to administer the government of Holland. Zeeland and Hainaut and was declared heir to Jacqueline, who promised not to marry again without his consent. Two years later Philip mortgaged Holland and Zeeland to the Borselen family, of which Francis, lord of Borselen, was the head. Jacqueline now made her last effort. In 1432 she secretly married Francis of Borselen and endeavoured to foment a rising in Holland against the Burgundian rule. Philip invaded the country, however, and threw Borselen into prison. To save the life of her husband, Jacqueline was compelled to abdicate her three countships in Philip's favour in April 1433. Retaining her title of duchess in Bavaria, she henceforth lived on Borselen's estates in retirement, and died childless on Oct. 9, 1436.

BIBLIOGRAPHY.—Ruth Putnam, *A Mediaeval Princess* (1904); K. H. Vickers, *Humphrey, Duke of Gloucester* (1907); H. Pirenne, *Histoire de Belgique,* vol. ii (1922). (T. B P.)

JACOBABAD, a municipal town, taluka and district in Khairpur division of West Pakistan. Jacobabad town (pop., 1951, 22,835) is the administrative headquarters of the district and is famous for the consistently high temperatures which it attains each year.

In the month of June the shade temperature normally rises to a maximum of 120° F., and the absolute maximum of 126° F. is the highest recorded in Indo-Pakistan. The town was founded on the site of the village of Khanghar in 1847 by Gen. John Jacob, for many years commandant of the Sind horse, who died there in 1858. An annual horse show is held in January.

JACOBABAD TALUKA (area 262 sq.mi.) had a population in 1951 of 67.990. It is watered by two canals.

JACOBABAD DISTRICT has an area of 2.046 sq.mi. and a population (1951) of 345,080. It consists of a narrow strip of alluvial plain which slopes away from the Indus in the east. It is protected from flood by the Kashmor embankment. Bugti hills border the district in the north while the outliers of the Kirthar hills occur in the extreme southeast. Annual rainfall averages less than four inches. Agriculture is practised with the help of canal irrigation.

JACOB BEN ASHER (1269–1340), codifier of Jewish law, was born in Germany (Cologne?) and died in Toledo, Sp. A son of Asher ben Yehiel (*q.v.*), Jacob is best known for his work *Arb'a'ah Turim,* or four rows or classes of law, from which he is called *Ba'al ha-Turim* ("Master of the Rows"). Jacob divided the entire Jewish law systematically into four classes: (1) *Orah Hayyim* ("Path of Life") contains laws dealing with the prescribed prayers and ritual observances of a Jew; (2) *Yoreh De'ah* ("Teacher of Knowledge") contains laws dealing with permitted and forbidden things, such as dietary laws; (3) *Eben ha-Ezer* ("Stone of Help") contains lams dealing with family relations; and (4) *Hoshen ha-Mishpat* ("Breastplate of Judgment") contains civil and criminal law. Jacob eliminated from his work all laws and customs which ceased to operate after the destruction of the Second Temple. He paid special attention to customs which originated in Germany. The systematically arranged work of Jacob superseded the codes of earlier times and served as a basis for the final edifice of codified Jewish law, the *Shulhan 'Arukh* by Joseph Qaro (*q.v.*).

See Meyer Waxman, *History of Jewish Literature,* vol. ii, **p.** 140 ff. (1933). (J. M. RL.)

JACOBEAN STYLE, in architecture, is that style of early English Renaissance uhich followed the Elizabethan style (*q.v.*), and is generally contemporary with the reign of James I (1603–25). It is characterized by a combination of motives from the late Perpendicular period (*q.v.*), with a great use of crude and misunderstood classical detail, in which the influence of Flanders is strong. The Tudor pointed arch is common, and in interior work there is considerable simple, Tudor paneling and an occasional use of perpendicular vaulting forms. Doorways, fireplaces and the like are usually framed with classical forms, and both out-

side and inside there is a wide use of terms, pilasters, S-scrolls and the type of pierced, flat ornament known as strapwork. This style, despite its name, is found over a longer period of time than the strict limits above stated; thus Wollaton hall, Nottinghamshire (1580), can rightly be termed Jacobean, and traces of the same style are found in the colleges of Oxford and Cambridge that were constructed up to the beginning of the 18th century. *See* also TUDOR PERIOD.

JACOBI, ABRAHAM (1830–1919), German-U.S. physician, was born at Hartum, Westphalia (Germany), May 6, 1830, and educated at the *Gymnasium* of Minden and the Universities of Greifswald, Gottingen and Bonn (M.D., 1851). Because he participated in the German revolutionary movement he was imprisoned, 1851–53, in Berlin and Cologne for "high treason."

Upon his release he went to the United States and began practice in New York city. In 1860 he became professor of children's diseases at the New York Medical college, holding the first chair in the subject founded in the United States. From 186 j to 1870 he was professor of children's diseases in the medical department of New York university, and from 1870 to 1902 in the college of physicians and surgeons of Columbia university. Jacobi was physician to several hospitals and consulting physician to the New York city department of health. He established the first special clinic for diseases of children in the country in New York city in 1862 and later established many others. He taught and wrote on his specialty for more than half a century, was ranked among the foremost authorities on the diseases of children and is considered the founder of pediatrics in the United States. He died at Bolton Landing, N.Y., July 10, 1919.

Jacobi's wife, MARY CORINNA PUTNAM (1842–1906), also a physician, taught at Woman's Medical college in New York city.

JACOBI, FRIEDRICH HEINRICH (1743–1819), German philosopher, a leading exponent of the *Gefühls-* or *Glaubensphilosophie* (philosophy of feeling or of belief), was born at Diisseldorf on Jan. 25, 1743. Having completed his education at Geneva (1759–62), where he came under the influence of contemporary French writers, he took his father's place as head of a sugar factory in 1764, but gave this up in 1772, when he became a member of the governing council of the duchies of Jdlich and Berg. His house at Pempelfort then became a centre of literary activity. Associated with C. M. Wieland in the launching of the literary periodical *Der Teutsche Mercur* (1773), Jacobi published in it the second part of his philosophical novel *Eduard Allwills Briefsammlung* (1776; the first part had appeared in *Iris,* 1775) and the first part of another novel, *Woldemar: ein Seltenheit aus der Naturgeschichte* (1777; complete ed. 1779). In 1779 he was appointed privy councilor to the electoral court of Bavaria.

When Lessing, whom he met in 1780, told him that he knew no philosophy but Spinoza's, Jacobi took up the study of Spinozism. The rationalism of it repelled him; he denounced it in *Uber die Lehre des Spinoza, in Briefen an den Herrn Moses Mendelssohn* (1785; and ed. 1789). When Moses Mendelssohn and other partisans of the Enlightenment attacked his notion of "belief" as being obscurantist, he replied in *David Hume über den Glauben, oder Idealismus und Realismus* (1787), maintaining that his notion of belief as the only means of immediate cognition of individual facts was the same as that held by the most advanced philosophers.

Jacobi went to see Goethe at Weimar in 1784 and visited London in 1786. In 1794 he left his house at Pempelfort because of danger from the approach of the French Revolutionary armies and went to Hamburg. Eventually he settled for a time at Eutin. When Fichte was accused of atheism, Jacobi published an open letter, *Jacobi an Fichte* (1799), to make his own theistic position clear. His *Über das Unternehmen des Kriticismus, die Vernunft zu Verstande zu bringen,* against Kant, appeared in 1801.

In 1801 Jacobi began a round of travels which took him to Pempelfort, Aachen, Paris and Hanover. In 1804, however, financial losses obliged him to return to Eutin. He then received an invitation to Munich in connection with the establishment of an academy of sciences there. He arrived in Munich in 1805, and was president of the academy from 1807 to 1812. His treatise *Von den gottlichen Dingen und ihrer Offenbarung* (1811) was directed against Schelling, to whose philosophy he objected and whose presence in Munich was disagreeable to him. Jacobi died in Munich on March 10, 1819.

Jacobi's philosophy is closely related to that of his friend Johann Georg Hamann (*q.v.*). Belief for him meant an immediate conviction not only of the reality of sense–data but also of truths present in the heart or in the spirit of man, including his knowledge of God, all of which Jacobi felt to be endangered if they were to be submitted to the rationalizing processes of the mind. He specifically disclaimed any intention of constructing a system of philosophy.

The collected edition of his works, which he began, was completed by F. Koppens, 6 vol. (1812–25).

BIBLIOGRAPHY.—There are: selections of Jacobi's letters ed. by F. von Roth (1825–27) and by R. Zoppritz (1869) and collections of his correspondence with Goethe (1846), with Herder (1856–57), with Hamann (1868) and with F. Bouterwek (1868). *See* E. Zirngiebl, *F. H. Jacobis Leben, Dichten und Denken* (1867); L. Lévy-Bruhl, *La Philosophie de Jacobi* (1894); A. W. Crawford, *The Philosophy of F. H. Jacobi* (1905); O. F. Bollnow, *Die Lebensphilosophie Jacobis* (1933).

JACOBI, JOHANN GEORG (1740–1814), one of the anacreontic group of German poets which included J. N. Gotz and J. W. L. Gleim (*qq.v.*). Jacobi was born in Diisseldorf on Sept. 2, 1740, son of a wealthy businessman and elder brother of F. H. Jacobi (*q.v.*). After studying at Gottingen and elsewhere he became in 1766 professor of philosophy at Halle. From 1768 to 1774 he lived in Halberstadt and then returned to Diisseldorf, where he published *Iris* (1774–76), a quarterly which numbered Goethe, Gleim. Hermann Lenz and J. J. W. Heinse among its contributors. In 1784 he became professor of aesthetics in Freiburg, ,where he issued a series of "pocket books" (1795–1813) to which Klopstock, M. Claudius, J. H. Voss, Jean Paul Richter and others contributed. This series was also, from 1803. called *Iris.*

Jacobi's poetry is largely lyric and his delicate, oversweet anacreontic verses are strongly influenced, in form and content. by contemporary French models. Later (and especially after his prose and verse *Winterreise* of 1769) the influence of Goethe and Laurence Sterne led him to develop more genuine traits of feeling and he ultimately wrote some distinctive poetry which combines intimate feeling for nature with melodiousness and an appealing simplicity. Some of his poems were attributed to Goethe. He died in Freiburg on Jan. 4, 1814.

BIBLIOGRAPHY.—His *Samtliche Werke* were first published in 2 vol. (1770): of subsequent editions may be mentioned the 3rd, 8 vol., with a biography by J. A. von Ittner (1819–22); *Ausgewählte Werke,* 3 vol. (1854). *See* also U. Schober, J. G. *Jacobis dichterische Entwicklung* (1938); E. B. Gladding, "J. G. Jacobis *Die U'interveise," Modern Language Notes,* 56 (1941). (K. Sc.)

JACOBI, KARL GUSTAV JACOB (1804–1851), German mathematician, who was one of the great algorists, was born at Potsdam on Dec. 10, 1804. He studied at Berlin university, where he obtained the degree of doctor of philosophy in 1825, his thesis being an analytical discussion of the theory of partial fractions. He first became known through his work on the theory of numbers, which he communicated in letters to K. F. Gauss. In 1827 he became extraordinary and in 1827 ordinary professor of mathematics at Konigsberg, which chair he filled until 1842. Together with Niels Abel, he was one of the founders of elliptic function theory; his principal work was *Fundamenta nova theoriae functionum ellipticarum* (1829). He made notable research on differential equations and applied his analysis to dynamical problems. He introduced the theory of the last multiplier, which is fully treated in his *Vorleszingen über Dynamik,* edited by R. F. A. Clebsch (1866).

Jacobi advanced the theory of configurations of rotating liquid masses by showing that the ellipsoids, which are now known as Jacobi's ellipsoids, should be figures of equilibrium. He was one of the early founders of the theory of determinants. and he invented the functional determinant formed of the n^2 differential coefficients of n given functions of n independent variables that bears his name (Jacobian) and which has played an important part in many analytical investigations.

Valuable also are his papers on Abelian transcendents and his investigations in the theory of numbers to which he applied el-

liptic functions. He left a vast store of manuscript, portions of which have been published at intervals in August Crelle's *Journal* for Pure and Applied *Mathematics*. He died in Berlin Feb. 18, 1851.

Jacobi's Gesammelte Werke were published by the Berlin academy (1881–91).

See Leo Konigsberger, *Carl Gustav Jacob Jacobi* (1904); *E.* T. Bell, *Men of Mathematics* (1937). (O. OE.; X)

JACOBINS, THE, the most famous of the political clubs of the French Revolution. It originated in the Club Breton, established at Versailles shortly after the opening of the states general in 1789. At first composed of deputies from Brittany, it was soon joined by others from various parts of France, among its early members being Mirabeau and Robespierre. After Oct. 6 the club followed the national assembly to Paris, where it rented the refectory of the monastery of the Jacobins in the Rue St. Honore, near the seat of the Assembly. The name "Jacobins," given in France to the Dominicans, because their first house in Paris was in the Rue St. Jacques, was first applied to the club in ridicule. The title assumed by the club itself, after the promulgation of the constitution of 1791, was *Société* des *amis* de la *constitution séants aux* Jacobins *à* Paris, which was changed on Sept. 21, 1792, after the fall of the monarchy, to *Société* des Jacobins, *amis* de la *liberté et* de *l'égalité*.

Once transferred to Paris, the club underwent rapid modifications. The first step was the admission as members or associates of others besides deputies. On Feb. 8, 1790, the society was formally constituted by the adoption of the rules drawn up by Barnave. The objects of the club were defined as (1) to discuss in advance questions to be decided by the National Assembly; (2) to work for the establishment and strengthening of the constitution; (3) to correspond with other societies of the same kind. The club was to have a president, elected every month, four secretaries, a treasurer and committees elected to superintend the correspondence and the administration of the club's affairs.

Any member who showed that his principles were contrary to the constitution and the rights of man was to be expelled, a rule which later on facilitated the "purification" of the society by the expulsion of its more moderate elements. The 7th article provided for the admission of other similar societies as associates.

This last provision was of far-reaching importance. By Aug. 10, 1790 there were already one hundred and fifty-two affiliated clubs, and at the close of 1791 the Jacobins had a network of branches all over France. It was this widespread yet highly centralized organization that gave to the Jacobin Club its formidable power.

At the outset the Jacobin Club was not distinguished by extreme political views. The high subscription confined its membership to men of substance, and to the last the central society in Paris was composed almost entirely of professional men, such as Robespierre, or well-to-do bourgeois, like Santerre. Other elements, however, were present. Besides Louis Philippe, duc de Chartres (afterwards king of the French), liberal aristocrats of the type of the duc d'Aiguillon, and the bourgeois who formed the mass of the members, the club contained such figures as "Pere" Michel Gérard, a peasant proprietor from Brittany, whose rough common sense was admired as the oracle of popular wisdom, and whose countryman's waistcoat and plaited hair were to become the model for the Jacobin fashion. The provincial branches, although more democratic, were usually led by members of the middle classes. The club took no official part in the insurrections of June 20 and, Aug. 10, 1792, and only formally recognized the republic on Sept. 21. But the character and extent of its influence cannot be gauged by its official acts alone, and long before it emerged as the principal focus of the Terror, its character had been profoundly changed by the secessions of its more moderate elements, some to found the Club of 1789, some in 1791 to found the club of the Feuillants scoffed at by their former friends as the club *monarchique*.

From the date of the admission of the general public to its sittings (Oct. 14, 1791), the constituency to which the club was responsible, and from which it derived its power, was the Paris mob; the sans-culottes — decayed lackeys, cosmopolitan ne'er-do-weels and starving workpeople — who crowded its tribunes. To this audience, and not primarily to the members of the club, the speeches of the orators were addressed and by its verdict they were judged. As the chaos in the body politic grew, and with it the appalling material misery, the mob, no longer satisfied with the platitudes of the philosophes, began to clamour for the blood of the "traitors" in office by whose corrupt machinations the millennium was delayed, and only those orators were listened to who pandered to its suspicions. Hence the elimination of the moderate elements from the club; hence the ascendancy of Marat, and finally of Robespierre, the secret of whose power was that they really shared the suspicions of the populace, to which they gave a voice and which they did not shrink from translating into action. After the fall of the monarchy Robespierre was in effect the Jacobin Club; for to the tribunes he was the oracle of political wisdom, and by his standard all others were judged. With his fall the Jacobins too came to an end.

SECRET OF THEIR STRENGTH

Not the least singular thing about the Jacobins is the slender material basis on which their power rested. France groaned under their tyranny: yet it was reckoned by competent observers that, at the height of the Terror, the Jacobins could not command a force of more than 3,000 men in Paris. The secret of their strength was this: in the midst of the general disorganization, they alone were organized. The Girondin government was urged to meet organization by organization, force by force; and it is clear from the daily reports of the police agents that even a moderate display of energy would have saved the National Convention from the humiliation of being dominated by a club, and the French Revolution from the blot of the Terror. But the Girondins were too convinced of the ultimate triumph of their own persuasive eloquence, to act. In the session of April 30, 1793 a proposal was made to move the Convention to Versailles out of reach of the Jacobins, but the motion was not carried, and the Girondins remained to become the victims of the Jacobins.

The Jacobin Club was closed after the fall of Robespierre on the 9th of Thermidor of the year III., and some of its members were executed. An attempt was made to re-open the club, which was joined by many of the enemies of the Thermidorians, but on the 21st of Brumaire, year III. (Nov. 11, 1794), it was definitely closed. Its members and their sympathizers were scattered among the cafés, where a ruthless war of sticks and chairs was waged against them by the young "aristocrats" known as the jeunesse *dorée*. Nevertheless the "Jacobins" survived, in a somewhat subterranean fashion, emerging again in the club of the Panthéon, founded on Nov. 25, 1795, and suppressed in the following February (see BABEUF, FRANÇOIS NOEL). The last attempt to reorganize them was the foundation of the *Réunion d'amis* de *l'égalité* et de la *liberté*, in July 1799, which had its headquarters in the *Salle* du *Manège* of the Tuileries, and was thus known as the Club du *Manège*. It was patronized by Barras, and some two hundred and fifty members of the two councils of the legislature were enrolled as members, including many notable ex-Jacobins. But public opinion was now preponderatingly moderate or royalist, and the club was violently attacked. It was suppressed in August, after barely a month's existence. Its members revenged themselves on the Directory by supporting Napoleon Bonaparte.

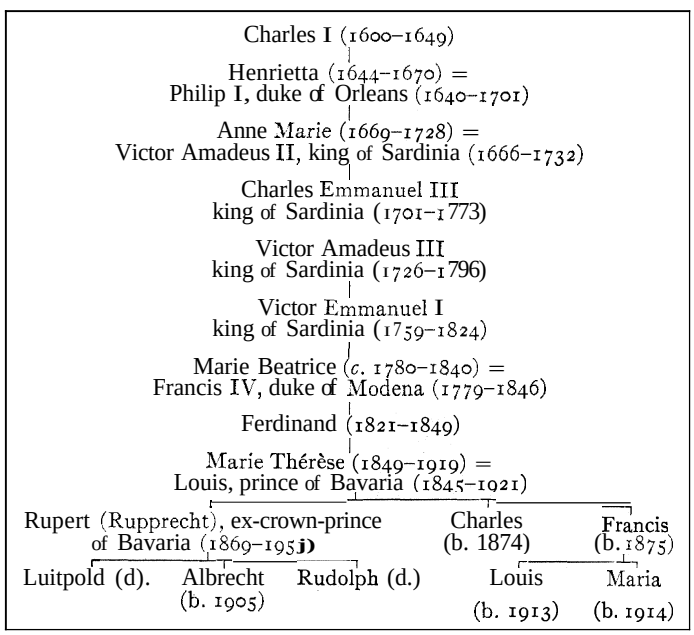
Long before the suppression of the Jacobin Club the name of "Jacobins" had been popularly applied to all promulgators of extreme revolutionary opinions. In this sense the word passed beyond the borders of France and long survived the Revolution. Canning's paper, The Anti-Jacobin, directed against the English Radicals, consecrated its use in England; and in the correspondence of Metternich and other leaders of the repressive policy which followed the second fall of Napoleon, "Jacobin" is the term commonly applied to anyone with Liberal tendencies, not excepting the emperor Alexander I. of Russia.

See F. A. Aulard, La *société des Jacobins, Recueil de documents* (1889, etc.), where a critical bibliography will be found. This collection does not contain all the printed sources — notably the official

Journal of the Club is omitted—but these sources, when not included, are indicated. The documents published are furnished with valuable explanatory notes. *See* also W. A. Schmidt, *Tableaux de la révolution française* (Leipzig, 1867–70), notably for the reports of the secret police, which throw much light on the actual working of the Jacobin propaganda, and Albert Mathiez, *Etudes robespierrstes* and other works. (W. A. P.)

JACOBITES, the name given after the revolution of 1688 to the adherents, first of the exiled English king James II, then of his descendants, and after the extinction of the latter in 1807, of the descendants of Charles I, *i.e.*, of the exiled house of Stuart (Lat. *Jacobus,* James).

The history of the Jacobites, culminating in the risings of 1715 and 1745, is part of the general history of England, and especially of Scotland; there were also many Jacobites in Ireland. They were recruited largely, but not solely, from among the Roman Catholics; the Protestants among them were often identical with the Non-Jurors. A variety of causes led Jacobitism to lose ground after the accession of George I; the suppression of the revolt of 1715 and the total failure of "the '45" marked its end as a serious political force. But as a sentiment it remained for some time longer. In 1750, during a strike of coal workers at Elswick, James III was proclaimed king; and in Manchester a Jacobite rendezvous known as "John Shaw's Club" lasted from 1735 to 1892; North Wales was another Jacobite centre. Jacobite traditions also lingered among the great families of the Scottish Highlands. Until the accession of King Edward VII finger bowls were not placed upon the royal dinner table, because in former times those who secretly sympathized with the Jacobites were in the habit of drinking to the king *over the water.* Sentimental Jacobitism was practically extinguished during World War I by the fact that the "rightful king" was Prince Rupert (Rupprecht) of Bavaria. Upon the death of Henry Stuart, Cardinal York, the last of James II's descendants, in 1807. the rightful occupant of the British throne according to legitimist principles was to be found among the descendants of Henrietta, daughter of Charles I. The table of succession runs as follows:



See James Hogg, *Jacobite Relics* of *Scotland* (1819–21); J. Allardyce (ed.), *Historical Papers relating to the Jacobite Period* (1895–96); F. W. Head, *The Fallen Stuarts* (1901); de Ruvigny, *Jacobite Peerage* (1904). The chief collections of Jacobite poems: Charles Mackay, *Jacobite Songs and Ballads of Scotland, 1688–1746, with Appendix of Modern Jacobite Songs* (1861); *English Jacobite Ballads,* ed by A. B. Grosart from the Towneley manuscripts (1877); G. S. Macquoid's *Jacobite Songs and Ballads* (1888).

JACOBS, CHRISTIAN FRIEDRICH WILHELM (1764–1847), German classical scholar, was born at Gotha, Oct. 6, 1764, and died there on March 30, 1847. He was a notable teacher and publicist, but his great work was an edition of the Greek Anthology, with copious notes, in 13 vol. (1798–1814), supplemented by a revised text from the Codex Palatinus (1814–17). He published also notes on Horace, Stobaeus, Euripides, Athenaeus and the *Iliaca* of Tzetzes; translations of Aelian *(History of Animals)*; miscellaneous essays on classical subjects.

See E. F. Wüstemann, *Friderici Jacobsii laudatio* (1848); *C.* Bursian, *Geschichte der classischen Philologie in Deutschland* (1883); and article by C. Regel in *Allgemeine deutsche Biographie.*

JACOBS, W. W. (WILLIAM WYMARK) (1863–1943), English author of short stories about seafaring men and dockyard workers, was born at Wapping. East London, on Sept. 8, 1863. His books, speaking through their characters, displayed a gentle humour and economy of style. Though his seamen were rarely at sea, their adventures or misadventures ashore provided many a thrilling tale. His first volume of short stories. *Many Cargoes* (1896), had an immediate success and was followed by two others, *The Skipper's Wooing* (1897) and *Sea Urchins* (1898). One of his most famous short stories, "The Monkey's Paw," came to be regarded as a "horror" classic and was dramatized many times. An omnibus, *Snug Harbour,* containing some 17 volumes of his work, was published in 1931. Jacobs died in London on Sept. 1, 1943.

JACOBS' CAVERN, a cavern in latitude 36° 35' N., 2 mi. E. of Pineville, McDonald county. Mo., named after its discoverer, E. H. Jacobs, of Bentonville, Ark. It was scientifically explored by him, in company with Charles Peabody and Warren K. Moorehead, in 1903. This small cave is hardly more than a rock shelter, and is entirely in the "St. Joe Limestone" of the subcarboniferous age. The ash surface of its floor was staked off into square metres and the substance carefully removed in order. Each stalactite, stalagmite and pilaster was measured, numbered and removed in sections. Six human skeletons were found buried in the ashes. Seven-tenths of a cubic metre of animal bones were found: deer, bear, wolf, raccoon, opossum, beaver, buffalo, elk, turkey, woodchuck. tortoise and hog; all contemporary with man's occupancy. Three stone metates, one stone axe, one celt and 15 hammer stones were found. The cavern was peculiarly rich in flint knives and projectile points. The rude type of the implements, the absence of fine pottery and the peculiarities of the human remains, indicate a race of occupants more ancient than the mound builders.

JACOBSEN, JENS PETER (1847–1885), Danish novelist and poet, an outstanding exponent of late 19th-century literary naturalism, was born April 7, 1847 at Thisted, Jutland, the son of a prosperous merchant. As a student in Copenhagen his interests were divided between literature and the natural sciences, particularly botany; he wrote a number of important treatises and translated Darwin's *Origin of Species* (1872) and *The Descent of Man* (1875). The first Danish Darwinist, he preceded Georg Brandes in rejecting the Christian interpretation of life and, from 1871 onward, supported the new, naturalistic, anti-Romantic movement with articles in its journals and with *Mogens* (1872), a story written in an impressionistic style, describing a young man's progress from daydreams to reality. About this time appeared the first symptoms of the tuberculosis which cut short Jacobsen's life and overlaid his meagre literary output with melancholy. He died at Thisted, April 30, 188;.

Despite constant struggles against illness he managed to write two novels, *Marie Grubbe* (1876; Eng. trans., 1914) and *Niels Lyhne* (1880; Eng. trans , 1919). The first, set against a vividly depicted late 17th-century background, tells the story of a *grande dame* who, after several ill-starred marriages and liaisons, elopes with a groom and ends her life in poverty. The second novel develops a theme similar to that of *Mogens*—of the dreamer who through experience and disillusionment becomes a realist—with the additional element of the problem confronting the atheist in bearing the burden of his lack of belief, Both show Jacobsen's scientific training in that character is interpreted biologically and psychologically. but they also show his warm sympathy and emphasis on the human striving for moral unity, balance and individuality. It is this humanity which ensures his reputation, rather than the consciously picturesque and rhythmical, somewhat

affected prose style which was revolutionary at the time and was much admired and imitated.

Jacobsen was a highly independent and original writer, self-conscious and self-critical. As a novelist of the naturalist school, he can be compared to Flaubert, but was probably most influenced by Turgenev and, among Scandinavians. by Hans Christian Andersen and Bjornstjerne Bjørnson. Some of his best work appeared in *Mogens og andre Noveller* (1882; Eng. trans.. 1921). He had written poetry all his life, posthumously collected in *Digte og Cdkast* (1886; Eng. trans., 1920), which revealed his considerable original gifts as a lyric poet, using language with unusual boldness and anticipating in some ways the poetry of a later period. His *Samlede Skrifter* were published in a 2-vol. edition (1918; 11th ed., 1948) and in an annotated edition *Samlede Værker*, 5 vol. (1924–29). There are several editions of his interesting letters. many of which are included in *Georg og Edv. Brandes' Brevveksling*, vol. 11 (1940).

See G. Christensen, *J. p. Jacobsen*, 2nd ed. (1924); A. Gustafson, *Six Scandinavian Novelists* (1940). (S. M. K.)

JACOB'S WELL, the scene of the conversation between Jesus and the "woman of Samaria" narrated in the fourth Gospel, is described as being in the neighbourhood of an otherwise unmentioned "city called Sychar." From the time of Eusebius this city has been identified with Sychem or Shechem (modern Nablus): the well is still in existence 1½ mi. E. of the town, at the foot of Mt. Gerizim. When Edward Robinson visited it in 1838 it was 105 ft. deep, but it is now much shallower and often dry.

JACOBUS, the name of a British gold coin issued in the reign of James I and called after him. Jacobus being Latin for James. It was of the value of 25 shillings.

JACOBUS DE VORAGINE (1228/9–1298), archbishop of Genoa, chronicler and author of the *Golden Legend*, was born in Genoa and became a Dominican in 1244. After gaining a reputation throughout northern Italy as a preacher and theologian he was provincial of Lombardy (1267–78 and 1281–86) and archbishop of Genoa (1292) until his death there on July 13/14, 1298. He was beatified in 1816 for his work as a peacemaker between Guelphs and Ghibellines and his feast day in the Dominican order is July 13.

His works include sermons on gospel lections, saints' days and the Virgin Mary, a chronicle of Genoa and the *Legenda aurea, (Golden Legend,* also known as the *Lombardica historia*). This book is a collection of saints' lives. of accounts of events in the lives of Christ and of the Virgin Mary, and of information about holy days and seasons. the whole being arranged as readings (Lat. *legenda*) for the church year. Immensely popular in the middle ages, it was translated into all western European languages and gradually much enlarged. William Caxton's translation was one of the first books printed in English (1483). Medieval artists found the *Golden Legend* a storehouse of events and persons to be illustrated. But the miraculous stories it contains and its natural lack of historical perspective rendered the book unacceptable at the Reformation and after the rise of the new learning. so it then went completely out of fashion.

BIBLIOGRAPHY.—*Legenda aurea* ed. by T. Grasse (1846); Caxton's Eng. trans. revised by F. S. Ellis (1900); modern Eng. trans. by G. Ryman and H. Ripperger (1941). *Chronicon januense* ed. by G. Monleone, 3 vol. (1941). *See* also E. C. Richardson, *Materials for a Life of Jacopo da Varagine* (1935); A. Dondaine, "Le Dominicain français Jean dc Mailly et la legend dorée," *Archives d'histoire dominicaine,* 1:53–103 (1946); P. Lorenzin, *Mariologia Iacobi a Varagine* (1951); E. Mâle, *L'Art religieux du xiii^e siècle en France,* pp. 269–233, 6th ed. (1925).

JACOPO DELLA QUERCIA: *see* QUERCIA, JACOPO DELLA.

JACOPONE DA TODI (JACOPO DE' BENEDETTI) (*c.* 1230–1306), Italian religious poet whose work was based on a spiritual conception of poverty. He was born in Todi, Umbria, where he practised as a lawyer until his sudden conversion following the death of his wife, about 1268. He became a Franciscan tertiary and, ten years later, a lay brother. The importance he attached to the ideal of poverty made him sympathize with the Spirituals *(see* FRANCISCANS) and brought him into conflict with Pope Boniface VIII. In 1297 he signed the manifesto which declared Boniface's election invalid, and was excommunicated and imprisoned from 1298 to 1303, when Benedict XI released him. He died at Collazzone, Umbria, Dec. 25, 1306.

Jacopone wrote more than 100 *laudi spirituali,* varying greatly in tone and feeling. His art is unself-conscious, but he often writes with great power. Poverty is his theme. His realization of the "foolishness" of God's love for men overturns all worldly values: poverty of spirit, giving freedom from the desire to possess goods. honour, wisdom or even goodness, is for him the opening out of the human soul to be filled by God. Its other name is love.

Jacopone's *Laudi, Trattato e Detti,* were ed. *bv* F. Ageno (1953). E. Underhill, *Jacopone da Todi, Poet and Mystic* (1919), includes some translations; *see* also M. Casella, "Jacopone da Todi," in *Archivum Romanicum,* vol. 4 (1920). (S. Rs.)

JACOTOT, JEAN JOSEPH (1770–1840), French educationist and inventor of the "universal method" of education, was born at Dijon on March 4, 1770. In 1795 he became subdirector of the École Polytechnique in Dijon and shortly afterward professor of the method of sciences. His ideas were mainly a product of his extremely varied experience. He was successively soldier, politician, professor of languages, mathematics. Greek and Latin literature, French language and literature, military secretary and director of the military École Normale. In 1818 he left France for Louvain, Belg. He died in Paris on July 30, 1840.

In *Enseignement Universel* (1823) Jacotot asserted the equality of the mental capacities of all men and attributed existing differences to will. If the individual starts on the right lines he can educate himself. Newly acquired knowledge must be linked with existing knowledge, a process which is assisted by association of ideas. A course of study should begin by memorizing one section of subject matter until it has been thoroughly assimilated; then it can be associated with other sections. In the study of French, pupils were required to memorize six books of François Fénelon's *Télémaque* by concentrating in turn on the separate words, sentences and the grammar and finally linking up their knowledge through a number of varied exercises.

See A. Guillard, *Biographie de J. Jacotot* (1860). (S. J. C.)

JACQUARD, JOSEPH MARIE (1752–1834), French inventor of a loom that included all the weaving movements, was born at Lyons on July 7, 1752. After fighting both against and for the Convention in the French Revolution, he worked in a Lyons factory, and in his spare time constructed his improved loom. In 1801 he exhibited it at the industrial exhibition at Paris; and in 1803 he was summoned to Paris and attached to the Conservatoire des Arts et Métiers. A loom by Jacques de Vaucanson (1709–82), deposited there, suggested various improvements in his own, which he gradually perfected to its final state. Although his invention was fiercely opposed by the silk weavers, who feared that its introduction, because of the saving of labour, would deprive them of their livelihood, its advantages secured its general adoption; by 1812 there were 11,000 Jacquard looms in use in France. The loom was declared public property in 1806, and Jacquard was rewarded with a pension and a royalty on each machine. He died at Oullins (Rhône) on Aug. 7, 1834; six years later a statue was erected to him at Lyons. *See* WEAVING: *Weaving Machinery.*

JACQUARD LOOM: *see* WEAVING.

JACQUELINE OF HAINAUT: *see* JACOBA.

JACQUERIE, THE, an insurrection of the French peasantry which broke out in the Ile de France and about Beauvais at the end of May 1358. The hardships endured by the peasants in the Hundred Years' War and their hatred for the nobles who oppressed them were the principal causes which led to the rising, though the immediate occasion was an affray which took place at the village of Saint-Leu between "brigands" (militia infantry armoured in brigandines) and country-folk. The latter having got the upper hand united with the inhabitants of the neighbouring villages and placed Guillaume Karle at their head. They destroyed numerous châteaux in the valleys of the Oise, the Brèche and the Thérain, where they subjected the whole countryside to fire and sword, committing the most terrible atrocities. Charles the Bad, king of Navarre, crushed the rebellion at the battle of Mello, and the nobles then took violent reprisals upon the peasants, massacring them in great numbers.

See Simeon Luce, *Histoire de* la *Jacquerie* (1859 and 1895). (J. V.)

JACTITATION, in English law, the maliciously boasting or giving out by one party that he or she is married to the other. In such a case, in order to prevent the common reputation of their marriage that might ensue, the procedure is by suit of jactitation of marriage, in which the petitioner alleges that the respondent boasts that he or she is married to the petitioner, and prays a declaration of nullity and a decree putting the respondent to perpetual silence thereafter.

JADE (JAHDE), a deep bay and estuary of the North sea, belonging to Oldenburg, Germany. The bay, which was for the most part made by storm-floods in the 13th and 16th centuries, measures 70 sq.mi., and has communication with the open sea by a fairway, 1½ mi. wide, which never freezes, and with the tide gives access to the largest vessels. On the west side of the entrance to the bay is the port of Wilhelmshaven. A stream, about 14 mi. long also known as the Jade, enters the head of the bay.

JADE is a general term applied to the various types of minerals which are tough, hard, fine grained, and range in colour from almost pure white through clear emerald green to a dark black-green. Because of its pleasing colour and extreme toughness jade has been widely used, both by the ancients and moderns, as a lapidary stone and for small decorative carvings.

Most jades are made up of one or the other of two widely differing minerals, jadeite and nephrite. Jadeite is a pyroxene with the composition $Na_2O.Al_2O_3 4SiO_2$. It forms in nature at high pressure deep in the earth's crust at depths of 20 to 30 mi. It can be synthesized in the laboratory by subjecting the mineral analcite, $Na_2Al_2O_3.4SiO_2O$, to pressures of greater than 15,000 atm. in the temperature range of 400°–800° C. Jadeite plus water are the products. The common feldspar, albite, $Na_2O.Al_2O_3.6SiO_2$, can be converted to a mixture of jadeite plus quartz by pressures of 15,000–20,000 atm. in the temperature interval of 500°–800°. Jadeite is a rare mineral because rocks which have been subjected to this temperature and pressure are found only uncommonly on the surface of the earth. Its presence indicates great uplift of earlier deeply buried regions and great amounts of erosion. Many impurities may be present in the mineral. These are dominantly calcium, magnesium and iron oxides. The presence of these impurities accounts for the widely contrasting colour of different specimens of jadeite.

Nephrite, the other mineral of the jade family, although externally similar in appearance to jadeite, contrasts markedly in origin and in composition. Nephrite is an amphibole which may range in composition from the mineral tremolite to the mineral actinolite. The composition of tremolite is $2CaO.5MgO.8SiO_2.2H_2O$. Actinolite contains up to 50% of the molecule FeO substituting for MgO in the mineral tremolite. The colour of nephrite ranges from pure white. if it is made up solely of the tremolite molecule, to dark black-green, depending on the amount of iron in the mineral.

For discussion of hardness and other characters, occurrence and uses *see* JADE AND OTHER HARD STONE CARVINGS. (G. C. KY.)

JADE AND OTHER HARD STONE CARVINGS, in this article, refers to stones of jadeite, nephrite or similar minerals, that have been shaped for utilitarian, aesthetic or religious purposes, from earliest times to the present and in all parts of the world. For information about similar carvings in other materials, *see* GEM and JEWELLERY; for information about the mineralogical properties of jade, *see* JADE.

The Material. — The name "jade" has been applied loosely to a variety of stones worked by lapidaries, but is now confined by common consent to two only — jadeite and nephrite. These stones differ from each other both in chemical composition and in crystalline structure. The first is a silicate of sodium and aluminum and is classed as a pyroxene. It is a cryptocrystalline mineral, the minute crystals being interlocked to form a compact aggregate. It ranks as 6¾ or 7 on Mohs' scale of hardness, and has a remarkably constant specific gravity of 3.33 and a refractive index of 1.65–1.68. Nephrite, on the other hand, is a silicate of calcium and magnesium belonging to the amphibole group of minerals. It is properly regarded as a compact form of tremolite or, if iron is present in considerable quantity, of actinolite. In these minerals the crystals take the form of hairlike fibres of microscopic size, and in nephrite they are felted together to form a tough and closely integrated mass. The hardness is 6½, and the specific gravity is usually close to 3.0, with extreme limits of 2.9 and 3.1. The refractive index varies between 1.60 and 1.65. Both jadestones are too hard to be scratched by metal tools, but nephrite, though not quite so hard as jadeite, has sometimes proved even more resistant to the lapidary's abrasives. The name "nephrite" was introduced as a geological term in the 18th century, but it mas not until 1863 that A. Damour showed that it had been applied indiscriminately to two minerals closely resembling each other but of quite different composition. Damour called the sodium-aluminum silicate jadeite, while the name nephrite was henceforth reserved for the silicate of calcium and magnesium.

Both stones may be white or colourless. The great range of shades of green, brown, mauve, blue, yellow, red, gray and black is mainly due to the presence, usually in very small quantities, of other elements such as iron, chromium and manganese. The two minerals, when worked and polished, can usually be distinguished by their appearance alone. The fine lustre of polished nephrite is oily rather than vitreous, and that of jadeite the reverse, while some colours are peculiar to one stone and some to the other. For example, the popular apple- and emerald-green jewelry jades are invariably jadeite. There are wide variations of translucency in both stones.

Confirmed occurrences of jadeite were rare prior to the 1940s, and the large deposits near Tawmaw in upper Burma are still the only important source of gem-quality material. The mineral has now, however, been located in Japan (Niigata prefecture), at several places in western California, in Celebes and New Guinea (traces) and most recently in the Motagua river valley of Guatemala. Occurrences of nephrite are more numerous. China's most important source throughout its history has been the region of Khotan (Hotien) and Yarkand in central Asia. In more recent times the Chinese have also imported nephrite from the neighbourhood of Lake Baikal in eastern Siberia. Other important sources are in the South Island of New Zealand from which the Maoris obtained their supplies; near Kotzebue in Alaska; and along the Sweetwater river in Wyoming. Great boulders of nephrite have been found near Jordanow Slaski (Jordansmiihl) in the Silesia region. Pol., and in the valleys of the Turnagain and Fraser rivers in British Columbia. There are geological reports of nephrite from Brazil and of both nephrite and jadeite from the Ligurian Apennines.

From time to time the presence of jadestone has been reported or rumoured in several provinces of China and in many other countries, but these reports are at present unconfirmed and in most cases have been shown to be false. The frequency of misleading rumours is mainly due to inexact terminology and the fact that certain other minerals are easily mistaken for jade. Mexico, Tibet, Mongolia, Manchuria and Indochina have been repeatedly named as sources of jadestone, but it has not been proved to exist in any of them.

Jade in the Neolithic Age. — Both the jadestones, nephrite and jadeite, were worked into implements by Neolithic man in many parts of the world. The best-known finds are those from the lake dwellings of Switzerland, from western France and from China, but specimens have been reported from many countries of Europe, Asia and America. Jade is hard, tough and heavy; it takes and keeps a good edge, while its fine colours and warm polish must have been the delight of the Stone-Age craftsman. Unlike most stones it cannot be chipped or flaked, yet the laborious task of fashioning it with sandstone rubbers may well have seemed to be justified by the result. In more recent times too, primitive men to whom metals were unknown, like the Alaskan Indians and the Maoris of New Zealand before their discovery by Captain Cook, have made and treasured tools, weapons and simple ornaments of jade. When, however, the stone cultures were succeeded by those of bronze and iron, jade gradually lost its industrial value and fell from favour as a gem stone in all but a few regions. Evidence as to the possibility that the Greeks and Romans were

acquainted with jade is inconclusive.

Mexico and Central America. — The first carved jades to reach Europe in historical times were brought back by the early Spanish navigators from their colonies in Mexico and Central America. where the natives wore them as ornaments, amulets and badges of rank. Among the Spaniards they acquired a reputation for the cure and prevention of diseases of the kidneys, whence the stone became known as *piedra de los riiiones* ("stone of the kidneys") or *piedra de ijada* ("stone of the flank" or "of the loins"). This name passed into French as *le jade* and into English as "jade." The name *piedra de los riiiones* was rendered *lapis nephriticus* in Latin writings, and this in due course gave us our word "nephrite." But since jadeite was the material of the Aztec and Mayan jade carvers. and the great majority of their works in collections are of that material, it follows that the *lapis nephriticus* of 16th- and 17th-century writers was, in fact, what is now called jadeite.

Nearly all the Meso-American jades are of one or another shade of green, ranging from emerald through apple (sometimes mottled with nhite), pea and celadon to greenish-gray. There are also the peculiar bright green and the very dark green of the varieties known respectively as diopside-jadeite and chloromelanite. The Aztecs knew them all by the generic name of *chalchihuitl,* and had distinctive names for the various colours. The most highly prized was the emerald green, which they called *quetzalchalchihuitl,* after the brilliant plumage of the quetzal bird. The carvings comprise plaques, figurines, small masks, pendants and implements. Most of them have smoothly polished surfaces, and some follow the kidneylike conformation of the pebbles from which they were carved, so that notions of sympathetic magic may have given rise to the belief in their therapeutic value. The appreciation of jade and the art and craft of jade carving in Middle America died out soon after the Spanish conquest.

China. — Jade and jade carving are associated pre-eminently with China since in no other region of the world has this obdurate material, too hard to be cut by steel, been worked with such skill and in such a long and unbroken tradition. From the dawn of their civilization the Chinese have regarded jade as the fairest and most desirable of stones, a material supremely fit to be fashioned into religious ritual objects and the insignia of kings and princes. It was believed to be, in a special sense, a product of Heaven itself, and so to be highly charged with creative force. Mysterious powers of healing the body and even of conferring immortality were attributed to it. Jade amulets were buried with the dead for their supposed virtue as a preservative of the corpse. Others were kept in the home or carried on the person. But apart from this the mere possession and frequent contemplation of finely worked objects of jade, especially white jade, have been held to be conducive to the cultivation of virtue and the expulsion of evil thoughts from the mind. In the course of time the stone became a recognized medium of artistic expression, and the craft of the jade carver enjoyed a status comparable to that of the goldsmith in the west. The word *yü* 玉 ("jade") is employed in Chinese metaphor as a symbol of nobility, beauty and purity, much as "gold" and "golden" are used in English.

Jade in its natural state is not found within the 18 provinces of China proper, and there is at present no valid evidence that it was ever obtained from native sources. The belief that it was may be accounted for by the fact that in Chinese writings the name for jade, *yü,* was frequently applied to lapidary stones in general, especially those showing some resemblance to jade, such as the serpentines. The provinces of Kansu, Shensi and Yunnan, moreover, which have been credited with the production of jade, would have acquired such a reputation because the stone entered China by routes passing through those provinces, from which other parts of the country received their supplies.

It is probable that the Chinese always obtained their jadestone, as they certainly have done for more than 2,000 years, from the region of Khotan and Yarkand in what is now Sinkiang, where pebbles and boulders were collected from the beds of rivers, and where jade was later quarried from deposits in the western Kunlun mountains. The length and hazards of the journey were one reason for the high price it commanded in China.

From Neolithic sites have come not only tools, but what are believed to be simple cult objects in the form of flat disks with circular orifices at the centre. In the Bronze Age and throughout the formative period of their civilization, jade was the most precious substance known to the Chinese. It was conspicuous in court ceremonial, and it shared with bronze the function of providing the material, or the principal component, of ritual objects. The stone of the ancient Chinese jade carvers was nephrite. There are many allusions to yii in the classics. In the most ancient ritual text, the *Chou li,* dating from the 4th century B.C. but perhaps containing material from earlier times, certain jade insignia and ritual jades are named and their functions rather cryptically defined. The most notable are the *pi* 璧 and the *ts'ung* 琮. The disk with the circular perforation is identified with the first and regarded as the ancient symbol of the Supreme Deity, the Lord on High, or Heaven. It is the most sacred and venerable of Chinese religious symbols, occupying a place in the Chinese world comparable to that of the cross form in Christendom. The reason for its adoption as the divine symbol is uncertain. It may represent the solar disk, or perhaps the hole may depict the sun shining in the vault of heaven. Its form has been used as an ornamental device and as a base for decorative design, especially in jade, throughout the history of China. Another well-known form, the hollow cylinder or truncated cone enclosed in a rectangular body, is identified with the *ts'ung,* traditionally the symbol of the deity Earth, the complement and counterpart of Heaven. Here again the origin of the shape is obscure. The most acceptable explanation is that it derives from the plan of ancient royal tombs, such as those revealed by the excavations at Anyang, Honan province. Certainly a better symbol of Mother Earth could hardly be found than the portal by which her children returned to her bosom. Other ritual objects mentioned in the *Chou li* have been identified provisionally with various ancient jades in collections.

The earliest ornamental jades comprise small plaques and pendants, shaped from slabs of the stone a few millimetres thick, with surface decoration incised or in low relief. The majority represent animals — mammals, birds, fish and insects. The most common are dragons, tigers, deer, hares, pheasants, owls and parrots. The manner in which many of them were used is unknown since the clothing or other material to which they were attached has perished long ago. They are datable by the circumstances of excavation or by analogy with the decoration of ritual bronzes of the first stylistic phase; *i.e.,* to the Shang-Yin or early Chou dynasty (*c.* 1550–900 B.C.).[1] More accomplished carvings were executed in the middle and later reigns of the Chou dynasty, especially after the introduction of iron tools, perhaps about 500 B.C. From then onward the application of jade carving was extended from simple ritual objects and small slabs with decorated surfaces to many articles of use and luxury — belt hooks and ornaments, sword and scabbard furniture, hollow vessels, sculpture in the round and fittings with loosely linked parts contrived from the solid block or pebble. The best designs of this period are of unsurpassed excellence and breath-taking beauty to which the camera can hardly do justice. The craft attained maturity toward the close of the Chou dynasty in 249 B.C., and continued to show notable achievements of design and workmanship in the succeeding Han period (206 B.C.–A.D. 220).

Criteria for the dating of Chinese jade carvings, at least to within a few centuries, have been fairly well established up to this period by excavation or by analogy with works of art in other materials. By comparison very few sites dating from the 3rd century to the Ming dynasty (A.D. 1368–1643) have been excavated under control.

The artistic potentialities of this remarkable mineral were by this time fully appreciated, and though still laborious to work jade was found to be free from some of the limitations imposed by the material of other crafts. The subject matter and its treatment

[1] Since Chinese dynastic dates are not universally agreed upon among authorities, the dates given here are not necessarily the same as those in other articles. In each case the author's preferences were followed.

therefore tended to diverge from those of the others, so that recognizable analogies are fewer. The many delightful animal carvings in jade are particularly hard to date since their forms depend less upon the unfettered will of the designer than upon the peculiar shapes and markings of the pebbles or boulders from which they are fashioned. For the 18th century more evidence is available, especially in regard to the reign of the great Ch'ien-lung emperor (1736–95). Under his patronage and in those times of exceptional prosperity and luxury there was great interest in jade and jade carving. Many thousands of carved jades were added to the imperial collections, upon some of which poems composed by their owner were incised in characters imitating the imperial calligraphy. Jade was applied to countless new uses in the Forbidden City and the stately homes of nobles and officials. Though the inspiration of the designers of 2,000 years earlier was rarely attained, the execution and finish left nothing to be desired. Greater quantities of the raw material were entering China than ever before, and designers, craftsmen and purchasers became more discriminating. Fabulous prices were paid for fine work in nephrite of choice colours and textures, like the famous yang chih 羊脂 ("congealed mutton fat"), the dark green pi *yü* 碧玉 and the rare chi-tan huang 雞蛋黃 ("egg-yolk yellow"). There was also renewed interest in ancient jades and in such curiosities as the burned and calcified carvings called *chi-ku pai* 雞骨白 ("chicken-bone white").

At this period too began the vogue for the vivid-green jadeite of Burma, later to become familiar to Europeans and Americans in the form of Chinese jewelry jade. Jadeite does not appear to have been worked in China before the 18th century A.D. when it was entering the country through Yunnan province from Burma. A contemporary Chinese writer regarded it as having merely "usurped the name of jade," but the brilliant emerald-green colour of some of the finer specimens soon earned it a place in public esteem as high as that of nephrite. An old name, *fei-ts'ui* 翡翠 ("plumage of the kingfisher"), which had been applied at least as early as the 11th century to certain fine green nephrites but had passed out of currency, was revived to distinguish the new material. This is the name by which it is still known throughout China. The belief that Burmese jadeite was carved in China in much earlier times appears to rest on a confusion of the two uses of the term, *fei-ts'ui*.

Jade carving, both of *yü*, nephrite, and fei-ts'ui, jadeite, has been practised with great skill and success, notably in Peking, in the 20th century. The best work is little inferior in design and quality to that of the Ch'ien-lung period. Most of the jadeite jewelry has been carved in Canton and Shanghai. *See* also CHINESE SCULPTURE.

India and Persia.—Jade carving in India is associated especially with the courts of the Mogul emperors. Prior to the end of the 16th century the Indians had no tradition of jade carving, though certain other hard stones, notably rock crystal, had been worked in the Islamic world, including India, for centuries. Within a few decades jade vessels of a quality and complexity of design unequaled anywhere but in China, but markedly different in style, were appearing in India. It has been surmised that the Moguls succeeded in attracting Chinese jade carvers to India, as they did craftsmen from other countries.

The material used for Indian carvings was nephrite, usually white or pale green, apparently imported from Khotan or Yarkand like the jade used by the Chinese themselves, since there is no known source of gem-quality nephrite in India. The most distinctive and un-Chinese of the Mogul jades are the hilts of swords and daggers of Persian design. These are usually plain but beautifully formed and finished, and since they would not require the more complicated equipment used for making and decorating the vessels, they may well have been worked by Persians or Afghans in their own countries or in India. The favourite technique of decoration of Mogul jades is insetting with gold and precious stones, diamonds, rubies or emeralds, an example of painting the lily that would hardly have commended itself to the Chinese jade carver, though the result is a fine glow of colour. In the 18th century some of these Indian jades reached Peking, perhaps as imperial gifts, and were there inscribed with eulogistic poems by order of the Chinese emperor. Other jades in the Mogul style appear to have been carved in China to satisfy the vogue there for wares in the "Indian taste," or possibly even for export to India. See also INDIAN ART; ISLAMIC ART.

New Zealand.—Until Capt. James Cook landed in New Zealand in 1769, the Maoris were entirely ignorant of metals. Their weapons, tools and ornaments were made of hard and tough woods, whalebone, shell and stone. The most highly prized of their industrial stones was the *pounamu*, or nephrite, known to the European settlers as "greenstone." From it they made axes, knives, chisels, adzes and the mere, or warclubs, of their chiefs. A mere is about 13 to 15 in. long, of flattened shape and tapered toward the edges. It has a hole drilled in the handle through which a thong was passed to secure it to the wrist. These jade clubs served not only as weapons, but as symbols of authority and muniments of title to land. They were usually worked from stone of specially fine colour or distinctive markings.

Jade jewelry of the Maoris consisted chiefly of earrings and pendants, of which the hei-tiki is the most characteristic. The name means "neck ornament in human form." The shape varies little, being that of a squat figure with a big head inclined to one side. These pendants were treasured as mementos of ancestors and greatly venerated, though not, it appears, as objects of religious worship.

Europe and the U.S.—Jade carving has not been practised extensively in the west in historical times. Some beautifully designed gems and trinkets incorporating jade, chiefly Siberian nephrite, were made in the ateliers of the St. Petersburg jeweler Peter Carl Fabergé (active 1870–1918). The sculptor Donal Hord, of San Diego, Calif., has carved some remarkable statues from Wyoming nephrite, using power-driven drills and carborundum sticks. He records that he and one assistant devoted 15 months' steady work to fashioning and polishing a figure weighing 161 lb. from a 300-lb. block. The stone is also worked into small ornaments on power lathes by amateur lapidaries, especially in the U.S.

Technique.—The means by which jade was worked in prehistoric times may be inferred from examination of artifacts and the records of methods employed by the Maoris within the 19th century. The stone was cut with laminae of sandstone or with "hard cutters" of slate, working in quartz sand and water, and then shaped with sandstone rubbers. Holes were made by drills of wood, hollow bone or bamboo carrying the wet sand. These perforations were usually conical in shape due to the rapid wearing away of the tool, or biconical if drilled from opposite sides of the jade. In the Bronze and Iron ages metal tools were used as vehicles for the abrasive. Most of the work of Chinese lapidaries in modern times is carried out, as it has been for centuries, on rough treadle-operated lathes fitted with tools of steel, wrought iron, wood and leather. This method avoids the dangers to the material attendant on high speeds, but leaves the craftsman's hands free to manipulate the jade and to apply the abrasive "sand" mixed with water to the rotating head of the tool. The natural abrasives formerly in use, such as crushed garnets and corundum (emery), have been superseded in the 20th century by carborundum. Perforations are drilled with the diamond point, and enlarged with a wire saw. A great variety of tools is employed, but there is much specialization, so that any important carving is almost certain to be the work of a team of specialists. The training is long and arduous, and the work makes great demands on the craftsman's patience.

Minerals and Imitations Mistaken for Jade.—Several minerals native to China have a superficial resemblance to nephrite and, because of the scarcity and high value of the latter, have been worked and applied to the same purposes through the ages. These stones were also called *yü* by the Chinese, who nevertheless recognized them as substitutes for *chen yü* 眞玉 ("true jade"; nephrite). They are sometimes designated *fu* yu 玞玉 ("false jades"). Though softer than nephrite, they are usually carved less skillfully, and in any case they do not take its characteristic polish. Fraudulent imitations of ancient jades are, of course, always made of true jade, though sometimes it is artificially

stained. Most of the false jades prove to be one or other variety of serpentine. Apart from lacking the lustre of nephrite they are lower both in hardness and in specific gravity. The variety which approaches those of nephrite most closely is known as bowenite, which has a hardness ranging up to 6 and a specific gravity of 2.8. Bowenite carvings and other false jades are often "improved" by staining. Pyrophyllite, an aluminum silicate, is another mineral extensively carved in China and sometimes mistaken for nephrite, but it is still softer and lighter than bowenite. There are a few cryptocrystalline minerals of a weight and hardness near to those of jadeite, such as sillimanite, an aluminum silicate, and saussurite, a silicate of calcium and aluminum (a mixture of zoisite or epidote and feldspar). Lacking the natural beauty of jade and being no easier to work, they have, however, rarely been used as substitutes. The most successful imitations of jadeite are artificial and made of a heavy lead glass, cleverly tinted to imitate the distinctive apple-green colour. Great numbers of bracelets, necklaces, earrings and pendants of this material are in circulation.

Other Hard Stones.—Many other ornamental stones have been carved and polished by methods similar to those of the jade carvers. The Chinese have also excelled in working these, though none have enjoyed the esteem that the Chinese have accorded to jade. The most numerous are members of the quartz group, the gem varieties of which fall into three categories—the transparent, the translucent and the opaque. The transparent varieties are found as single individual crystals, occasionally two feet or more in length. They comprise the clear, colourless rock crystal, the amethyst and citrine, the smoky quartz and the rose quartz (the last is not fully transparent). The translucent varieties consist of an aggregate of minute, needle-shaped crystals arranged in parallel layers and have the general designation of chalcedony. There is a wide range of colours. The yellow, orange and red are called carnelian, the brown is called sard and the bright green chrysoprase. There are also pale blue, violet and mauve chalcedonies. The natural colours have sometimes been changed or brightened by impregnating the heated stone with dyes, the presence of which is not easily detected by the naked eye. Agate is the well-known variety in which successive layers of the stone are brought into prominence by being differently coloured. Clever use has been made of this peculiarity by Chinese lapidaries to portray natural objects of contrasting colours. Aventurine quartz is a translucent stone containing small flakes of mica which give it an attractive spangled effect. In the opaque quartzes the finely granular aggregate is coloured with intermixed impurities, as in the many-hued jaspers with their attractive streaked and mottled effects. A number of other beautiful opaque stones have been worked by lapidaries through the centuries. Lapis lazuli is a crystalline limestone coloured with minute crystals of the deep-blue mineral lazurite, and speckled with brassy yellow iron-pyrites. Turquoise is a hydrous phosphate of aluminum with variable amounts of copper and iron, giving colours ranging from sky blue to pale sea green. Malachite is a hydrous carbonate of copper of rich warm green colour; it forms in rounded nodules which impart a marbled effect to the carved and polished surface. A relatively inexpensive translucent stone, with a hardness of only 4 on the scale, and also extensively worked by the Chinese, is fluorspar or fluorite. This is found in a wide range of delicate colours, the best known being the pale greens and the blues.

Two other gem materials, though not in fact minerals, have been worked by lapidary techniques, and with outstanding success both in Europe and China. They are amber, a fossil resin ranging in colour from "amber yellow" to reddish and dark brown; and coral, the closely compacted and petrified skeletons of colonies of the minute coral polyps. The most highly valued colour is the beautiful rose pink.

BIBLIOGRAPHY.—J. P. A. Rémusat, *Histoire de la ville de Khotan, tirée des annales de la Chine et traduite du chinois; suivie de Recherches sur la substance minérale appelée par les Chinois Pierre de Iu, et sur le jaspe des anciens* (1820); H. Fischer, *Nephrit und Jadeit nach ihren mineralogischen Eigenschaften sowie nach ihrer urgeschichtlichen und ethnographischen Bedeutung*, 2nd ed. (1880); F. R. Chapman, "On the Working of Greenstone or Nephrite by the Maoris," *Trans. N.Z. Inst.*, xxiv (1892); S. W. Bushell, G. F. Kunz *et al.*, *Investigations and Studies in Jade: the Heber R. Bishop Collection*, 2 vol., available in only a few libraries (1906); B. Laufer, *Jade: a Study in Chinese Archaeology and Religion* (1912). The above are records of pioneer research by Europeans and Americans on jade and jade carving.

H. G Robley, *Pounamu: Notes on New Zealand Greenstone* (1915); G. T. Emmons, *Jade in British Columbia and Alaska and Its Use by the Natives* (1923); T. A. Joyce, *Maya and Mexican Art* (1927); H. L. Chhibber, *The Mineral Resources of Burma* (1934); W. C. White, *Tombs of Old Lo-yang* (1934); H. D. Skinner, "New Zealand Greenstohe," *Trans. Roy. Soc. N.Z.*, lxv (1935); H. C. Bainbridge, *Peter Carl Fabergt: His Life and Work* (1949); S. H. Hansford, *Chinese Jade Carving*, includes a bibliography of Chinese and western writings (1950) and *The Seligman Collection of Oriental Art*, vol. I, *Chinese Bronzes, Jades and Sculptures* (1957); A K. Snowman, *The Art of Carl Fabergt* (1953); W. F. Foshag, *Mineralogical Studies on Guatemalan Jade*, includes a bibliography of writings in Spanish and English (1957); S. K. Lothrop, W. F. Foshag and Joy Mahler, *Pre-Columbian Art in the Collection of Robert Woods Bliss* (1957).

For excellent illustrations *see* also: S. Jenyns, *Chinese Archaic Jades in the British Museum* (1951); A. Salmony, *Carved Jade of Ancient China* (1938), *Archaic Chinese Jades in the Edward and Louise B. Sonnenschein Collection* (1952). (S. H. HD.)

JAEGER, the name used in America for three species of smaller, lighter-built skuas (*q.v.*) with a central pair of tail feathers 3 to 7 in. beyond the others. Like the great skua, with central tail feathers almost even with the next, they are gull-like, but with plumage chiefly sooty or blackish (or lighter below), cered and hook-tipped bill, and large, strongly-hooked, sharp claws. They are strong, rapacious pirates of the high seas, harassing gulls and terns until they disgorge food. Jaegers constitute the genus Stercorarius and, with the skua (Catharacta), the family Stercorariidae next to the gulls in the order Charadriiformes. (G. F. Ss.)

JAÉN, an inland province of southern Spain, formed in 1833 of districts belonging to Andalusia; bounded N. by Ciudad Real and Albacete, E. by Albacete and Granada, S. by Granada, and W. by Córdova. Pop. (1940) 753,308; (1950) 781,228; area 5,209 sq.mi. Jaén .comprises the upper basin of the river Guadalquivir. The Sierra Morena, which divides Andalusia from New Castile, extends along the northern half of the province, its most prominent ridges being the Loma de Chiclana and the Loma de Úbeda; the Sierras de Segura, in the east, derive their name from the Segura river, which rises just within the border; and between the last-named watershed, its continuation the Sierra del Pozo, and the parallel Sierra de Cazorla, is the source of the Guadalquivir. The loftiest summits in the province are those of the Sierra Magina (7,103 ft.). In a region which varies so markedly in the altitude of its surface, the climate is naturally unequal; and while the bleak, windswept highlands are available only as sheep-walks, the well-watered and fertile valleys favour the cultivation of the vine, the olive and all kinds of cereals. The mineral wealth of Jaén has been known since Roman times, and mining became an important industry, with its centre at Linares. Lead, iron, copper and salt are obtained. There is trade in timber and cloth; esparto fabrics, alcohol and oil are manufactured. The main line Madrid-Córdova-Seville was joined south of Linares by two railways—from Algeciras and Málaga on the southwest, and from Almeria on the southeast. In the western half are Jaén (*q.v.*), the capital, with Andújar, pop. (1950) 26,993 (mun.), Baeza 17,028, Bailén 10,253, Linares 52.819, Martos 30,513 and Úbeda 30,378. The province remained mostly under government control until the end of the civil war of 1936–39.

JAÉN, the capital of the Spanish province of Jaén, on the Linares-Puente Genil railway, 1,500 ft. above the sea. Pop. (1950) 56,733 (mun., 61,247). Jaén is finely situated on the well-wooded northern slopes of the Jabalcuz mountains, overlooking the valleys of the Jaén and Guadalbullon rivers, which flow north into the Guadalquivir. The hillside upon which the narrow and irregular city streets rise in terraces is fortified with Moorish walls and a Moorish citadel. After the Moorish conquest the town became a commercial centre with the name Jayyan. Jaén was made an episcopal see. Its cathedral was founded in 1532; and, although it remained unfinished until late in the 18th century, its main characteristics are those of the Renaissance period. The identification, sometimes suggested, of Jaén with the Roman Aurinx is doubtful.

JAFARABAD (JAFRABAD), a taluka (subdivision) of Gohilwad district, Bombay state, India, on its southeast coast. Area, 149 sq.mi.; pop. (1951) 29,842. Before 1947 Jafarabad was ruled by the nawab of Janjira (*q.v.*) and politically controlled through the Western India States agency. Jafarabad town (pop. 7,296) is a port for coastal trade.

JAFFA: see JOPPA.

JAFFNA (native Yalpannan), a town of Ceylon, at the northern extremity of the island. Pop. (1953) 77,181. It was occupied by the Tamils about 204 B.C., and there continued to be Tamil rajahs of Jaffna till 1617, when the Portuguese took possession of the place. As early as 1544 missionaries under Francis Xavier had made converts in this part of Ceylon, and after the conquest the Portuguese maintained their proselytizing zeal. They had a Jesuit college, a Franciscan and a Dominican monastery. The Dutch drove out the Portuguese in 1658. It was occupied by the British in 1795. Several of the church buildings date from the time of the Portuguese. The natives grow palmyras freely, and established a trade in the fibre of this palm. They also grow and export tobacco.

JÄGER, GUSTAV (1832–1917), German naturalist and hygienist, was born at Burg, Württemberg, on June 23, 1832. After studying medicine at Tübingen he became a teacher of zoology at Vienna. In 1867 he was appointed professor of zoology at the academy of Hohenheim, and subsequently he became teacher of zoology and anthropology at Stuttgart polytechnic and professor of physiology at the veterinary school. In 1884 he abandoned teaching and started practice in Stuttgart.

In 1876 he anticipated August Weismann's germ-plasm theory by suggesting that the germinal protoplasm retains its specific properties from generation to generation, dividing in each reproduction into an ontogenetic portion, from which the individual arises, and a phylogenetic portion, reserved to form its reproductive material. In Die *Normalkleidung, als Gesundheitsschutz* (1880, 4th ed. 188j), he advocated the system of clothing associated with his name, objecting especially to the use of vegetable fibre for clothes. Jager died at Stuttgart on May 14, 1917.

Jager's other works include: *Die Darwinsche Theorie* (1869), *Lehrbuch der allgemeinen Zoologie* (1871–78), and *Die Entdeckung der Seele* (1878); *Selbstarznei im Heilmagnetismus* (1908) and *Leben im Wasser* (3rd ed. 1908).

JAGERSFONTEIN, a town in the Union of South Africa, 29° 42' S., 25° 25' E. Pop. (1951) 3,303 (1,142 white). The town is situated about 4,500 ft. above sea level, and owes its existence to the most important diamond mine in the Orange Free State. The mine was originated in 1870, and produced stones of fine quality. There were found the "Excelsior" (995.3 carats) and the "Jubilee." See DIAMOND.

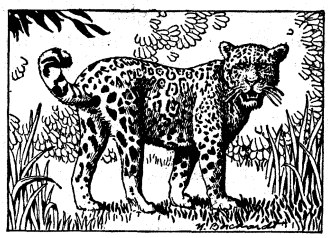
JAGGARD, WILLIAM (c. 1568–1623), English printer who published the First Folio of Shakespeare's plays, described as "the most important publication in English literature," was born c. 1568. He became a bookseller in London c. 1592 and a printer c. 1604. In 1610 he was appointed printer to the City of London, but soon after was stricken blind. He maintained, nevertheless, a flourishing business. About 1598 Jaggard published an anthology, The Passionate Pilgrirne, supposedly by Shakespeare, although three-quarters of the poems were by others. Only a fragment of this edition exists. In 1599 he published a second edition, and in 1612 he "much offended" Shakespeare by issuing a third edition which included several poems of Thomas Heywood without authorization of either poet. In 1619 Jaggard traded further on the popularity of Shakespeare's name by surreptitiously printing ten plays, some by Shakespeare, some falsely ascribed to him. Two years later, however, he began printing for Shakespeare's fellow actors his collected plays, a financially hazardous venture. The First Folio of Shakespeare was published in 1623, shortly after Jaggard's death. In it appeared for the first time half of Shakespeare's plays. It contains the Droeshout portrait which has become conventionally accepted as the best likeness of Shakespeare.

See E. E. Willoughby, *A Printer of Shakespeare* (1934); J. Q. Adams' introduction, "The Printing of the First Folio of Shakespeare," to facsimile, *The Passionate Pilgrime* (1939). (E. E. WI.)

JAGOW, GOTTLIEB VON (1863–1935), German foreign secretary at the outbreak of World War I, was born on June 22, 1863 in Berlin. He entered the diplomatic service in 1895 and after having been Prussian minister at Munich, German ambassador at Rome and German minister at The Hague, was appointed in 1913 foreign secretary. He played an active part in the negotiations preceding the outbreak of World War I and was, in particular, concerned in the German relations with Austria, being the first member of the Imperial government in Berlin to become acquainted with the terms of the Austrian ultimatum to Serbia. He wrote a defense of German policy *Ursachen und Ausbruch des Weltkrieges* (1919).

JAGUA: see CIENFUEGOS.

JAGUAR (Panthera onca), the largest species of the Felidae on the American continent, where it ranges from Texas through Central and South America to Patagonia. In the regions which bound its northern limit it is not frequently met, but in South America it is quite common. The jaguar is usually found singly and preys upon such quadrupeds as the horse, tapir, capybara, dog and cattle. Occasionally the jaguar becomes a man-eater. The cry of this great cat, which is heard at night, and most frequently during the pairing season, is deep and hoarse. Toward the close of the year the female brings forth from two to four cubs which are able to follow their mother in about 35 days after birth. The ground colour of the jaguar varies greatly, ranging from white to black, these extremes being, however, definite sports. The typical coloration is orange tan upon the head, neck, body, outside of legs and tail near the root, marked, except towards the end of the tail, which is ringed, with black spots, arranged in rosettes with a black spot in the centre (unlike the leopard). The nose and upper lip are light rufous brown. The average length is about 4 ft. from nose to root of tail. The jaguar is thick-set; it does not stand high upon its legs and in comparison with the leopard is heavily built; but its movements are rapid, and it is as agile as its more graceful relative. There are a number of local races in various parts of its range.



BY COURTESY OF THE N.Y. ZOOLOGICAL SOCIETY

JAGUAR, A LARGE AMERICAN CAT

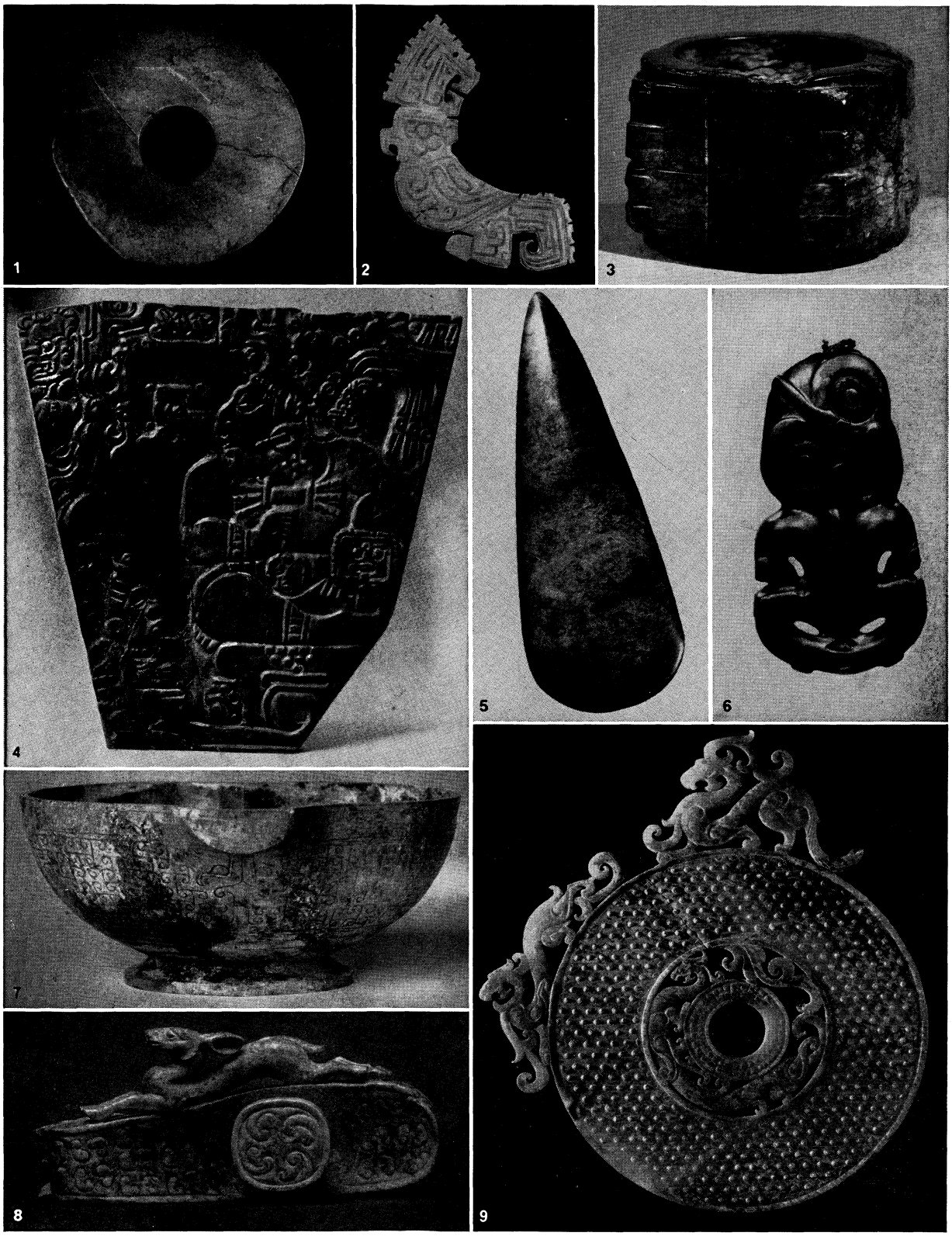
JAGUARÃO RIVER (Spanish Yaguarón) rises in the hilly upland of southern Rio Grande do Sul, Brazil, a little east of Bagé, and flows 135 mi. S.E. to Lagôa Mirim. For most of its course it forms the boundary between Brazil and Uruguay. It is not navigable. Between the towns of Jaguarão in Brazil and Rio Branco in Uruguay there is a highway and railroad bridge across the river. The highways on the Uruguayan side are not passable in wet weather. The Jaguarão flows through thinly populated ranch country. (P E. J.)

JAGUARONDI or YAGUARONDI (Felis jaguarondi), a small, unspotted American wild cat, found from southern Texas through central and South America to northern Argentina (30° S.). There are two colour phases, one dark gray (blackish mixed with whitish), the other rusty-red, sprinkled with black on the back. The red variety is called eyra (*q.v.*). (J. E. HI.)

JAHANGIR (JEHANGIR) (1569–1627), Mogul emperor of Delhi, succeeded his father Akbar the Great in 1605. His name was Salim, but he assumed the title of Jahangir. "Conqueror of the World," on his accession. During his father's Deccan campaign of 1598–99, he had meditated rebellion, but in 1604 they were reconciled, the son being made viceroy of southern and western India and allowed to live in Agra as heir apparent. After his enthronement on Oct. 24, 1605, Jahangir won a certain amount of popularity by declaring himself a Moslem, but his zeal soon waned, and his natural scepticism manifested itself in his indifferent toleration both of Christians and Hindus. In 1606, his son, the popular Prince Khusru, attempted rebellion with the result that some 300 of his supporters were brutally put to death and he himself blinded and imprisoned until 1622 when he was strangled by order of his brother Prince Khurram. Jahangir succeeded in keeping under control the'rana of Udaipur, Malik Amber the vizier of the Nizam shah in the Deccan, and the rebels of Bengal, though in 1622 he lost Kandahar to the shah of Persia. The rebellion of his son Shahjahan in 1624 was patched up by an apparent reconciliation in the following year.

In spite of opposition from the Portuguese, the missions of the Englishmen, William Hawkins, William Edwards and the ambassador, Sir

JADE AND OTHER HARD STONE CARVINGS

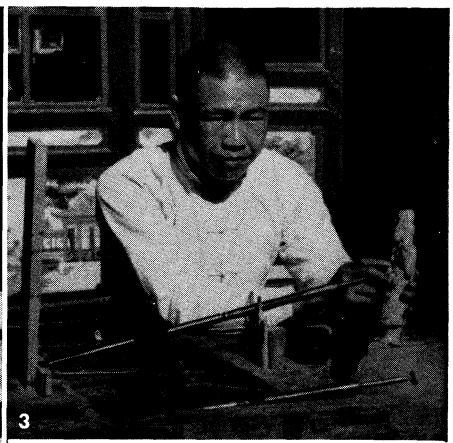


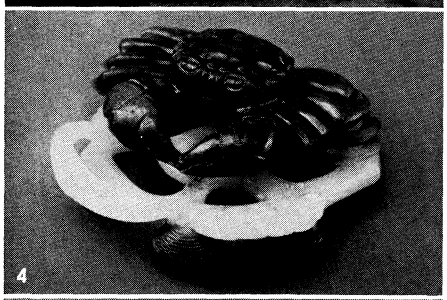
BY COURTESY OF (1) HIS MAJESTY KING GUSTAV VI ADOLF OF SWEDEN, (2–6) THE TRUSTEES OF THE BRITISH MUSEUM. (7) SMITHSONIAN INSTITUTION, THE FREER GALLERY OF ART, WASHINGTON, D.C.. (8) THE FOGG MUSEUM OF ART, CAMBRIDGE, MASS., (9) NELSON GALLERY–ATKINS MUSEUM (NELSON FUND), KANSAS CITY, MO.

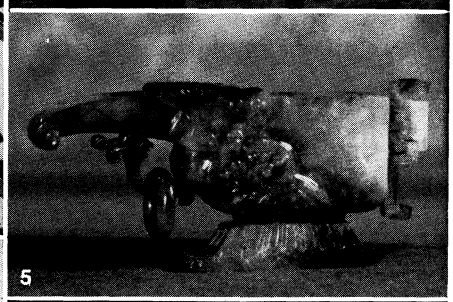
ANCIENT CARVINGS IN JADE

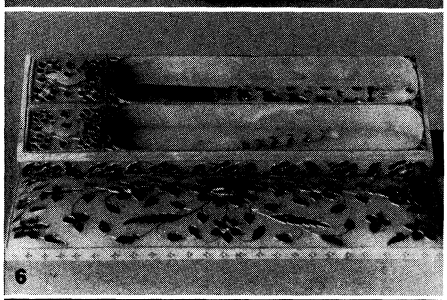
1. Nephrite ritual disk, ***pi.*** Chinese Neolithic. Diameter 7 in.
2. Nephrite carving of a cockatoo. Chinese, Shang dynasty (about 1550–1028(?) B.C.). Height 5⅛ in.
3. Nephrite ritual object, ***ts'ung.*** Chinese, Chou dynasty (1027–249 B.C.). Height 2⅝ in.
4. Jadeite plaque found at Teotihuacan, Mexico, but apparently of Mayan workmanship. Height 5½ in.
5. Jadeite ceremonial ax found at Canterbury, Eng. Bronze Age, about 1,400 B.C. Length 8⅝ in.
6. Nephrite pendant, ***hei-tiki.*** New Zealand. Height 4¼ in.
7. Nephrite heart-shaped cup. Chinese, period of the Contending States (about 481–221 B.C.). Length 4½ in.
8. Nephrite belt-hook. Chinese, Han dynasty (206 B.C.–A.D. 221). Length 2⅞ in.
9. Nephrite disk ornamented with figures of lions. Chinese, period of the Contending States. Height 8½ in.

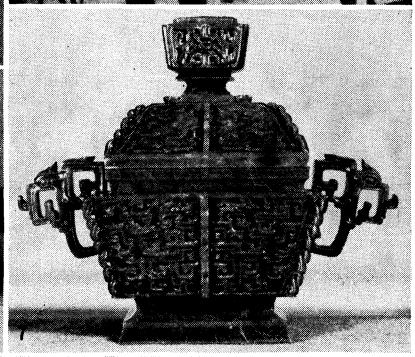
JADE AND OTHER HARD STONE CARVINGS

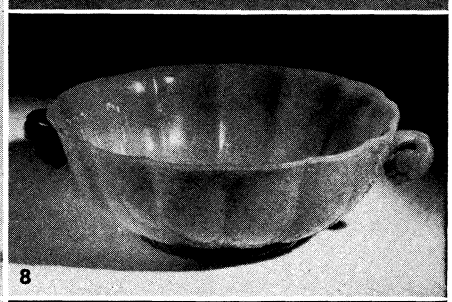


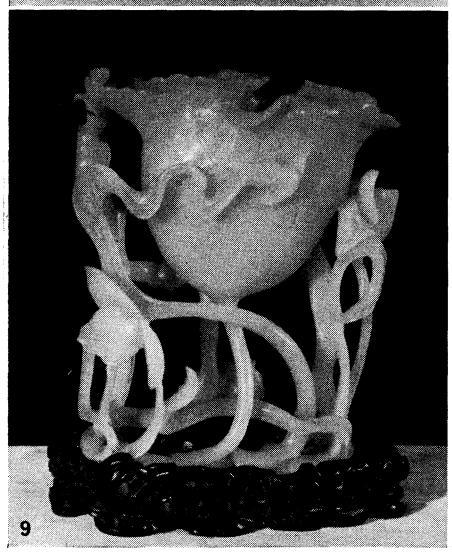












BY COURTESY OF (1–3) S. HOWARD HANSFORD, (4) SIR CHARLES HARDINGE, (5, 7) HER MAJESTY QUEEN ELIZABETH II, (6) VICTORIA AND ALBERT MUSEUM, CROWN COPYRIGHT (8) MISS M. L VON CALLENBERG, (9) T B. KITSON, ESQ (10) SIR GEORGE COOPER, (11) G J WINNER ESQ

CARVINGS IN JADE, CORAL AND LAPIS LAZULI

1. Chinese craftsman cutting a jade pebble with the circular saw, *cha-t'o,* carrying abrasive "sand"
2. Hollowing a jade snuff-bottle with the gouge. *wa-tzŭ,* and abrasive
3. Shaping a jade figure with drills and grinders
4. Black and white nephrite pebble carved to represent a crab, seaweed and shellfish. Length 3 in.
5. Apple-green jadeite water vessel. Length 3 in.
6. Indian Mogul-style pen-case and cover of white nephrite, inlaid with gold and encrusted with diamonds, rubies and emeralds. Length 8¼ in.
7. Spinach-green nephrite casket. Width 7¼ in.
8. Indian Mogul-style bowl of pale green nephrite inscribed with Imperial Ch'ien-lung poem, dated Spring, 1769. Diameter 7 in.
9. White "mutton fat" nephrite carving of a flowering lotus. Height 5¾ in.
10. Lapis lazuli table screen with carving in relief of a rocky landscape in which Shou Lao, the god of longevity, awaits the arrival of a visiting sage. Height 9½ in.
11. Rose-pink coral carving of Hsi Wang Mu, the fairy "Queen Mother of the West" riding above the clouds on a *fêng-huang,* phoenix. Height 13⅛ in.

NOTE, ALL THE CARVINGS SHOWN EXCEPT 6 AND 8 ARE CHINESE, OF THE CH'ING DYNASTY, 1644–1911, AND MOSTLY OF THE CH'IEN-LUNG PERIOD, 1736–95

Thomas Roe, led to the emperor's sanction of English trade at Surat. Though possessed of many natural abilities and a lover of art and literature, Jahangir was a dissolute, capricious and tyrannical ruler who gradually allowed his Persian wife, Nur Jahan, to secure the reins of government and thereby to satisfy the interests of her relatives and her own thirst for gold He died while returning from Kashmir in Oct. 1627, and is buried in the gardens of Shahdera on the outskirts of Lahore.

The best editions of his *Memoirs,* which were either written by himself or dictated to a scribe, appeared at Ghazipur in 1863 and at Aligarh in 1864 (Eng. trans. by Rogers and Beveridge, 2 vol, 1909–14). *See* also *Jahangir's India,* a translation from the Dutch of F. Pelsaert by W. H. Moreland (1925) and bibliography in W. A. Smith's *Oxford History of India* (2nd ed., 1923).

JAHIZ (ABU 'UTHMAN 'AMR IBN BAHR UL-JAHIZ; *i.e.,* "the man the pupils of whose eyes are prominent") (d. 1869), Arabian writer, spent his life in Basra where he devoted himself chiefly to the study of polite literature. A Mu'tazilite in his religious beliefs, he developed a system of his own and founded a sect named after him. He was favoured by Ibn uz-Zaiyat, the vizier of the caliph Wathiq.

His work, the *Kittib ul-Bayān wat-Tabyin, a* discursive treatise on rhetoric, appeared in 2 vol. (1895). The *Kitāb ul-Mahāsin wal-Addtid* was edited by G. van Vloten as *Le Livre des beautés* (1898); the *Kittib ul-Bu-halā, Le Livre des avares,* ed. by the same (1900); two other smaller works, the *Excellences of the Turks* and the *Superiority in Glory of the Blacks over the Whites,* also prepared by the same. The *Kitcib ul-Hayawtin,* or "Book of Animals," a philological work, was published at Cairo (1906). (G. W. **T.**)

JAHN, FRIEDRICH LUDWIG (1778–1852), German pedagogue and patriot, commonly called the "father of gymnastics," was born in Lanz on Aug. 11, 1778. He studied theology and philology, joined the Prussian army after Jena, and in 1809 went to Berlin, where he became a secondary-school teacher. Brooding upon the humiliation of his native land by Napoleon, he conceived the idea of restoring the morale of his countrymen by the development of their physical and moral powers through gymnastics. The first *Turnplatz,* or open-air gymnasium, was opened by him at Berlin in 1811, the young gymnasts being taught to regard themselves as members of a kind of guild for the emancipation of their fatherland. In 1813 he took an active part at Breslau in the formation of the famous corps of Liitzow, a battalion of which he commanded, though during the same period he was often employed in secret service. After the end of the Napoleonic Wars he returned to Berlin, where he was appointed state teacher of gymnastics.

A man of democratic nature, rugged, honest, eccentric and outspoken. Jahn often came into collision with the reactionary spirit of the time, and in 1819 the *Turnplatz* was closed and Jahn was arrested and imprisoned for six years. After his release he settled at Freiburg an der Unstrut, where he died on Oct. 15, 1852. He received the iron cross in 1840. and in the spring of 1848 was elected to the German national parliament.

A complete edition of Jahn's works was published at Hof in 1884–87.

JAHN, JOHANN (1750–1816), German orientalist, was born at Tasswitz, Moravia, on June 18, 1750. He studied philosophy at Olmiitz, and in 1772 began his theological studies at the Premonstratensian convent of Bruck, near Znaim, where, after a short interval, he became professor of Oriental languages and biblical hermeneutics. On the suppression of the convent by Joseph II in 1784, Jahn took up similar work at Olmiitz, and in 1789 he was transferred to Vienna as professor of oriental languages, biblical archaeology and dogmatics. His *Einleitung ins Alte Testament* (2 vol., 1792), rendered him suspect to the cardinal archbishop of Vienna who laid a complaint against him for having departed from the traditional teaching of the church, *e.g.,* by asserting Job, Jonah, Tobit and Judith to be didactic poems, and the cases of demoniacal possession in the New Testament to be cases of dangerous disease. An ecclesiastical commission reported that the views themselves were not necessarily heretical, but he was advised to modify his expressions in the future. Finally (1806) he was compelled to resign his chair and to accept a canonry at St. Stephen's, Vienna. Both his *Introductio in libros sacros veteris foederis in compendium redacta* (1804) and his *Archaeologia biblica* in *compendium redacta* (1805) were condemned. He died on Aug. 16, 1816.

He also published an edition of the Hebrew Bible (1806). The English translation of the *Archaeologia* by T. *C.* Upham (1840) passed through several editions.

JAHN, OTTO (1813–1869), German archaeologist, philologist, and writer on art and music, was born at Kiel, June 16, 1813. He was professor of archaeology at Greifswald and at Leipzig, but was dismissed (1851) from the Leipzig chair for political reasons. He was then director of the art museum at Bonn. and in 1867 was appointed to a chair in Berlin. He died at Gottingen, Sept. 9, 1869. He wrote many books on Greek art, and prepared editions of classical authors. Of his works on musical history the most important is *Biographie Mozarts* (3rd ed. by H. Disters, 1889–91; Eng. tran. by P. Townsend, 1891).

JAI ALAI is the name used in the western hemisphere for the Spanish-Basque game known as pelota vasca. *Jai alai,* from the Basque language, means "merry festival" and was adopted by the Cubans when they imported the game in 1900.

The origins of the sport are obscure, but it is generally agreed that *jai alai* evolved from handball in the 17th century. After the introduction of rubber for ball making. which created the first lively ball, athletes in the Basque provinces of Spain changed one-wall handball so that it would be faster and more interesting to watch. The first piece of equipment used after the rubber ball became popular was a *guante,* or bowl-shaped leather glove, to protect the hand. Since little speed could be obtained by hitting the ball with the *guante,* a flat wooden bat about two feet long was devised and the game of *pala* was born. It is still popular in Spain, but has not spread to other lands.

Later the *guante* took other forms and its purpose changed from a means of batting the ball to a catching and throwing device. A hand pocket was added and the basic shape was changed to a concave rigid pocket made out of heavy leather about 5×8 in. long. Using the improved *guante,* players could catch and throw the ball instead of batting it. With this modification, a side wall was added at right angles to the stone front wall and by the mid-18th century, a back wall was also used as at present.

UNITED PRESS INTERNATIONAL

JAI ALAI PLAYER DEMONSTRATING A PLAYING POSITION. THE CESTA, HOLDING THE BALL. IS STRAPPED TO THE PLAYER'S HAND

The desire for power and more efficient catching area led to the development of the *cesta,* or wicker basket. The frame of the modern *cesta* is steam-bent chestnut with ribs, which form the shape, planed down to $\frac{1}{16}$ in. thick and 1 in. wide. A durable Spanish reed is woven over the frame and ribs. The hand is inserted into a leather glove which is sewn to the outside of the *cest~* and tape is wound around the glove so that the hand cannot come out. *Cestas* vary in dimension and are tailor-made for each player.

The pelota (Spanish for "ball") used in modern *jai alai* is about three-fourths the size of a baseball. but much harder and more lively. It is constructed of hand-wound virgin de Pará rubber from Brazil. A layer of linen thread and two coats of especially hardened goatskin complete the pelota. In play, speeds of more than 150 m.p.h., or 220 ft. per second, are not uncommon and the outer cover must be replaced frequently.

In a *frontón,* as the *jai alai* auditoriums are called, the front wall is to the spectators' right, the side wall or *ble* is directly in front and the back wall or *rebote* is at the left. The front wall is constructed of huge granite blocks, since ordinary poured concrete will deteriorate under the constant hammering of the rock-hard ball. The side and back walls are made of gunite, a pressure-applied cement which is hard enough to take the secondary force of the ball, since it is always thrown to the front wall first, after which it may rebound off the back wall and ricochet off the

side wall.

The rules of the game are simple. The ball is served and the opposing player in the case of singles, or his partner in doubles games, must catch and return the ball after it hits the front wall. He can still make the catch off the back wall if the ball has hit the floor only once. This shot is one of the most spectacular since it often causes the player to hurl himself on the concrete floor to give power to his forward throw. The action during a game is virtually continuous since players must catch and throw without stopping the motion of their arms. The skill of the game lies in placing the ball out of reach of the opposition, throwing it at tremendous speed, or imparting an incredible amount of spin on the ball so that even if the opposition catch it, they will not be able to return it.

There are two types of *jai alai* games, *partidos* and *quinielas*. The former is a match singles or doubles game which lasts from 10 to 40 points and is popular in Spain, France, Cuba and Mexico. The *quiniela* version has from six to eight one- or two-man teams competing for five to seven points to establish a win; a play-off is conducted to determine place (second) and show (third) positions if teams are tied. This system is popular in Mexico and Cuba and has been used in the United States, Italy, China and the Philippines since the second decade of the 20th century. In 1935, a law was passed in the Florida state legislature permitting parî-mutuel wagering on the sport. At that time the only *frontdn* in the United States was located in Miami, Fla.; by the second half of the 20th century three more *frontones* had been built in that state and the original *frontdn*, the largest, reported attendance figures of over 330,000 persons who wagered more than $9,000,000 in 100 nights of play. (L. S. BN.)

JAINS, an important sect of dissenters from Hinduism, whose wealth gives them greater influence than their numbers, only 1,618,406 in 1951. Being generally traders they are found in most Indian cities, especially in those*of Mewlr, Guzerlt and the upper Malablr coast. Their religious centres are Mt. Abu in Rājpūtāna, Girnār and Satrunjlya and Ellora. Jainism is at least as old as Buddhism, the canons of the latter referring to it as a rival sect, the *Nirgrantha*, (Skt. "free from bonds").

Vardhamana Mahlvira, their last leader, is identifiable on strong grounds with Nigantha Nata-putta (Nirgrantha of the Jnatrika clan) of the Buddhist *Pitakas* and Buddha's contemporary. But Jain tradition claims a far greater antiquity, averring that Mahā-vira was preceded by 23 Tirthankaras or saints who have attained *nirvāna* and are also called *Jinas*, "conquerors" or leaders of schools of thought, whence the term "Jain." But how far these were historical personalities is open to grave doubt. The first, Rishabha, depicted as a golden bull, is probably mythical. The 23rd, Parshva ("a snake, and blue"), has better claims to have founded the sect some 250 years before Mahlvira. The Tirthankaras, though without care for or influence on the world, are worshipped as gods *(devas)*,the three mentioned being specially affected, while Nemi or Aristanemi, Parshva's predecessor (a black conch) also has many temples. Nemi is indeed related to Krishna in legend and this may indicate that he too is purely mythical. Mahlvira. on the other hand, is said to have been a Kshatriya (like all the rest of the 24 Jinas) of Vaishali, 27 mi. N. of Patna; brought up as a pious Jain he became a monk who discarded clothing; and after instructing 11 disciples he died at Pava (confirmed by Buddhist canons) aged 72, probably in 476 or 477 B.C.

It appears, then, safe to regard the nucleus of the sect as a strict monastic order, which eschewed ownership of everything mundane, even garments, as the Digambara ascetic does still when feasible. But Jain history has suffered much from schism. Still some facts may be regarded as ascertained. About 317 B.C. under Bhadrabāhu, Jainism expanded vigorously in north and northwest India, and good proof of this is that the language of the canons, redacted about A.D. 600 (though the Digambaras deny their authenticity), was old Magadhi (the tongue of south Behār). While it is doubtful if Samprati, a grandson of Asoka, was the first patron King of the Jains, inscriptions show that the Jains were powerful in Orissa in the 2nd century B.C., and during the 1st at Mathura. At an early stage, however, schisms had weakened the sect. Mahāvīra was succeeded by patriarchs. But there are two distinct lines of them. According to the Digambaras, in the time of Bhadrabāhu arose the Ardhaphllakas, an order of laxer principles, which in A.D. 80 developed into the Swetāmbaras, so called because they wear "white" clothes. The Swetāmbaras, however, claim to be the original order, and aver that the Digambaras originated in an heretical sect called Botika, three years later. Both orders agree that Bhadrabāhu was the 6th patriarch, but the Digambaras claim that he led the true monks to the south, accompanied by Chandragupta Maurya, who had abdicated his throne. The truth may be that Chandragupta was deposed and exiled, but he was eclectic in his beliefs and can only have embraced Jainism late in life. Since this exodus the Digambaras have been strongest in the south. In the north the Swetlmbara patriarchs each set up his own *gachchha* or "school of thought"; among them the Upakesa, followed by the Oswll Jains. About 1125 the conversion of the powerful King of Guzerlt, Siddharlja, gave the Jains their first historical royal patron, and under that dynasty they established their strong position in the west. The two orders differ little in theology, but, except for the Swetāmbara canons, the Digambara have the older literature, mostly in Sanskrit. They deny that women can attain *nirvāna*.

Jainism may be described as lacking an absolute Godhead. Sharing in the theoretical pessimism of the Buddhist. Sankhya and Yoga philosophies, it aims in practice at the goal of liberation from the transmigration of the soul. Matter exists, but only as something which may become anything. Being is indefinite, yet complex, not simple: a thesis upheld by a subtle dialectic. All substances are divided, broadly, into lifeless things, and souls or lives *(jiva)*. The former may become anything, whence the elements are bodies of souls in the lowest stage of development. But souls, though substances, are not matter: yet they are capable of expansion, indestructible and characterized by intelligence which can never be annihilated. And they are of two kinds, mundane and liberated; the former still subject to the Birth Cycle, the latter disembodied forever. Into the mundane soul pours subtle matter, ready to be transformed into *karma*, of eight kinds, and combining almost chemically with the soul it forms a subtle body which, clinging to it, determines its state and lot. Having done its work every *karma* is purged off from the soul until it is light enough to ascend to the top of the universe. But in actual life fresh *karma* tends to replace those eliminated, and then the soul must at death enter a new body. Moreover, the soul has transcendental colours, three good and three bad, indicating its character, and the soul itself may enter five stages, according as *karma* is neutralized, annihilated or partly one or the other. There are as many vows, first of which comes that "not to kill." This leads to a remarkable care to preserve all living things, and in strict practice the mouth should be covered with a cloth. lest the air be injured. Vermin must be removed, not killed, a Jain house being kept scrupulously clean. Monastic discipline is intense, and is not confined to bodily restraints, chastity, abstinence from alcohol, flesh, honey and roots, but includes mental discipline, purity of thought, contemplation, confession and repentance. The strength of Jainism lies in its association of the laity in these principles to a degree compatible with secular pursuits. A layman may make vows, after he has made sufficient progress, without entering an order or taking its full obligations upon him. While suicide is a sin, both ascetics and laymen may hasten death by voluntary starvation, though to the latter. this is only permissible in old age. The weakness of Jainism is that it is essentially a creed of a cultivated class, from which the masses are excluded. Its stability is due to its recognition of lay co-partnership in spirituality, and though many minor schools weakened the Jain solidarity, only one new movement threatened to destroy it. At the close of the 15th century Lonka Sha denounced idol worship and founded the Dhundhia ("Searchers") or Sthānakavāsi sect, which in turn split up into several sub-sects.

The Jain literature is vast, hut only a fraction of it has been published. The Digambaras say that most of the older has been lost, and the Swetāmbaras have only preserved a part of theirs. Books are strictly safeguarded and some may be concealed. In architecture the Jains excel, and though Buddhist models were adopted in *stupas* and cave-temples, they carried the art of carving in stone to the highest

point. Under Brahman influence Ajāyapala (A.D. 1174–76) is said to have destroyed many fanes in Delhi and the north, but more were pillaged by the Moslems to furnish materials for mosques. To save their temples from desecration the Jains often made miniatures of Mohammedan tombs in them, and blended their style with Mogul features. In the south the original characteristics were kept more intact. The temple courtyards contain colossi of the Digambara saint, Gomata or Gomateshvara.

JAINTIA HILLS. A mountainous region which with the Khasi hills forms one of the districts of Assam, republic of India. (See KHASI HILLS AND JAINTIA HILLS.)

JAIPUR, city, district and division (former princely state) in the union of Rajasthan, republic of India. The city, founded in 1728 by Maharaja Jai Singh II, is the capital of the union; pop. (1961) 402,760. It is well laid out and lighted, with wide (111 ft.) and regular main streets which divide it into six rectangular blocks; it is also a city of colour, as the houses are painted, and the whole town is surrounded by crenelated walls. overhung by rugged hills crowned with forts. The chief buildings are the huge palace in the middle of the city; a remarkable open-air observatory erected by Jai' Singh; a public library and a hospital; and a school of art for teaching and perfecting the local artistic industries. There is also. a fine public garden with a menagerie. The city, besides being the seat of the University of Rajputana (founded 1947), is a busy and prosperous commercial centre: its trades comprise jewel cutting and setting (a variety of precious stones are found locally); enamel and metal work; the colour painting of cloths and muslins; and the treatment of marble and inlay.

The DISTRICT OF JAIPUR (area 5,393 sq.mi.; pop. 1,900,902.in 1961) is one of seven which together form the DIVISION OF JAIPUR (area 25,711 sq.mi.; pop. 5,858,011 in 1951). The soil in the immediate neighbourhood of Jaipur city and to the west and north is generally sandy and barren, and 1,600 ft. above sea level. To the east and south the soil is mostly either black cotton or a rich alluvial loam. On the north and west the division is bounded by a broken chain of hills, an offshoot of the Aravalli mountains, beyond which lies the Rajputana desert. The hills are more or less covered with jungle trees, of no value except for fuel. Salt is largely manufactured from the Sambhar lake.

Jaipur belonged to a Rajput dynasty of the Kachwaha clan, claiming descent from Rama, king of Ajodhya. The state is said to have been founded about 1128 by Dulha Rai, from Gwalior, who with his Kachwahas is said to have absorbed or driven out the petty chiefs. The Jaipur houses furnished the Moguls with some of their most distinguished generals. Among them were Man Singh, who fought in Orissa and Assam; Jai Singh, commonly known by his imperial title of Mirza Raja, whose name appears in all the wars of Aurangzeb in the Deccan; and Jai Singh II, or Sawai Jai Singh, the famous mathematician and astronomer and the founder of Jaipur city. Toward the end of the 18th century the state was in great confusion; there was a constant rivalry between Jaipur and Jodhpur for the honour of marrying a princess of Udaipur, and at the same time Amir Khan with the Pindaris was exhausting the country. By a treaty in 1818 the protection of the British was extended to Jaipur and annual tribute fixed. During the mutiny the maharaja assisted the British and was rewarded by an extension of territory. Maharaja Sawai Man Singh, who was given full ruling powers in 1931, merged his state in the union of Rajasthan on March 30, 1949, and was chosen as *rajpramukh*.

(S. GL.)

JAISALMER, town and district (former princely state) in the union of Rajasthan, republic of India. The town of Jaisalmer is small, but famed for its yellowish sandstone buildings, its Jain temples and a fine fort. The district has an area of 15,968 sq.mi. and a population (1961) of 138,049. Jaisalmer is almost entirely a sandy waste, forming a part of the great Indian desert (*q.v.*). There are no permanent streams and only one small river, the Kakni, which, after flowing a distance of 28 mi., spreads over a large surface of flat ground and forms a lake or jhil called the Bhuj-Jhil.

The climate is dry and healthful. Throughout Jaisalmer only the poorer rain crops are grown; spring crops of wheat, barley, etc., are very rare. Most of the population lead a wandering life, grazing their flocks and herds. Large herds of camels, horned cattle, sheep and goats are kept. The principal trade is in wool, ghee, camels, cattle and sheep.

The majority of the inhabitants are Bhatti Rajputs, who take their name from an ancestor named Bhatti, renowned as a warrior before the tribe was driven from the Punjab into this oasis in the Great desert. Deoraj, a famous prince of the Bhatti family, assumed the title of rawal and founded a dynasty. In 1156 Jaisal, the sixth in succession from Deoraj, founded the fort and city of Jaisalmer, and made it his capital. It was sacked bv the emperor Ala-ud-din after an eight-year siege; ultimately in the time of Rawal Sabal Singh the clan had to accept the supremacy of the Mogul emperor Shah Jahan. The Jaisalmer princes had now arrived at the height of their power, but from this time till the accession of Rawal Mulraj in 1762 the fortunes of the state rapidly declined, and most of its outlying provinces were lost In 1818 Mulraj entered into political relations with the British, and some of the territory which had been lost in the previous century was restored after the conquest of Sind On March 30, 1949, the maharawal merged his state in the union of Rajasthan.

JAJCE (YAITSE or YAYTSE), a town of Bosnia, Yugos., occupies a hill overlooking a waterfall where the Pliva river rushes down to the Vrbas river, about 100 ft. below. In 1961 the population was 6,839.

The 14th-century citadel uhich crowns the hill is said to have been built for Hrvoje, duke of Split (Spalato). The ruined church of St. Luke, the legendary burial place of the evangelist, dates from the 15th century.

Chemicals form the principal industry and the power supplied by the main fall, at Jajce, is used for calcium carbide works.

From 1463 to 1528 Jajce was the principal outwork of eastern Christendom against the Turks. Venice contributed money for its defense, and Hungary provided armies; the pope entreated all Christian monarchs to avert its fall. In 1463 Mohammed II seized Jajce and beheaded the last king of Bosnia under its walls, in a field still called the "king's field." The Hungarians, under King Matthias I, came to the rescue and reconquered the greater part of Bosnia during the same year; and, although Mohammed returned in 1464, he was again defeated at Jajce and compelled to flee before another Hungarian advance.

In 1467 Hungarian bans, or military governors, were appointed to rule in northwestern Bosnia, and in 1472 Matthias appointed Nicolaus Ujlaki king of the country, with the town of Jajce for his capital. This kingdom lasted, in fact, for 59 years; but, after the death of Ujlaki in 1492, its rulers only bore the title of ban and of voivode. In 1500 the Turks, under Bajazet II, were crushed at Jajce by the Hungarians under John Corvinus, and several other attacks were repelled between 1520 and 1526 But in 1526 the Hungarian power was destroyed at Mohacs. Two years later Jajce surrendered and remained Turkish until the Austrian occupation (1908–18), when, at the close of World War I, Bosnia was incorporated in the kingdom of Yugoslavia.

JAJPUR, a town of Cuttack district, Orissa, republic of India, on the right bank of the Baitarani river. Pop. (1951) 11,026. It was the capital of Orissa some time prior to the 11th century, when it was superseded by Cuttack. A 20-ft. monolithic shaft, called the Chandeswar pillar, dates back to the 5th century A.D. A stone bridge, 240 ft. long with 11 spans, is another monument of the Hindu kings, to whom also may be ascribed some of the many temples.

JAKARTA or DJAKARTA, the capital of the republic of Indonesia, lies at the mouth of the Chiliwong (Tjiliwung) river on the northwestern coast of Java. Pop. (1956) 1,927,788.

The Town. — Evidence of the foreign influences on Djakarta's history can easily be detected in the modern city. Colonized and ruled by the Dutch government from early in the 17th century until after World War II, the Dutch colonial influence is naturally the most remarkable. Much of the original city has disappeared in the course of modern urban development, but fragments remain. Near the old town hall (a fine building dating from 1710) is the Penang or Amsterdam gate, with its two grotesque Gog and Magog figures. Historic buildings include the fine old house of Governor-General van Riebeeck (1708) with its entrance hall of old tiles depicting stories from the Bible; and the remains of the Portuguese church (1695).

This mixture of western and oriental styles is everywhere apparent in the life of the city. Traffic in the wide modern streets includes not only cars but horse-drawn carriages, handcarts and above all the betjak. This two-passenger vehicle, resembling a rickshaw on a foot-pedaled tricycle, is seen everywhere. Large modern stores have not displaced the many colourful markets nor the open-air shops which line the pavements. The river Chiliwong, which is canalized, flows through the city, among 17th-century houses in downtown Djakarta and beside wide business thoroughfares in the city, the intersecting canals being crossed by drawbridges. Gardens abound and the streets are lined with trees. On the chief shipping canal, which connects Djakarta's fish market with the Java sea, may be seen the local fishing boats, the *prahus,* with their high, curved prows and enormous single sails.

Jakarta has the usual facilities afforded by a prosperous city of the 20th century including many excellent hotels and restaurants, big stores and banks, theatres and clubs, schools, hospitals and churches. There is a Roman Catholic cathedral and of the Protestant churches many are late 17th-century. Faculties of the University of Indonesia include those of medicine, arts and law; and there is a teachers' training college. The Jakarta museum is an impressive white building with a pillared portico. There is a modern reference library there as well as in the Balai Pustaka, a government institute, At the meteorological bureau, built in 1858, records of temperature and humidity have been registered since 1864. There is also a special seismology department. The headquarters of Radio Republic Indonesia in Jakarta has one of the most powerful transmitting stations in southeast Asia.

The Port.—Along the coast to the east of the city, at Tandjung Priok, a modern harbour has replaced the original one (1877–83). The outer harbour, enclosed by two long stone breakwaters, is 525 ft. wide at the entrance. The outer harbour channel, which has a depth of 30 ft. at low water, leads to three inner harbours; they are suitable for ships drawing up to 27 ft., 30 ft. and 40 ft., respectively. There are ample, fully equipped quays with warehouses, two dry docks and a coal storage wharf.

Trade and Communications.—The port, which is connected with Jakarta by road, rail and canal, not only serves the hinterland of west Java but is also a clearinghouse for the whole archipelago. It exports, besides the main commodities of the region (rubber, tea, quinine, tapioca), a great variety of other tropical produce; the imports consist mainly of manufactured goods, which are in turn distributed in Java and the other islands.

During the 1930s manufacturing industries increased considerably and included several iron foundries and repair shops, oleomargarine and soap factories, breweries and printing works. There are now also tanneries, sawmills and textile mills.

Jakarta has good modern transport arrangements. It is connected by road and railway with every city of importance in Java. Between the harbour and the town is Kemajoran airport, an important link between Europe and the east and a stop on the England-Australia flight. Jakarta is the centre of the island's wireless communications and of Indonesia's postal, telegraph and telephone systems.

History.—The earliest river settlement was a harbour town in the kingdom of Tarumanagara. Little is known until the 16th century when the settlement was called Sunda Kelapa, and was the chief port of the Sundanese kingdom of Padjadjaran, from which trading was conducted with the Portuguese and later the Dutch.

The modern history of Jakarta dates from the end of the 16th century when the Dutch landed on the territories of the Sultan of Bantam, then ruler of Jakarta. After fighting between the Dutch and the sultan a trading post was established on the same site.

The earliest European buildings were erected by the Dutch East India company in 1614 on the eastern bank of the Chiliwong. The modern city owes its origin principally, however, to Jan Pieterszoon Coen (*q.v.*), who built a new township, surrounded by a wall and protected by a fortress on the shore, and named Batavia by the Dutch. This original town is largely the sector known today as Jakarta Kota or downtown Jakarta. The Chinese population lived within the walled city until 1740 when they were segregated. Jakarta's Chinatown has become in the 20th century the centre of its trade and business.

During the 17th century Batavia was the trade centre for the east; in the 18th century its prosperity declined for a variety of reasons including malaria epidemics and periods of unrest under Dutch rule. During the Napoleonic wars Batavia was for a short time administered by Great Britain but was returned to the Netherlands in 1814.

The town's prosperity grew during the 19th century when large-scale cultivation began of imported plants such as coffee and cinchona (quinine) and later rubber. The population, including many from the Malay peninsula as well as settlers of foreign trading powers, increased rapidly. On Aug. 17, 1945, Sukarno and Mohammed Hatta proclaimed Indonesia a sovereign independent republic. It was not until Dec. 27. 1949, that the ceremony took place in Amsterdam at which the official transfer of sovereignty was made from the Netherlands government to the United States of Indonesia. At a simultaneous ceremony in Batavia, the city was renamed Jakarta (Djakarta) and became the capital of the Indonesian republic.

JAKOBSON, ROMAN (1896–), Russian-U.S. linguist and Slavicist, one of the leading exponents of the European structural movement, known as the Prague school, was born in Moscow on Oct. 11, 1896. Jakobson's work. based on an assumption of a pervading binary structure in the phonological material of language, extended this dichotomization to grammatical structure as well. His linguistic studies included poetic language, child language, and loss of speech in aphasia. After 1941 he was active in the U.S. at Columbia. and after 1948, Harvard.

For a list of his publications *see* the bibliography in *For Roman Jakobson (1956).* (J. Lz.)

JAKUN, a proto-Malayan tribe of the Malay peninsula, divided into the Orang Bukit or Hill Jakun and the Orang Laut or Sea Jakun. The former include subtribes such as Besisi. Baduanda. Mantra, and the latter, including the Seletar among others, are akin to the Mawkhen tribe.

The Jakun are largely nomadic, though some of the Orang Bukit practise a little agriculture and hold a marriage carnival at harvest time. They smoke tobacco, chew betel, file their teeth to a point, do not circumcise but practise a form of incision. The general weapon is the blowgun; the spear and sword, or kris, are also used. Their huts, built of leaves or bark and raised on piles, are small and flimsy; dugout boats are used on the rivers. At tribal feasts they sing and dance in imitation of animals. They have chiefs (*batin*), bury their dead and erect a hut for the deceased's soul.

According to Sir James Frazer in The Golden *Bough* (1922), it became customary for the Jakuns to speak a special language while parties searched for camphor in the forests, the ordinary Malayan language being taboo to both hunters and villagers at that time. They named the language the bassa kapor (camphor language) or *pantang* (taboo) *kapur.*

JALALABAD or JELLALABAD, principal city of Eastern province, Afghanistan. The town lies at a height of 1,950 ft. in a plain on the south side of the Kabul river. 96 mi. from Kabul and 76 mi. from Peshawar. Estimated population. 6.000.

Between Jalalabad and Peshawar intervenes the Khyber pass, and between it and Kabul the passes of Jagdalak, Khurd Kabul, etc. The site was chosen by the emperor Baber, and he laid out some gardens there; but the town itself was built by his grandson Akbar in A.D 1560.

It resembles the city of Kabul on a smaller scale and has central bazaars, the streets generally being narrow.

The most notable episode in the history of the place is the famous defense by Sir Robert Sale (*q.v.*) during the first Afghan war, when he held the town from Nov. 1841 to April 1842. Ignoring orders to return to Kabul, Sale managed to survive a severe investment and his forces successfully attacked Akbar's lines in April. The town mas fortified and surrounded by a high wall with bastions and loopholes.

The Eastern province is about 80 mi. in length by 35 mi. in width. and includes the large district of Laghman north of the Kabul river, as well as that on the south called Ningrahar. The climate of Jalalabad is similar to that of Peshawar.

It is one of the most important positions in Afghanistan, for it dominates the entrances to the Laghman and the Kunar valleys, commanding routes to Chitral or India north of the Khyber, as well as the Kabul-Peshawar road.

JALAL-UD-DIN RUMI (MOHAMMED b. MOHAMMED MOULAVI BALKHI) (1207–1273), one of Persia's greatest mystical poets, was born on Sept. 30, 1207, in Balkh. His father, a prominent professor of theology and philosophy, moved a few years later because of a quarrel with the ruler, Sultan Mohammed Kharezmshah. After spending several years in Syria, the family settled at Konya (Iconium) in Asia Minor, then known as Rum, whence the poet's title. There his father resumed his professorship, in which Jalal-ud-din succeeded him on his death in 1231.

He continued in his orthodox teaching and study, until the whole tenor of his life was changed under the influence of a Socrates-like figure, Shamsuddin Mohammed of Tabriz. This mysterious wanderer appeared in Konya in 1244, and disappeared (probably violently) about two years later. Under the inspiration of his teaching, however, Jalal-ud-din abandoned formal theology and devoted himself to the pursuit of Sufi mysticism, in which field he is justly regarded as a supreme master. He was the spiritual founder of the Mevlevi order of "dancing" dervishes. His most important work, composed during the last ten years of his life, was the *Mathnawi-i Ma'nawi* (ed. with Eng. trans. and commentary by R. A. Nicholson, 1925–40). This comprises about 30,000 couplets in six books, a vast compendium of Sufi lore and doctrine, interspersed with fables and anecdotes, which has been described as "the Koran in the Persian-language"; it is especially remarkable for its insight into the laws of physics and psychology. Second to this, but perhaps higher in poetical quality, is the *Diwan-i Shams-i Tabriz* (pub. 1959; selected poems trans. by R. A. Nicholson [1898] and by Sir Colin Garbett [1956]), a collection of lyrics (*ghazals*) dedicated to his spiritual guide Shamsuddin of Tabriz. Their deep emotional content and mystical power have made them widely known throughout the east. Jalal-ud-din died at Konya on Dec. 17, 1273.

BIBLIOGRAPHY.—For Jalal-ud-din's life and work see R. A. Nicholson's *Selected Poems from the Divani Shamsi Tabriz* (1898); *Encyclopaedia of Islam*, vol. i, pp. 1004–1006 (1913); and E. G. Browne, *Literary History of Persia*, vol. ii, pp. 515–525 (1928). (L. P. E.-S.)

JALAP, a cathartic drug consisting of the tuberous roots of *Exogonium purga*, a convolvulaceous plant growing on the eastern declivities of the Mexican Andes at an elevation of 5,000 ft. to 8,000 ft. above sea level. The jalap plant has slender herbaceous twining stems, with alternately placed heart-shaped pointed leaves and salver-shaped deep purplish-pink flowers. The underground stems are slender and creeping; their vertical roots enlarge and form turnip-shaped tubers. The roots are dug up in Mexico throughout the year. They are suspended to dry in a net over the hearth of the Indians' huts and hence acquire a smoky odour. The large tubers are often gashed to cause them to dry more quickly. In their form they vary from spindle shaped to ovoid or globular and in size from a pigeon's egg to a man's fist. Externally they are brown and marked with small transverse paler scars, and internally they present a dirty white resinous or starchy fracture. The ordinary drug is distinguished in commerce as Veracruz jalap, from the name of the port whence it is shipped.

Jalap has been cultivated for many years in India, chiefly at Ootacamund, and grows there as easily as a yam, often producing clusters of tubers weighing more than nine pounds; they are rich in resin. containing 18%. The plant has also been grown in Jamaica, at first among the cinchona trees but later in new ground, as it was found to exhaust the boil.

Besides Mexican or Veracruz jalap, a drug called Tampico jalap has been exported from Mexico in considerable quantity. It has a much more shriveled appearance and paler colour than ordinary jalap, and lacks the small transverse scars present in the true drug. This kind of jalap. the *purga de Sierra Gorda* of the Mexicans. was traced by F. J. Hanbury to *Ipomoea simulans*. It grows in Mexico along the mountain range of the Sierra Gorda in the neighbourhood of San Luis de la Paz. from which district it is carried down to Tampico, whence it is exported. A third variety of jalap known as woody jalap, male jalap or Orizaba root, or by the Mexicans as *purgo macho*, is derived from *Ipomoea orizabensis*, a plant of Orizaba. The root occurs in fibrous pieces. which are usually rectangular blocks of irregular shape, two inches or more in diameter, and are evidently portions of a large root. It is only occasionally met in commerce.

Jalap is a typical water-expelling purgative, causing the excretion of more fluid than does scammony but producing less stimulation of the muscular wall of the bowel. The use of water-expelling purgatives for removing water from the body in such conditions as dropsy has been generally abandoned in favour of less irritating and dangerous substances. *See* DIURETICS.

JALAPA, a department in east-central Guatemala. Area: 796 sq.mi.; pop. (1950) 75,190. This isolated and mountainous department is occupied largely by Indians who grow maize, wheat, beans, tobacco and rice. Dairy cattle (for cheese production) are raised. The dense forests yield supplies of lumber. The departmental capital, Jalapa. can be reached by highway from the Motagua valley where connection is made with the road and railroad from Guatemala to the Caribbean coast. (P. E. J.)

JALAPA (JALAPA ENRÍQUEZ), capital city of the state of Veracruz in Mexico. Pop. (1950) 51,166. Picturesquely situated at an elevation of 4,300 ft. on the slopes of the sierra separating the cool central plateau from the hot Gulf coast, Jalapa has a moderate and healthful climate. A thriving Indian village when Cortés marched through it in 1519, Jalapa is known for its climate, its abundant flowers, and as a market for the rich coffee produced nearby.

Heavily populated by the Spanish after the Conquest because of its convenient location, Jalapa was famous in colonial days for its great annual fair held to dispose of the goods brought from Cadiz by the returning Spanish "silver fleet." The massive Spanish-Moorish architecture of Jalapa is reminiscent of viceregal days. Most impressive of the mountain peaks which surround Jalapa is Nauhcampatépetl rising to a height of 14,045 ft. (H. R. HY.)

JALAUN, a town and district of the Jhansi division of Uttar Pradesh. India. Pop. of town (1951) 11,559. Formerly it was the residence of a Naratha governor, but never the headquarters of the district, which are at Orai, an equally insignificant village (pop., 1951, 21,258).

The DISTRICT OF JALAUN has an area of 1.762 sq.mi. It lies entirely within the level plain of Bundelkhand, north of the hill country, and is almost surrounded by the Jumna and its tributaries the Betwa and Pahuj. The central region thus enclosed is a dead level of cultivated land, largely black-cotton soil and almost treeless.

The Non river flows through the centre of the district, which it drains by innumerable small ravines instead of watering. Jalaun has suffered from the noxious *kans* grass, the spread of which has resulted in many villages being abandoned and their lands thrown out of cultivation. Pop. (1951) 555,239. The two largest towns are Kunch (pop.. 1951, 20,732), and Kalpi (pop., 1951, 14,042). The district is particularly susceptible to famine, and only a small part of it is watered by the Betwa canal. Grain. oilseeds, cotton and ghee are exported.

In early times Jalaun seems to have been the home of two Rajput clans, the Chandels in the east and the Kachwahas in the west. The town of Kalpi on the Jumna was conquered for the princes of Ghor as early as 1196. Early in the 14th century the Bundelas occupied the greater part of Jalaun. and even after Akbar's governors established at Kalpi a nominal authority over the surrounding district, the Bundela chiefs were in a state of chronic revolt which culminated in the war of independence under Chhatar Sal.

In 1671, assisted by the Marathas, he reduced the whole of Bundelkhand. On his death he bequeathed one-third of his dominions to his Maratha allies, who before long succeeded in annexing them completely.

Under Maratha rule the country was a prey to constant anarchy and internal strife. To this period can be traced the origin of the poverty and desolation of the district. Between 1806 and 1840 the area came under British control. Various interchanges of territory took place, and in 1856 the modern boundaries were substantially settled.

JALISCO, a Pacific coast state of Mexico. Pop. (1950) 1,746,777. Area, 31,152 sq.mi. Jalisco is traversed from north-northwest to south-southeast by the Sierra Madre, locally known as the Sierra de Nayarit and Sierra de Jalisco. which divides the state into a narrow, heavily forested coastal plain and a high plateau region, part of the great Anáhuac tableland, with an average elevation of about 5,000 ft., broken by spurs and flanking ranges of moderate height. The sierra region is largely volcanic and earthquakes are frequent; in the south are the active volcanoes of Volcan de Colima (13,110 ft.) and the Nevado de Colima

(14,219 ft.). The *tierra caliente* zone of the coast is tropical and humid, while the inland plateaus vary from subtropical to temperate and are generally more dry and healthful. Lakes are numerous, the largest being Lago de Chapala, about 51 mi. long by 19 mi. wide, which is considered one of the most beautiful inland sheets of water in Mexico. The largest lake in the country, Lago de Chapala is a popular resort and also an important fishing area.

The agricultural products of Jalisco include Indian corn, wheat and beans on the uplands, and sugar cane, cotton, rice, indigo and tobacco in the warmer districts. Rubber and palm oil are natural forest products of the coastal zone. Stock raising is an important occupation of the more elevated districts. The mineral resources include silver, gold, cinnabar, copper, bismuth and various precious stones. There are reduction works and many industries, including cotton and woolen goods, pottery. cement plants, foodstuffs, electric power plants, highway and other construction, refined sugar and leather. Railway outlets reach Mexico City, Manzanillo. and Nogales. Ariz.

There is a large percentage of Indians and mestizos in the population. The capital is Guadalajara (pop., 1950, 377,928), elevation 5,037 ft., an industrial and ecclesiastical centre of great colonial charm. It has a huge, modern bus terminal and one of the most modern airports in Mexico. Other important towns with their populations (1950) are: Ciudad Guzmán (23,639), 60 mi N.E. of Colima; Lagos de Moreno (13,220), a mining town 100 mi. E.N.E of Guadalajara, on the Mexican National railways; Autlán (11,355); Ameca (13,589), in a fertile agricultural region on the western slopes of the sierras.

Jalisco was first invaded by the Spaniards about 1526 and was soon afterward conquered by Nuño de Guzmán. It once formed part of the *reyno* of Nueva Galicia, which also included Aguas Calientes and Zacatecas. Jalisco was taken by French troops during the period of intervention, but was recaptured in 1866.

In 1889 its area was much reduced by a subdivision of its coastal zone, which was set apart as the territory of Tepic (now the state of Nayarit). (J. A. Cw.)

JALPAIGURI, a town and district of West Bengal, India. The town is on the right bank of the Tista, with a station on the Eastern railway. Pop. (1951) 41,259.

The DISTRICT OF JALPAIGURI occupies an irregularly shaped tract south of Darjeeling and Bhutan and north of Cooch Behar. Area, 2,407 sq.mi. Pop. (1961) 1,360,110. The district is divided into a "regulation" tract and a strip of country, about 22 mi. in width, running along the foot of the Himalayas and known as the Western Duars, annexed from Bhutan after the war of 1864–65. The former is a continuous expanse of level paddy fields. The latter is a centre of tea cultivation; there were 189 tea gardens in the district in 1949, 131,777 ac. were plucked and the outturn of tea was 135,500,000 lb. The staple crop elsewhere is rice; jute and tobacco are grown extensively. The frontier toward Bhutan is formed by the Sinchula mountain range; some peaks are 6,000 ft. high. Buxa, standing 2,000 ft. high and commanding one of the chief passes into Bhutan, was formerly a cantonment; it has a rainfall of 209 in.

JALUD, a tributary of the Jordan river in Israel. It descends from the plains of Jezreel to near Beisan. See JORDAN.

JAMAICA, the largest island in the former West Indies federation. It lies about 90 mi. S. of the eastern extremity of Cuba, between lat. 17° 43′ and 18° 32′ N. and long. 76° 11′ and 78° 20′ W., is 146 mi. long; 51 mi. in extreme breadth and has an area of 4,411 sq.mi. The colony of Jamaica (4.413 sq.mi.) comprises, in addition to the island of that name, the dependencies of Morant and Pedro Cays.

PHYSIOGRAPHY

Geography.—A mountainous backbone runs through the island from east to west, rising in the east to the Blue mountains uhere Blue Mountain peak (7,402 ft.) is the highest elevation in the British West Indies. East of these lie the John Crow or Blake mountains, a rugged limestone plateau reaching a height of about 3,800 ft. Altitudes of the five mountain passes are from 3,000 to 4,000 ft. Two-thirds of the island is occupied by a plateau of deep-sea white limestone, forming a region of great beauty broken by innumerable hills, valleys, "cockpits" and sinkholes, and covered with luxuriant vegetation. These uplands usually terminate in steep slopes or bluffs, separated from the sea, in most cases, by a strip of level land. On the south coast, especially, these plains are often extensive, the Liguanea plain, on which Kingston and Spanish Town stand, having an area of about 132 sq.mi. More than 100 rivers and streams find their way to the sea, with numerous tributaries which issue from every ravine in the mountains—hence the name "Isle of Springs" (see *History* below). These streams are mostly not navigable, and in times of flood become violent torrents. Some of the larger rivers have laid down alluvial plains in their lower valleys and considerable deltas at their mouths.

The Black river (44 mi. long) threads a vast morass, once the sea bed, and is navigable by small craft for about 22 mi. Vestiges of intermittent volcanic action occur (including one truncated cone of basaltic lava) and there are several radioactive hot springs Jamaica has 16 harbours, the chief of which are Port Morant. Kingston, Old Harbour, Lucea, Montego Bay, Falmouth, St. Ann's Bay, Port Maria and Port Antonio.

Geology.—The greater part of Jamaica is bedded with Tertiary deposits, but in the Blue mountains and some of the other ranges older rocks emerge. The foundation of the island is composed of stratified shales and conglomerates, with tuffs and other volcanic rocks and occasional bands of marine limestone. The limestones contain Upper Cretaceous fossils, and the whole series has been heavily folded. Upon this foundation rests uncomformably a series of marls and limestones of Eocene and Oligocene age. Some of the limestones are composed of Foraminifera, together with Radiolaria, and indicate a subsidence to great depths, while the higher peaks of the island still remained above the sea. Toward the middle of the Oligocene period, when the folding pressure took place, the island was lifted far above its present level and was probably connected with the rest of the Greater Antilles and perhaps with the American mainland also. In the same period plutonic rocks of various kinds were intruded into the deposits already formed. and in some cases produced considerable metamorphism. During the Miocene and Pliocene periods the island again sank, but never to the depths which it reached in the Eocene period. The deposits formed in this period were shallow-water conglomerates, marls and limestones, with Mollusca. Brachiopoda, corals, etc. Finally, a series of successive small upliftings, less than 500 ft. in the aggregate, raised the island to its present level. The terraces which mark the successive stages in this elevation are well shown near Montego Bay.

The remarkable cavities of the Cockpit country and the closed basins of various rivers have been formed by the solution of the white limestone layer resting upon insoluble rocks. The island produces a great variety of marbles, porphyrites, granite and ochres. Traces of gold have been found associated with some of the oxidized copper ores (blue and green carbonates) in the Clarendon mines. Copper ores are widely diffused, and lead, cobalt, manganese iron ores and a form of arsenic occur. Jamaica has the world's largest known deposits of bauxite, with reserves estimated at 300,000,000 tons.

Climate.—The climate is one of the island's chief attractions. Near the coast it is warm and humid, tempered by sea breezes, but in the uplands is delightfully mild and equable. At Kingston the temperature ranges between 80° and 86° F., and this is generally the average of all the low-lying coast land. At Hill Gardens in the Blue mountains, 4,907 ft. above the sea, it varies from 40° to 45° F. The vapours from the rivers and the ocean generate, in the upper regions, clouds saturated with moisture which there maintain vegetation belonging to a colder climate. During the rainy seasons the accumulation of these vapours causes a general coolness and occasional heavy showers, and sometimes destructive floods. These seasons, in May and October, last for about three weeks, although, as a rule, no month is quite without rain.

The rainfall varies greatly; while the annual average for the island varies between 74 and 77 in., at Kingston it is 30-35 in., in the western parishes over 85 in., at Moore Town, on the north-eastern slopes of the Blue mountains, it is over 200 in. and in the

John Crow mountains it reaches nearly 300 in. The climate of the Santa Cruz mountains is very favourable to sufferers from tubercular and rheumatic diseases. Except near morasses and lagoons, the island is very healthy, and yellow fever, once prevalent, is extinct.

Jamaica lies within a zone liable to hurricanes: these usually pass to the northeast or southwest of the island, but occasionally pass over it, causing severe damage. (R. H. Y.)

Vegetation. — The abundance and variety of the flora may be largely accounted for by the differences of altitude, temperature and humidity. It includes tropical plants, halophytes, xerophytes, aquatics and marine plants. Over 3,000 species of flowering plants, 194 of which are orchids, and 524 species of pteridophytes have been identified. In many moist lowland places the woodland has been cleared, but the dry limestone plateau of the Cockpit country is densely covered with valuable timber trees with an undergrowth of shrubs and herbs. Many of these trees are brilliant in bloom; *e.g.,* lignum vitae (Guaiacum *officinale*), mountain pride (Spathelia simplex), ebony and coratoe. which is very attractive to hummingbirds. The biggest tree, and one of the few deciduous ones, is the silk-cotton tree (Ceiba) from whose trunks, 50 ft. in girth, canoes are dug out; the cotton of the tree is known as kapok. Among the 12 native species of palms on the coastal plains the grugru (Acrocomia lasiospatha), the cabbage palm (Oreodoxa oleracea) and the bull-thatch (Sabal *jamaicensis*) are particularly striking.

Mangroves occupy the brackish swamps, samphire thrives in the salt-marshes, water lilies and water hyacinths are common in fresh water. On the arid coastal plain are many species of cactus, seven of which are only found in Jamaica. Fungi grow everywhere, lichens in the higher parts and mosses abundantly in the damp woods. The chief food plants include cassava, mammee, arrowroot, guava, naseberry and papaw. Pindar nut, citrus fruits, bamboo, coconut palm, mango, banana, coffee, cocoa and sugar cane are among those introduced.

Fauna. — Apart from about 30 kinds of bats the only indigenous mammal is the coney. The house mouse, various rats and the mongoose (in 1872) were introduced. The manatee or sea cow is found in the coastal waters. Tanagers, hummingbirds, parrots and pigeons are among the 57 resident species of birds. Of these 42 are said to be peculiar to the island (9 more are now extinct) and 6 of them belong to genera unknown elsewhere but closely allied to American forms. In the winter 52 species of wood-warblers, ducks and waders arrive from North America. The freshwater fish include the mountain mullet and crayfish. Among the 55 species of amphibia and reptiles are a crocodile, a freshwater turtle, 8 snakes (none poisonous), lizards, a toad (introduced in 1844 to kill the rats) and frogs. Jamaica is a home of the primitive *Peripatus* and of innumerable insects including fireflies, moths and butterflies (14 peculiar to the island). Coral reefs surround the shores, except for part of the south coast, and there polyps, anemones and brilliantly coloured alcyonarians abound. The island is celebrated for the number of its landshells (about 500 species), very few of which are found anywhere else. **(X).**

HISTORY

Discovery and Development. — Jamaica was discovered by Columbus on May 3, 1494. He was subsequently stranded for 12 months on the north coast, in 1503–04. In 1509 Don Juan de Esquivel was appointed by Diego, Columbus's son, as governor, and from that date till 1655 the island remained under Spanish rule. The Spaniards named it Sant' Jago. Its native Arawak name was Xaymaca, "Isle of Springs." Villa de la Vega (later Spanish Town), was founded in 1523 and was the capital till 1872. During the Spanish occupation the inoffensive Arawak inhabitants were exterminated and Negro slaves were imported in small numbers to take their place. When Jamaica was taken by the British the total population was about 3,000. Oliver Cromwell attacked the Spanish West Indies and Adm. William Penn and his military colleague Robert Venables succeeded in capturing and holding Jamaica in 1655. The Spanish were completely expelled in 1660. Their slaves took to the mountains, and till the end of the 18th century the efforts of these Maroons, as they were called, to maintain their independence gave rise to repeated fighting.

Jamaica was governed by military authority until 1661 when Edward D'Oyley was appointed captain general and governor in chief with an executive council. Under his successor a legislative assembly was established, with power to make laws subject to disallowance by the crown. Jamaica soon became a chief resort of buccaneers, who frequently united the profession of merchant or planter with that of pirate or privateer. By the treaty of Madrid, 1670, the British title to the island was recognized, and the buccaneers were suppressed. The Royal African company was formed in 1672 with a monopoly of the English slave trade, and from this time Jamaica became one of the greatest slave marts in the world, with a thriving smuggling trade to Spanish America. At this date there were in Jamaica 70 sugar works, 60 indigo works and 60 cacao works.

An attempt was made in 1678 to impose royal taxes and to supersede the powers of the legislature. The privileges were restored in 1682; but not till 46 years later was the question of revenue settled, by a compromise by which Jamaica undertook to pay £8,000 (later reduced to £6,000) per annum to the crown, provided that the laws of England were made binding in Jamaica; all additional taxes had to be voted annually by the assembly.

In 1692 a severe earthquake destroyed the greater part of the town of Port Royal and led to the foundation of Kingston.

A threatened invasion by the French and Spanish in 1782 was averted by the victory of the admirals George Rodney and Samuel Hood off Dominica. The last attempt at invasion was made in 1806, when the French were defeated by Admiral Duckworth.

During the French war Jamaica was at the zenith of its prosperity, with coffee rivalling sugar as an export crop and with over 3,000,000 slaves at work. The abolition of the slave trade in 1807, however, raised the planters' costs, and the end of the war brought a steady drop in sugar prices. Most of the planters, always improvident, and usually indebted to their London factors, became hopelessly involved.

Emancipation struck a further blow at the planters' prosperity and security. All slaves were emancipated by an act of the imperial parliament in 1833. They became free in fact, after a period of so-called apprenticeship, in 1838. Many of the more enterprising among them left the plantations and took to the hills, where their descendants live as small-holding peasants today. The planters received compensation at the rate of £19 per slave, but most of this compensation went into the hands of their creditors. They were left financially exhausted and with a scarcity of labour. The abolition in 1846 of the tariff protection of colonial produce in the British market reduced the price of sugar still further and in many cases destroyed the profits of the already impoverished planter.

Dissensions between the executive, the legislature representing propertied interests, and the home government, as to the means of retrenching public expenditure, created much bitterness. Although some slight improvement marked the administration of Sir Charles Metcalfe and the earl of Elgin, when Indian immigration was introduced to redress the scarcity and irregularity of labour and the railway was opened, the improvement was not permanent. Poverty, increased taxation, land hunger and maladministration of justice combined to cause widespread discontent. An outbreak occurred at Morant Bay in Oct. 1865, in which the chief magistrate of the parish and 18 other white persons were killed. The rising was ruthlessly suppressed under martial law, and the principal instigator, G. W. Gordon, was hanged. These severities were widely applauded in the West Indies, but indignation in England led to the recall of the governor, Edward John Eyre, and to a drastic change in the government of the island.

Crown Colony Government. — Before his recall, Eyre had induced the Jamaican assembly, frightened by the riots, to vote its own extinction. Crown colony government was established by act of parliament in 1866.

The new governor, Sir John Peter Grant, achieved a remarkable reorganization of the affairs of the colony. He established a constabulary on the lines of that of Ireland, reconstructed the ju-

dicial establishment, substituting stipendiary magistrates for the planter-justices, established a public medical service, a, public works department and government savings bank, improved education and irrigated the fertile but drought-stricken plain between Spanish Town and Kingston. During his government the lucrative trade in bananas was started by Capt. A. W. Baker, founder of the organization which later became the United Fruit company. Bananas soon became a principal crop, grown for export by small farmers as well as by large estates. Many Jamaicans also found employment in the early years of the 20th century on banana plantations in Central America; others worked on the construction of the Panama canal and on sugar plantations in Cuba.

On Jan. 14, 1907, a violent earthquake struck Kingston. Almost every building in the capital and in Port Royal, and many in St. Andrew, were destroyed or seriously damaged. About 800 persons were killed and a large part of the city was burned. These disasters offered an opportunity of improving Kingston, and under the government of Sir Sydney (Lord) Olivier the scattered public offices were reconstructed in two blocks flanking a planted square on the finest street of the city.

Representative government was restored by stages from 1884, when 9 elected members were introduced into the legislature. Their number was increased to 14 in 1895. Further changes were discussed from 1922 to 1926, and more vigorously from 1938, partly as a result of riots in that year. In 1944 a new constitution established a house of representatives elected by universal suffrage. A modification of this constitution in 1953 gave the elected ministers departmental responsibilities, but retained a nominated legislative council as an upper house with limited powers; and an executive council including both official members and elected ministers, with the governor presiding.

Jamaica was relatively little affected by the two world wars, though many Jamaicans served in the armed forces overseas. A U.S. air base was built on the island during World War II, but dismantled in 1950.

Between 1946 and 1953 a number of new industrial undertakings were started, including a sugar refinery, citrus factories, a coconut product factory and a cement factory. The large-scale mining of bauxite began in 1952. The number of tourists visiting the island also increased. These developments to some extent offset the loss of openings for employment in Cuba and Central America, though unemployment remained a major problem.

In 1946 the University College of the West Indies was founded near Kingston. The capital cost of building the college was borne by the United Kingdom, the recurrent cost by the West Indian governments, Jamaica assuming nearly one-half of the recurrent burden.

A severe hurricane in Aug. 1951 devastated crops throughout the island and killed about 150 people. Energetic reconstruction, assisted by gifts and loans from the United Kingdom, made possible a remarkably rapid recovery. Jamaica became a territory within the The West Indies federation in 1958, when the federation uas organized. In Sept. 1961, however. the electorate voted against continued membership in the federation. The referendum was accepted by Great Britain and Jamaica's independence within the commonwealth was set for 1962. (J. H. PY.; X.)

SOCIAL AND ECONOMIC CONDITIONS

People. — Jamaica is rich in traces of its former Aramak inhabitants. Aboriginal petaloid celts and other implements, flattened skulls. and vessels are common. Images and drawings have been found in limestone caverns. The 1960 census gave a total population for the island and colony of 1,613.880 (the two dependencies of Morant and Pedro Cays are uninhabited). In the 1953 census. less than 25% were white, 17% were coloured (*i.e.*, of mixed race) and 76% Negro; the remaining were East Indian, Chinese or not determined. About 495% of gainfully occupied persons were found to be employed in agriculture. The population of the island is mainly Christian.

The capital. Kingston (*q.v.;* pop., 1960 census. 123,495), is on the southeast coast, and near it is the tonn of Port Royal Spanish Town (pop. 14,424), the former capital, is in the parish of St. Catherine, 11¾ mi. west of Kingston. After the transfer of the seat of government to Kingston (1872), Spanish Town sank greatly in importance, but has revived as the centre of valuable sugar and banana cultivation in the irrigated Liguanea plain. Many governors of the island are buried in the cathedral. A marble statue of Lord Rodney commemorates his victory over the Count de Grasse off Dominica in 1782. Montego Bay (pop. 23,822), on the northwest coast, is the second town of the island and a favourite bathing resort. Port Antonio (pop. 7,745) lies between two secure harbours on the northeast, and owes its prosperity mainly to the fruit trade.

Education. — Jamaica is the site of the University College of the West Indies (1946), with faculties of arts, science and medicine open to students from all the British Caribbean territories.

Government scholarships were available to children living at a distance from secondary schools, and those schools receiving grants-in-aid were required to maintain free places for at least 20% of their school rolls. Elementary education was conducted in government and voluntary (grant-aided) schools. Compulsory attendance was limited to areas where it could conveniently be enforced. Technical education was available at an institute in Kingston.

Administration. — The constitution of 1944, as amended in 1953, gave Jamaica a substantial measure of self-government. The legislature is bicameral, with a house of representatives consisting of 32 members elected by adult suffrage and presided over by a speaker of its own choosing, and a legislative council comprising three ex officio members, not more than two official members, and not fewer than ten unofficial members nominated by the governor. The principal instrument of policy is the executive council, which comprises the governor as president, the colonial secretary, attorney general, and financial secretary (these three being officials), two members of the legislative council nominated by the governor, and eight ministers. The chief minister is appointed by the governor, and the other ministries allocated by him on the chief minister's advice. The island is divided into 14 parishes. Local administration of the amalgamated parishes of Kingston and St. Andrew's was conducted by a corporation comprising a mayor, council and corporation, the council consisting of 13 elected councilors and 8 ex officio councilors. The council elected a mayor and deputy mayor annually. In the other 13 parishes there were parochial boards.

Agriculture and Industries. — The chief agricultural products of Jamaica are sugar cane, bananas, tobacco, citrus fruits, coffee, cocoa, pimento and ginger. Maize and rice are grown for local consumption. Before World War II bananas made up more than half of the colony's exports by value, but wartime shipping difficulties combined with the ravages of Panama disease and Cercospora (leaf spot) virtually brought exports to a halt by 1943.

After the war the banana industry made an encouraging recovery, and a species resistant to Panama disease was developed and widely distributed for planting; leaf spot was being controlled by spraying. By 1953 exports had not reached the prewar level of over 20,000,000 stems a year; but 5,773,000 stems were shipped in 1950. In 1958 exports had risen to 9,966,000 stems, less than half the prewar number. The colony's second largest export is sugar; 366,000 tons, worth $29,027,000, were shipped in 1958 as well as 1,917,000 gal. of rum, worth $3,719,000. Three companies are engaged in the mining and export of bauxite. Development has been so rapid that bauxite and concentrates have replaced sugar as the colony's largest export. The value of bauxite and concentrates shipped in 1958 was $60,842,000. Gypsum is mined and processed locally. A cement factory with a capacity of at least 100,000 tons a year came into operation in 1952. Other manufactures include cigars and cigarettes, matches, condensed milk, margarine and beer. The Pioneer Industries (Encouragement) law provides incentives to the establishment of new industries.

Imports were valued at $163,281,000 in 1956 and $181,048,000 in 1958. The United Kingdom supplied 38.6% of imports in 1958, the United States 21% and Canada 10.6%. Imports of food, drink and tobacco in 1958 were worth $41,270,000; machinery and vehicl'es $39,334,000; and fuel oil $10,088,000. The

value of exports in 1956 was $107,056,000 and in 1958 $130,279,000. The U.K. took 35.6% of the 1958 exports, the U.S. 31.8% and Canada 20.6%. Bauxite and concentrates made up 46.7% of exports in 1958, sugar and rum 25.2% and bananas 11.1%.

The deficit on visible trade was offset by capital inflow in mining and other projects, by a tourist trade valued at $28,000,000, by interest on overseas investments, and by the earnings of Jamaicans employed in the United States and other remittances to individuals from overseas.

Finance.— Public revenue in the fiscal year 1956–57 amounted to $62,726,927, expenditures $61,092,035. In that year 55% of revenue was derived from customs and excise taxes and 23.7% from direct taxation of income, land and property, death duties and stamp duties. Some of the main recurrent expenditures were public debt charges (6.8%), medical and health (12.3%) and education (10.9%). Beginning with the fiscal year 1952–53, government expenditures on capital development was provided from a special fund, current ordinary transactions being separated from development operations in the budget. The public debt on March 31, 1957, amounted to $55,143,858. The main unit of currency was the Jamaican pound which was linked with sterling and managed by a local currency board.

Four commercial banks operated in Jamaica. There was a government savings bank and numerous co-operative loan banks; also an agricultural loan societies board which made advances and loans to co-operative banks.

Jamaica's allocation under the Colonial Development and Welfare act of 1945 was $16,800,000; the colony benefited also from certain regionally and centrally administered schemes. The colony's 10-year development plan for government projects, as revised in 1958, provided for an expenditure of $220,763,200 over the period 1957–67.

Of the $73,996,160 to be spent between 1957 and 1960, the largest part was for agricultural projects, followed in order by communications and educational schemes and tourism.

Communications.— Regular steamship services are maintained with the United Kingdom, Canada and the United States; in addition, many cruise ships call during the winter months. There is an excellent system of roads (in 1956, 2,645 mi. of main roads and 2,137 mi. of parochial roads capable of carrying light motor traffic) and a government-owned railway with 248 mi. of track, the four main routes being from Kingston to Montego Bay, Port Antonio, Frankfield and Linstead. There are main airfields at Palisadoes (a port of entry) and Montego Bay, and four private air strips.

The government operates the inland telegraph services and Cable and Wireless, Ltd., the overseas cable, wireless, and radio-telephone services. A commercial broadcasting service transmits on short and medium waves and operates a wired rediffusion service in Kingston and its environs.

BIBLIOGRAPHY.—A. M. Whitson, *The Constitutional Development of Jamaica, 1660–1729* (1929); F. Cundall, *The Governors of Jamaica in the 17th Century* (1936); Lord Olivier, *Jamaica, The Blessed Island* (1936); A Macmillan, *The West Indies, Past and Present* (1938); R. R. Platt *et al., The European Possessions in the Caribbean Area* (1941); A. E Aspinall, *The Pocket Guide to the West Indies,* 10th ed. (1954); *The West Indies Year Book* (annual); *Colonial Report* (annual); *Handbook of Jamaica* (annual). (R. H. Y.)

JAMBI, a province and former residency in Indonesia, 17,345 sq.mi. in area, on the east coast of Sumatra, separated from the islands of Singkep and Lingga by the Straits of Berhala. Pop. (1956 est.) 610.976. Jambi comprises a long and narrow strip of territory, extending nearly across the country to the mountain range which traverses Sumatra's west coast and throws out spurs into Jambi. Its borders included Mt. Tuju, 8,543 ft., and the Kerintji, 12,483 ft., and well into the interior, Mt. Tebatalas, 6,662 ft., and Mt. Masurai, 9,630 ft.

Except for a hilly range in the mid-north region extending from Rinting (Merbau), 2,503 ft., the country slopes gradually to the sea, and, some distance before reaching it, is very flat and swampy, while near the coast it is intersected by numerous small rivers, Sungei Tungkal being the largest.

A number of rivers, large and small, flow down from the western mountains, water the country abundantly and unite at a point in the centre, above Muaru Tembesi, to form the Batang Hari (Jambi river). This river is navigable for ocean-going ships from Jambi, the capital, to the sea, a distance of 50 mi.

The town of Jambi is connected by road with Palembang and Muara Bungo, where a road leads over the mountains northwest to Padang. Many of the rivers are used for great distances by the natives for small-craft transport. Jambi is sea-connected with Java, Singapore, Sumatra and Malayan ports, and by telegraph with Padang; several of the small towns of the interior were connected with each other and with Palembang by telephone.

Jambi, the capital (pop. [1956 est.] 69,895), Muaru Tembesi, Bangku, Sarolangun, Muara Bungo, Muaru Tebu and Sungai Penuh are chief centres of population, and all but Jambi are quite small. The people are agriculturists and fishermen, rice is grown very largely, and a great proportion of it is ladang or dry culture. Jambi is one of the chief centres of native-grown rubber; other export items are copra and forest products, such as rattan. There is petroleum production southwest of the city of Jambi, near Bedjubang. Jambi, under an independent sultan, caused the Dutch trouble (they were established in the neighbouring territory of Palembang), until, in 1901, they sent an armed expedition into the country, and later made it into a residency.

Jambi was elevated to the status of a province after the Republic of Indonesia was created. (E. E. L.; J. O. M. B.; **X.**)

JAMES, a masculine proper name popular in Christian countries as having been that of two of Christ's apostles (a variant of the name Jacob, Heb. יַעֲקֹב, one who holds by the heel, outwitter, through O.Fr. James, another form of Jacques, Jaques, from Low Lat. Jacobus). It has been borne by many sovereigns and princes.

JAMES (Biblical), the name of several persons who are mentioned in the New Testament (Gr. Ἰάκωβος, the Heb. Ya'akob or Jacob).

1. JAMES, the son of Zebedee: see APOSTLE.

2. JAMES, the son of Alphaeus: see APOSTLE.

3. JAMES, the little, is described as the son of a Mary (Matt. xxvii, 56; Mark xv, 40), who was in all probability the wife of Clopas (John xix, 25). And on the ground that Clopas is another form of the name Alphaeus, this James has been thought by some to be the same as 2. But the evidence of the Syriac versions, which render Alphaeus by Chalphai, while Clopas is simply transliterated Kleopha, makes it extremely improbable that the two names are to be identified.

And as we have no better ground for finding in Clopas the Cleopas of Luke xxiv, 18, we must be content to admit that James the little is an almost unknown personality.

4. JAMES, the father of Judas. There can be no doubt that in the mention of "Judas of James" in Luke vi, 16 the ellipsis should be supplied by "the son" and not as in the A.V. by "the brother" (cf. Luke iii, 1; vi, 14; and Acts xii, 2, where the word ἀδελφός is inserted). This Judas, who is known as Thaddaeus by Matthew and Mark, afterward became one of the apostles, and is expressly distinguished by St. John from the traitor as "not Iscariot" (John xiv, 22).

5. JAMES, one of the Lord's "brethren." In Matt. xiii, 55 and Mark vi, 3 we read of a certain James as, along with Joses and Judas and Simon, a "brother" of the Lord. The exact nature of the relationship there implied has been the subject of much discussion. Jerome's view (de *vir.* ill. 2), that the "brothers" were in reality cousins, "sons of Mary the sister of the Lord's mother," was questioned by Bishop Lightfoot in his essay on "The Brothers of the Lord" (Galatians, pp. 252 sqq., Dissertations *on* the Apostolic Age, pp. 1 sqq.). Even, however, if we understand the word "brethren" in its natural sense, it may be applied either to the sons of Joseph by a former wife, or to sons born to Joseph and Mary after the birth of Jesus.

The first view, generally known as the *Epiphanian* view from its most zealous advocate in the 4th century, can claim for its support the preponderating voice of tradition (see the catena of references given by Lightfoot, *loc. cit.,* who himself inclines to this view). On the other hand the Helvidian theory as propounded by Helvidius, and apparently accepted by Tertullian (cf. *adv.*

Marc. iv, 29), which makes James a brother of the Lord. as truly as Mary was his mother, seems to some to be more in keeping with the statements of the Gospels, and also with the after history of the brothers (see W. Patrick, *James* the Brother of the Lord, 1906, p. 5). In any case there can be no question as to the important place which James occupied in the early Church. Converted to a full belief in the living Lord, perhaps through the special revelation that was granted to him (1 Cor. xv, 7), he became the recognized head of the Church at Jerusalem (Acts xii. 17; xv, 13; xxi, 18, *cf.* Gal. ii, 9). He was traditionally the author of the epistle of the New Testament which bears his name (see JAMES, EPISTLE OF). According to Hegesippus (see Eus. H.E. ii, 23) he was a Nazarite, and on account of his eminent righteousness was called "Just" and "Oblias." So great was his influence with the people that he was appealed to by the scribes and Pharisees for a true and (as they hoped) unfavourable judgment about the Messiahship of Christ. But from a pinnacle of the temple. he made public confession of his faith, and was at once thrown down and murdered. This happened immediately before the siege. Josephus (Antiq. xx, 9, 1) tells that it mas by order of Ananus the high priest that James was put to death; and his narrative gives the idea of some sort of judicial examination, for he says that James and some others were brought before an assembly of judges, by whom they were condemned and delivered to be stoned. Josephus is also cited by Eusebius (H.E. ii, 23) to the effect that the miseries of the siege were due to divine vengeance for the murder of James. Later writers describe James as an ἐπίσκοπος (Clem. Al. *apud* Eus. H.E. ii, 1) and even as an ἐπίσκοπος ἐπισκόπων (Clem. *Hom.*, ad *init.*). According to Eusebius (H.E. vii, 19) his episcopal chair was still shown at Jerusalem at the time when Eusebius wrote.

BIBLIOGRAPHY.—In addition to the relevant literature cited above, *see* the articles under the heading "James" in Hastings's *Dictionary of the Bible* (Mayor) and *Dictionary of Christ and the Gospels* (Fulford), and in the *Encycl. Biblica* (O. Cone); also the introductions to the Commentaries on the Epistle of James by Mayor and Knowling. Zahn has an elaborate essay on *Bruder und Vettern Jesu* in the *Forschungen zur Geschichte des neutestamentlichen Kanons*, vi, 2 (Leipzig, 1900). *See* art. APOSTLE. (G. MI.; X.)

JAMES I, THE CONQUEROR (1208–1276), king of Aragon, son of Peter II and of Mary of Montpellier, was born at Montpellier on Feb. 2, 1208. Peter, whose interests in Provence and Languedoc entangled him in the Albigensian troubles, arranged an alliance between James and Simon de Montfort's daughter, and in 1211 he entrusted the boy to Montfort's care. At his death (Sept. 12, 1213) the Aragonese and Catalans appealed to the pope for the surrender of the child, and he was put in the care of the Templars, who educated him at Monzón. He married Leonora, daughter of Alphonso VIII of Castile, in 1221 but divorced her later on the ground of consanguinity and mairied Yolande, daughter of Andrew II of Hungary, in 1234 (wedding ceremony 1235). James was astute and patient, bf gigantic stature and immense strength, and by 1229 he had so far reduced his unruly vassals that he was able to undertake the conquest of the Balearic Islands, achieved in six years (Majorca, 1230; Minorca, 1232; Iviza not until 1235). He then turned to the Moorish kingdom of Valencia, conquering the town on Sept. 28. 1238, after a three-year campaign. By the treaty of Almizra (1244) James agreed that all further conquests in the south should be reserved to Castile. On May 11, 1258, he signed the treaty of Corbeil with Louis IX of France, which ended Aragonese attempts to expand beyond the Cerdaiia and Roussillon.

During the last 20 years of his life James carried on war with the Moors in Murcia on behalf of his son-in-law, Alphonso the Wise of Castile. As a legislator and organizer he occupies a high place among the Spanish kings. Though orthodox and pious, he had an ample share of moral laxity, and the favour that he showed his bastards led to protest from the nobles and to conflicts between his sons, legitimate and illegitimate. He divided his states between his sons Peter and James, leaving Aragon, Valencia and Catalonia to Peter and the Balearic Islands, Roussillon, the Cerdaña and Montpellier to James—a division which inevitably produced conflict. James died at Valencia on July 27, 1276.

See *The Chronicle of James I,* trans. by John Foster, with notes by P. de Gayangos, 2 vol. (London, 1883); F. Darwin Swift, *The Life and Times of James the First, the Conqueror* (Oxford, 1894); H. J. Chaytor, *A History of Aragon and Catalonia* (London, 1933).

JAMES II (1264–1327), king of Aragon, son of Peter III, was left king of Sicily (1285) by his father. Having inherited Aragon on the death of his brother Alphonso (1291), he resigned Sicily (1295) and married Blanche, daughter of Charles II of Naples, in an endeavour to make peace with the Angevins. Sardinia and Corsica were both assigned to him in compensation for Sicily, but he was able to occupy Sardinia only (1324).

JAMES I (1566–1625), king of Great Britain and Ireland, and James VI of Scotland, son of Mary, queen of Scots, and her second husband Henry Stewart, Lord Darnley, was born in Edinburgh castle on June 19, 1566. After his father's murder and the enforced abdication of his mother, he was proclaimed king of Scotland on July 24, 1567. During the troubled times of his minority he was kept for safety's sake in Stirling castle, while a succession of regents struggled to assert his authority. His tutors, among them George Buchanan. gave him a sound education, especially in languages and theology, which developed in him literary ambitions rarely found in princes, but which also tended to make him a pedant. His first published work, The *Essays* of *a Prentice* in the ***Divine Art*** of Poesy (1584), contained, besides verses, a tract upon the rules to be observed in Scottish poetry.

By then he had already begun to play his part in public affairs. Before he was 12 he had taken the government nominally into his own hands when the earl of Morton was driven from the regency (1578); but for several years more he remained the puppet of contending intriguers and faction leaders. Morton, after a brief return to power, lost influence to Esmé Stewart, duke of Lennox, the nephew of James's grandfather, who had been brought up as a Catholic in France and now schemed to win Scotland back for Mary and for Rome. The Protestant party defeated these plans by kidnapping James in the Ruthven raid (1582) and forcing Lennox into exile; but next year James escaped from his captors and began to pursue policies of his own.

His chief purposes were to escape from subservience to Scottish factions and to establish his claim to succeed Elizabeth I upon the throne of England. For these ends he was ready to use whatever means looked most promising. He intrigued with Spain and the Guises for an understanding with his mother and in a letter to the pope (Feb. 1584) virtually promised to turn Catholic if given recognition and effective support by the Catholic powers. At the same time he took steps to curb the pretensions of the Presbyterian party, which had been alarmed by Lennox' intrigues and his own vacillations into claiming an independent authority for their church that would have left the king, in Andrew Melville's famous phrase, no more than one of "God's silly vassals." The "black acts" of 1584 accordingly declared the king head of the church, gave him power to appoint bishops to govern it and forbade its ministers to hold assemblies without his consent or to express opinions on public affairs. All this did not, however, mean that James was committing himself to the Catholic side. On the contrary, realizing that more was to be gained by cultivating Elizabeth's good will than by seeking the support of her enemies, in 1585–86 he concluded an alliance with England. Thenceforward, in his own unsteady fashion, he remained true to this policy and even Elizabeth's execution of his mother, Mary, queen of Scots, in 1587 drew from him only formal protests.

Yet his Catholic flirtations continued. Like his marriage to Anne of Denmark (1589), they were a means of showing a measure of independence toward Elizabeth, who steadfastly avoided recognizing him as her successor. They also raised hopes at Rome and among the English Catholics which were to help smooth his path to the English throne, even if they did not convince Philip of Spain. to whom Mary had bequeathed her claims. Moreover, in Scotland the monarchy was too weak, after his mother's follies and his own long minority, for James to be able to take strong measures against the Catholics without falling into unwelcome dependence upon the Protestant lords and the Presbyterian ministers. And, since Mary's execution and the defeat of the Spanish Armada (1588), he could almost regard such dependence as a

worse danger to monarchy than the often disappointed plottings of the Catholic lords. For several years, therefore, he continued to connive at, and even to share in, Catholic plottings, showing, for example. remarkable lenience toward the earls of Huntly and Erroll when they were detected in treasonable correspondence with Spain (1589). Nevertheless their increasing boldness gradually drove him into their enemies' arms. Protestant opinion, outraged by Huntly's murder of the popular earl of Moray (Murray), compelled him in 1592 to allow the statutory establishment of a full presbyterian system of church government and the repeal of the "black acts" of 1584. Then, after the exposure of the intrigue with Spain known as the affair of the Spanish blanks (1592–93) (see HUNTLY, EARLS AND MARQUESSES OF), the combination of the turbulent earl of Bothwell with Huntly and Erroll compelled the king to take drastic measures against them.

Once the earls' defeat (1594) had broken the power of the Catholic faction, James began to assert himself against the Presbyterians. He was able to divide the more moderate ministers from the extremists. Thanks to an act of 1587 vesting in the crown the extensive property of the ancient church, he also had the means to tempt away their noble allies. His finances were brought into rather better order by the eight commissioners known as the Octavians (1596–97). Thus he was now able to rule Scotland through his privy council almost as absolutely as Elizabeth ruled England through hers. How completely he had established his ascendancy was shown by the mysterious Gowrie conspiracy (1600) (see GOWRIE, JOHN RUTHVEN, THIRD EARL OF). In this it is not clear whether James was the intended victim or the successful villain, but he was strong enough to extort, even from the ministers, declarations of their belief in his own version of the affair. A year or two earlier he had expounded his exalted views of the nature of royal authority, and the divine right upon which he believed it to be based. in two considerable books—The True *Law* of Free Monarchies (published anonymously, 1598) and the *Basilikon Doron* (completed 1598; published 1599).

So, when James at length succeeded to the English throne on the death of Elizabeth I (March 24, 1603), he was already, as he told his English parliament, "an old and experienced king" and one with a clearly defined theory of kingship. Unfortunately neither experience nor theory equipped him to solve the new problems that faced him; and he lacked the qualities of mind and character to supply their defect. The remaining 22 years of his life proved therefore almost as unfortunate for his dynasty as the years before 1603 had been fortunate. There was still much that was sensible in his policies and the opening years of his reign as king of Great Britain were a time of material prosperity for both realms. For he brought them peace. He speedily ended the English war with Spain (1604). He seized the chance to establish law and order on the border. He asserted his authority over the Scottish islands, an easier task now that Elizabeth had tamed their Irish neighbours. He strengthened his control of Scottish local government by introducing justices of the peace. He encouraged Scottish trade and. if his plans for Nova Scotia did not flourish, he planted Scottish colonists firmly in Ulster. The test of his statesmanship north of the border was, however, his ecclesiastical policy and here he pressed his hardly won advantage too far. He succeeded by 1612 in grafting on to the Scottish church a royally appointed episcopacy, complete with courts of high commission on the English pattern. But it was only after much management and browbeating that he persuaded a general assembly (1618) and parliament (1621) to authorize rites such as confirmation by bishops and kneeling at communion. The new ceremonies. so far as they could be enforced, provoked even greater opposition than the new bishops and, if outwardly James had done much to assimilate the independent Scottish church to the more obedient Anglican model, beneath the surface he had stoked up the smouldering hostility that his son was to fan into a consuming fire.

In England, too, James had done more to exacerbate his problems than to solve them. There the test of his statesmanship lay in his handling of parliament. In parliament the English monarchy had a junior partner that mas rapidly coming of age and claiming ever wider rights to criticize and shape public policy. Moreover, its established monopoly of granting taxes made its assent necessary for the improvement of the crown's financial position, which had been seriously undermined by the general rise in prices, the rising costs of government and the expense of the long war with Spain. James, who had so successfully divided and corrupted Scottish assemblies, never mastered the subtler art of managing an English parliament. He kept few privy councillors in the house of commons and so allowed independent members to seize the initiative there, while his lavish creations of new peers and, later in his reign, his subservience to upstart favourites loosened the crown's hold upon the house of lords. His fondness for lecturing the houses about his prerogative rights and about the dependence of their privileges upon his grace and favour at once put them on their guard and drew from them counterclaims such as the 1604 Apology of the commons. His shambling gait, restless garrulity and dribbling mouth sorted ill, in the eyes of men used to Tudor dignity, with his exalted claims; and his actions and policy did little to redeem his physical shortcomings. His favour to impecunious Scots was partly responsible for the English parliament's rejection of his sensible plan for a closer union of the two kingdoms. By getting the law courts thereupon, in Calvin's case (1608; see ENGLISH HISTORY), to proclaim as law part of what parliament had just refused to enact, he struck at the houses' legislative supremacy. By using the judges' decision in Bates's case (1606) to justify a new scale of customs duties, he seemed to threaten their control of the purse strings.

Finally his ecclesiastical policy was bound to displease them. "No bishop, no king" might be a sensible maxim for a king of Scotland, but English puritans were not Scottish Presbyterians. By threatening at the Hampton Court conference (1604) to harry them out of the land if they would not conform, James threw away the chance of a comprehensive settlement offered by the moderation of their Millenary petition. By abetting the bishops' efforts to enforce his threat, he gave new life to the puritan alliance with the house of commons which had caused so much trouble for Elizabeth. The growing breach was widened by the slowness of James, coming from the poverty of Scotland, to appreciate the financial difficulties of the English crown. In four years of peace he practically doubled the debt left by Elizabeth after 17 years of war and his lack of economy blurred parliament's appreciation of his real necessities. It is therefore hardly surprising that when in 1610–11 the Great Contract (see ENGLISH HISTORY) offered a chance for a new start with consent of parliament, the project failed through faults on both sides.

That failure, and the death of Robert Cecil, earl of Salisbury, the next year, marked the turning point of the reign. During the ensuing ten years James summoned only the brief Addled Parliament of 1614. Deprived of parliamentary grants, his government was forced to adopt unpopular expedients, such as the sale of monopolies, of which at least one—Sir William Cokayne's project—had disastrous effects on English trade. Driven to rely even more upon the judges to declare the law in his favour, James fell into a quarrel with the independent and self-willed chief justice Edward Coke and took the unusual course of dismissing him in 1616. Moreover, during these years the king succumbed to the influence of the upstart and incompetent Scot, Robert Carr, earl of Somerset, whose ascendancy culminated in the scandals of the countess of Essex' divorce and Sir Thomas Overbury's murder. Somerset was then succeeded by the young George Villiers (created duke of Buckingham in 1623), who was less unworthy but even more hated for his arrogance and monopoly of royal favour. With the help of Lionel Cranfield (later earl of Middlesex), he did, however, something to restore efficiency and solvency to the administration.

On top of all this James embarked upon a foreign policy that fused discontent into a formidable opposition. Earlier, he had earned some popularity by helping France and the Dutch to resist Spanish designs in the Cleves-Julich question and by marrying his daughter Elizabeth to Frederick of the Palatinate, the leading Calvinist prince of Germany. But by the time that the Thirty Years' War began to embroil Germany and Europe (1618), James had fallen under the spell of the Spanish ambassador Count Gondomar. At Gondomar's demand he sent Sir Walter Raleigh to the block (1618). With Gondomar's encouragement he developed a plan for marrying his son and heir Charles to a Spanish infanta and of joining with Spain

to mediate peace in Germany. The plan, though plausible in the abstract, showed an astonishing disregard for English opinion. Moreover, if England were to have the strength to impress Spain, it required money; money meant a parliament; and when a parliament was at last summoned in 1621, its alarm and anger led it into a general attack upon the king's government and into a quite novel claim to dictate his foreign policy. James in fury tore the record of the offending Protestation from the commons' journals and dissolved the parliament.

He had now less means than ever either to impress Spain or rescue his son-in-law. Yet still he persisted and even, though reluctantly, allowed Charles and Buckingham to make a reckless journey to Madrid in the vain hope of winning the infanta by personal entreaty (1623). For the abrupt reversal of policy which followed their disillusioned return, and for the capitulation to parliament in 1624, James was hardly responsible. Never a very hard worker, he was now aging rapidly and leaving decisions largely to his son and his favourite. On March 27, 1625, he died at his favourite residence, Theobalds.

Besides the political problems that he thus bequeathed to his son, James left a body of writings which, though of mediocre quality as literature, entitle him to a unique place among English kings since Alfred. In addition to the works already mentioned, he was the author of *Demonology* (1597), a treatise advocating severe measures against witchcraft; of the *Counterblast to Tobacco* (published anonymously, 1604); and a number of other volumes of prose and verse. His prose works and speeches were collected and published in 1616 by James Montaeu, bishop of Winchester. who also translated them into Latin (1619).

BIBLIOGRAPHY.—T. F. Henderson, *James I and VI* (London, 1904); P. Hume Brown, *History of Scotland,* vol. ii (Cambridge, 1902); G. Davies, *The Early Stuarts, 1603–1660* (Oxford, New York, 1937); S. R. Gardiner, *History of England . . . 1603–1642,* 10 vol. (London, 1883–84). For James's literary work, *see* Arber's reprints of the *Essayes* and *Counterblaste* (London, 1869); R. S. Rait, *Lusus Regius* (Westminster, 1902); G. Gregory Smith, *Elizabethan Critical Essays,* vol. i (Oxford, 1904); A. F. Westcott, *New Poems by James I* (New York, 1911); *Basilikon Doron,* ed. by J. Craigie, 2 vol. (Edinburgh, 1944–50); *The Political Works of James I,* introduction by C. H. McIlwain (Cambridge, Mass., 1918). (R. B. WM.)

JAMES II (1633–1701), king of Great Britain and Ireland, second son of Charles I and Henrietta Maria, was born at St. James's palace on Oct. 14, 1633. He was created duke of York in Jan. 1634. During the Civil War he lived at Oxford from Oct. 1642 until the city surrendered in June 1646. He was then removed by the parliamentarians to St. James's palace but on April 20, 1648, he escaped to Holland. Early the next year he joined his mother in France. After a long visit to Jersey (Sept. 1649 to Sept. 1650) and another to the Netherlands, he joined the French army in April 1652, showing in four campaigns courage and ability that won commendation from Turenne. When France allied with Cromwell against Spain (Oct. 1655), James very reluctantly moved to the Spanish Netherlands (Sept. 1656) and joined the Spanish army there, commanding the right wing at the battle of the Dunes (June 3, 1658).

At the Restoration James was appointed lord high admiral and by his intelligent and loyal support of able subordinates, such as Samuel Pepys and Matthew Wren, did much to maintain the efficiency and improve the organization of the navy. He commanded the fleet in the opening campaigns of the second and third Dutch Wars and again showed marked courage in a successful battle against Jacob van Wassanaer, lord of Opdam (1665), and an indecisive encounter with Michael de Ruyter (1672). In politics he was a strong supporter of the earl of Clarendon, whose daughter Anne he married in Sept. 1660. Both before and after the marriage he seems to have been as great though not so fastidious a libertine as his brother. By 1668 James, whose loyalty to Protestantism had long been suspect, was negotiating for his admission into the Roman Church. The exact date of his reception is unknown, but it probably occurred before 1671, though he continued to take the Anglican sacraments until 1672 and to attend Anglican services until 1676. His resignation of the admiralty and all other offices after the Test act (1673) made his position clear for all to see, and the childlessness of Charles II's queen made this conversion of the heir presumptive greatly alarming to Protestant England. His two daughters by Anne Hyde, Mary and Anne, were certainly being brought up as Anglicans, though their mother too joined the Roman church before her death (March 31, 1671). But in Nov. 1673 James married again. His new wife, Mary of Modena, was also a devout Catholic. If they had a son, that son would certainly be brought up as a Catholic and he would, of course, come before Mary and Anne in the succession.

James's conversion and remarriage, as well as his indiscreet zeal—la *sottise de mon frère,* Charles II called it—thus did much to stimulate the Protestant frenzy that culminated in the "popish plot" scare and in the Exclusion bills whereby Lord Shaftesbury and his followers sought to exclude James from the succession. During these excitements the king persuaded James to withdraw to Brussels (March 1679). He came back when the king was ill (August), but was soon sent off to Scotland, where he mas well received (November). Returning to England in Feb. 1680, he was again sent back to Scotland when parliament met in October and there he stayed until March 1682. By then Charles had triumphed over the exclusionists and English opinion was swinging in James's favour, a swing accelerated by the abortive Rye House plot (1683). From May 1684 he was again lord high admiral in all but name. When Charles lay dying (Feb. 6, 1685) it was James who brought a priest to receive him into the Roman Church.

The revulsion of feeling in James's favour continued for some time after his accession. There was only a brief outcry when he publicly attended mass. The parliament which assembled in May 1685 showed a large Tory majority, thanks largely to Charles II's remodelling of the borough corporations and the vigorous electioneering of the government; and it promptly voted James all the revenues which Charles had enjoyed. Moreover, that summer his realms as a whole showed their loyalty during the abortive rebellions of the duke of Monmouth in England and the duke of Argyll in Scotland; nor does it appear that public opinion was much stirred at the time by the severe punishment of the rebels, notably in Judge Jeffreys' "bloody assizes." Nevertheless, the suppression of these rebellions marked a turning point in James's reign. His political judgment. never remarkable, had shown signs of decline even before his accession; now success in the parliamentary elections and against the rebels seemed to destroy what little was left. He soon alienated the loyalty of parliament and people by a series of measures that seemed clearly designed to make Roman Catholicism the dominant if not the only religion in his dominions and to support it by armed force and arbitrary power. The army collected against Monmouth was kept in being, increased to about 20,000 men and assembled each summer on Hounslow heath, hard by London. Roman Catholic officers were given commissions in it, despite the Test act, and parliament was prorogued (Nov. 1685) when it protested, even though the king thereby sacrificed a proposed grant of £700,000. In 1686, 6 of the 12 judges were dismissed and the bench, thus attuned, pronounced in *Godden* v. *Hales* in favour of the king's power to dispense individuals from the Test act. Roman Catholics were then made privy councillors as well as army officers and were forced into the headships of two Oxford colleges. An ecclesiastical commission was established contrary to the 1641 act, with wide powers over the Anglican clergy, especially to suppress anti-Romanist preaching, while Henry Compton, bishop of London, was suspended for refusing to deal with the preachers except through the ordinary ecclesiastical courts. Meanwhile, one by one the leading Anglicans were driven from office in the state—the marquess of Halifax in 1685, the earl of Clarendon and the earl of Rochester in 1687. In April 1687 a royal Declaration of Indulgence suspended the laws against both the Roman Catholics and the Protestant Nonconformists. This was followed by an intensive campaign to secure a new parliament that would be ready to repeal the penal laws. The lords lieutenant were required to secure promises to support repeal from local notabilities and office holders and measures were taken to purge the commissions of the peace and of lieutenancy and the borough corporations of those who would not give favourable answers.

Such answers were few and the chief result of this misguided pressure was to make James's opponents aware of their own strength. Already leading Englishmen of diverse political views were getting in touch with William of Orange, to whom James's elder daughter and heir presumptive, Mary, had been married in 1677. Then on April 27, 1688, James reissued his Declaration of Indulgence and on May 4 ordered it to be read twice in every

church. This strained Anglican loyalty too far, and seven bishops petitioned the king to withdraw his order. By some means their petition was spread abroad. whereupon the king had them prosecuted for seditious libel. Just before their trial began, his queen bore him a son (June 10), an event which destroyed the hope that there would soon be a Protestant successor to undo James's work. Then on June *30* the seven bishops were acquitted and even the troops on Hounslow heath did not forbear to cheer.

On the same day Adm. Arthur Herbert set off with a letter, signed by a group of leading Englishmen. inviting William to bring over an army to uphold the nation's rights and his wife's succession. Even now James was slow to realize his danger. rejecting Louis XIV's warnings and offers of aid. Louis, rebuffed. turned his armies toward the upper Rhine and William, freed from anxiety about Holland, sailed to England. He landed at Torbay on Nov. 5 and within a few weeks James found himself deserted by army and people and even by his daughter Anne. On Dec. 11 he fled for France. He was caught and brought back but allowed to escape again (Dec. *23)* and find shelter at St. Germain.

In March *1689* he joined the earl of Tyrconnel in Ireland, but after his defeat at the Boyne (July *1*, 1690) he again fled to France. In Ireland he had shown none of his former military ability and now in exile he aged rapidly. He became daily more absorbed in his devotions and took but a small part in shaping the proclamations and policies that emanated from his court. The peace of Ryswick between Louis and William *(1697)* removed his last hopes of restoration.

See F. C Turner, *James II* (London, New York, 1948); F. M *G.* Higham, *King James the Second* (London, 1934); G. N Clark, *The Later Stuarts, 1660–1714* (Oxford, New York, 1934). (R. B. WM.)

JAMES I (1394–1437), king of Scots. third son of Robert III and Annabella Drummond, was born at Dunfermline in July 1394. After the death of his mother in 1401 and that of his surviving brother, David, duke of Rothesay, at the following Easter in suspicious circumstances, his father determined to send him for safety to France. Captured, however, off Flamborough head in March *1406,* he was kept the prisoner of successive English kings for *18* years. Robert III died on hearing of the capture and James became king but the regent Albany showed no desire for his nephew's release. Growing to manhood in England, he received an excellent education by order of Henry IV. In 1420 Henry V summoned him to confront the Scots serving with the French armies and he took part in the sieges of Melun, Dreux and Meaux. He was knighted at Windsor in 1421 by Henry, at whose funeral he was a principal mourner the next year. The minority of Henry VI in England and the death of Albany in Scotland provided the opportunity for negotiating his release in 1424 with his marriage to Joan Beaufort. A ransom of £40,000, less 10,000 marks as Joan's dowry, was to be paid within six years and a truce was concluded for seven.

Returning to a kingdom which had had no strong ruler for 100 years, James resolved to "make the key keep the castle and the bracken bush the cow." His first parliament enacted that "ferme and sikker pece be kepit throu all the realme." To curb the nobles he had Duke Murdoch (regent, 1420–24) executed with his two sons and the earl of Lennox. The lord of the Isles was imprisoned and the earls of Strathearn and March dispossessed. Several Highland chiefs were arrested and some put to death. More constructively, James improved the machinery of government. He transferred the chamberlain's financial duties to a treasurer and a controller, is thought to have introduced the quarter seal and was the first Scottish king to use a sign manual. An act of *1428* provided for shire representation in parliament with a speaker and marked off prelates and nobles as lords of parliament, but only the last part was effective. The committee of articles, which was to dominate parliament till *1689,* can be first seen in this reign. He instituted a court of justice which is the real origin of the court of session and introduced the tradition of counsel for the poor.

James vacillated between friendship with England and the old French alliance. Only 9,500 marks of the ransom were paid altogether and in *1428* he made with France a treaty for sending military help and for marrying his daughter, Margaret, to the dauphin, Louis; but the English truce was renewed in 1431 for five years more. In *1436,* however, after the raid of Piperden, James came donn on the French side, sending Margaret to her unhappy marriage and besieging Koxburgh with ignominious failure.

In ecclesiastical policy James protected church property, required integrity of religious houses and hospitals, founded at Perth the only Scottish charterhouse and approved the burning of a Hussite, Paul Crawar. But he endeavoured to stop the traffic at Rome in Scottish benefices, passing statutes which antagonized successive popes and supporting the Council of Basel against Eugenius IV. The dispute brought Aeneas Silvius to Scotland in 1435 and Antonio Altani as nuncio in 1436.

Much of his legislation bore on economic and social life. Export of precious metals were restricted, shipping fostered, archery encouraged and football forbidden. Precautions were prescribed against fire and leprosy. A close time was enacted for game and salmon and the destruction ordered of wolves and rooks. The yield of the crown lands was trebled and that of the customs doubled.

Thirteen years of vigorous central government antagonized the nobles. Therefore Walter, earl of Atholl (who as the son of Robert II by his second marriage claimed a better right to the throne than those of the first, legitimated only *per subsequens matrimonium*), incited Sir Robert Stewart and Sir Robert Graham to murder James at Perth on the night of Feb. 20, 1437. The tale of Catherine Douglas barring the door with her arm is without contemporary support. James was buried in the charterhouse he had founded as was Queen Joan, who, after marrying Sir James Stewart of Lorne, died in 1445.

Although thickset and fat James was strong and vigorous. Walter Bower describes his athletic prowess, musical skill. artistic talent and interest in "moral sciences and mechanical arts." Of the poems once attributed to him only *The Kingis Quair* is now thought to be his and even that is disputed by some.

He had twin sons, Alexander, who died in infancy, and James (afterward James II), and six daughters: Margaret, who married Louis the dauphin; Isabella. who married Duke Francis I of Brittany; Joan, who married James, earl of Morton; Eleanor, who married Archduke Sigismund of Austria; Mary, who married Count Wolfert of Grandpré; and Annabella, who married George, earl of Huntly.

BIBLIOGRAPHY.—E W. M. Balfour-Melville, *James I, King of Scots, 1406–1437* (London, Toronto, 1936); Sir J. H. Ramsay, *Lancaster and York* (Oxford, 1892); *L.* A. Barbé, *Margaret of Scotland and the Dauphin Louis* (London, 1917); W M. Mackenzie (ed), *The Kingis Quair* (London, 1939); J. T. T. Brown, *The Authorship of the Kingis Quair* (Glasgow, 1896); W. W. Skeat (ed.), *The Kingis Quair,* rev. ed. (Edinburgh, 1911). (E. W M. B.-M.)

JAMES II (1430–1460), king of Scots, "of the fiery face," only surviving son of James I and Joan or Jane Beaufort, was born at Holyrood on Oct. *16,* 1430, and succeeded to the throne on Feb. 21, 1437. During his minority schism in the church intensified the strife between the Douglas-Livingstone (antipapal) party and that of the Crichtons who were supported by the papalist Bishop James Kennedy of St. Andrews. The situation changed, however, with the healing of the schism and the king's coming of age; and from the date of his marriage to Mary of Guelders, niece of Philip of Burgundy (Jply *3,* 1449), James was his own master. He continued his father's policy of strengthening the croan against the barons and of securing control over the national church; and he also sought to profit from the international situation to pursue an imperialistic policy against England. The first of these aims involved a struggle with the overgrown house of Douglas, which maintained a treasonable intercourse with the Yorkists in England and with the disaffected Crawford and lord of the Isles at home. The final contest was precipitated by the king's rash act in murdering William, 8th earl of Douglas, while his guest under safe-conduct at Stirling castle, on Feb. 22, 1452. The new earl procrastinated, and James on the advice of Kennedy won over some of his supporters. The Black Douglases were overthrown in 1455 and their estates annexed to the crown. Thereafter James sought to aggrandise the royal house by forming a semi-royal peerage and a nobility of service and by securing the earldoms of Mar and Moray and the lordship of Man for his sons.

James maintained the French alliance and sought French support for an attack on England. He plotted with both Lancaster and York, although ostensibly his quarrel was with the Yorkists, who harboured the renegade Douglas and revived claims to the overlordship of Scotland. He raided Northumberland in 1456 and in 1460 laid siege tc Roxburgh castle, where he was killed by the bursting of a cannon. A soldier's king, James was impulsive and masterful, with the charm and versatility of the Stewarts.

See Sir A. H. Dunbar, *Scottish Kings,* 2nd ed. (Edinburgh, 1906); A. I. Dunlop, *Life and Times of James Kennedy, Bishop of St. Andrews* (Edinburgh, 1950). (A. I. D.)

JAMES III (1451–1488), king of Scots, eldest son of James II, was born on July 10, 1451. He was crowned in Kelso abbey in 1460. The control of the kingdom, at first exercised by the sagacious Bishop Kennedy (d. 1405), was in 1466 usurped by Sir Alexander Boyd and his brother, Lord Boyd. Their downfall came soon after the marriage (1469) of James to Margaret, daughter of Christian I of Denmark, a marriage which resulted in the annexation of the Orkneys and Shetlands to Scotland (1472). In 1476 an expedition against the lord of the Isles resulted in his submission and the forfeiture of his earldom of Ross *(see* Ross AND CROMARTY).

James, however, incurred the hostility of his nobles, who did not share in his passion for music and architecture, and blamed him and his low-born familiars for the poverty and lawlessness which afflicted the country. In 1479 he arrested his brothers, Alexander, duke of Albany, and John, earl of Mar. Mar's mysterious death and Albany's daring escape from Edinburgh castle further diminished James's popularity. When in 1482, threatened by an invasion from England, he led a small army to the border, he was overtaken by his disaffected nobles, who hanged his favourites over Lauder bridge and brought him back captive to Edinburgh. Albany, summoned from exile by Edward IV, now advanced, with the duke of Gloucester, against Berwick, captured the town and proceeded to Edinburgh, where he liberated the king and ruled the country as his lieutenant general till, in March 1483, the discovery that he had made a treasonable compact with Edward forced him to flee. James strove to render his position less precarious by entering into friendly relations with Henry VII and by negotiating with Innocent VIII a concordat (1487) which gave him extensive rights of patronage within the Scottish church; but in 1488 his nobles again rose in rebellion, proclaiming his eldest son, James, duke of Rothesay, as their leader, and, on June 11, defeated him at Sauchieburn near Stirling. James escaped from the battlefield to meet his death at the hands of some person unknown. He left three sons—his successor, James IV; James Stewart, duke of Ross (d. 1504); and John Stewart, earl of Mar (d. 1503).

See P. Hume Brown, *History of Scotland,* vol. i (Cambridge, 1911); T. F. Henderson, *The Royal Stewarts* (London, 1914). *(R.* L. ME.)

JAMES IV. (1473–1513), king of Scotland, eldest son of James III., was born on March 17, 1473. He was nominally the leader of the rebels who defeated the troops of James III. at the Sauchieburn in June 1488, and became king when his father was killed. Few if any of the kings of Scotland have won such general popularity, or passed a reign so untroubled by intestine strife. Crowned at Scone a few days after his accession, James began at once to take an active part in the business of government. A slight insurrection was easily suppressed, and a plot formed by some nobles to hand him over to the English king, Henry VII., came to nothing. In spite of this proceeding Henry wished to live at peace with his northern neighbour; a five years' truce was concluded on Dec. 21, 1491. When, in 1495, Perkin Warbeck, pretending to be the duke of York, Edward IV.'s younger son, came to Scotland, James prepared to invade England in his interests, but the war was confined to a few border forays, and a seven years' peace was negotiated in 1497. In 1502 a marriage was arranged between James and Henry's daughter Margaret (1489–1541) which took place at Holyrood in Aug. 1503. This union led to the accession of the Stewart dynasty to the English throne.

About this time James crushed a rebellion in the western isles, and parliament took measures to strengthen the royal authority therein. He may be said to have been responsible for the unification of the country. James also began to treat as an equal with the powerful princes of Europe, Maximilian I., Louis XII. and others; sending assistance to his uncle Hans, king of Denmark, and receiving special marks of favour from Pope Julius II. But his position was weakened when Henry VIII. succeeded to the English throne in 1509. Causes of quarrel already existed, and Henry's attitude was not conciliatory; sea-fights took place between their ships, while war was brought nearer by the treaty of alliance which James concluded with Louis XII. in 1512. Urged on by his French ally and his queen, James declared for war, in spite of the counsels of his advisers. Gathering a large and well-armed force, he took Norham, Ford and other castles in August 1513. He met the advancing English army under Thomas Howard, earl of Surrey, at Flodden, or more correctly, at the foot of Brankston Hill. The battle, which took place on Friday, Sept. 9, 1513, is among the most famous and disastrous, if not among the most momentous, in the history of Scotland. Having led his troops from their position of vantage, the king himself was killed while fighting on foot, together with nearly all his nobles. He left one legitimate child, his successor James V., but he had many illegitimate children, among them (by Marion Boyd) Alexander Stewart, archbishop of St. Andrews and chancellor of Scotland, who was killed at Flodden, and (by Janet Kennedy) James Stewart, earl of Moray (d. 1544). One of his other mistresses was Margaret Drummond (d. 1501).

James appears to have been a brave and generous man, and a wise and energetic king. He was possessed of considerable learning; during his reign the Scottish court attained some degree of refinement, and Scotland began to count in European politics. Literature flourished under the royal patronage, education was encouraged, and the material condition of the country improved enormously. The king was specially interested in his navy. The tournaments which took place under his auspices were worthy of the best days of chivalry in France and England. He is said to have worn an iron belt as penance for his share in his father's death; and by his frequent visits to shrines, and his benefactions to religious foundations, he won a reputation for piety.

JAMES V. (1512–1542), king of Scotland, only legitimate son of James IV., was born at Linlithgow on April 10, 1512, and succeeded his father in 1513. The regency was at first vested in his mother, but after Queen Margaret's second marriage, with Archibald Douglas, 6th earl of Angus, in Aug. 1514, it was transferred by the estates to John Stewart, duke of Albany. The minority of James was disturbed by constant quarrels between a faction, generally favourable to England, under Angus, and the partisans of France under Albany; while the queen-mother and the nobles struggled for possession of the king's person. The English had not followed up their victory at Flodden, but Henry VIII. was watching affairs in Scotland with an observant eye, and other European sovereigns were not indifferent to the possibility of a Scottish alliance. In 1524, when Albany had retired to France, the parliament declared James fit to govern with the advice of his mother and a council. This "erection" of James as king was mainly due to the efforts of Henry VIII. In 1526 Angus obtained control of the king, and kept him in close confinement until 1528, when James, escaping from Edinburgh to Stirling, compelled him to flee to England. In 1529 and 1530 the king made a strong effort to suppress his turbulent vassals in the south of Scotland. Negotiations for peace with England were begun, and in May 1534 a treaty was signed. Henry VIII. wished James to marry his daughter Mary, but the Scottish king married Madeleine, daughter of King Francis I. at Paris in Jan. 1537. Madeleine died on June 7, 1537, and in 1538 James made a much more important marriage, being united to Mary (1515–60), daughter of Claude, duke of Guise, and widow of Louis of Orleans, duke of Longueville. This connection probably induced James to forsake his vacillating foreign policy, and to range himself definitely among the enemies of England. In 1536 he had refused to meet Henry VIII. at York, where Henry had hoped to kidnap him, and in the following year had received the gift of a cap and sword from Pope Paul III., thus renouncing the friendship of his uncle. Although in 1540 the English king made another attempt to win the support of James for his religious **pal-**

icy, the relations between the two countries became very unfriendly, and in 1542 Henry sent an army to invade Scotland. James's forces, owing to the lack of support from the nobles, were easily scattered at the rout of Solway Moss on Nov. 25, 1542. This blow preyed upon the king's mind, and on Dec. 14 he died at Falkland, having just heard of the birth of his daughter. His two sons had died in infancy, and his successor was his only legitimate child, Mary. He left several bastards, among them James Stewart, earl of Moray (the regent Moray), Lord John Stewart (1531–63) prior of Coldingham and Lord Robert Stewart, earl of Orkney (d. 1592).

James showed great vigour and independence as a sovereign, both in withstanding the machinations of his uncle, Henry VIII., and in opposing the influence of the nobles, and his habit of mingling with the peasantry secured for him a large amount of popularity. The persecutions of heretics during this reign were due mainly to the influence exercised by the ecclesiastics, especially by David Beaton, archbishop of St. Andrews.

JAMES (JAMES FRANCIS EDWARD STUART) (1688–1766), prince of Wales, known to the Jacobites as James III. and to the Hanoverian party as the Old Pretender, the son and heir of James II. of England, was born in St. James's Palace, London, on June 10, 1688. The scandalous story that he was a supposititious child has been completely disproved, and contemporary writers allude to his family likeness to the Royal Stuarts. Shortly before the flight of the king to Sheerness, the infant prince with his mother was sent to France, and afterwards he continued to reside with his father at the court of St. Germain. On the death of his father, on Sept. 16, 1701, he was immediately proclaimed king by Louis XIV. of France, but a fantastic attempt to perform a similar ceremony in London so roused the anger of the populace that the mock pursuivants barely escaped with their lives. A bill of attainder against him received the royal assent a few days before the death of William III. in 1702, and the Princess Anne, half-sister of the Pretender, succeeded William on the throne. An influential party continued to adhere to the Jacobite cause; but an expedition from Dunkirk in favour of James in the spring of 1708 failed, although the French ships reached the Firth of Forth. At the Peace of Utrecht James withdrew from French territory to Bar-le-Duc in Lorraine. A rebellion in the Highlands of Scotland in his favour in Sept. 1715 was checked in November by the indecisive battle of Sheriffmuir and by the surrender at Preston. James landed in Dec. 1715 at Peterhead, and advanced as far south as Scone, accompanied by a small force under the earl of Mar; but on learning of the approach of the duke of Argyll he retreated to Montrose, where the highlanders dispersed to the mountains, and he embarked again for France. A Spanish expedition sent out in his behalf in 1719, under the direction of Alberoni, was scattered by a tempest, only two frigates reaching the appointed rendezvous in the island of Lewis.

In 1718 James had become affianced to the young princess Maria Clementina Sobieska, grand-daughter of the warrior king of Poland, John Sobieski. The marriage was forbidden by the emperor, who kept the princess and her mother in honourable confinement at Innsbruck. Clementina was abducted by a zealous Jacobite, Charles Wogan, reached Italy in safety, and married James at Montefiascone on Sept. 1, 1719. James and Clementina were now invited to reside in Rome at the special request of Pope Clement XI., who openly acknowledged their titles of British King and Queen, gave them a papal guard of troops, presented them with the Palazzo Muti, and made them an annual allowance of 12,000 crowns. At the Palazzo Muti, the chief centre of Jacobite intriguing, were born James's two sons, Charles Edward (the Young Pretender) and Henry Benedict Stuart. James's married life proved turbulent and unhappy, owing to the hot temper and jealous nature of Clementina, who soon after Henry's birth in 1725 left her husband and spent over two years in a Roman convent. At length a reconciliation was effected, but Clementina died in Feb. 1735. Full regal honours were paid to the Stuart queen at her funeral, and the splendid but tasteless monument by Pietro Bracchi (1700–73) in St. Peter's was erected to her memory by order of Pope Benedict XIV.

His wife's death affected James's health and spirits greatly, and he began to grow indifferent, so that the political adherents of the Stuarts were gradually led to fix their hopes upon the two young princes. James appeared seldom in public, and much of his time was given up to religious exercises; he was *dkvot à l'excès*, so Charles de Brosses, an unprejudiced Frenchman, informs us. With great reluctance James allowed his elder son to leave Italy for France in 1744; in the following year, he permitted Henry to follow his brother's example, but with the news of Culloden regarded his cause as definitely lost. Henry's adoption of an ecclesiastical career so embittered his last years that he sank into a moping invalid and rarely left his chamber. With the crushing failure of the "Forty-five" and his quarrel with his heir, the once-dreaded James soon became a mere cipher in British politics, and his death at Rome on Jan. 2, 1766 passed almost unnoticed in London. He was buried with regal pomp in St. Peter's, where Canova's famous monument, erected by Pius VII. in 1819, commemorates him and his two sons. James was grave, high-principled, industrious and dignified, and the unflattering portrait drawn of him by Thackeray in *Esmond* is utterly at variance with historical facts. Although a fervent Roman Catholic, he was far more reasonable and liberal in his religious views than his father, as many extant letters testify.

See Earl Stanhope, *History of England and Decline of the Last Stuarts* (1853); *Calendar of the Stuart Papers at Windsor Castle;* J. H. Jesse, *Memories of the Pretenders and their Adherents* (1845); Dr. John Doran, *"Mann," and Manners at the Court of Florence* (1876); Charles de Brosses, *Lettres sur l'Italie* (1885). (H. M. V.)

JAMES, DAVID (1839–1893), English actor, was born in London, his real name being Belasco. He began his stage career at an early age, and after 1863 gradually made his way in humorous parts. His creation, in 1875, of the part of Perkyn Middlewick in *Our Boys* made him famous as a comedian, the performance obtaining for the piece a then unprecedented run from the 16th of January 1875 till the 18th of April 1879. In 1885 he had another notable success as Blueskin in *Little Jack Sheppard* at the Gaiety Theatre, his principal associates being Fred Leslie and Nellie Farren. His song in this burlesque, "Botany Bay," became widely popular. In the part of John Dory in *Wild Oats* he again made a great hit at the Criterion Theatre in 1886; and among his other most succesful impersonations were Simon Ingot in *David Garrick,* Tweedie in *Tweedie's Rights,* Macclesfield in *The Guv'nor,* and Eccles in *Caste.* His unctuous humour and unfailing spirits made him a great favourite with the public. He died on the 2nd of October, 1893.

JAMES, GEORGE PAYNE RAINSFORD (1799–1860), English novelist, son of Pinkstan James, physician, was born in London, on Aug. 9, 1799, and was educated at a private school at Putney, and in France. He had, according to his own account, composed the stories afterwards published as *A String of Pearls* before he was 17. His early works were: *Life of Edward the Black Prince* (2 vols., 1822), and *Richelieu* (1829), which was well thought of by Sir Walter Scott. James took up historical romance writing at a lucky moment. Scott had firmly established the popularity of the style, and James in England, like Dumas in France, reaped the reward of their master's labours as well as of their own. For 30 years the author of *Richelieu* continued to pour out novels of the same kind, and also some historical works and verse narrative. In the British Museum 67 of his works are catalogued. The best examples of his style are *Richelieu* (1829); *Philip Augustus* (1831); *Henry Masterton* (1832); *Mary of Burgundy* (1833); *Darnley* (1839); *Corse de Léon* (1841); *The Smuggler* (1845). His poetry does not require special mention. For a short time during the reign of William IV. he held office of historiographer royal. In 1850 he went to America as British Consul for Massachusetts. He was consul at Richmond, Virginia in 1852, and in Venice from 1856 until his death on June 9, 1860.

JAMES, HENRY (1843–1916), U.S. novelist and critic and one of the most influential theorists of fiction in the English-speaking world, was born in New York city on April 15, 1843, and

died in London in 1916. Although he wrote for more than half a century as an American, he became a British citizen a few months before his death. A creator of the cosmopolitan novel, James also laid the foundations for the modern psychological novel, experimented with narrative techniques and sought, in his critical papers, to arrive at a "codification" of the art of fiction. His influence was pervasive. Joseph Conrad, James Joyce, Virginia Woolf, Dorothy Richardson and Graham Greene are among many novelists who derived technique or aesthetic ideas from James. Much of the contemporary terminology used in discussion of fiction stems from the critical prefaces written by the novelist to his own novels late in life. Assembled, they amount to a major treatise on the art.

The novelist was the second son of Henry James (1811–1882), an idiosyncratic and voluble Swedenborgian with a pungent wit and vigorous style; his elder brother was William James (1842–1910), the psychologist and philosopher of pragmatism. Both sons derived from their father his vivid sense of words and adapted it to their own needs. In early childhood Henry James lived in Albany, N.Y., where his grandfather, an Irish immigrant, had amassed one of the largest fortunes in the state. He passed his boyhood in New York city; during his adolescent years he was schooled by tutors and governesses in Europe. A shy boy. he resisted formal education and was described by his father as a "devourer of libraries." Most of his reading was in fiction. On the eve of the Civil War the family returned from one of their European sojourns and settled at Newport, R.I. There the 17-year-old Henry formed a friendship with John LaFarge, the painter, who encouraged him to begin writing. In the early weeks of the war the future novelist suffered a strained back while helping to put out a fire, and this "obscure hurt," as he called it in his memoirs, kept him from military service. In 1862 he briefly attended the Harvard law school; he was already writing short stories and book reviews. The first identified piece of fiction by him is an unsigned tale, "A Tragedy of Error," published in a New York magazine, the *Continental Monthly,* Feb. 1864. By this time the James family had established itself in Cambridge, Mass., opposite the Harvard yard, and here Henry James met Charles Eliot Norton and certain of the Boston Brahmins. Norton accepted his precocious book notices in the *North American Review* and in 1865, when Henry James was 22, his first acknowledged short story was published in the *Atlantic Monthly.* By the time he was 2j he was called by the *Nation* "the best writer of short stories in America." William Dean Howells, who became an editor of the *Atlantic* in 1866, promptly recognized the gifts of the young contributor and from that time on the pages of this journal were open to him. Young James and Howells, between them, inaugurated the era of realism in American fiction.

James's first tales are placed in the American scene; they show a careful study of his principal models: Balzac, Merimée, George Eliot and George Sand. Of American writers. the principal influence was Hawthorne. From the first James showed a close awareness of certain fictional problems which few storytellers had recognized or studied: the value of "point of view" in fiction; the need to maneuver the reader so as to involve him in the story; the need for careful identification of narrators in first person stories. In general James created his fiction out of an acute observation, of patterns of human behaviour; his early stories dealt largely with American manners and human relationships.

In 1869–70 James paid his first adult visit to Europe and gained his first experience of Italy, where many of his later stories were set. While he was abroad, his cousin, Minny Temple, to whom he was deeply attracted, died. Later he wove her into *The Portrait of a Lady,* his first major novel, and *The Wings of the Dove,* one of his last works, as well as into certain of his tales. The fruit of his year of wandering in Europe was his first important story, "A Passionate Pilgrim." This was followed by a short novel, *Watch and Ward,* serialized in the *Atlantic,* but later virtually disowned by its author. For two years (1870–72) James tried to make his way in Boston by writing book reviews and stories as well as art criticism. A renewed stay in Europe for two years (1872–74), largely in Italy, yielded his first full-length work, *Roderick Hudson,* the story of an Anierican sculptor's brief success and disintegration in the art studios of Rome. In this book James posed the problem of the American artist: was he to try to create at home, in a country busy with material expansion, or to expatriate himself into the complexities and dark corruptions of Europe? He implied that not the artist's country so much as his creative personality was the determining force in his life. In 1875, after trying once again to make his way in America, this time in New York—by writing theatre and art criticism as well as fiction—he decided Europe would yield him more material, including the opportunity to write travel papers for American journals. Late in that year he settled in Paris.

In the French capital he sought out the Russian novelist. Ivan Turgenev, whose work had attracted him, and was introduced by him in turn to Flaubert and the group of French realists: Zola, Edmond de Goncourt, Daudet and Maupassant. James admired the art discussions of the French writers; deplored their Parisian parochialism and "unclean" subjects; and learned from Turgenev the lesson that character, rather than story, was important: indeed, that once the artist discovers a character the latter will supply his own story. While in Paris. James wrote letters on current affairs and Parisian art events for the *New York Tribune,* and completed his novel *The American* which won him a wider public. But he felt himself too much an outsider in France. and in 1876 transferred to London. There, in small rooms in Bolton Street off Piccadilly. James wrote the major fiction of his middle life. When he withdrew from London, it was to the British seaside, there to continue his writing; or for periodic trips to France and Italy. where he collected materials for his travel and his literary papers written on the margin of his fictions. In 1878, with the publication of "Daisy Miller," he became internationally known. The story. dealing with an American flirt whose behaviour is misunderstood by the international set in Rome. was central to James's first phase. In this period most of his stories were "international." They presented the contrast of American and European manners, and they inaugurated a series of studies of the American girl against the European background, of which *The Portrait of a Lady* (1881) established James as a major figure in world literature. In several years of rapid writing, with no falling off in quality or style, James produced *The Europeans* (1878); *Washington Square* (1881), one of the best known of his American subjects (posthumously dramatized as *The Heiress);* and such shorter tales as "An International Episode," "A Bundle of Letters" and "The Point of View," in which he balanced American innocence against European sophistication. During James's lifetime many of his American readers felt that the contrast was weighted in favor of the Europeans, but later critics recognized that all of James's "international" stories give his American protagonists a moral victory over the more cultivated, but also more corrupt, Europeans, and that Europe in reality is pictured often as a museum-world which James believed must not be exalted above human values.

In 1881 James revisited America. His parents died during the following year; thereafter the novelist ceased his crossings of the Atlantic and for 20 years remained uninterruptedly abroad, largely in England. He inherited a small income from his father, but turned it over to his sister, since his literary earnings were sufficient to support him. In England and France he formed friendships with a group of notable writers, critics and painters, among them Robert Browning. Robert Louis Stevenson, Edmund Gosse, Alphonse Daudet, Paul Bourget, George du Maurier, John Singer Sargent. Jules Jusserand, Mrs. Humphry Ward and later Joseph Conrad. H. G. Wells, Rudyard Kipling and Edith Wharton.

The second phase of his writings began with *The Bostonians* (1886). a novel with a wholly American subject; and *The Princess Casamassima* (1886), his first novel dealing exclusively with European life. Both novels were concerned with reformers, *The Bostonians* with the earliest phase of the suffragette question, *The Princess* with anarchism. *The Tragic Muse* (1889) is a novel of the art studios and the stage. It ushered in the novelist's "dramatic years," five years (1890–95) devoted assiduously to playwriting. A dramatization of *The American* in 1891 had a modest

run; but an original play, *Guy Domville,* produced Jan. 5, 1895, was booed out of the theatre. James reluctantly accepted this verdict and returned to the novel. He now wrote a series of short fictions, *The Other House* (1896), *The Spoils of Poynton* (1897), *What Maisie Knew* (1897), *In the Cage* (1898) and *The Awkward Age* (1899), which are set in England and show the influence of the scenic methods he had studied in the theatre. The novelist had never married, and in 1898 he purchased historic Lamb house in Rye, Sussex, where during the next dozen years he divided his time between long periods of solitary work and the practice of genial bachelor hospitality. He had written all his earlier works in longhand, but now he dictated the long, inflected and parentheses-studded sentences of his late style. With unabated power and increasingly subtle narrative skill he wrote his famous ghostly tale, *The Turn of the Screw,* and after the turn of the century, *The Ambassadors* (written in 1901 but published in 1903), *The Wings of the Dove* (1902) and *The Golden Bowl* (1904). In their tragic vision and technical virtuosity—innovations in "point of view" and manipulation of scene and subjectivity—these massive novels marked James's last phase and have come to be regarded as the summit of his work.

In 1904–05 James revisited the United States after his two-decade absence and wrote *The American Scene* (1907), remarkable for its prose pictures and its brooding concern with the materialistic drift of American life. During his remaining years James revised his novels and tales for the "New York edition" of his works, rigidly selected and arranged in 24 volumes and published between 1907 and 1909. It was for this edition that he wrote his famous prefaces on the art of fiction. Between 1910 and 1914 he wrote his two volumes of autobiography, *A Small Boy and Others* and *Notes of a Son and Brother.* A fragment of a third volume, *The Middle Years,* was published posthumously, as were two unfinished novels, *The Ivory Tower* and *The Sense of the Past,* the latter becoming the successful play *Berkeley Square.*

He wrote in all 20 full-length novels, a dozen novelettes, more than 100 short stories; he collected his travel writings in *Transatlantic Sketches* (1875), *Portraits of Places* (1883), *A Little Tour in France* (1885), *English Hours* (1905) and *Italian Hours* (1909). His essays are grouped in *French Poets and Novelists* (1878), *Partial Portraits* (1888), *Essays in London* (1893), *Picture and Text* (1893) and *Notes on Novelists* (1914).

Henry James was elected to the American Academy of Arts and Letters in 1905, and on becoming a British subject in 1915 received the Order of Merit from George V. He died on Feb. 28, 1916, and his ashes were taken to America and buried in the James family plot in Cambridge cemetery.

Although he was a remarkable innovator and widely known in the literary world, James's public was comparatively small during his lifetime. With the revival of interest in his work following centenary observances in 1943, and the growing comprehension of the extent of his fictional explorations, he has reached an ever-widening audience.

His rendering of subjective states places him as a forerunner of the "stream of consciousness" method in fiction. In his originality, distinction of style and inventiveness, he has been regarded as the prototype of the American artist and is often spoken of as a "novelists' novelist."

BIBLIOGRAPHY.—Posthumous publication of James has been extensive. His notebooks, constituting a remarkable document on the creative process, were edited by F. O. Matthiessen and K. B. Murdock in 1947; his 12 plays, edited by Leon Edel, appeared in 1949. Miscellaneous essays have been collected in *The Scenic Art,* ed. by A. Wade (1947); *The American Essays of Henry James,* ed. by Edel (1956); *The Painter's Eye,* ed. by J. L. Sweeney (1956); *The House of Fiction,* ed. by Edel (1957); *Parisian Sketches,* ed. by Edel and I. D. Lind (1957). In 1920 Percy Lubbock edited a selection from his vast correspondence in *The Letters of Henry James* in two large volumes. Further letters appeared in *The Selected Letters of Henry James,* ed. by Edel (1955). A complete bibliography of James's writings, compiled by Leon Edel and Dan H. Laurence, was published in 1957. In addition to earlier critical-works by Rebecca West, Joseph Warren Beach, Ford Madox Hueffer, Van Wyck Brooks and Pelham Edgar, the late F. O. Matthiessen edited an anthology of James family writings and wrote a study of the later novels; F. W. Dupee wrote a short critical biography (1952); and Edel completed the first part of a full-length biography, *Henry James: The Untried Years* (1953). (LN. E.)

JAMES, JESSE WOODSON (1847–1882), U.S. outlaw, was born Sept. 5, 1847, in Clay county, Mo. In the early months of the Civil War the family was partisan to the Southern cause, and as a result suffered greatly at the hands of the Union forces. By way of retaliation, Jesse turned informer and later, when only 15 years of age, joined the guerilla forces of W. C. Quantrill. There he soon established a reputation for marksmanship and daring. At the conclusion of the war, he, with other members of the band, surrendered, but soon afterward was treacherously shot and severely wounded. In the following year he was declared an outlaw, and thereafter until his death he was a fugitive from the law. In 1867 he became the leader of the "James band" of bank and train robbers, and during the following years attained a wide repute for crimes of the most daring and cold-blooded type. As the result of a reward of $10,000 offered by Governor Crittenden of Missouri for the capture of Jesse James, dead or alive, two members of his own band, Robert and Charles Ford, turned traitors and shot and instantly killed him in his home at St. Joseph, Mo., April 3, 1882.

Jesse's brother, Frank (1843–1915), was a partner in crime in most of the exploits of the James band. He surrendered and was twice brought to trial soon after the death of his brother, but was acquitted both times. The closing years of his life were spent quietly on a farm in Missouri.

JAMES, WILLIAM (d. 1827), English naval historian, author of the *Naval History of Great Britain From the Declaration of War by France in 1793 to the Accession of George IV,* practised as a proctor in the admiralty court of Jamaica between 1801 and 1813. He was in the United States when the war of 1812 broke out, and was detained as a prisoner, but escaped to Halifax. His literary career began by letters to the *Naval Chronicle* over the signature of "Boxer." In 1816 he published *An Inquiry Into the Merits of the Principal Naval Actions Between Great Britain and the United States.* In 1819 he began his *Naval History* (1822–24). James died on May 28, 1827, in London.

JAMES, WILLIAM (1842–1910), U.S. psychologist, philosopher, leader of the movement known as pragmatism, and most renowned and representative of the thinkers of the United States, was born in New York city on Jan. 11, 1842. He was the eldest of the five children of Henry and Lucy (Walsh) James; the second of the five, William's brother Henry (*q.v.*), became the distinguished author of novels proclaimed for their psychological subtlety and their refinement of style. The other brothers and sisters do not figure notably, nor do the ancestors of William and Henry James. There is no indication in the American line of Irish, Scotch and English forbears, whose bloods mingled in their veins, of that deep and urgent concern with the ultimates of nature and human nature which moved the two brothers and their father. The grandfathers were "farmers, traders and merchants," prosperous and Presbyterian, with hardly even a doctor or a lawyer among them. There is a probable connection between the father's philosophic interests and an accidental burning during his boyhood that required the amputation of one leg above the knee. Both the physical and the spiritual life of Henry James the elder were marked by restlessness and wanderings, largely in Europe, which affected the training of his children at school and their education at home. He had himself graduated from Union college, in Schenectady, N.Y., and then gone to the Princeton theological seminary, to prepare himself for the Presbyterian ministry, but had developed while there "antipathy to all ecclesiasticisms which he expressed with abounding scorn and irony throughout all his later years." In 1844, when William was two years old, a friend introduced to his father the works of Swedenborg. In these he seems to have found something of the consolation and security that he was seeking, and upon them he built a system of his own which seems to have served as a vision of spiritual life adequate to compensate for his bodily misfortune. The best of it William James conserved in *The Literary Remains of Henry James,* published in 1886. It provided the permanent intellectual atmosphere of William James's home life. Its perduration made up for the

disciplineless irregularity of his schooling, which ranged from New York in the United States to Boulogne in France, Geneva in Switzerland, and back. The habits acquired in dealing with the father's views at dinner and at tea carried over into the extraordinarily sympathetic yet critical manner of dealing with anybody's views on any occasion.

When James was 18 years of age and the family was living in Newport, R.I., he tried his hand at studying art, with William M. Hunt for a teacher and John LaFarge for a fellow pupil. But he soon tired of it. and the following year entered the Lawrence scientific school of Harvard university. From courses in chemistry, anatomy and similar subjects there, he went to the study of medicine in the Harvard medical school, but interrupted this study in order to accompany Louis Agassiz, in the capacity of assistant, on an exploring expedition to the Amazon. There his health failed and his duties irked him. He returned to the medical school for a term, and then during 1867–68 went to Germany for courses with Helmholtz, Virchow and Bernard, among others. At the same time he read widely in the psychology and philosophy then current, especially Renouvier.

The acquaintance with Renouvier is a focal point in James's personal and intellectual history. He seems from adolescence to have been a delicate boy, always ailing, and at this period of his stay in Germany to have suffered a breakdown, with thoughts of suicide. When he returned home, in Nov. 1868, after 18 months in Germany, he was still ill. Though he took the degree of M.D. at the Harvard medical school in June 1869, he was unable to begin practice. Between that date and 1872 he lived in a state of semi-invalidism in his father's house, doing nothing but reading, and writing a very occasional review. Early in this period he experienced a sort of phobic panic which persisted until the end of April 1870. It was relieved, according to his own statement, by the reading of Renouvier on free will and the decision that "my first act of free will shall be to believe in free will." The decision carried with it the abandonment of all determinisms—both the scientific kind which his training had established for him and which seems to have had some relation to his neurosis, and the theological, metaphysical kind that he kept combating in the notion of "the block universe." His revolutionary discoveries in psychology and philosophy, his views concerning the methods of science. the qualities of men and the nature of reality, seem all to have received a definite propulsion from this resolution of his poignant personal problem.

In 1872 James was appointed instructor in physiology in Harvard college. He served in this capacity until 1876. But he could not be diverted from his ruling passion, and the step from teaching physiology to teaching psychology—not the traditional "mental science" but physiological psychology—was as inevitable as it was revolutionary. It meant a challenge to the vested interests of the mind, mainly theological, which were entrenched in the colleges and universities of the United States. It meant a definite break with what Santayana called "the genteel tradition." Psychology ceased to be mental philosophy and became a laboratory science. Philosophy ceased to be an exercise in the grammar of assent and became an adventure in methodological invention and metaphysical discovery.

With his marriage in 1878, to Alice H. Gibbens of Cambridge, Mass., a new life began for James. The old neurasthenia practically disappeared. He went at his tasks with a zest and an energy his earlier record had given no hint of. It was as if some deeper level of his being had been tapped: his life as an originative thinker began in earnest. He signed a contract with Henry Holt and Company to produce a textbook of psychology by 1880. But the work grew under his hand and did not appear until 1890. When it did appear, as *The Principles of Psychology*, it was not a textbook but a monumental work in two great volumes from which the textbook was condensed two years later. The *Principles* was at once recognized as both definitive and innovating in its field. It established the functional point of view in psychology. It assimilated mental science to the biological disciplines and treated also thinking and knowledge in the aspect of instruments in the struggle to live. It made at one and the same time the fullest use of principles of psychophysics and defended, without embracing, free mill..

The *Psychology* completed, James seems to have lost interest in the subject. Creator of the first U.S. demonstrational psychological laboratory, he disliked laboratory work and did not feel himself fitted for it. He liked best the adventure of free observation and reflection. Compared with the problems of philosophy and religion, psychology seemed to him "a nasty little subject" that he was glad to have done with. His studies were now of the nature and existence of God, the immortality of the soul, free will and determinism, the values of life. They differed from the usual thing in method: they were empirical, not dialectical. James went directly to religious experience for the nature of God, to psychical research for survival after death, to the fields of belief and action for free will and determinism. He was searching out these things. not arguing foregone conclusions. He had begun to teach ethics and religion in the late 1880s, and his collaboration with the psychical researchers dated even earlier. Survival after death he found at the end to be unproved; but the existence of divinity he held to be established by the record of the religious experience, but as a plurality of saving powers, "a more of the same quality" as oneself, that in a crisis one's personality can make contact with and be saved. Freedom he found to be a certain looseness in the conjunction of things, so that what the future shall be is not made inevitable by past history and present form; freedom or chance corresponds to Darwin's "spontaneous variations"; it is what saves history from being mere repetition. These views were set forth in the period between 1893 and 1903 in various essays and lectures, afterward collected into works: *The Will to Believe and Other Essays in Popular Philosophy* (1897); *Human Immortality* (1898); *Talks to Teachers on Psychology and to Students on Some of Life's Ideals* (1899); *The Varieties of Religious Experience* (1902). The decade may be correctly described as James's religious period. All his studies are concerned with one aspect or another of the religious question. His natural interest in the subject was reinforced by the practical stimulus of an invitation to give the Gifford lectures on natural religion at the University of Edinburgh. He was not able to give them until 1901–02, and their preparation focused his labours for a number of years.

His disability, involving his heart, was due to prolonged effort and exposure during a holiday in the Adirondacks in June 1899. A trip to Europe which was to have taken up a sabbatical year away from university duties turned into two years of invalidism. The Gifford lectures were prepared during this distressful period. Published as *The Varieties of Religious Experience*, they had an even greater acclaim as a book than as articles. Cautious and tentative though it was, the rich concreteness of the material, the final summary of the evidence that the varieties of religious experience point to the existence of specific and various reservoirs of consciousnesslike energies with which we can make specific contact in times of trouble, touched something fundamental in the minds of religionists and at least provided them with apologetic material not in conflict with science and scientific method.

The book also topped off James's interest in the psychology of religion. He now explicitly turned his attention to the ultimate philosophic problems that were at least marginally present with his other interests. Already in 1898, in a lecture at the University of California on philosophical conceptions and practical results, he had formulated the theory of method known as pragmatism. Having its roots in the strict analysis of the real logic of the sciences made in the middle 1870s by that extraordinary eccentric genius Charles S. Peirce, it underwent in James's hands a transforming generalization. He showed how the meaning of any idea whatsoever—scientific, religious, philosophical, political, social, personal—can be found ultimately in nothing save the succession of experiential consequences it leads through and to; that truth and error are identical with these consequences or else nothing within reach of the mind at all. He had made use of the pragmatic rule in his study of religious experience. He now turned it, upon the ideas of change and chance, of freedom, variety, pluralism, novelty, which from the time he had read Renouvier it had been his

preoccupation to establish. He used the pragmatic rule in his polemic against monism and the "block universe," against internal relations (*i.e.*, the notion that you can't have one thing without having everything), against all finalities, staticisms and completenesses. His classes rang with the polemic against absolutes, and a new vitality crept into the veins of American philosophers. The historic controversy over pragmatism saved the profession from iteration and dullness.

Meantime (1906) James had been asked to lecture at Stanford university, in California. and experienced there the earthquake which destroyed San Francisco. The same year he delivered the Lowell lectures, in Boston, Mass., afterward published as *Pragmatism: A New Name for Old Ways of Thinking*. Various studies—"Does Consciousness Exist." "The Thing and its Relations," "The Experience of Activity," etc.—appeared, chiefly in the *Journal of Philosophy;* they were essays in the extension of the empirical and pragmatic method to everything that has a name. These studies were collected after James's death and published as *Essays in Radical Empiricism* (1912). The fundamental point of these essays is that the relations between things, holding them together or separating them, are at least as real as the things themselves, that their function is real and that no hidden substrata are necessary to account for the clashes and coherences of the world. The empiricism was radical, because until this time even empiricists believed in a hidden turtle on whose back the cosmic elephant rode.

James was now the centre of a new life for philosophy in the English-speaking world; the continentals did not "get" pragmatism; if its German opponents altogether misunderstood it. its Italian adherents—Papini, of all people—travestied it. In England it was championed by Schiller; in the United States there were Dewey and his school. The pragmatists were by no means unanimous among themselves, but that added to the interest of the situation. In 1907 James gave his last course—an introduction to philosophy—in Harvard, and the students surprised him and broke an academic precedent by presenting him with a loving cup. In the spring he went to Columbia university in New York city to repeat the lectures on "Pragmatism." It was as if a new prophet had come: the lecture halls were crowded on the last day as on the first, with people standing outside the door. He was fêted and photographed; he himself describes the visit as the "high tide of my existence." His hope was, when the thing was over, to settle down at last to a free consideration of the philosophical questions that obsessed him. But there came an invitation to give the Hibbert lectures at Manchester college in Oxford, England, that constituted, he felt. a challenge which, in view of the status of pragmatism in England at that time, he might not disregard. These lectures, published in 1909 as *A Pluralistic Universe*, state in a more systematic and less technical way than the *Essays in Radical Empiricism,* the same essential positions. They present in addition certain religious overbeliefs of James's which further thinking. if the implications of the posthumous *Some Problems in Philosophy* may be trusted, seemed to be mitigating. These overbeliefs involve a pan-psychistic interpretation of experience which goes beyond radical empiricism and the pragmatic rule into conventional metaphysics.

Home again, James found himself working, against growing physical trouble, upon the material of which some was published after his death (1911) as the *Some Problems, etc.* referred to above. He also collected the occasional pieces in the controversy over pragmatism and published them as *The Meaning of Truth* (1909). He remained available to students and good causes, and he wrote various other pieces—the last one about B. P. Blood, the "pluralistic mystic." Finally his physical discomfort exceeded even his reinarkable voluntary endurance. It was decided to try again a cure at Nauheim and he sailed with Mrs. James in the spring of 1910 for Europe. But in Europe he gave himself too freely to people and Nauheim did not help him. They came back, in the company of his brother Henry, in midsummer, going straight to the country home in Chocorua, N.H. There he died on Aug. 26, 1910. He was survived by his widow, three sons and one daughter.

It is still too early to estimate James's significance and influence. In psychology, his work is of course dated, but it is dated as Galileo's is in physics or Darwin's in biology, because it is the originative matrix of the great variety of nen developments which are the current vogue. In philosophy, his positive work still is prophetic. The world he argued for is that which the new physics, the physics of Einstein and Russell and Bohr, definitely points to—a world of events connected with one another by kinds of next to next relations, a world various, manifold, changeful, originating in chance, perpetuated by habits (we call such habit laws) and transformed by breaks. spontaneities and freedoms. In human nature, James thinks, these visible traits of the world are equally manifest. The real specific event is the individual: his character, his beliefs, his endeavour are an adventure in autobiography of which the conclusion is not established in advance. He integrates societies as he lives, and he breaks them. He validates beliefs by living them out or he makes them false. He is the primary event from which history dates, and whose intervention gives it in each case a new and unexpected turn. But in history as in nature, the flux of change and chance transforms every being, invalidates every lam and alters every ideal. "What," he asks, "has concluded, that we should conclude about it"? Let us therefore, he urged, allow the claim of everything that makes a claim before us. let us give it an opportunity to make good its claim. The world of thought and the world of things are alike to be treated in the spirit of sportsmanlike fair play; the new, the untried, the doubtful are to have their chance whenever and however they arise.

James lived his philosophy. It enters into the texture and rhythms of his rich and vivid literary style. It determined his attitude toward scientifically unaccepted therapies, such as Christian Science or mind cure, and repugnant ideals, such as militarism. It made him an anti-imperialist, a defender of the small, the variant, the unprecedented, the weak, wherever and whenever they appeared. His philosophy is too viable and subtle, too hedged, experiential and tentative to have become the dogma of a school. It has functioned rather as a germinative of new thought in others than as a standard old system for others to repeat. (H. M. K.)

For James's functional psychology, *see* PSYCHOLOGY, HISTORY OF; for the James-Lange theory of emotions, *see* EMOTION; for his philosophy, *see* PRAGMATISM.

BIBLIOGRAPHY.—H. *L.* Bergson, *The Creative Mind,* tr. *by M* L. Andison (1946); T. Flournoy, *The Philosophy of William Janzes,* authorized trans. by E B. Holt and W James, Jr. (1917); C. H. Grattan, *The Three Jameses* (1932); *The Letters of Willianz James,* ed. by his son, Henry James (1920); J. M. Moore, *Theories of Religious Experience* (1938); *R. B.* Perry, *Thought and Character of Willianz James* (1936).

JAMES, EPISTLE OF. This epistle, according to its opening verse, is addressed by James to "the twelve tribes of the dispersion," which probably means Christendom in general, conceived as the new Israel (*cf.* 1 Peter i. 1, 3, 23–5; Gal. vi. 16). According to the traditional view, this James is the Lord's brother, the "pillar" of Gal. ii. 9. But this is very far from being certain. With the superscription of this epistle may be compared that of the Epistle of Jude (*q.v.*), whose author. it would seem. seeks to clothe a message of denunciation against heretics guilty of moral laxity with similar apostolic authority, the "kindred of the Lord being regarded in post-apostolic times as guardians of faith and morals for the Church (Hegesippus *ap.* Euseb., H. *E.* iv, xxii. 4).

Though some conservative critics still maintain the authenticity of the work, the superscription failed, even in antiquity, to secure its general acceptance; for Origen (A.D. 230), who is the first writer to make explicit mention of it, speaks of it as only "the so-called Epistle of James," Eusebius classes it among the "disputed" writings, and even Jerome admits that it was "said to have been published by another in the name of James." It is included in the *Catalogus Claromontanus* (Alexandria. 4th century) and in the lists of Athanasius, Cyril of Jerusalem and Epiphanius. But the Western Church, like the Syrian, refused it fecognition down to the 5th century.

Luther maintained that the epistle was not apostolic (*Sämmtl. Werke*. Erl., vol. lxiii. p. 157), but his objections were largely doctrinal in character and the later reformers, disregarding the well-founded doubts of Erasmus and Cajetan, fell back upon the tradi-

tional view. Modern criticism begins with de Wette's *Introd. to* the N.T. (1826), which definitely denied the claim to apostolic origin. It is true that the epistle cannot have been composed later than A.D. 150, and that from the beginning it bore the name of James. But the language in which it was composed is a strongly Hellenized type of patristic Greek. This, and its motive, that of combating the type of degenerate Paulinism denounced in the Pastoral Epistles, Polycarp, and Papias as "vain talk" in place of a life in accordance with the new commandment of love, serve to link it, so far as motive is concerned, with the Gospel of Matthew, the Epistles of John (cf. 1 John iii. 16–24), Ps.-Barnabas (A.D. 132?), and the Ignatian Epistles (115).

Zahn and Mayor would avoid the difficulty of taking ii. 14–26 as a direct polemic against the watchword of Paul by assuming a date shortly before the beginning of the legalistic controversy or immediately after the death of Paul. But internal evidence shows that the date must fall "in the period of quiet after the destruction of Jerusalem in A.D. 70 and before the disturbances which culminated in the rebellion of Bar-Cochba, A.D. 132–135." This conclusion is that of Prof. J. H. Ropes of Harvard in the most thorough treatment ever given to the epistle (*I.C.* Comm., 1916).

While, as regards motive, the writer stands close to the Pastoral Epistles and Matthew, his use of the moral teachings of Jesus is closer to the form reflected in Luke. Like the Lucan source James shows affinity with the Jewish wisdom literature as well as with the Hellenistic diatribe. His extraordinary lack of interest in Jesus as actual Leader and Founder of the Church (cf. James v. 10, 11 with 1 Peter iii. 13–iv. 6), resulting in a type of religion equivalent to the Jewish doctrine of the Torah as an indwelling better impulse (yetser hattob), informing and sustaining the spiritual life, can scarcely be paralleled unless in the Preaching of Peter, an early product of the Syrian Church in which, as Clement reports, the titles applied to Christ were Word and Law (Λόγος καὶ Νόμος). Hermas at Rome, who shows several other contacts with James, has also the strange declaration that "The Law of God given to the whole world is the Son of God" (*Simil.* viii. 3). The foundation is seemingly 1 Peter i. 23–25, adopted in James i. 18, 21; but the outcome is a Logos doctrine widely different from that developed in Asia under the influence of Paul.

As between Syria and Rome internal indications, such as the reference to conditions of agriculture (v. 7) as well as the pseudonym invoked, suggest a Syrian origin as more probable. As an example of the kind of surroundings likely to give rise to such a writing Ropes suggests Caesarea, second only to Jerusalem as a Palestinian cradle of the Church. In his carefully chosen words "The epistle is probably the pseudonymous production of a Christian of Jewish origin, living in Palestine in the last quarter of the 1st century or the first quarter of the 2nd."

BIBLIOGRAPHY.—The Commentaries by J. B. Mayor (4th ed., 1913), J. H. Ropes (Int. Crit. Comm., 1916); J. E. Belser, *Die Epistel d. heiligen Jakobus* (1909); *H.* Windisch, *Die Katholischen Briefe* (Handbuch z. *N.T.*, 1911); J. Moffatt, *Zntrod. to the Lit.* of *the N.T.* (3rd ed., 1918), with full bibliography. (B. W. BA.)

JAMESON, SIR LEANDER STARR (1853–1917), British colonial statesman, son of R. W. Jameson, a writer to the signet in Edinburgh, was born at Edinburgh in 1853, and was educated for the medical profession at University College Hospital, London (M.R.C.S. 1875; M.D. 1877). After acting as house physician, house surgeon and demonstrator of anatomy, his health broke down from overwork in 1878, and he went out to South Africa and settled down in practice at Kimberley. There he came into contact with Cecil Rhodes. In 1888 he used his influence with Lobengula, who was one of his patients, to induce him to grant the concessions to the agents of Rhodes which led to the formation of the British South Africa Company; and when the company proceeded to open up Mashonaland, Jameson abandoned his medical practice and joined the pioneer expedition of 1890. From this time his fortunes were bound up with Rhodes's schemes in the north. Immediately after the pioneer column had occupied Mashonaland, Jameson, with F. C. Selous and A. R. Colquhoun, went east to Manicaland and secured the greater part of that country, to which Portugal was laying claim, for the Chartered company. In 1891 Jameson succeeded Colquhoun as administrator of Rhodesia. At the end of 1894 "Dr. Jim" (as he was familiarly called) came to England and was feted on all sides.

On the last day of 1895 the world was startled to learn that Jameson, with a force of 600 men, had made a raid into the Transvaal from Mafeking in support of a projected rising in Johannesburg, connived at by Rhodes at the Cape (see RHODES, CECIL JOHN, and TRANSVAAL). Jameson's force was compelled to surrender at Doornkop, receiving a guarantee that the lives of all would be spared; he and his officers were sent to Pretoria, and, after a short delay, President Kruger, on the surrender of Johannesburg (Jan. 7), handed them over to the British government for punishment. They were tried in London under the Foreign Enlistment Act in May 1896, and Dr. Jameson mas sentenced to 1j months' imprisonment at Holloway. He served a year in prison, and was then released on account of ill health. He still retained the affections of the white population of Rhodesia, and returned there in an unofficial capacity. He was the constant companion of Rhodes on his journeys up to the end of his life, and when Rhodes died in May 1902, Jameson was left one of the executors of his will. In 1903 Jameson came forward as the leader of the Progressive party in Cape Colony; and after the Progressive victory at the general election in Jan.–Feb. 1904, Jameson was prime minister. He attended the Colonial conference held in London in 1907. In September of that year the Progressives were defeated at the polls, and Jameson resigned office on Jan. 31, 1908. In 1908 he was one of the delegates from Cape Colony to the inter-colonial convention for the closer union of the South African states. The union of the South African colonies in 1909 accomplished the principal object which Jameson had set before himself as a political leader. He wished to carry the spirit of union further by forming a combination of political parties to support a non-racial government for the new Union, regarded General Botha as the natural leader of such a combination, and was completely ready to serve under him. This project of a "best man" government, however, was not accepted by Botha, who thought that the Dutch-speaking people of South Africa were not ready for it. The alternative, to which Jameson then set himself, was the formation of a new party representing the majority of the English-speaking people in the Cape, the Transvaal, the Orange Free State and Natal. The program of the new Unionist party of South Africa showed his influence in every clause.

For two years Jameson led the Unionists in the South African house of assembly with moderation and self-restraint, but he was compelled by ill-health to retire from the leadership of the party in 1912. He returned to England and settled in London, devoting himself to business interests. He died on Nov. 26, 1917. Diffident and utterly free from self-seeking, Jameson's labours for racial reconciliation and material progress in South Africa were conspicuous, and the close friendship of Botha was a final proof of the quality of his patriotism. Jameson was created a K.C.M.G. on the inauguration of the Union in 1909 and a baronet in 1911. See also SOUTH AFRICA, UNION OF.

JAMESON, ROBERT (1774–1854), Scottish naturalist and mineralogist, was born at Leith on July 11, 1774. He became assistant to a surgeon in his native town. He studied natural history under John Walker in 1792 and 1793, and went in 1800 to Freiberg to study for nearly two years under Abraham Werner. In 1804 he succeeded-Walker as regius professor of natural history in Edinburgh university. He became perhaps the first eminent exponent in Great Britain of the Wernerian geological system, but was ultimately converted to the views of James Hutton. His influence in the classroom gave a marked impetus to the study of geology in Britain. His energy also amassed a great part of the splendid collection in the natural history department of the Royal Scottish museum in Edinburgh. In 1819 Jameson, with Sir David Brewster, started the Edinburgh Philosophical Journal, and after the tenth volume edited it alone, until his death in Edinburgh on April 19, 1854.

Jameson was the author of *Outline of the Mineralogy of the Shetland Islands and of the Island of Arran* (1798), incorporated with *Mineralogy of the Scottish Isles* (1800); *Mineralogical Description of Scotland*, vol. i, pt 1 (Dumfries, 1805); this was to have been the first of

a series embracing all Scotland; *System of Mineralogy* (3 vol., 1804–08; 3rd ed, 1820); *Elements of Geognosy* (1809); *Mineralogical Travels through the Hebrides, Orkney and Shetland Islands* (2 vol., 1813); and *Manual of Mineralogy* (1821); and occasional papers, of which a list will be found in the *Edinburgh New Philosophical Journal* (July 1854), with a portrait and biographical sketch of the author.

JAMES RIVER (DAKOTA RIVER), a nonnavigable stream of North and South Dakota, U.S., named Dakota by the Dakota Territorial legislature, although better known as the James river or, in the vernacular, Jim river. Its alternate name is presumably derived from a French-Indian fur trapper who attached his own name to the river: Rivière de Jacques. The river has a length of 710 mi.

The river rises in Wells county, central North Dakota, and from there flows in a generally south-southeasterly direction across the entire state of South Dakota to its junction with the Missouri river about five miles below Yankton. In its sinuous course across the Dakota prairies the river falls only 460 ft. Its stream flow is subject to the rainfall variability in this subhumid region; consequently, it may fluctuate between flood stage and a mere trickle. A number of low-head dams have been constructed for recreation and water supply purposes, but there is no hydroelectric power development. A dam near Jamestown, N.D., provides flood protection and water for irrigation. The drainage basin of the river encompasses 22,100 sq.mi. and contains some of the most productive agricultural land in North and South Dakota, a region dominated by wheat, corn and livestock farming. Major cities along the river are Jamestown, N.D., and Huron, S.D. Its chief tributaries are Elm river and Turtle creek. (E. HG.)

JAMESTOWN, a city of Chautauqua county, N.Y., U.S., at the southern outlet of Lake Chautauqua, 68 mi. S.W. of Buffalo, is an industrial centre providing wood and metal furniture, automobile and airplane parts, washing machines, voting machines, office equipment, woolen textiles and tools. It was named for James Prendergast, who, while searching for his runaway horses, came upon the rapids of the Chadakoin at the outlet of Chautauqua lake and selected the site for his mill, around which grew the community. Settled in 1810, Jamestown was incorporated as a village in 1827 and chartered as a city in 1886. Water power was abundant and the migration of Swedes to Jamestown provided excellent skilled labour; their progeny continued to form a major portion of the population in the latter part of the 20th century. A significant number of Italians and English also enrich the heritage of the area.

A community college, opened in 1950, offers liberal arts, business and engineering degrees; the well-known Chautauqua institution is nearby. There are many recreational facilities: ski tows are within easy access, Lake Erie and Chautauqua lake provide boating and fishing, and large and small game make interesting hunting. For comparative population figures *see* table in NEW YORK: *Population. See* also CHAUTAUQUA. (A. W. B.)

JAMESTOWN, a former village in what is now James City county, Va., U.S., on Jamestown Island, in the James river, about 40 mi. above Norfolk. It was there that the first permanent English settlement in America was founded on May 14, 1607, that representative government was inaugurated on the American continent in 1619 and that Negro servitude was introduced into the original 13 Colonies, also in 1619. The first Anglican church built in America was in Jamestown. The settlement was in a low marshy district which proved to be unhealthy; it was accidentally burned in Jan. 1608, and was almost completely destroyed by Nathaniel Bacon in Sept. 1676. The state house and other buildings were again burned in 1698, and after the removal of the seat of government of Virginia from Jamestown to the Middle Plantations (now Williamsburg) in 1699 the village fell rapidly into decay. Its population had never been large: it was about 490 in 1609 and 183 in 1623; the mortality was always very heavy. By the middle of the 19th century the peninsula on which Jamestown had been situated had become an island, and by 1900 the James river had worn away the shore but had hardly touched the territory of the "New Towne" (1619), immediately east of the first settlement; almost the only visible remains, however, were the tower of the brick church and a few gravestones. In 1900 the Association for the Preservation of Virginia Antiquities, to which the site was deeded in 1893, induced the United States government to build a wall to prevent the further encroachment of the river; the foundations of several of the old buildings were uncovered later, many interesting relics found and in 1907 there were erected a brick church (which was as far as possible a reproduction of the fourth one built in 1639–47), a marble shaft marking the site of the first settlement, another shaft commemorating the first house of burgesses, a bronze monument to the memory of Capt. John Smith and another monument to the memory of Pocahontas. (For additional details concerning the early history of Jamestown, *see* VIRGINIA: *History.*) The founding at Jamestown of the first permanent English-speaking settlement in America was celebrated in 1907 by the Jamestown Tercentennial exposition, held at Sewell's point on the shore of Hampton Roads. About 20 foreign nations, the federal government and most of the states of the union took part in the exposition.

See also Index references under "Jamestown" in the Index volume.

See L. G. Tyler, *The Cradle of the Republic: Jamestown and James River* (2nd ed., 1906); Mrs. R. *A.* Pryor, *The Birth of the Nation: Jamestown* 1607 (1907); and particularly S. H. Yonge, *The Site of Old "James Towne" 1607–1698* (1904), embodying the results of the topographical investigations of the engineer in charge of the river wall built in 1900–01. *See* also J. *T.* Faris, *The Romance of Forgotten Towns* (1924).

JAMI (NURUDDIN ABDURRAHMAN) (1414–1492), is sometimes regarded as the last great Sufi poet of Persia. Born on Nov. 7, 1414, at Jam in Khurasan, he spent most of his life in Samarkand and Herat, where he died on Nov. 9, 1492. It was perhaps his mystical authority that brought him his widest contemporary fame, not only in Khurasan and the rest of Persia, but also in India and the Ottoman empire.

His major poetical work, the *Haft Aurang,* a collection of seven romantic, philosophical and ethical poems, owes an admitted debt to Nizami (*q.v.*). Included in the collection are *Salaman va Absal* (Eng. trans. by Edward FitzGerald, *Salaman and Absal,* 1856); *Yusef va Zulaikha* (Eng. trans. by R. T. H. Griffith, *Yusuf and Zulaikha,* 1882) and *Laila va Majnun.* His prose and verse work *Baharistan* (Eng. trans. by E. Rehatsek, *The Beharistan: Abode of Spring,* 1887) is similarly modeled on the *Gulistan* ("Rose Garden") of Sa'di (*q.v.*), and his lyrics on the *ghazals* of Hafiz (*q.v.*). Nevertheless they all have a freshness and originality of their own. His many prose works, ranging from mystical writings and Koranic studies to biography, grammar and music, include *Lawa'ih,* a treatise on Sufiism (Eng. trans. by E. H. Whinfield, 1906).

BIBLIOGRAPHY.—W. Nassau Lees, *A Biographical Sketch of the Mystic Philosopher and Poet Jami* (1859); *E.* G. Browne, *A Literary History of Persia,* vol. iii, pp. 507–548 (1928); C. Huart in *Encyclopaedia of Islam,* vol. i, p. 1011 (1913). (L. P. E.-S.)

JAMIESON, JOHN (1759–1838), Scottish lexicographer, was born in Glasgow on March 3, 1759. Educated at Glasgow university and at Edinburgh, he became pastor of an Antiburgher congregation in Forfar; and in 1797 he was called to the Antiburgher church in Edinburgh. The union of the Burgher and Antiburgher sections of the Secession Church in 1820 was largely due to his exertions. He died in Edinburgh on July 12, 1838.

Jamieson's *An Etymological Dictionary of the Scottish Language . . .* 2 vol. (1808), with *Supplement* (2 vol., 1825), was revised by Longmuir and Donaldson in 1879–87.

JAMMES, FRANCIS (1868–1938), French poet and novelist, was born at Tournai Dec. 2, 1868. He became for a short time a notary's clerk at Orthez. There he published his first verses, in 1893, and from the countryside of Orthez he drew much of the matter of his poetical work. The chief characteristics of his style are a great simplicity and a preoccupation with the humble manifestations of everyday life, especially of French provincial life. His *Oeuvres* (2 vol.) were collected in 1925.

Among his works are: *De l'Angelus de l'aube à l'Angelus du soir* (1898); *Clara d'Ellébeuse* (1899); *Les georgiques chre'tiennes* (1912); *Feuilles dans le vent* (1914); *Le Rosaire au Soleil* (1916); *Le Curé d'Ozeron* (1918); *Les livres des quatrains* (1923–25); *Ma France*

poétique (1926). *See* also T. Braun; *Des pobtes simples: Francis Jammes* (1900); *A.* de Bersancourt, *Francis Jammes, pobte chrétien* (1910); *A.* Lowell, *Six French Poets* (1915).

JAMMU, winter capital of the state of Jammu and Kashmir on the river Tavi, a tributary of the Chenab. Pop. (1941) 50,379. The town and palace stand upon the right bank of the river; the fort overhangs the left bank, at a height of 150 ft. above the stream. The city was the seat of a Rajput dynasty. After conquest by the Sikhs, it formed part of Ranjit Singh's dominions. After his death it was acquired by Gulab Singh as the nucleus of his dominions, to which the British added Kashmir in 1846. It is connected with Sialkot in Pakistan by a railway 16 mi. long.

JAMMU PROVINCE, now part of Jammu and Kashmir state, consisted of a submontane tract, the upper basin of the Chenab. Pop. (1941) 1,981,433.

JAMNIA, Greek form of Hebrew JABNEH, JABNEEL ("God builds"), a Philistine city on the border of Judah (Josh. xv, 11), whose walls were destroyed by Uzziah (II Chr. xxvi, 6). In the Maccabean period a non-Jewish town it became Jewish again after Alexander Jannaeus and was reckoned to Judah (Josephus, Antiq. xiii. 15, 4). Pompey detached it from Judah and Gabinius rebuilt it (57 B.c.). Through Herod and Salome it became a possession of that royal house, was presented to Livia and ultimately passed to Tiberius.

Once a very populous city it was a centre of learning in Talmudic times. After the destruction of Jerusalem it became the home of the Great Sanhedrin and remained the Jewish religious centre until the time of Barcocheba (A.D. 132). It was erected into a bishopric at the time of Eusebius (4th century) and its bishop was present at Nicaea. The Crusaders,, who called it Ibelin (corruption of Jabneel), built a fortress there in 1144. The site is now occupied by the Jewish village of Yabneh, displacing the Arab village of Yebna. It stands on a hill in a fertile district 13 mi. S. of Jaffa and 4 mi. from the sea. Its harbour (Minet er-Rubin) at the mouth of the river is a survival from ancient times.

There was a Jabneel (mod. Yemma) 8 mi. S. of Tiberias and Josephus (Vita, 37) mentions a fortress in Upper Galilee named Jamnia. (E. Ro.)

JAMRUD, a fort and cantonment in the frontier region, Khyber Agency, West Pakistan.

It is situated at the mouth of the Khyber pass, 9 mi. W. of Peshawar on the extension of the North-Western railway to the Afghan frontier. It was occupied by Hari Singh, Ranjit Singh's commander, in 1836; but in April 1837 Dost Mohammed sent a body of Afghans to attack it. The Sikhs gained a doubtful victory, with the loss of their general. During the military operations of 1878–79, Jamrud was a place of considerable importance as the frontier outpost on British territory towards Afghanistan, and it was also the base of operations for a part of the Tirah campaign in 1897–98. It was the headquarters of the Khyber Rifles, and the collecting station for the Khyber tolls.

JAMS AND JELLIES. In the article FOOD PRESERVATION it is pointed out that concentrated sugar solutions inhibit the growth of organisms and so have a preservative action. The preparation of jams and jellies is based upon this fact. All fresh and succulent fruit contains a large percentage of water, amounting to at least four-fifths of the whole, and a comparatively small proportion of sugar usually not exceeding 10% to 15%. Such fruit is naturally liable to decomposition unless the greater proportion of the water is removed and the percentage of sugar much increased. Jams and jellies are preserves containing about two-thirds their weight of sugar. All kinds of edible fruit can be made into jam but for the preparation of jellies only those fruits are suitable which contain a sufficient proportion of a chemical substance called pectin, on which the gelatinizing power of fruit depends. This substance is a carbohydrate of no food value but, being allied to the vegetable gums, after boiling has the property of solidifying to a gelatinous mass. It is present to some extent in all fresh fruit but to a larger extent in citrous fruits, red and black currants, gooseberries and apples, and certain other fruits which are capable of forming jellies. As some degree of gelatinization is aimed at in jams pectin is sometimes added in the case of strawberries, raspberries, and other fruits which do not contain sufficientpectin to make them set. Iceland moss, gelatine and agar-agar have sometimes been added to give the necessary gelatinizing power, but such additions are not desirable.

The art of jam-making, once entirely domestic, is now a large branch of manufacture. The pulped or sliced fruit, sometimes with the addition of a little water, is mixed with about an equal weight of sugar and rapidly boiled down to the required consistency. As the jellifying power of the pectin depends upon the acidity of the fruit, the consistency can often be improved by the addition of a small quantity (say one-half of 1%) of tartaric or citric acid. Manufacturers sometimes add small quantities of aniline dyes to improve the colour. Considerable experience is required to stop the boiling at the right point; too short boiling leaves an excess of water, which results in fermentation, while overboiling may cause crystallization of the sugar. The finishing point is usually judged by rule of thumb, although in some factories it is regulated by accurate thermometric measurement. The addition of chemical preservatives, such as salicylic acid, was at one time common, but it is not now permitted in most countries. Although a jam or jelly containing 60% to 70% of sugar does not ferment or decompose it is still liable to the growth of mould on the surface, so in order to prevent this the pots into which the boiled jam is to be poured should be thoroughly cleaned and the jam or jelly sealed hermetically immediately, so that the spores of moulds may not fall upon the surface from the air.

Sometimes starch glucose and beet sugar are used to replace part of the cane sugar; the addition of glucose is not held to be an adulteration and is said to reduce the liability of the jam to crystallize and to aid gelatinization. A popular prejudice has it that beet sugar is not suitable for jam-making; this is quite erroneous; large quantities of beet sugar are used and the product is indistinguishable from that made from cane sugar. The gross adulteration of jam is now a thing of the past, but sometimes there is the addition of apple pulp, or the pulp of certain vegetables to give gelatinizing power, particularly when fruit pulp which has been long stored or which has been preserved with sulphur dioxide is used, as such is apt to be very deficient in pectin. (H. E. C.)

Homemade Jams and **Jellies.**—*Jellies.*—The gelatine must first be soaked about 20 minutes in water, and then melted with a small amount of water by stirring on top of a fire. Water should then be added in the proportion of about one pint to one ounce of gelatine, but certain fruits, such as the lemon, require more gelatine. The wine or other flavourings should be added while the mixture is hot; if fruit juice is to be added instead of whole fruits, the fruit must be stewed until as much as possible of its body has gone into the juice. The mixture should be poured into a mould and left to cool.

To remove jelly from the mould, it is best to place the mould once in very hot water—not several times in lukewarm water. The jelly can then generally be removed with one sharp jerk.

In the United States jelly-making from fruit is still a general home process, especially in rural communities and the smaller towns. The process is the same as for commercial jellies, cane or beet sugar being used. Paraffin is in common use for sealing. Of late years preparations of pectin have been marketed for use in the home, and these are being more and more employed.

For gelatine jellies, one pint of liquid requires about one tablespoon of the usual granulated gelatine. This is soaked five minutes in double its own quantity of cold water, and dissolved in a little hot liquid before stirring into the mixture. The use of manufactured gelatine jellies, already flavoured and needing only the addition of hot water, is wide and increasing.

Jams.—Sugar should be provided in the proportion of anything from ½ lb. to 1 lb. for each pound of fruit, according to taste. The sugar should first be melted over the fire in a small quantity of water, and the fruit then added. The whole should be boiled in a preserving pan from 20 to 60 minutes, according to the hardness of the fruit, being stirred regularly with a wooden spoon or stick, to prevent burning. The jam must then immediately be placed in perfectly dry pots and sealed at once.

JAMSHEDPUR, a city in the Singhbhum district of Bihar, republic of India. The city is situated in an angle of the Subarnarekha and Kharkhai rivers, with a station on the Eastern railway. With a population (1961) of 332,134, it is the second largest city in the state. It owes its creation and development to the Tata Iron and Steel company. Land on a village site was acquired here for the erection of the company's works in 1907, the foundations were laid in 1909, and iron was first produced in 1911. Since then Jamshedpur has grown rapidly with the expansion of the company's business, especially during World War I. It is an industrial town with blast furnaces, steel works and rolling mills; output after the outbreak of World War II tremendously increased and reached to considerably more than 1,000,000 tons of pig iron annually.

JANÁČEK, LEOS (1854–1928), Czech composer, was born in Hukvaldy, Moravia, on July 3, 1854, and educated in the monastery of the Austin Friars in Brno under the composer Pavel Křížkovský. After studies in Prague, Leipzig and Vienna he returned to Brno, where, in 1881, he became founder and director of the organ school, and later professor of composition in the master school of the State conservatoire, into which the organ school developed. Janáček followed in Křížkovský's footsteps, as a collector of folk songs, especially of Moravia, but went deeper than his master into their psychology. Among his operas, which contain some of his most original work, are *Její pastorkyňa* (more generally known by its German title, *Jenufa),* a psychological drama of Moravian village life, first produced in Brno (1904) and later heard in Prague (1916), Berlin, Vienna and New York; *Katya Kabanová* (Brno, 1921), based on *The Storm,* a Russian drama by Alexander Ostrovsky; and *Z mrtvého domu* on Theodore Dostoievsky's *The House of the Dead.* In lighter mood are *The Excursions of Mr. Brouček* (1920), an operatic satire, and *Liška bystrouška* (Brno, 1924), an animal opera. Janáček's other works include a dramatic song cycle, *The Diary of One Who Vanzshed;* a symphonic poem, *The Fiddler's Child;* an orchestral rhapsody, *Taras Bulba;* a string quartet; a concertino for small orchestra; a sextet for wind instruments, *Youth;* and some fine choral works. These last are extremely important in their own country, but not easy to transplant abroad, as Janáček's music very closely follows the inflections of the Slovak language. His music is more closely fashioned on human speech than that of any other composer. Janáček died on Aug. 12, 1928.

See Max Brod, *Leoš Janáček* (Prague, 1924; German trans., Vienna, 1925); Daniel Müller, *Leoš Janáček* (Paris, 1930).

JANESVILLE, a city of southern Wisconsin, U.S., the seat of Rock county, 32 mi. S.E. of Madison on the Rock river. Janesville was settled in 1835 and named for its pioneer settler Henry F. Janes; it was incorporated in 1853. A centre for trade in a dairy farming, grain and tobacco-growing region, the city had a rapid early growth. In 1919 General Motors opened a tractor plant which in 1922 became the Fisher Body and Chevrolet plant. Another industry is the Parker Pen company. incorporated in 1892. Other industries include the manufacture of church furniture, electrical and electronic equipment. punch presses. woolen and cotton goods, shades and awnings. The Wisconsin School for the Visually Handicapped is located in Janesville. Historically. the city is noted as the site of the Lincoln-Tallman museum and as the birthplace of Carrie Jacobs Bond, composer. and the home of Frances Willard. feminist and founder of the Women's Christian Temperance union. For comparative population figures *see* table in *WISCONSIN : Population.* (R. H. I)

JANET, PIERRE MARIE FÉLIX (1859–1947), French psychologist and neurologist, chiefly distinguished for his work in the field of disordered personality, was born in Paris on May 30, 1859, and educated there. He qualified at the École de Médecine and then became, like Freud, a pupil of J. M. Charcot. Throughout most of his life Janet practised as a specialist in nervous and mental diseases. After a few years as part-time lecturer in philosophy at several of the larger Parisian *lyce'es,* he became director of the psychological laboratory of the Salpêtrière. In 1898 he was appointed lecturer on psychology at the Sorbonne, and in 1902 professor at the Collbge de France. He died in Paris on Feb. 24, 1947.

Janet's chief work lay in the investigation of disorganized, alternating or split personality, as observed in certain of his hysterical patients. These conditions he interpreted in terms of a modified associationist theory. His studies led to a conception of normal personality as an integration of conscious and unconscious ideas and tendencies, and of hysteria as due to a lowered psychic tension, resulting in varying degrees of dissociation. The specific symptoms he interpreted as arising from subconscious thoughts. But his theories, unlike those of Freud, were formulated in terms of ideas rather than of emotions, and were intellectualistic and static rather than emotional and dynamic. Encyclopaedic in his learning, versatile in his interests, Janet published numerous papers and books.

Of these the more important were *L'Automatisme psychologique* (1889); *The Mental State of Hystericals* (1892; Eng. trans., 1901); *Névroses et iddes fixes* (1898); *Les obsessions et la psychasthdnie* (1903); *The Major Symptoms of Hysteria* (1907; Eng. trans., 1920); and *Les débuts de l'intelligence* (1933). (CY. B.)

JANEWAY, THEODORE CALDWELL (1872–1917), U.S. physician, was born in New York city Nov. 2, 1872. He was educated at the Sheffield Scientific school, Yale university, and the College of Physicians and Surgeons, Columbia university. From 1898 to 1906 he taught medical diagnosis in New York university. In 1907 he became associate in medicine in Columbia university, and two years later professor of medicine.

He was called to Johns Hopkins university in 1914 as first full-time professor of medicine, and became physician-in-chief to the Johns Hopkins hospital. His investigations in the phenomena of blood pressure opened up a hitherto unexplored field of medical research. He died at Baltimore, Md., Dec. 27, 1917.

JANIN, JULES GABRIEL (1804–1874), French critic, was born at St. Etienne (Loire) on Feb. 16, 1804. and died near Paris on June 19, 1874. He worked on *Figaro, Quotidienne,* etc., until in 1830 he became the dramatic critic of the *Journal* des *de'bats.* After many years of *feuilleton* writing he collected some of his articles in *Histoire de la littérature dramatique en France* (6 vol., 1853–58). In 1870 he was admitted to the academy. One of the best of his books is *Fin d'un monde et du neveu de Rameau* (1861), in which, under the guise of a sequel to Diderot's masterpiece, he showed great familiarity with the late 18th century. His *Oeuvres diverses* (12 vol, 1876–78) and his *Oeuvres de jeunesse* (5 vol., 1881–83) were edited by A. de la Fitzeliere.

A study on Janin with a bibliography was published by A. Piédagnel in 1874. *See* also, Sainte-Beuve, *Causeries du lundi,* ii and v, and Gustave Planche, *Portraits littéraires.*

JANINA or IOÁNNINA, a town of northern Epirus in Greece. Pop. (1961) 36,295. The largest ethnical groups in the population are the Albanian and Greek. The position of Janina is picturesque. At the foot of the gray limestone mass of Mount Mitzekeli (5,938 ft.), which forms part of the range of hills running north from the Gulf of Arta, there lies a valley (the *Hellopia* of antiquity) partly occupied by a lake; and the city is built on the slopes of a slight eminence, stretching down to the western shore. It has greatly declined from the state of barbaric prosperity which it enjoyed from 1788 to 1822, when it was the seat of Ali Pasha (*q.v.*), and was estimated to have from 30,000 to 50,000 inhabitants. The fortress—Demir Kule or Iron Castle, which, like the principal seraglio, was built on a promontory jutting into the lake—is now in ruins. But the city is the seat of a Greek archbishop, and still possesses many mosques and churches, besides synagogues, a Greek college (gymnasium), a library and a hospital.

The rich gold and silver embroidery for which the city has long been famous was in the 20th century still one of the notable articles in its bazaar.

The lake of Janina (perhaps to be identified with the Pambotus or Pambotis of antiquity) is 6 mi. long, and has an area of 24 sq.mi., with an extreme depth of less than 35 ft.

As Anna Comnena, in describing the capture of the town by Bohemond in 1082, speaks of the walls as being dilapidated, it may be supposed that the place existed before the 11th century. It is mentioned from time to time in the Byzantine annals, and on the establishment of the lordship of Epirus by Michael Angelus Comnenus Ducas, it became his capital. In the middle ages it

was successively attacked by Serbs, Macedonians and Albanians; but it was in possession of the successors of Michael when the forces of the Sultan Murad appeared before it in 1430 (cf. Hahn, Alban. Studien, Jena [1854], pp. 319–322). After 1431 it remained under Turkish rule but was occupied by the Greeks early in 1913 in the first Balkan war. It then became the principal town of Epirus. It uses as ports Prevoza, to the South, and Santi Quaranta in Albania. In 1940 the Italian invasion of Greece aimed futilely at Janina; in 1941, after Germany's victory in the Balkans, the Italians occupied the city and annexed it to Albania.

See Holland's Travels (1815); Hughes, Travels in Greece, etc. (1830); H. F. Tozer, Researches in the Highlands of Turkey (London, 1869). See also ALBANIA and the authorities there cited.

JANISSARIES, an organized military force constituting, until 1826, the standing army of the Ottoman empire. The word is a corruption of the Turkish yeni *chéri,* new troops. At first Turkey possessed no standing army. It was under Orkhan that a regular paid army was first organized; but the result was unsatisfactory, as the Turcomans, from whom these troops were recruited, were unaccustomed to fight on foot or to submit to military discipline. Accordingly, in 1330, on the advice of Chendéréli Kara Khalil, the system was adopted, whereby a certain number of Christian youths (at first 1,000) were every year taken from their parents and, after undergoing a period of apprenticeship, were enrolled as yeni *chéri* or new troops. The venerable saint Haji Bektash, founder of the Bektashi dervishes, blessed the corps and promised them victory; he remained ever after the patron saint of the janissaries.

At first the corps was exclusively recruited by the forced levy of Christian children, for which purpose the officer known as *tournaji-bashi,* or head-keeper of the cranes, made periodical tours in the provinces. The fixed organization of the corps dates only from Mohammed II., and its regulations were subsequently modified by Suleiman 1. In early days all Christians were enrolled indiscriminately; later those from Albania, Bosnia and Bulgaria were preferred. The recruits, while serving their apprenticeship, were instructed in the principles of the faith. Until the accession of Murad III. (1574) the total effective of the janissaries, including the *ajami* or apprentices, did not exceed 20,000. In 1582 irregularities in the mode of admission to the ranks began. Soon parents themselves begged to have their children enrolled, so great were the privileges attaching to the corps; later the privilege of enlistment was restricted to the children or relatives of former janissaries; eventually the regulations were much relaxed, and any person was admitted, only negroes being excluded. In 1591 the whole corps (ojak) of janissaries numbered 48,688 men. Under Ibrahim (1640–48) they were reduced to 17,000, but from this time they continually increased until at the time of their destruction in 1826 they numbered 135,000. It would perhaps be more correct to say that these are the numbers figuring on the pay-sheets. In time of peace the janissary received no pay. In time of war the commander (aga) of the janissaries and several of his subordinates received a percentage of the pay and allowance of the troops; they also inherited the property of deceased janissaries. Moreover, the officers profited largely by retaining the names of dead or fictitious janissaries on the pay-rolls. Rations of mutton, bread and candles were furnished by the Government, the supply of rice, butter and vegetables being at the charge of the commandant. The rations would have been entirely inadequate if the janissaries had not been allowed, contrary to the regulations, to pursue different callings, such as those of baker, butcher, boatman, etc. At first the janissaries bore no distinctive mark save the white felt cap. Soon the red cap with gold embroidery was substituted. Later a uniform was introduced, distinguished less by the colour than the cut of the coat and the shape of the head-dress. The only distinction in the costume of commanding officers was in their boots, those of the *beuluks* (who had the privilege of serving as the sultan's guard and keeping the sacred banner in their custody) being red while the others were yellow; subordinate officers wore black boots.

The fundamental laws of the janissaries, which were very early infringed, were implicit obedience to their officers; perfect accord among themselves; abstinence from luxury, extravagance and practices unseemly for a soldier and a brave man; observance of the rules of Haji Bektash and of the religious law; exclusion from the ranks of all save those properly levied; special rules for the infliction of the death-penalty; promotion to be by seniority; janissaries to be admonished or punished by their own officers only; the infirm and unfit to be pensioned. Janissaries were not to let their beards grow, not to marry, nor to leave their barracks, nor to engage in trade; but were to spend their time in drill and in practising the arts of war.

In time of peace the State supplied no arms, and the janissaries on service in the capital were armed only with clubs; they were forbidden to carry any arms save a cutlass, the only exception being at the frontier-posts. In time of war they provided their own arms, and these might be any which took their fancy. However, they were induced by rivalry to procure the best obtainable and to keep them in perfect order. The banner of the janissaries was of white silk, on which verses from the Koran were embroidered in gold. This banner was planted beside the aga's tent in camp, with four other flags in red cases, and his three horse-tails. Each unit (orta) had its flag, half-red and half-yellow, placed before the tent of its commander. Two or three great cauldrons used for boiling the soup and pilaw were under the guard of subordinate officers. A particular superstition attached to them: if they were lost in battle all the officers were disgraced, and the orta was no longer allowed to parade with its cauldrons in public ceremonies.

At first a source of strength to Turkey as being the only well-organized force in the country, the janissaries soon became its bane. One frequent means of exhibiting their discontent was to set fire to Constantinople; 140 such fires are said to have been caused during the 28 years of Ahmed III.'s reign. The janissaries were at all times distinguished for their want of respect towards the sultans; their outbreaks were never due to a real desire for reforms, but solely to obtain the downfall of some obnoxious minister. The first recorded revolt of the janissaries is in 1443, on the occasion of the second accession of Mohammed II., when they broke into rebellion at Adrianople. A similar revolt happened at his death, when Bayazid II. was forced to yield to their demands and thus the custom of the accession-bakshish was established. In the 17th century they had become a praetorian guard in the worst sense of the word. Sultan Selim III. in despair endeavoured to organize a properly drilled and disciplined force to take their place; whereupon the janissaries dethroned him and obtained the abolition of his force. But after the successful revolution of Bairakdar Pasha of Widdin, the new troops were re-established and drilled; the resentment of the janissaries rose to such a height that they attacked the grand vizier's house, and after destroying it marched against the sultan's palace. They were repulsed by cannon, losing 600 men in the affair (1806). But such was the alarm caused at Constantinople that the new troops had to be suppressed. During the next 20 years the turbulence of the ianissaries knew no bounds. Sultan Mahmud II., powerfully impressed by their violence and lawlessness at his accession, determined to rid the State of this scourge. In 1825 he decided to form a corps of regular drilled troops known as eshkenjis. A fetva was obtained from the Sheikh-ul-Islam to the effect that it was the duty of Muslims to acquire military science. The imperial decree announcing the formation of the new troops was promulgated at a grand council, and the high dignitaries present (including certain of the principal officers of the janissaries, who concurred) undertook to comply with its provisions. But the janissaries rose in revolt, and on June 10, 1826, began to collect on the Et Meidan square at Constantinople; at midnight they attacked the house of the aga of janissaries, and, finding he had made good his escape, proceeded to overturn the cauldrons of as many ortas as they could find, thus forcing the troops of those ortas to join the insurrection. Then they pillaged and robbed throughout the town. Meanwhile the Government was collecting its forces; the sacred standard of the prophet was unfurled, and war was formally declared against the rioters. Can-

non were brought against the Et Meidan, which was surrounded by troops. Ibrahim Aga, the commander of the artillery, made a last appeal to the janissaries to surrender; they refused, and fire was opened upon them. Such as escaped were shot down as they fled; the barracks, where many found refuge, were burnt; those who were taken prisoner were brought before the grand vizier and hanged. Before many days were over the corps had ceased to exist.

See M. d'Ohsson, *Tableaux de l'empire ottoman* (Paris, 1787–1820); *A.* Djévad Bey, *État militaire ottoman* (1885).

JANJIRA, formerly a princely state in the Gujarat states agency, India, extending for about 40 mi. along the indented Western Ghats coast, south of Bombay city. Area 326 sq.mi.; pop. (1941) 103,557. Janjira was merged into Bombay on March 8, 1948. The chief, whose title was nawab, was by descent a Sidi or Abyssinian Moslem; his ancestors were for generations admirals to the Moslem rulers of the Deccan.

The state, popularly known as Habsan (Abyssinian), did not come under direct British rule until 1870.

Murud (pop., 1951, 9,744), 40 mi S.S.W. of Bombay city and in regular communication with it by steamer, was the state capital; the name Janjira, apart from the state, is applied only to an island fort. The nawab of Janjira was also ruler of Jafarabad (*q.v.*), a state on the south coast of the Kathiawar peninsula (Saurashtra).

JAN MAYEN, an arctic island, belonging to Norway, between Greenland and the north of Norway, about 71° N., 8° W.; 34 mi. long and 9 mi. in greatest breadth, divided into two parts by a low, narrow isthmus. The island is of quaternary volcanic formation and mountainous, the highest summit being the extinct volcano of Beerenberg (7,470 ft.). Eruptions of ashes and steam have been observed. Glaciers are fully developed. Henry Hudson discovered the island in 1607 and called it Hudson's Tutches. It was several times observed by navigators who successively claimed its discovery and renamed it. Thus, in 1611 or 1612 Hull whalers named it Trinity Island; in 1612 Jean Vrolicq, a French whaler, called it Ile de Richelieu; and in 1614 Joris Carolus, mate of the Dutch ship of Captain Jan May named it Joris Eylandt. The climate is cold and foggy. There is a little tundra and a few foxes exist on the island. The island has been frequently visited by explorers, sealers, trappers and whalers; and an Austrian observatory was maintained here for a year in 1882–83. J. M. Wordie and P. L. Mercanton completed the exploration in 1921. A Norwegian observatory, with wireless communication, has been working since 1921. Jan Mayen was annexed to Norway, May 8, 1929.

See E. von Wohlgemuth, *Osterreichische Polarstation Jan Mayen* (Vienna, 1886); J. M. Wordie, *Geographical Journal* (March 1912), and *Trans. Royal Soc. Edin., 54* (1926).

JANNINGS, EMIL (1886–1950), German actor known for his tragic roles in motion pictures, was born in Brooklyn, N.Y., on July 26, 1886, and taken as an infant to Germany, where he was reared by his grandparents. At 14 he ran away to sea and two years later joined a traveling stock company. By 1906 he was acting for Max Reinhardt in Berlin. Early film roles were Louis XV, opposite Pola Negri, in *DuBarry,* and Henry VIII in *Anne Boleyn.* In 1924, under F. W. Murnau's direction, *The Last Laugh* brought him his best-remembered role as a hotel doorman who lost his job; and in *Variety* (1925) he was a sideshow operator deceived by a woman. In *The Blue Angel* (1929), which introduced Marlene Dietrich, he was an aging professor married to a young night club singer. Moving to the U.S., Jannings was the first actor to win an award from the Academy of Motion Picture Arts and Sciences for *The Way of All Flesh* (1927). He won further critical approval for *The Patriot* and *The Last Command* (1928). Howard Barnes of the *New York World* declared that he had "taken a place in motion-picture tragedy only comparable to Chaplin's eminence in comedy." Returning to Germany and the stage, Jannings continued to work during the Nazi regime. He became an Austrian citizen in 1948 and died in Austria on Jan. 2, 1950. (R. D. MacC.)

JANSEN, CORNELIUS (1585–1638), bishop of Ypres, and father of the religious revival known as Jansenism (*q.v.*), was born of humble Catholic parentage at Accoy in the province of Utrecht on Oct. 28, 1585. In 1602 he entered the university of Louvain, then in the throes of a violent conflict between the Jesuit, or scholastic, party and the Augustinians, followers of Michael Baius. Jansen joined the latter party. He made a momentous friendship with a like-minded fellow-student, Du Vergier de Hauranne, afterwards abbot of Saint Cyran. After taking his degree he went to Paris, partly to recruit his health by a change of scene, partly to study Greek. Eventually he joined Du Vergier at his country home near Bayonne, and spent some years teaching at the bishop's college. His spare time was spent in studying the early Fathers with Du Vergier, and laying plans for a reformation of the Church. In 1616 he returned to Louvain, to take charge of the college of St. Pulcheria, a hostel for Dutch students of theology. Pupils found him a somewhat choleric and exacting master and academic society a great recluse. He took part in the university's resistance to the Jesuits, who had established a theological school of their own in Louvain, which was a formidable rival to the official faculty of divinity. Jansen was sent twice to Madrid, in 1624 and 1626; the second time he narrowly escaped the Inquisition. He warmly supported the Catholic missionary bishop of Holland, Rovenius, in his contests with the Jesuits. He also crossed swords more than once with the Dutch Presbyterian champion, Voetius, still remembered for his attacks on Descartes.

Antipathy to the Jesuits brought Jansen no nearer Protestantism; he desired to prove to them that Catholics could interpret the Bible in a manner quite as mystical and pietistic as theirs. This became the great object of his lectures, when he was appointed regius professor of scriptural interpretation at Louvain in 1630. Still more was it the object of his *Augustinus,* a bulky treatise on the theology of St. Augustine, barely finished at the time of his death. Its preparation had been his chief occupation ever since he went back to Louvain. But Jansen, as he said, did not mean to be a school-pedant all his life; and there were moments when he dreamed political dreams. He looked forward to a time when Belgium should throw off the Spanish yoke and become an independent Catholic republic on the model of Protestant Holland. These ideas became known to his Spanish rulers, and to assuage them he wrote a philippic called the *Mars gallicus* (1635), a violent attack on French ambitions generally, and on Richelieu's indifference to international Catholic interests in particular. The *Mars gallicus* did not help Jansen's friends in France, but it appeased the wrath of Madrid against Jansen, and in 1636 he was appointed bishop of Ypres. He died on May 6, 1638; the *Augustinus,* the book of his life, was published posthumously in 1640.

Full details as to Jansen's career will be found in Reuchlin's *Geschichte von Port Royal* (Hamburg, 1839), vol i. *See* also *Jansénius* by the Abbés Callawaert and Nols (Louvain, 1893).

JANSENISM, the religious principles laid down by Cornelius Jansen in his *Augustinus.* This was simply a digest of the teaching of St. Augustine, drawn up with a special eye to the needs of the 17th century. In Jansen's opinion the church was suffering from three evils. The official scholastic theology was anything but evangelical. Having set out to embody the mysteries of faith in human language, it had fallen a victim to the excellence of its own methods; language proved too strong for mystery. Theology sank into a branch of dialectic; whatever would not fit in with a logical formula was cast aside as useless. But average human nature does not take kindly to a syllogism, and theology had ceased to have any appreciable influence on popular religion. Simple souls found their spiritual pasture in little mincing "devotions"; while robuster minds built up for themselves a natural moralistic religion, quite as close to Epictetus as to Christianity. All these three evils were attacked by Jansen. As against the theologians, he urged that in a spiritual religion experience. not reason, must be our guide. As against the stoical self-sufficiency of the moralists, he dwelt on the helplessness of man and his dependence on his maker. As against the ceremonialists, he maintained that no amount of churchgoing will save a man, unless the love of God is in him. But this capacity for love no one can give

himself. If he is born without the religious instinct, he can only receive it by going through a process of "conversion." And whether God converts this man or that depends on his good pleasure. Thus Jansen's theories of conversion melt into predestination; although, in doing so, they somewhat modify its grimness. Even for the worst miscreant there is hope—for who can say but that God may yet think fit to convert him?

Such doctrines have a marked analogy to those of Calvin; but in many ways Jansen differed widely from the Protestants. He vehemently rejected their doctrine of justification by faith; conversion might be instantaneous, but it was only the beginning of a long and gradual process of justification. Secondly, although the one thing necessary in religion was a personal relation of the human soul to its maker, Jansen held that that relation was only possible in and through the Roman Church. Nevertheless, Jansen's principles inevitably brought him into conflict with the Jesuits, whom he accused of giving absolution much too easily, without any serious inquiry into the dispositions of their penitent, and of excessive reliance on sacramental grace. His views were expounded at length by his disciple, Antoine Arnauld, in a book on *Frequent Communion* (1643). This book was the first manifestation of Jansenism to the general public in France, and raised a violent storm. With the support of the government, representations were made to Rome, and in 1653 Innocent X declared heretical five propositions from Jansen's book. In 1656 Arnauld was deprived of his degree, in spite of Pascal's *Provincial Letters* (1656–1657), begun in an attempt to save him *(see* PASCAL, BLAISE; JESUS, SOCIETY OF). In 1661 a formulary, or solemn renunciation of Jansen, was imposed on all his suspected followers; those who would not sign it went into hiding, or to the Bastille.

The Jansenists had set out to reform the Church of Rome; they ended by having to fight hard for a doubtful foothold within it. Even that foothold soon gave way. Louis XIV was a fanatic for uniformity, civil and religious. During the lifetime of his cousin, Madame de Longueville, the great protectress of the Jansenists, Louis stayed his hand; on her death (1679) the reign of severity began. That summer Arnauld, who had spent the greater part of his life in hiding, was forced to leave France for good. Six years later he was joined in exile by Pasquier Quesnel who succeeded him as leader of the party. Long before his flight from France Quesnel had published a devotional commentary—*Réflexions morales sur le Nouveau Testament*—*which* had gone through many editions without exciting official suspicion. But the Jesuits determined to make an end of Jansenism. They played upon the king's superstitions, and at their instigation he wrote to the pope asking for a bull that would tear up Jansenism by the roots. This was forthcoming in 1713, in the bull *Unigenitus,* anathematising no less than 101 propositions from Quesnel's *Réflexions.* Indeed, in his zeal against the Jansenists the pope condemned various practices in no way peculiar to their party; thus, for instance, many orthodox Catholics were exasperated at the heavy blow he dealt at popular Bible reading. During the following 10 years, however, the opposition was slowly crushed, and in 1730 the *Unigenitus* was proclaimed part and parcel of the law of France. This led to a great quarrel with the judges, who were intensely Gallican in spirit *(see* GALLICANISM), and had always regarded the *Unigenitus* as a triumph of ultramontanism. The quarrel dragged indefinitely on through the 18th century, though the questions at issue were really constitutional and political rather than religious.

Meanwhile the most ardent Jansenists had followed Quesnel to Holland. There they met with a warm welcome from the Dutch Catholic body, which had always been in close sympathy with Jansenism, although without regarding itself as formally pledged to the *Augustinus.* But it had broken loose from Rome in 1702, and was now organizing itself into an independent church *(see* **UTRECHT**). The Jansenists who remained in France had meanwhile fallen on evil days. Persecution usually begets hysteria in its victims; and the more extravagant members of the party were far advanced on the road which leads to apocalyptic prophecy and "speaking with tongues." They were eventually disowned by the more reputable Jansenists, and were severely repressed by the police. Meanwhile genuine Jansenism survived in many quiet country parsonages and convents.

BIBLIOGRAPHY.—For an instructive survey of the whole movement *see* St. Cyr's art."Jansenism" in Hastings' *Encyclopaedia of Religion and Ethics;* for bibliography, *Cambridge Modern History,* vol. v, ch. 4. Here the following titles may be mentioned: Beard, *Port-Royal* (1861); J. de Maistre, *De l'église gallicane* (1881). Séché, *Les derniers Jansénistes* (1891); Paquier, *Le Jansénisme* (1909).

(ST. C.; X.)

JANSSEN, JOHANNES (1829–1891), German historian, was born at Xanten on April 10, 1829, was ordained priest in 1860, became a member of the Prussian chamber of deputies in 1875, and in 1880 was made domestic prelate to the pope and apostolic pronotary. He died at Frankfort on Dec. 24, 1891. Janssen was a stout champion of the Ultramontane party in the Roman Catholic Church. His great work is his *Geschichte des deutschen Volkes seit dem Ausgang des Mittelalters* (8 vol., Freiburg, 1878–94), in which he attempts to prove that the Protestants were responsible for the general unrest in Germany during the 16th and 17th centuries.

The *Geschichte,* which went through many editions, was later continued and improved by Ludwig Pastor, and the greater part of it has been translated into English by M. A. Mitchell and A. M. Christie (1896, fol.). Of his other works perhaps the most important are: the editing of *Frankjurts Reichskorrespondenz, 1376–1519* (Freiburg, 1863–1872); and of the *Leben, Briefe und kleinere Schriften* of his friend J. F. Bohmer (Leipzig, 1868); a monograph, *Schiller als Historiker* (Freiburg, 1863); and *Zeit- und Lebensbilder* (Freiburg, 1875).

See L. Pastor, *Johannes Janssen* (Freiburg, 1893); F. Meister, *Erinnerung an Johannes Janssen* (Frankfort, 1896); Schwann, *Johannes Janssen und die Geschichte der deutschen Reformation* (Munich, 1892).

JANSSEN, PIERRE JULES CESAR (1824–1907), French astronomer. was born at Paris. Fr., on Feb. 22, 1824, and studied mathematics and physics at the faculty of sciences. Various scientific missions were entrusted to him. In 1857 he went to Peru in order to determine the magnetic equator; in 1861–62 and 1864, he studied telluric absorption in the solar spectrum in Italy and Switzerland; in 1867 he carried out optical and magnetic experiments at the Azores; he successfully observed both transits of Venus, that of 1874 in Japan, that of 1882 at Oran in Algeria; and he took part in a long series of solar eclipse-expeditions. At the great Indian eclipse of 1868 he demonstrated the gaseous nature of the red prominences, and devised a method of observing them spectroscopically under ordinary daylight conditions. One main purpose of his spectroscopic inquiries was to answer the question whether the sun contains oxygen or not. For this, he perceived the advantage of reducing the thickness of air through which observations have to be made, and established an observatory on Mont Blanc (1893). In 1875 he was appointed director of the new astrophysical observatory established by the French government at Meudon, and began there in 1876 the remarkable series of solar photographs collected in his great *Atlas de photographies solaires* (1904). The first volume of the *Annales de l'observatoire de Meudon* was published by him in 1896. Janssen died at Paris on Dec. 23, 1907.

See A. M. Clerke, *Hist. of Astronomy During the 19th Century* (1903); H. Macpherson, *Astronomers of To-Day* (1905).

JANSSENS, ABRAHAM (JANSSENS VAN NUYSSEN) (*c.* 1575–1632), Flemish historical painter, was born at Antwerp, studied under Jan Snellinck and was in Rome between 1598 and 1601. In 1601 he appears as a master of the Antwerp painters' guild, of which he was dean in 1607. His stylistic development indicates that he revisited Rome between 1601 and 1610, though there is no certain evidence of this. His earliest pictures are characteristic of the northern mannerist tradition, but from about 1610 his work shows the marked influence of Caravaggio. Until eclipsed by Rubens, Janssens was the most successful of the Flemish historical painters. (R. E. W. J.)

JANSSEN (JONSON, JANSON) **VAN CEULEN, CORNELIUS** (CORNELIS) (1593–1662), Flemish portrait painter, was apparently born in London and baptized on Oct. 14, 1593. His family derived originally from Cologne and emigrated from Antwerp to England about 1568. He worked in England from 1618 to 1643, and afterward retired to Holland, working at Middelburg, Amsterdam, The Hague and Utrecht. In England he was

patronized by James I and the court, and under Charles I he continued to paint the numerous portraits which adorn many English mansions and collections. Janssen's pictures, chiefly portraits, are distinguished by clear colouring, delicate touch, good taste and careful finish. He generally painted upon panel and often worked on a small scale, sometimes producing replicas of his larger works. In all probability his earliest portrait (1618) was that of John Milton as a boy of ten.

JANUARIUS (GENNARO), **SAINT** (c. 304?), a bishop of Benevento said to have been martyred at Pozzuoli under Diocletian, whose present fame rests on the relic alleged to be of his blood, kept in a glass phial in the cathedral at Naples. The solid substance in the phial often becomes liquid when the phial is exposed; this phenomenon has been frequently tested and seems certainly to be genuine. No wholly satisfactory natural explanation of it has been found. The feast day of St. Januarius is Sept. 19.

See H. Thurston in *The Month,* vol. 149 (1927) and 155 (1930), on the blood miracle. (D. AR.)

JANUARY (Lat. IANUARIUS), the first month of the modern calendar, with 31 days. Though named for Janus, the two-faced Roman god of "beginnings," January was regarded as the 11th month, not the 1st, until at least 153 B.C. In later antiquity New Year's day, Jan. 1, became a popular festival, celebrated with masquerades and the giving of gifts. Partly to avoid the pagan associations of that day various other dates were widely used in the middle ages to begin the year, and in England the legal and ecclesiastical calendar still began with March 25 (Feast of the Annunciation) until the Gregorian calendar was finally adopted in 1752. (F. R. WN.)

JANUS, in Roman cult, the animistic spirit of doorways (ianuae) and archways (iani). His worship traditionally went back to Romulus and a period even before the actual founding of the city. There were many iani (*i.e.,* ceremonial gateways) in Rome, usually not part of a wall but freestanding structures symbolic of auspicious entrance (or exit). These were used ceremonially on the setting out of any party, but particular superstition was attached to the departure of the army, for which there were lucky and unlucky ways to march through a gate. The most famous of these iani was the Ianus Geminus, actually a shrine of Janus at the north side of the Forum where the Argiletum entered. It was a simple rectangular bronze structure with double doors at each end. Tradition recorded that it was erected by Numa to indicate, when the doors were open, that Rome was at war; and when closed, that it was at peace (which occurred only twice between the reigns of Numa and Augustus! Cf. Livy i, 19, 2).

Some scholars regard Janus as a god of all beginnings and believe that his association with doorways is derivative. He was invoked as the first of any gods (including Jupiter) in regular liturgies. The beginning of the day (cf. his epithet Matutinus), month and year, both calendar and agricultural (cf. his epithet Consivius, "the sower"), were sacred to him. January is of course named for him, and his festival took place on Jan. 9, the Agonium. His priest was no less than the rex sacrorum, the representative of the ancient king in his capacity as religious head of the state; and the offering of a ram on Jan. 9 took place at the Regia, the old royal household, later symbolic of the state household. In the hymn of the Salii (*q.v.*) he is referred to as divom deus, "god of gods."

This exalted aspect of his worship set later Romans speculating as to the true nature of the divinity, and they came forth with various explanations of a cosmic deity; *e.g.,* a sun-god, a sky-god or the universe itself. Modern interpretations have also been varied. Some regard him as a god of water crossings and others, finding in Janus the same root as in Diana, believe him to be a moon deity.

There was a temple of Janus in the Forum Holitorium dedicated from the booty of the defeat of the Carthaginian fleet off Mylae (260 B.C.) by G. Duilius. It has been identified with the ruins of one of the three temples under the present church of S. Nicola in Carcere. It is assumed also that Janus had an early cult on the Janiculum, which the ancients took to mean "the city of Janus."

In addition to the gate, his symbol is a double-faced head, and thus he is seen represented, both bearded and unbearded, in art. Occasionally he was even four-faced as the spirit of the four-way arch. . There was a temple to Janus Quadrifrons erected by Domitian in the Forum Transitorium which contained such a statue. A four-way arch of the 3rd or 4th century A.D. still stands in the Velabrum.

BIBLIOGRAPHY.—W. W. Fowler, *Roman Festivals,* pp. 280–290 (1899), *Religious Experience of the Roman People,* pp. 125–127 (1911); G. Wissowa, *Religion und Kultus,* 2nd ed., pp. 103–113 (1912); Platner-Ashby, *Topographical Dictionary,* pp. 275–280. For other explanations of Janus *see A.* B. Cook, *Zeus,* vol. ii, pp. 316 ff.; James Frazier, *Golden Bough,* 3rd *ed.,* vol. ii, pp. 376-387; L. A. MacKay in *University of California Publications in Classical Philology,* vol. xv, pp. 157–181 (1956). (R. B. LD.)

JAORA, a tehsil (subdistrict) in the Ratlam district of Madhya Pradesh, India. It consists of two isolated tracts, between Ratlam and Neemuch. Area 793 sq.mi. Pop. (1951) 119,004. In 1818 the British recognized the rule of a Mohammedan dynasty, but in Aug. 1948 the nawab merged his state in the Union of Madhya Bharat. The chief crops are millet, cotton and maize. The town of JAORA is on the Rajputana-Malwa railway, 20 mi. N. of Ratlam. Pop. (1951) 29,598. It is well laid out, with many good modern buildings. (S. GL.)

JAPAN (NIPPON, NIHON). The island country of Japan lies off the east coast of Asia and entirely within the temperate zone. Its land area of 142,727 sq.mi. supports more than 93,000,000 people. The over-all density of 654.5 persons to the square mile is remarkable considering that over 80% of Japan is composed of uninhabitable rugged mountains. Although located adjacent to eastern Asia and in the Chinese culture realm, Japan has been protected by relatively wide intervening seas and straits and so has developed strong indigenous characteristics. There is considerable parallelism between Japan and western Europe in the historical development of social and economic patterns. When Japan was opened to world trade and intercourse in the mid-19th century it had reached the stage of late maturity in feudalism. Consequently, it was able to adopt modern industrial civilization much faster than other Asian countries.

The territorial limits of Japan, following World War II, remained unsettled in the second half of the 20th century. The area under direct control comprises the four main islands of Honshu, Shikoku, Kyushu and Hokkaido and many adjacent smaller islands.

The island arcs of Japan are subject to intense crustal movements and violent earthquakes and volcanic activity. The islands are exceedingly mountainous and have only narrow littoral plains and limited intermontane basins. Their latitudinal range (27° N.–45° N.) and location between Eurasia and the Pacific ocean are the chief controlling factors of climate and vegetation. The climate ranges from warm temperate to cold temperate and the frequent occurrence of typhoons and cyclones and the moisture-bearing monsoons ensure an abundant precipitation, with frequent floods and no marked dry season.

In spite of the paucity of arable land about 38% of the population is rural. Rice is the dominant crop, supplemented by commercial crops, fruit, vegetables and sericulture. Japan is the world's first fishing nation measured both by catch and by people employed. It has a variety of minerals, both metallic and nonmetallic, but except for coal, limestone and sulfur, production is not significant.

Japan entered the modern industrial period in the beginning of the 20th century and the phenomenal development achieved made possible large population and urban growth. The manufacturing industries encompass a wide range from light to heavy, chemical and iron and steel. Industrial plants are concentrated largely in the core belt of great cities and conurbations extending from Tokyo westward through Nagoya and Osaka and on to include northern Kyushu.

This article is divided into the following main sections and subsections:

I. Physical Geography
1. Geology
2. Relief and Drainage
3. Climate
4. Vegetation

5. Animal Life
II. Geographic Regions
1. Hokkaido
2. Tohoku or Ōu
3. Kwanto
4. Chūbu
5. Kinki
6. Chūgoku
7. Shikoku
8. Kyushu
III. The People
1. Physical Characteristics
2. Language and Writing
3. Religion
4. Culture
IV. History
A. The Imperial State
B. The Development of Feudalism
C. The Unification of Japan
D. The Tokugawa Period
E. The Meiji Restoration
F. Imperial Japan
G. Japan After World War II
V. Population
VI. Administration and Social Conditions
1. The Constitution
2. The Emperor
3. The Executive
4. The Legislature
5. The Judiciary
6. Civil Liberties
7. Local Government
8. political Parties and Pressure Groups
9. The Public Welfare
10. Education
11. Defense
VII. The Economy
A. Production
1. Agriculture
2. Forestry
3. Mining
4. Fisheries
5. Power
6. Industries
B. Trade and Finance
1. Trade
2. Banking and Currency
3. National Finance
C. Transport and Communications
1. Roads
2. Railways
3. Shipping
4. Air Transport
5. Postal Service
6. Telecommunications

Further geographic, historic, political and economic aspects can be found in articles on individual islands and groups, the prefectures and main cities. (R. B. H.)

I. PHYSICAL GEOGRAPHY

1. Geology.— The Japanese archipelago is one of several island arcs that stretch north and south in the western Pacific between the southern tip of Kamchatka (*q.v.*) peninsula in Siberia and southeast Asia. The Russian island of Sakhalin (*q.v.*), which lies due north of Hokkaido, has shared a common geologic history with Japan and can be considered geologically an integral part of the Japanese arc. Between northeastern Hokkaido and southern Kamchatka is the Kuril Islands (*q.v.*) arc; between southern Kyushu and northeastern Formosa (Taiwan) is the Ryukyu Islands (*q.v.*) arc; and southward from the vicinity of Tokyo bay stretches the Bonin Islands (*q.v.*) arc, which also incorporates the seven Isles of Izu (Izu-shichitb [*q.v.*]). The contact points of these three arcs with Japan have been great centres of volcanic activity through long periods of geologic time. The Japanese archipelago bends perceptibly eastward in a convex arc, separated from the Asian mainland by a shallow depression occupied by the Sea of Japan. Despite this pronounced eastward bulge, the two extremities of Japan are near the mainland. Northwestern Hokkaido is only about 150 mi. from the Russian coast, and Sakhalin, separated from Hokkaido by La Pérouse (Soya) strait, comes to within a scant 10 mi. of the coast across Tatar strait (Gulf of Tatary). To the southwest, a 125-mi. expanse of ocean, Korea strait (the section nearest Japan called Tsushima strait), stands between Japan and the southeastern tip of the Korean peninsula.

The Japanese arc had its origin in mid-Paleozoic time, when marine sediments derived from the continent were piling up in a great downwarped oceanic trough. Paleontological evidence indicates the existence of a fairly complete sequence of marine sedimentation and periodic volcanism from Silurian to Permian time. Large sections of Japan began to appear from beneath the sea during Middle and Late Triassic time, during what the Japanese call the Akiyoshi orogenic movements. By Early Jurassic time, most of present Japan was above sea level. However, partial submergence took place during the Jurassic and Early Cretaceous, when some of the most remarkable diastrophic movements of Japan's geological history took place. Large-scale igneous intrusions were a feature of the Cretaceous. The Tertiary was marked by extremely complex orogenic movements. and many parts of Japan were flooded, especially during the Miocene. The Miocene and Pliocene brought strong folding movements and widespread volcanic extrusion. In more recent geologic times, terraces and shore lines of emergence are indicative of coastal movement during the Pleistocene. The frequency of earthquakes, volcanic activity and minor crustal movements in contemporary Japan is eloquent testimony to the instability that still prevails in the earth's crust beneath the Japanese islands.

The rocks that make up the Japanese islands can be grouped into five broad classifications. (1) The oldest, Pre-Cambrian rocks, mostly gneisses and crystalline schists, have a limited occurrence. The largest exposures are in central Shikoku, the Kii peninsula in Honshu and the Abukuma mountains of northeastern Honshu. (2) The oldest unmetamorphosed rocks are sandstone, slate, limestone and chert of marine origin from the Paleozoic (called the Chichibu complex by the Japanese) and both marine and nonmarine sedimentary rocks from the Mesozoic. Both classes are widespread; they are most conspicuous in central Hokkaido and central Honshu, central Kyushu, southern Shikoku, the southern Kii peninsula and the Kitakami mountains of northeastern Honshu. They are typically folded and faulted into some of Japan's highest relief. (3) Cenozoic sedimentary rocks, chiefly sandstone and shale, are of both marine and nonmarine origin and are often interbedded with volcanic materials. Weak and poorly consolidated, they form hills and low mountains in central western and northwestern Honshu and western and eastern Hokkaido. Most of Japan's coal and oil is derived from rocks of this age. (4) Granitic rocks are widespread, reaching their best development in central and western Honshu and northern Kyushu. The age of some of the western Honshu granite has been established as Late Cretaceous. Many minerals are associated with the granitic rocks. (5) Volcanic rocks—lava, tuff and breccia---of Cenozoic age cover about one-fourth of Japan's surface, more than any of the other four rock categories.

Broadly generalized, the oldest rocks in Japan occur east of a main line of dislocation that passes through central Kyushu, north central Shikoku, the central Kii peninsula, east central and northeastern Honshu and central Hokkaido. This is labeled the outer zone by Japanese geologists to differentiate it from the inner zone of younger rocks that lie west of the line. Both zones are interrupted dramatically in central Honshu by the Fossa Magna, a massive fault depression, now occupied by younger strata and volcanic deposits, that cuts across Honshu between longitude 138° and 139° E. Thus Japan can be divided into five major geomorphic regions: the northern (northeastern) inner and outer zones, the Fossa Nagna and the southeastern inner and outer zones.

2. Relief **and** Drainage.——For such a small country, Japan exhibits exceptional regional diversity in its surface features. Seascapes, mountains, volcanic peaks, rivers, plains and lakes are interblended in a natural tableau that changes in detail swiftly over short distances. This variety has won Japan's landscape (*sansui*) acclaim as one of the world's loveliest. Land forms, along with climate and other natural elements, has been important in shaping the geographic patterns of the Japanese population and its activities.

Coast Line.—The Japanese coast line is noted for its length and

variety, and for its role in the emergence of Japan as a leading fishing and maritime power. For each square mile of land surface there are nine miles of coast line. No place in Japan is more than 75 mi. from the sea.

Adjacent seas (naikai) and their coasts are of sharply different character. The Sea of Japan, which is over 500 mi. wide at its broadest point, has few depths in excess of 10,000 ft., and no part of the East China sea, west of Kyushu and Korea, is more than 3,000 ft. deep. Japan's Sea of Japan coast line is only one-fourth as long as the Pacific coast line because of its general lack of indentations. The fingerlike Noto peninsula and deeply incised Wakasa bay are its main irregularities. Sado and Oki (*qq.v.*) are noteworthy offshore islands. Coastal sand bars, often with shallow lagoons on their lee sides, and sand dunes are common features. There are few natural harbours along the smooth coast line, and the entire Sea of Japan coast is exposed to strong winds and wave action generated by the winter monsoon. However, southern and western Kyushu, which face on the Korea strait and the East China sea, have remarkably indented coast lines and a profusion of offshore islands, among which the Amakusa, Tsushima, Iki and Gotō-rettō (*qq.v.*) groups are largest. Omura bay and the Ariakeno sea, the latter bordered by the volcanic Shimabara peninsula west of its mouth, are prominent coastal indentations.

Immediately east of Japan, the waters of the Pacific ocean plunge abruptly into one of the world's most profound submarine trenches, where soundings have located depths in excess of 26,000 ft. The Pacific coast line of Japan, although smooth for long stretches, has a number of large indentations. Natural harbours free from river silting are rare, yet Pacific ports are among Japan's best. North of Tokyo bay, the coast is relatively smooth except for one irregular section north of Ishinomaki bay in northeastern Honshu. Between Tokyo bay and the eastern entrance of the Inland sea, three great bays (Sagami, Suruga and Ise) and intervening peninsulas (Miura. Izu, Atsumi, Chita, Shima and Kii) are striking coastal features. Kagoshima bay is cut deeply into southern Kyushu. The Inland sea is noted for its irregular coast line and hundreds of small islands. qualities that place it among the leading beauty spots in Japan. Its calm, easily navigated waters extend east to west for more than 250 mi. The Inland sea is formed by five distinct basins, each caused by faulting and subsidence. The Kii strait (or channel) and Bungo strait (or channel) link the Inland sea with the Pacific, whereas access to the East China sea is by the narrow Shimonoseki straits.

Japanese offshore waters are the meeting ground of warm currents moving northward from equatorial areas and cold currents bearing southward from the polar area. The Kuroshio (also called the Japan current or Black stream), a warm current equivalent to the Gulf stream of the North Atlantic ocean, passes close to the southeastern coasts of Japan. At about 35° N. it veers eastward into the North Pacific. An offshoot, the Tsushima current, makes its way through Tsushima strait into the Sea of Japan, where it parallels the Japanese coast. Cold waters of the Oyashio (its northern portions known as the Bering current or Kamchatka current) and others from the Sea of Okhotsk wash the coasts of Hokkaido and northeastern Honshu. The convergence points of these waters can be identified by oppressive fog banks, especially off eastern Hokkaido.

Mountains.—Mountains (yama, san or *zan,* take or *dake, sammyaku)* dominate the Japanese landscape. Only about 15% of the land surface is level or of modest enough slope to permit agricultural settlement. Although the extensive hill and mountain tracts impose strict limitations on the amount of easily habitable space and hinder communications, they also have a positive function. Many of the mountainous areas have valuable forest stands, serve as watersheds to the many swift rivers and streams and offer recreational and tourist facilities. Of mixed blessing is the function of the mountains as climatic modifiers; some areas are protected from weather extremes, while others receive heavier rainfall and snowfall because of their presence.

Japan's rocky spine is formed mostly by folded mountains upthrust from the floor of the Pacific ocean. However, there is great diversity of land forms resulting from block faulting, crustal movements, intense volcanism and vigorous erosive forces. The typical Japanese mountain landscape is one of deep-cut valleys, sharp contours and other evidence of relatively recent uplift. Only in areas of easily weathered granite or sedimentary rocks are contours softer and more rounded. Highest elevations are in the Japanese Alps or the Hida range, now a national park, in central Honshu, where peaks over 10.000 ft. are not uncommon. Elevation decreases in general northward and southward from this area. Despite the complexity of Japan's physiography, a fairly regular arrangement of a number of mountain systems in the form of arcs can be discerned. In general, these systems parallel the long axis of the islands and are strung between three irregular mountain knots in central Honshu (Gifu node), central Hokkaido and central Kyushu. In few places is movement easy between the Pacific and Sea of Japan coasts.

The two major mountain systems of western Japan, which parallel each other between central Kyushu and central Honshu, are of different character. The Chūgoku range, which forms the backbone of the long peninsular extension of western Honshu, has rounded contours and elevations seldom above 3 ooo ft. The range is sufficiently high, however, to block most weather extremes from the Sea of Japan. South of the Inland sea a forbidding range having a steep northern face and three interruptions by arms of the sea runs from central Kyushu (Kyushu mountains) through Shikoku (Shikoku mountains) and the Kii peninsula (Kii mountains) into central Honshu (Akaishi mountains) to terminate at the Fossa Magna. Highest elevations, exceeding 10,000 ft., are at its eastern extremity, with elevations decreasing to the west.

The Honshu knot is remarkable for its intricate pattern of fault lines, as shown in the presence of uplifted block mountains and waste-filled depressions, and a rich variety of volcanic forms. It is an area of over-all high relief and superb mountain landscapes. Northward from the knot three mountain systems trend through northern Honshu in echelon. The central Ōu range is continuous, but the westernmost (Echigo mountains in its southern part) and easternmost (Abukuma and Kitakami mountains) are interrupted by alluvial plains and fault basins.

Elevations generally decrease to the north, where Tsugaru strait stands between the land masses of Honshu and Hokkaido. The lower elevations and discontinuity of these ranges keeps their modifying effect on climate less than that of higher ranges elsewhere. The relief of Hokkaido is compounded of subdued mountains and volcanic masses, the latter including the highest peaks of more than 6.000 it. The arrangement of the mountains is in the form of an irregular knot, although two short ranges in the north central (Kitami mountains) and south central (Hidaka mountains) parts of the island can be singled out as the chief components of the mountainous core.

Volcanism.—The Japanese islands lie within a continuous zone of crustal instability that extends through the Pacific rimlands in the form of a horseshoe, from southeast Asia northward to the Aleutian Islands, then southward to the southern tip of South America. This zone is noted for its numerous earthquakes and volcanoes, giving rise to its popular name, the circum-Pacific ring of fire. Volcanism in Japan has produced more than 150 major volcanoes, about 40 of which are active but dormant, and widespread lava and ash plateaus. During recorded history many disastrous eruptions have occurred. Volcanic cones are among the highest elevations in Japan.

Japan is traversed by seven principal volcanic chains, most of which parallel and blend with the mountain ranges. The westernmost chain passes through the Ryukyu Islands and southern Kyushu. The terminal cone of Mt. Kirishima (5,577 ft.) is still active. Mt. Sakura-jima (3,668 ft.) in Kagoshima bay erupted violently in 1914 and is constantly discharging fumes. The Aso chain extends from central Kyushu eastward through northern Shikoku. Its chief feature is Mt. Aso (5,223 ft.), in Kyushu, which has the largest caldera in the world, measuring 71 mi. in circumference, 17 mi. from south to north and 10 mi. from east to west. A third chain passes through western Honshu and converges in central Honshu with the Fuji chain, which comes from the Bonin Islands, in a splendid rash of volcanic peaks. Towering above this

largest collection of volcanic peaks in Japan is the lovely conical form of Fujiyama (Fuji-san [*q.v.*]; 12.388 ft.), the highest elevation in Japan. Also in the central Honshu group is Mt. Asama (8,340 ft.), which ranks after Mt. Aso as the largest active Japanese volcano. Its cone is constantly emitting smoke and ash. Extending northward from central Honshu are two parallel volcanic chains. The easternmost has the highest and most numerous peaks: Mt. Nasu (6,289 ft.), Mt. Azuma (7,654 ft.) and Mt. Bandai (5,968 ft.) are best known. Mt. Chōkai (7,316 ft.) is the highest volcano in the westernmost chain. The northernmost volcanic chain passes through central Hokkaido, the Kuril Islands and Kamchatka. It gives rise to several important volcanic masses in Hokkaido found in the Akan National park to the east and the centrally located Daisetsuzan National park.

Another feature of the volcanic zone is the thousands of natural hot springs to which tourists flock for relaxation and medical treatment. Earthquakes are of disturbing frequency. There is an average of four seismic disturbances daily, not counting many so slight that they can be detected only by delicate measuring instruments. The typical tremor is a matter of momentary agitation that may cause wooden houses to sway. Severe shocks, which occur at the average rate of once every six years, cause fearful destruction of life and property. The southern shores of Honshu and Shikoku were formerly most subject to earthquakes, but the centre of seismic disturbance seems to have shifted to central and northeastern Honshu and Hokkaido.

Rivers and Lakes.—Abundant precipitation gives birth to more than roo main Japanese river systems whose waters run from the mountainous interior to the sea. It is the vigorous erosive force of runoff, streams and rivers that modifies mountain topography and builds the alluvial plains and mountain basin floors on which Japanese life centres. Japanese rivers (kawa or gawa) all have short courses and small drainage basins. Only three rivers exceed zoo mi. in length: the Shinano (229 mi.) of northwestern Honshu, the Ishikari (227 mi.) of western Hokkaido and the Tone (200 mi.) of the eastern Kwanto (Kantō) plain. The Tone river also has the largest drainage basin (6,08j sq.mi.). River beds are commonly higher than the level of the lowlands through which they pass in their lower courses because of heavy stream sedimentation and confining natural or artificial levees. As a result, a rapid build-up of stream volume such as often occurs during the typhoon season results in dramatic and destructive floods. Rivers furnish two-thirds of the irrigation water used in agriculture. most of the water for industrial and household use, and are an important source of hydroelectric power. (See The Economy: Production, below.)

Numerous lakes (ko, *numa* or ike) are scattered among the mountains and plains, but they are mostly small and of limited utility. Some lakes support small-scale fishing and have scenic and recreational value. The largest lake is Biwa (Biwa-ko, *q.v.*) in central western Honshu. Other well-known lakes are Imba (Kwanto plain), Suwa and Nojiri (central Honshu), Chūzenji (Chūzenji-ko, *q.v.*), Inawashiro, Tazawa and Towada (northern Honshu) and Tōya, Shikotsu and Akan (Hokkaido).

Plains.—The bulk of the Japanese population lives in many small, dispersed coastal lowlands (heiya) and interior basins whose combined size is only one-fifth of the land surface. The largest single expanse of relatively level land, the Kwanto plain of the Pacific coast of central Honshu, is only about 5,000 sq.mi. in extent. The largest, most productive and most populated plains are found along the seacoasts. Most of them have been formed by the deposition of earth materials transported seaward from the mountainous interior by swiftly moving streams and rivers. Conspicuous exceptions are surfaces of marine-abrasion origin, to be found in northeastern Honshu and southeastern and northern Hokkaido. In the interior there are only a few small, scattered basins, mostly in central and northern Honshu. Recent uplift has created terraces in many places. In the Kwanto plain, where terraces abound, older alluvial surfaces have been uplifted, reworked by erosive forces and their sediments redeposited by stream action in a new location as alluvium. Natural terraces are of limited fertility for agriculture and have few supplies of surface water. At the other extreme, low-lying portions of many coastal plains are poorly drained, have high water tables and pose real problems to successful human occupancy unless successful drainage works can be instituted.

The most important plains, from the standpoint of size and economic function, are located along the Pacific coast of central Honshu, north and west of the Kwanto plain. The key lowland of northeastern Honshu is the Sendai plain and its northern continuation, the Kitakami river valley, which knifes through the interior between the Ōu and Kitakami mountains. Westward from the Kwanto plain many small plains hug the coast as far as the large Nōbi plain, just east of the Kii peninsula. The Nōbi lowlands continue along the western shores of Ise bay. The shores of the Inland sea are also dotted by small plains in Honshu, northeastern Kyushu and northern Shikoku. The largest of these, the Settsu (Osaka) plain, is at the Inland sea's eastern extremity. Only slight topographic irregularities separate it from the interior Kyōto basin to the northeast.

In Shikoku the lowlands bordering the Inland sea are supplemented by the Yoshino river valley in the northeast and the Kōchi plain in the extreme south central portion. Kyushu's plains are best developed in the island's western (Tsukushi plain) and northern sectors. Southern Kyushu is overlain by thick volcanic-ash plateaus. Among the many small plains that line the Sea of Japan coast line of Honshu, centrally located Echigo plain, the largest, and Toyama plain are outstanding. In Hokkaido the Ishikari plain, in the west, is the largest plain; other level expanses are found in the southeastern (Tokachi and Kushiro-Nemuro plains) part of the island.

3. Climate.—Japan has a latitudinal span of 15°, hence it is not surprising that there are significant regional differences in temperature and precipitation between the two extremes of humid, subtropical Kyushu and humid, continental Hokkaido. Surrounding oceanic bodies exert a modifying influence on seasonal temperatures, and countless variations in climatic pattern are produced by relief differences. The broad outlines of the Japanese climate are set by the summer and winter monsoons. During the winter the intense cold of the Asian interior creates a vast high-pressure area over eastern Siberia. The presence of a low-pressure area over the western Pacific accentuates the flow of dry, cold air eastward. Air masses pick up moisture as they cross the Sea of Japan and deposit it as rain or snow over the Japanese islands. During the summer the pressure gradient is reversed and moist, cool Pacific air moves from the south and east across Japan toward the Asian low-pressure area. The summer monsoon brings early summer rains. The monsoon pattern results in colder winters and wetter summers than might be expected in Japan's latitudinal and marine location. Frequent weather changes are brought by the passage of mid-latitude cyclonic storms, and during late summer and early fall Japan is visited by destructive typhoons, violent rotary storms of tropical origin. Southwestern Japan suffers the worst typhoon damage.

Temperature.—Low winter temperatures in Japan are accentuated by penetrating northwest winds. From December through February the temperature is below freezing in many localities, especially in Hokkaido and northern Honshu. At Asahigawa (central western Hokkaido), the January mean temperature is 14° F., and the mean minimum temperature, 3°. Temperature rises gradually to the south, with little difference between the Pacific and Sea of Japan coasts. During January, the coldest month, Tokyo has a mean temperature of 37"; Osaka, to the southwest, with a winter climate typical of the Inland sea basin, is two degrees warmer. Southern Kyushu is the warmest part of Japan during the winter with a January mean temperature of 45°.

Japan's long latitudinal stretch has little bearing on summer air temperatures, although marked differences occur with elevation. Everywhere temperatures on the plains are high and are accompanied by high relative humidity. Relief comes with the cooler nights. Hokkaido is cooler than areas to the south. Some examples of mean temperatures for August, the hottest month, for scattered localities are: Kagoshima 79°; Osaka 81°; Tokyo 77°; and Sapporo 69°. In northern Japan spring and autumn, transi-

tional periods between the two extreme seasons, are of shorter duration than in southern Japan. The frost-free period ranges from 120 days in Hokkaido to twice that number in southern Kyushu.

Precipitation. — *No* part of Japan is deficient in its total supply of atmospheric water received in the form of rain or snow. Maximum precipitation generally occurs during the early summer and minimum precipitation during winter in keeping with the monsoon pattern. The major exception is the Sea of Japan coast, where winter precipitation, mostly in the form of snow, exceeds that of summer. It has the largest snow accumulation in Japan. The summer rainy period, known as the *baiu* or "plum rain" because it commences when plums are ripening, continues for much of June and July. Torrential rains accompany late summer and early fall typhoons. Rainfall patterns on a national scale are very irregular because of topography, but most of Japan receives precipitation in excess of 40 in. annually. Western Hokkaido. eastern Honshu and the Inland sea region receive 40–60 in. annually. Heavier amounts occur in central Honshu and along the Sea of Japan coast. In these localities, 100–120 in. annually is not uncommon.

Snow falls on most parts of Japan in winter, but the amount and duration vary greatly. Snow blankets Hokkaido, northern Honshu, the Sea of Japan coast and the mountainous interior of Honshu from November to April. Winter weather in areas of heavy snowfall is marked by successive overcast or cloudy days. However, brighter weather is more the rule in such favoured areas as the Inland sea borderland, where the entry of moisture-bearing winds is blocked by mountain ranges.

4. Vegetation. — Japan's latitudinal extent and climatic and topographic diversity are reflected in the composition and geographic arrangement of its flora. A distinct feature of the flora is the great variety of forms; approximately 9,000 species of vascular plants alone have been identified. The flora can be described as essentially a temperate-zone type with boreal forms present in northern Japan and at higher elevations to the south and subtropical forms present in the southern extremes. The temperate forms are closely related to those of the Yangtze valley of central China. Long centuries of landscape modification by the Japanese has upset the natural order on a vast scale. In the plains and cultivable hills, native species have been eradicated or reduced in number and new, sometimes imported, species have taken their place. In similar fashion, continuous cutting of native trees and shrubs and purposeful reforestation with favourite commercial species has changed the complexion of the mountain flora. For purposes of simplicity, the following discussion of Japan's floral zones is limited to the dominant vegetation, trees. More than 1,100 species of trees and shrubs are involved; they can be grouped into three broad geographic classifications: subtropical, temperate and boreal zones.

The subtropical zone, which includes most of Kyushu, Shikoku and Honshu as far north as the Kwanto plain, has an evergreen vegetation. This flora requires an average annual temperature of 55° to 70° F., so at elevations above 2,500 ft. within the zone it is replaced by a more northern type of deciduous and mixed forest stand. Oaks. represented by several species, and members of the laurel and tea families are most prevalent. Banyan (*Ficus benghalensis*), palms (*Trachycarpus* and *Rhapis*), cycads, camphor (*Cinnamomum camphora*) and other tropical elements are found in southern Shikoku and Kyushu. Small groves of tall bamboo add a graceful note to the landscape. Such tropical food crops as banana, citrus fruits and sugar cane are grown.

The temperate zone includes central Honshu except for elevations over 5,400 ft., northern Honshu and the western one-third of Hokkaido. Included are areas whose average annual temperature is between 43° and 55° F. Primary floristic components of the predominantly mixed forest are maples, ash, birch, beech. poplar, chestnut, horse chestnut and other deciduous trees. The empress tree (*Paulownia*) is a common deciduous tree of the cultivated lowlands. Among the zone's many valuable conifers are Japanese cedar (*Cryptomeria japonica*), cypress, hemlock, umbrella pine (*Sciadopitys verticillata*), false arborvitae, yew and white pine (*Pinus pentaphylla*). Black pine (*P. thunbergi*) and red pine (*P. densiflora*) occur in dense stands in the hills, low mountains and along sandy shores.

The boreal zone is best developed in central and eastern Hokkaido and at elevations between 5,400 and 8,400 ft. as far south as central Honshu, where the average annual temperature is below 43° F. Forest stands are dominated by such conifers as fir, spruce, larch, hemlock and Japanese cedar. These, together with such broadleaf trees as birch, alder and dogwood, generally occur at elevations over 1,000 ft. There is a great variety of broadleaf trees, mostly at lower elevations: oaks, maples, linden, ash, elm, walnut, cherry and magnolias. Above timber line in the high mountains of central Honshu and points farther north, azalea, dwarf species of birch and bamboo and alpine plants make an appearance. The Manchurian dwarf pine (*P. pumila*) forms dense carpets on high ridges. In southeastern Hokkaido large bogs in the lower reaches of several rivers have a distinctive flora.

The luxuriant and diversified forests, whether the cool green of the conifers or the resplendent fall colours of the deciduous trees, are one of Japan's most famed natural sights. The Japanese have used native and imported flowering plants, trees and shrubs to advance the art of gardening to a high degree of perfection, stressing maximum effect in minimum space through judicious plant arrangement. Japanese success in the cultivation of chrysanthemum, flowering cherry, wisteria, camellia, azalea, iris and a host of other domesticated plants is unsurpassed. The cultivation of dwarf trees in pots, bonsai, is another Japanese gardening art. Private and public gardens are high lights of town and city. (*See* JAPANESE GARDEN.)

Marine flora can also be subdivided into tropical, temperate and boreal classifications. The tropical zone, as a result of the presence of warm currents, extends as far northward on the Pacific coast as Tokyo bay, but it barely penetrates into the Sea of Japan.

5. **Animal** Life. — Japan has a rich fauna that, like the islands' climate and vegetation, shows strong regional variations with latitude and altitude. Most Japanese land animals are temperate-zone species, blending with subarctic types in Hokkaido and tropical types in Kyushu and southern Shikoku. Hokkaido fauna, in general, is most distinctly different in detail from that of the rest of Japan. Close resemblances to species in China, Korea, Siberia and southeast Asia suggest that many Japanese animals may have originally reached Japan from the continent. Marine fauna can also be subdivided into northern, central and tropical classifications, although the tropical zone extends much farther north than on the land. Warm-water species commonly accompany the Japan current as far north as the Bōsō peninsula outside Tokyo bay.

About 140 mammals have been identified in Japan and adjacent waters. The orders best represented are the rodents, carnivores and cetaceans. There are numerous species of shrews, moles and bats and one primate, the Japanese macaque (*Macaca fuscata*). The carnivores include bears, badgers, otters, ermines, mink, martens, racoon dogs, foxes, wolves, eared seals and walrus. Wild pigs, deer and deer antelopes are also found. Japanese seas are inhabited by more than 30 different cetaceans.

Japan has about 450 species of birds, of which more than one-third are water birds. Shore birds, gulls and auks are most fully represented among these with 95 species. Also numerous are grebes. albatrosses. shearwaters, tropic birds, cormorants (sometimes trained by fishermen to catch smelt or ayu), herons, storks, glossy ibises, ducks, geese, swans and cranes. Other species include vultures, hawks, falcons, grouse, pheasants, quail. ptarmigan, pigeons and doves, cuckoos, owls and woodpeckers. There are about 150 songbirds.

Thirty species of reptiles have been identified, including sea turtles. fresh-water tortoises, sea snakes and a large number of lizards. Among the snakes, only two rarely encountered species are poisonous. The largest snake (*Elaphe climacophora*) attains a length of five feet but is harmless. A colony of albino snakes of this species is found in Yamaguchi prefecture. Amphibians are well represented by many toad, frog and newt species. In the mountain streams of Kyushu and western Honshu lives a species of giant salamander (*Megalobatrachus japonicus*) which is one of the largest living amphibians, attaining a length of five feet.

The seas around Japan swarm with fish, some strictly native

and others migratory species from as far away as the cold waters of the Sea of Okhotsk and the equatorial waters of the Indian ocean. The chief fish of commercial value taken from the sea include salmon, sardine, sea bream, yellowtail, horse mackerel, tuna, trout, herring, shark, flying fish, gray mullet, smelt and cod. There are also many species of fresh-water fish; carp, goldfish and eels are raised commercially. (See also The Economy: Production: Fisheries, below.)

Trout are fairly common in Japanese rivers and lakes which are also the home of fresh-water crabs and crayfish. However, most crustaceans, such as shrimps and prawns, are found in the sea. A giant crab (Macrocheirus *kaempferi*) with a limb spread of ten feet visits Japan from southeast Asian waters. There is no lobster along the coasts of Japan, but there are various species of lobster-like crustaceans (*Palinurus* and *Scyllarus*) that are highly prized as food. Nearly 1,200 marine mollusks and many echinoderms, such as sea urchins and starfish, are also found in Japanese coastal waters. A remarkable number of species of clams, oysters, abalone and sea snails are used for food; both mussels and oysters are raised commercially for food, and the pearl oyster is raised for the production of cultured pearls. Japan is not rich in coral or sponges, although extensive coral beds are found off the western coast of Kyushu and the southern coast of Shikoku.

Among the worms, the most notable and troublesome representatives are the all too numerous parasites that prey on man and domesticated animals: roundworms, tapeworms, liver fluke and distomes. Japan has a good cross section of the insect orders; some of their more striking members are tropical butterflies and beetles. The showy destructive beetle known as the Japanese beetle (*q.v.*) in the United States is an undistinguished dull colour in its native land and is kept in check by insect parasites. In addition to the true silkworm, Japan has many large, colourful moths. Wasps, bees, hornets, flies, mosquitoes, ants and cockroaches are much in evidence. Fireflies, dragonflies, grasshoppers, crickets, mantes and cicadas abound during the summer. Japanese spiders range from a giant species to one of minute dimensions.

II. GEOGRAPHIC REGIONS

Based upon political subdivisions (prefectures), Japan is conventionally divided into the eight following regions, each having an over-all similarity in its physical and human geographic conditions.

1. Hokkaido.—A land of severe continental climates, rugged mountains and volcanic masses, Hokkaido was not colonized for the most part until the 1870s and still has a pioneer-area atmosphere. Agriculture, based on U.S. models, is highly commercialized and specialized. Hokkaido is Japan's most important stock grazing and dairying area, is a leader in forestry and ocean fishing and has the second largest coal production. Most natural resources move southward to Japan's industrial belt, giving Hokkaido's economy a semicolonial flavour. Industry is restricted to Muroran (mainly iron and steel) and a few other centres. Sapporo (*q.v.*), in the large and heavily settled Ishikari plain, is the island's urban centre.

2. Tohoku or Ōu.—A region of northern Honshu, consisting of Aomori, Akita, Yamagata, Iwate, Miyagi and Fukushima prefectures. Climatically transitional between Hokkaido and subtropical Japan, and topographically dominated by three parallel mountain systems, Tohoku is a predominantly rural region. Some sections are among the poorest and most primitive in Japan. Its large farming population occupies the coastal plains and several large interior basins. Tohoku agriculture is limited to one (summer) crop because of deep snow accumulation, poor drainage and low winter temperatures. It produces large rice surpluses and much silk. Forestry, fishing and mining (petroleum, coal, iron ore and copper) flourish, but production moves to cities and industries outside the region. Sendai is the regional centre.

3. Kwanto.—Consists of Ibaraki, Tochigi, Gumma, Saitama, Chiba and Kanagawa prefectures, and the metropolis of Tokyo. Formed by the Kwanto plain and its mountainous borderlands, the Kwanto region has a split personality. Its eastern half, which suffers from poor drainage, contains the many water bodies of the Tone river system, Kasumiga lake and marshes and lagoons in abundance. It remains essentially agricultural with the exception of such industrial centres as Mito and Utsunomiya. The western half of the region is elevated, terraced, and is among Japan's most urbanized and advanced industrial-commercial areas. Tokyo-Yokohama constitute the nucleus of Japan's largest population cluster, around Tokyo bay and spreading into the interior. Interior sections are noted for their intensive, city-market oriented agriculture and silk production.

4. Chūbu.—This large region of central Honshu has three distinct geographic personalities. First, the Sea of Japan coastal portion (Niigata, Toyama and Ishikawa prefectures) is one of Japan's most highly specialized rice-growing areas, producing great rice surpluses. Some industry based on petroleum, natural gas and hydroelectricity has developed. Niigata and Kanazawa are outstanding cities. Second, in the mountainous interior (Nagano, Yamanashi and Gifu prefectures) life centres in a series of elevated mountain basins set amid the formidable terrain. There is the heart of the silk-producing and silk-reeling industry. Fruits and other agricultural specialties are grown, rich forests are worked and rivers have been dammed to produce Japan's largest supply of hydroelectric power. Third, the Pacific coastal strip (Shizuoka and Aichi prefectures) is highly developed industrially, centring on Nagoya and smaller industrial cities. It has superb rail transportation and is noted for its citrus-fruit, tea and vegetable growing. Shizuoka ranks after Nagoya as the regional service centre.

5. **Kinki.**—In central western Honshu, consisting of Shiga, Kyōto, Fukui, Osaka, Nara, Wakayama and Mie prefectures, Kinki is one of Japan's most historic and densely settled regions. Regional life centres on the great urban clusters of Osaka and Kyōto. Greater Osaka ranks as one of Japan's two largest industrial-commercial nuclei and is second only to greater Tokyo in size. Elsewhere, agriculture of an intensive, multiple-crop type is the prevalent economic mainstay, with forestry in the mountains and fishing along the coasts. Biwa-ko, the rugged Kii mountains and the heavily indented Fukui coast line are outstanding physical features.

6. Chūgoku.—The Sea of Japan coastal portion (Shimane and Tottori prefectures) of this region of western Honshu are its "shady side," so called because of its typically cold, snowy winter weather. It is relatively remote from the large centres of western Japan and has a simple farming-forestry-fishing economic base. The Inland sea side, or "sunny side" (Hyōgo, Okayama, Hiroshima and Yamaguchi prefectures), has Japan's most pleasant winter weather and is a progressive, prosperous and densely settled region. It is part of the historical "cradle of Japanese civilization," the Inland sea borderlands, and has a modern economy based upon a thriving, diversified agriculture and industry that is dispersed among many of the region's cities. Hiroshima (*q.v.*) is the regional centre.

7. Shikoku.—Composed of four prefectures (Kagawa, Ehime, Tokushima and Kōchi), Shikoku is divided physically and culturally by the east-west Shikoku mountains. The northern plains resemble their Chūgoku counterparts across the Inland sea in physical and economic qualities. Takamatsu (*q.v.*), in the northeast, is the leading Shikoku city. Southern Shikoku is isolated and dependent upon farming, forestry and fishing.

8. **Kyushu.**—Consists of Fukuoka, Saga, Nagasaki, Ōita, Kumamoto, Miyazaki and Kagoshima prefectures. Like neighbouring Shikoku, Kyushu has two contrasting faces. Northern Kyushu is one of the most highly industrialized parts of Japan. specializing in heavy industry, has the nation's largest coal production and is very urbanized. Fukuoka and the old port city of Nagasaki (*qq.v.*) are its chief cities. Plains in central western Kyushu, noted for their large rice surpluses and general agricultural output, are important as food suppliers to the northern cities. Kumamoto is the main service centre for this central agricultural zone. Tropical southern Kyushu, dominated by extensive ash plateaus and volcanic peaks, is one of Japan's most isolated, poorest and most tradition-bound regions. It rests on a primitive farming, fishing and forestry economic base. Kagoshima provides urban leadership for the area.

(J. D. EE.)

III. THE PEOPLE

1. Physical Characteristics. — Japan was populated primarily from the mainland, and the majority of the people belong to the Mongoloid stock and exhibit few traits by which they can easily be distinguished from various other Mongoloid groups. There are minority elements in the population that represent mixtures with the aboriginal Ainu of northern Japan and with strains from southeast Asia, Korea, Europe, etc.; but there has been relatively little admixture for 1,000 years and considerable homogeneity has been attained. It has been estimated that the majority are genetically closest to Koreans, the Tungus tribes and groups in northern China. (See RACES OF MANKIND.)

Most Japanese tend to have more body and facial hair than other Mongoloid groups, and skin colour is more often brown than yellowish. Body build tends to be sturdy. While the Japanese are classed among short-statured peoples, rather remarkable changes in physique occurred after 1900. Studies made by the government revealed that by the early 1950s the average stature of the male population had risen to nearly 5 ft. 4 in. (163 cm.), an increase of almost 3 in. over the conscript of 1900. The change has been attributed to improved diet and medical care, exercise and freer circulation resulting from the decrease in the habit of sitting on the floor with the legs buckled under. Paralleling tendencies in other industrialized nations, the urban population is, on the average, taller than the rural. Japanese wrestlers have exceptional physiques. Selected in early youth for size and proficiency, they are often at least 6 ft. tall and weigh more than 300 lb. Most of their size is attributed to selection and specialized physical training, although some cases reputedly show traces of acromegaly.

Of minority ethnic groups in Japan, the Ainu constitute the most notable. They are distinctive in physical type as well as culture and language. Although their origin is unknown, they show traits suggesting Caucasoid affiliation, and have sometimes been referred to as the "hairy Ainu" because of their abundant body hair (see AINU).

2. Language and Writing. — The Japanese language has not been conclusively related to any other, although some scholars believe it may show affinities to Korean and, possibly, to the Altaic group (Mongolian, Manchu and Turkic families). Others suggest Polynesian or Malaysian affinities. It is quite different from Chinese, from which. however, many words have been borrowed (see JAPANESE LANGUAGE). The Ainu tongue has not been related to Japanese or any other language. Writing originally was borrowed from China in the form of the Chinese ideographs, and for centuries a scholarly prestige value was attached to the ability to write in classical Chinese. Gradually, however, a Japanese system of writing was developed in which Chinese characters were abbreviated and used for phonetic value only—not for meaning. These syllabaries or kana, originally consisting of about 50 syllables, greatly stimulated the development of literature from the 9th century on (see JAPANESE LITERATURE). Two such systems, the *hiragana* and *katakana,* are used in modern times, but are employed in association with the many kanji, or Chinese characters, which can be pronounced several different ways; *e.g.,* as pure Japanese or in modified Chinese. Traditional-style Japanese is written in columns from right to left. (R. F. SR.)

3. Religion. — The Japanese term *shūkyō* ("religion") was coined in the 19th century from the traditional words for "sect" (*shū*) and "teaching" (*kyō*). However, religion in Japan, as elsewhere, means more than an ecclesiastical organization and a body of sacred beliefs and practices. It is a way of life, individual and collective; it is a pattern of various kinds of values and of interpersonal relationships; it also represents the spirit of the people and the community. Thus, religion has affected all other aspects of Japanese culture and society, and in turn has been influenced by them.

There is no single dominant religion in Japan; several religious and quasi-religious systems exist side by side. National and communal cults have been traditionally regarded as the domain of Shinto, a public and private morality has been based on Confucianism and spiritual and metaphysical problems have been the concern of Buddhism. The Code of Warriors (*Bushidō, q.v.*) was the guiding principle of the warriors during the feudal period, and the masses have always been influenced by an unorganized "folk" Shinto, related to but not altogether compatible with the institutionalized form.

While these systems have never lost their identities, each has been deeply influenced by the others. To complicate the matter further, in the 19th century the Japanese government recognized 13 Sect Shinto denominations outside traditional Shintō, and after World War II numerous "New Religious Cults" emerged.

According to the 1957 report of the department of education, in that year Shinto claimed about 80,000,000 members or believers; Buddhism 40,000,000; Christianity nearly 600,000; and New Religions Cults 3,500,000. These figures indicate that there are considerably more adherents than the total population of Japan, a discrepancy caused mainly by the accepted pattern of plurality of religious affiliation among the Japanese, who find no contradiction in paying homage to Buddhist and Shinto deities alike. Traditionally, a person conforms to the beliefs and practices of his family instead of following his own inclination toward a religious system. The average home has both the Shintō family shrine (kami-dana) and the Buddhist family altar (*Butsu-dan*). The former is a simple unpainted wooden shelf, placed a little below the ceiling, with a piece of paper on which the names of the Shinto deities (kami) are inscribed; usually a twig of the sacred tree (*Cleyera japonica*) is placed on the side next to some candlesticks. The Buddhist altar, heavily decorated, usually is located in a small room set aside for family rites. In the centre is the statue of a Buddha or a bodhisattva, surrounded by tablets on which are written the names of deceased members of the family. Every morning members of the family light candles and offer flowers to the Shinto deities. They also light candles and offer a small bowl of rice, sweets and fruits at the Buddhist altar.

In addition to these family rites, pious Japanese visit their tutelary Shinto shrines twice a month; others do so only on special festive occasions. Many Japanese also visit the Buddhist temples to which their families belong on such holy days as the Buddha's birthday (April 8 according to the Mahayana tradition) and the day of his Enlightenment (Dec. 8). As the family cemetery is usually taken care of by the Buddhist temple, members of the family visit the cemetery and temples as well as ask a Buddhist priest to read passages from a sacred scripture (sutra) at their family altar on the anniversaries of deceased relatives. When a child is born, the infant is taken to the Shintō shrine to receive the blessing and protection of the tutelary deity, but funerals and all memorial services are performed according to Buddhist rites. Most Japanese participate rather indiscriminately in both Shinto and Buddhist festivals. In the modern period, the observance of the traditional religious practices has broken down considerably, especially among the urban populations, but the pattern of plural belonging has persisted.

Early Period. — Very little is known about the religious beliefs and practices of the inhabitants of the Japanese islands in the prehistoric period. For example, the religious influence of the aboriginal Ainu (*q.v.*) on the non-Ainu groups cannot be clearly ascertained. The earliest Japanese religion, however, had much in common with the shamanism (*q.v.*) of northeastern Asia. A Chinese chronicle of the 3rd century A.D. mentions that a female shaman-ruler, Pimiku (in Japanese Himiko, meaning "sun-daughter"), reigned over one of the kingdoms in Japan; she "was old and unmarried, and had devoted herself to magic." Although this record is not altogether reliable, it portrays something of Japanese life in the 3rd century. It states that people in Japan practised divination (*q.v.*) by burning bones, and that they appointed a diviner who was not allowed to comb his hair, to wash, to eat meat or to approach women. When someone died, the whole family went into the water and washed after the funeral. Also according to the Chinese records, when Queen Himiko died a great mound was raised over her, and more than 1,000 of her male and female attendants followed her in death. She was succeeded by a young female relative named Iyo or Ichiyo.

Scholars have not agreed as to where Himiko's kingdom was

situated. The usually accepted interpretation is that there were two main power blocs, one in Kyushu and the other in Izumo (the present Shimane prefecture), and that the Kyushu people gradually pushed along the shores of the Inland sea and established themselves as the political power, between the 1st and the 4th centuries, in the Yamato district (the present Nara prefecture) in central Japan. Himiko and Iyo were most likely rulers of the Kyushu group. In the course of time, probably in the 4th century, the Kyushu people, now settled in the Yamato district and known as the Yamato clan, subjugated the people in the Izumo district and established the Yamato kingdom.

The religion of the early Yamato clans was a simple polytheistic nature worship, in which each clan (*uji*) also venerated its own special deity (uji-gami). Among all the clan deities, the sun-goddess, the deity of the imperial clan, held a special position of honour. Gradually, simple shrines were constructed for the performance of religious rites consisting of obeisance, offerings and prayer. While the early Japanese were not concerned with moral sins, they were preoccupied with ceremonial defilement; thus the most important feature of the early Japanese religion was purification, which was achieved by exorcism, cleansing and abstention. This religion was later called Shintō or "the way of the gods," and most of the characteristics of the early Shintō have been preserved to a significant degree in the present-day religion.

Influence of Chinese Civilization. — The historical situation in the 4th and 5th centuries (see History, below) brought Japan close to the kingdoms in the Korean peninsula, which were cultural satellites of China, and many aspects of Chinese civilization were transmitted to Japan by Korean and Chinese immigrants. Japan, which previously had no written language, adopted the Chinese script. Japanese society, based on primitive communal rules and authorities, accepted Confucian ethical principles and Confucian social and political theories. Thus, although the traditional paternalistic authoritarianism was retained, interpersonal relationships came to be regulated in terms of such concepts as filial piety, the veneration of ancestors and reciprocal rights and obligations between superiors and inferiors. Also, Japanese indifference to metaphysical speculations gave way to the acceptance of many philosophical concepts from Taoism (*q.v.*) and the yin-yang system. Numerous kinds of divination and witchcraft, palmistry and fortunetelling, too, were introduced from China, and the influence of astrologers and sorcerers was strongly felt, even in court life.

Introduction of Buddhism. — Buddhism, which originated in India, penetrated other parts of Asia as a great religious and cultural movement. At the turn of the Christian era it was introduced into China, where it quickly won many adherents, and in the 4th century Korea came under the influence of Chinese Buddhism. In 538 or 552 one of the Korean kings presented to the Japanese court a Buddhist image, copies of Buddhist scriptures and liturgical ornaments, and from this date Buddhism in Japan is usually said to have begun, though it had been known earlier among Japanese of Chinese and Korean ancestry. The Buddhism that reached Japan was no longer the simple religion of an Indian mendicant; it was the bearer of civilization, blending within it the spiritual wisdom and learning of India and China, with well-organized ecclesiastical institutions and highly developed arts and architecture which had matured under royal favour in China and Korea. Significantly, Buddhism was recommended to the Japanese court as a religion which would bring endless and immeasurable blessings and fruits. (See also BUDDHA AND BUDDHISM.)

After an initial period of resistance on the part of Shinto priestly families and conservative aristocrats, Buddhism gradually captured the Japanese. Many scholars, priests, nuns and ecclesiastical artists were welcomed from China and Korea. While the majority of the people did not understand or appreciate the subtleties of Buddhist doctrine, they were dazzled by the arts, ceremonies and architecture of Buddhism and they hoped to accumulate merit in the life to come by contributing money, land and buildings to the monastic orders. The relatively rapid expansion of Buddhism in Japan was due in large part to the support it received from the court.

By far the most famous patron of Buddhism was Prince Shōtoku (see History, below), whose religious policy left lasting marks on Japanese Buddhism. Shōtoku realized that the establishment of strong and enlightened authority from the imperial throne above the quarrelsome clan leaders was the only way for Japan to survive as a neighbour to China, which was then unified under the powerful Sui dynasty, and he tried to unify Japanese culture and society and to centralize political administration. He sent Japanese students, many of them Buddhist monks, to China to be trained in the arts, literature, medicine, philosophy and religion. The so-called Seventeen Articles, moral injunctions issued by the prince regent, show a blend of Shinto, Confucian and Buddhist elements, but it is Buddhism that is considered the spiritual foundation of the unified empire.

The second of Shōtoku's articles reads: "Revere the three treasures — Buddha, the Law and the Holy Community — for these are . . . the supreme object of faith in all countries." Shōtoku, himself a lay Buddhist, built temples, supported monastic orders and lectured on the Buddhist scriptures. He regarded the different sects as facets of the one religion of Buddha. He was also fully aware of the political significance of Buddhism as a stabilizing and unifying force for the nation. With such active encouragement and support from the government, Buddhism prospered, and Buddhist temples served as religious, educational and philanthropic institutions. The government went so far as to issue an official decree in 685 ordering the establishment of Buddhist family altars in all households.

Nara Period. — During the 8th century Japan erected its first permanent capital at Nara, modeled after Ch'ang-an, the capital of T'ang China. During this period, the Records of Ancient Matters (Kojiki) and the Chronicles of Japan (*Nihongi* or *Nihonshoki*) were compiled from oral traditions; these chronicles have remained the semisacred scriptures of Shinto. Both Shinto and Buddhism were regarded as important departments of the state, and the government controlled the appointment of ecclesiastics. There were six schools of Buddhism during this period: the Jōjitsu (Sautrantika), Kusha (Sarvastivadin), Sanron (Madhyamika), Hossō (Yogacara), Kegon (Avatamsaka) and Ritsu (Vinaya). The first two are Hinayanistic, and were studied only as intellectual disciplines; the last was a nondoctrinal study of monastic rules and ordination rites. Doctrinally important were the three Mahayana (*q.v.*) schools, Sanron, Hossō and Kegon. Although lofty philosophical systems intrigued some studious monks, these were ignored by pious followers. Many people were interested in the reading of certain scriptures and in charitable works which they believed would bring rewards both in this world and in the next life, and they were undiscriminating in their attitudes toward Buddhism, Shinto and Confucianism. Confucianism was often characterized as the "Outer Gate," a steppingstone toward the "Inner Gate" of Buddhism. Shintō deities were enshrined within the compounds of many Buddhist temples. In the rural areas unauthorized holy men (hijiri) influenced the masses, who lived in the fear of malevolent spirits (*goryō*). Also during this period, under the leadership of En-no-Gyōja (d. 701?), whose religion combined folk Shinto, Buddhism and Taoism, emerged the order of Mountain Priests (Shugen-dō), destined to play an important role in the subsequent history of Japanese religions.

In the capital city, however, Buddhism exerted a decisive influence, as evidenced by the construction of the Tōdaiji, the national cathedral, dedicated to Buddha Lochana, a heavenly manifestation of Buddha Sakyamuni. The consecration of the colossal image of Lochana in 752 in the presence of Emperor Shōmu, who declared himself the humble slave of Buddha, was the outstanding event of Buddhism during the Nara period. The close affiliation of Buddhism and the court, however, resulted in the involvement in political intrigues of rich and powerful monks. The daring attempt of Dōkyō, the priest chancellor, to usurp the throne failed, but the incident illustrates the power of the Buddhist hierarchy of 8th-century Japan.

Heian or *Fujiwara* Period. — During the two and a half centuries

that followed the move of the capital to Kyōto (794) Japanese culture integrated Chinese elements, as evidenced by the invention of the Japanese syllabary based on Chinese characters and by the subtle, elegant art and poetry of the courtiers in Kyoto. Two schools of Buddhism prospered in this period, the Tendai school, founded by Saichō or Dengyō Daishi (767–822), and the Shingon school founded by Kiikai or Kōbō Daishi (d. 83;). Saichō tried to synthesize the doctrines of the Tendai (T'ien-t'ai in Chinese), Zen (*Ch'an* in Chinese) and the esoteric school of Buddhism within the doctrinal framework of the Lotus Sutra. He envisaged the monastic centre at Mt. Hiei, not far from Kyōto, as the religious capital of the nation. Kūkai dedicated his life to the establishment of the esoteric Shingon (Ch'en-yen in Chinese) school of Buddhism in Japan. He was a great synthesizer in both doctrinal and practical matters. In addition to erecting the great monastic centre at Mt. Kōya, 50 mi. S. of Kyōto, Kiikai also served as abbot of Tōji, the national cathedral in Kyoto, and as chief priest of the Inner Sanctuary of the imperial court. His Shingon school embraced both lofty philosophy and magical incantations, and it influenced the courtiers in Kyoto as well as the masses in remote areas. Even the Tendai school, shortly after the death of Saichd, came under the influence of the Shingon, and became de facto another esoteric school.

Kiikai is credited with the theoretical formulation of Ryōbu ("Two Aspects") Shintō, a pattern of coexistence or amalgamation of Shinto with Buddhism. A similar attempt, called Ichi-jitsu ("One Reality") or Sannō Ichi-jitsu Shinto, was made by the Tendai school. Both of them interpret Shintō deities as Japanese manifestations of Buddha, finding no contradiction between Buddhism and Shintd. Also, the orders of Mountain Priests allied themselves with these Buddhist schools and came to be known as the Shingon Shugen-dō and Tendai Shugen-dō respectively. In the course of time the monastic centres at Mt. Hiei and Mt. Kōya became rich, powerful and corrupt, overshadowing all the old Buddhist institutions at Nara and the historic Shinto shrines.

Spiritual Awakening *During* the Karnakura Period.—This period, from the end of the 12th century to the early part of the 14th, marked the beginning of the feudal regime (*bakufu*) in Japan. The Kamakura period is noted for a number of great individuals who exerted a far-reaching influence on the religious life of the people; *e.g.,* Hōnen and Shinran, who advocated Amida pietism; Dōgen, who systematized Zen Buddhism; and Nichiren, a patriotic prophet and the founder of the Nichiren sect. Among the warriors the *Bushidō* (*q.v.*), which taught serenity and simplicity, tenderness and courage, calm resignation and lofty idealism, became the guiding principle. There was also a movement to restore the ancient glory of Japan. In the political domain this resulted in a short-lived restoration of the imperial rule (1333–36), and in the religious domain it gave rise to the Shinto movements in reaction against the Buddhist domination of the Heian period.

Social Disintegration and Religious Strife.—The Ashikaga period (1338–1573) was marked by a series of natural calamities and political rivalries. For over half a century two families contended for the imperial throne, and the country was tormented by earthquakes. floods, famines and typhoons. A hermit wrote: "Beggars swarmed by the roadside, and our ears were filled with the sound of their lamentations." On the other hand, this period also witnessed the development of the lyric drama (nō) and the tea ceremony. Cultural leadership was maintained by Buddhist monks, especially those of Zen Buddhism. However, the Zen school lost its earlier simple discipline and became a semiofficial state religion. Many Zen priests were shrewd businessmen, actively engaged in foreign trade, mainly with China; as by-products of the China trade, the arts of the Sung period and of Neo-Confucianism were introduced, stimulating cultural and religious developments in Japan.

Social disintegration during the 16th century was greatly accentuated by a series of conflicts among religious groups, such as the followers of Nichiren, the followers of Shinran (known then as the Ikkō or "One Direction" sect) and the monk soldiers of the Tendai monastic centre at Mt. Hiei. They engaged in bloody battles, invoking the holy name of Buddha, fighting for the political control of ecclesiastical jurisdictions. Buddhist institutions became in many instances dens of mercenaries and vagabonds, while many Shinto shrines were totally neglected. The decline of the Ashikaga regime resulted in the increased power of competing warrior lords (daimyb), who fought among themselves for survival. Although the emperor had long since been stripped of political power, during this period imperial prestige reached its lowest point; one emperor died in extreme poverty and his body remained unburied for six weeks; several emperors were forced to sell their own poems to make a living.

The social and political chaos sent many ambitious young men to build their careers in foreign countries or engage in foreign trade, and foreign trade brought Europeans to Japan. Portuguese traders were soon followed by Roman Catholic missionaries; the Jesuit Francis Xavier (*q.v.*) and his companions arrived on Japanese shores in 1549. To the Japanese, Roman Catholicism, known as the Kirishitan sect, was not only a new religion but a symbol of European civilization. While some of the oppressed peasantry welcomed the gospel of salvation. the merchants and trade-conscious warrior lords regarded Catholicism as an important link between themselves and the expanding European continent. Some of them dispatched emissaries to the Vatican and to courts of Catholic princes in Europe.

Catholic missionary work was encouraged by Oda Nobunaga, who was trying to unify Japan and who, although he had no religious interest in it, used Catholicism to counteract the political strength of the powerful Buddhist institutions. Under Nobunaga's successor, Toyotomi Hideyoshi (*q.v.*), the Kirishitan sect was greatly restricted. (See History, below.) However, according to one report sent to the Vatican, there were about 150,000 Japanese converts toward the end of the 16th century.

Tokugawa Period.—The initial policy of the Tokugawa feudal regime toward Roman Catholicism wavered because of two considerations: the Tokugana rulers were afraid of the Catholic nations, which were expanding rapidly in Asia; at the same time, they did not wish to lose trade with Europe. Prohibition edicts mere issued repeatedly against Japanese *Kirishitans,* but they were not thoroughly enforced. The severest blow came to the Roman Catholics in 1637, when thousands of Kirishitan men and women on the island of Kyushu rebelled against the Tokugawa regime. Although they fought valiantly, they fell when their food and munitions were exhausted. When the uprising was quelled, Japanese Catholics were ordered to renounce their faith; if they did not, they were either tortured or shipped out of the country. Medieval Kotnan Catholicism in Japan was brought to an end.

Following the *Kirishitan* uprising, the Tokugawa regime took the far more drastic measure of "seclusion," cutting off all trade and other relations with foreign powers with the exception of the Netherlands. In order to exterminate Japanese *Kirishitans,* every family was required to belong to a Buddhist temple, thus making Buddhist priests de facto officials of the regime. While the Tokugawa rulers utilized religion, however, they did not trust the ecclesiastical authorities and took pains to minimize their influence. By rigidly stratifying the society into the four'classes of warriors, farmers, artisans and merchants, the Tokugawas attempted to maintain permanent martial law to guard against insubordination. The Buddhist and Shintō ecclesiastics, however, considered apart from the hierarchical social order, were governed by the commissioner of temples and shrines.

In order to cement the feudalistic social structure, the Tokugawa regime depended on Neo-Confucianism (see CONFUCIANISM) as the guiding system of morality. What attracted the Tokugawas was the Stoic qualities in Neo-Confucianism, especially in the tradition of Chu Hsi (*q.v.;* Shushi in Japanese). To a regime that was trying to rationalize its existence, the Neo-Confucian ideology of heavenly sanction for the empirical social order was enticing. According to this paternalistic ethic, the superior was urged to be benevolent and just, while the inferior was expected to be obedient and to observe propriety. The Tokugawa rulers emphasized Neo-Confucian ethics as the cornerstone of education, which was systematized and propagated by such influential men as Kinoshita Jun-an, Arai Hakuseki and Muro Kyūsō. The cardinal virtues

thus taught were filial piety, loyalty, obedience and the sense of indebtedness to one's superiors.

Neo-Confucian moral concepts also helped the development of the *Bushidō,* which had originated in the 13th century. Although it was never meant to be a religion. the *Bushidō* was greatly influenced by Buddhism, Shintō and Confucianism, and developed a quasi-religious cult. In times of war *Bushidō* taught the capacity to stand on the verge of life and death, and in times of peace it taught the virtues of self-renunciation, frugality, obedience to superiors and benevolence.

According to a 17th-century manual of *Bushidō,* whenever one has a spare moment of quiet, even in peacetime, "he should not fail to revert to the question of death and reflect carefully on it." One of the best examples of *Bushidō* was the incident of the **47** retainers (1702), whose sense of loyalty and fidelity won them the title of gishi or "righteous warriors" (see FORTY-SEVEN RŌNIN). During the greater part of the Tokugawa period the ruling regime managed to keep peace and civic order by indoctrinating the warriors, who were at the top of the social ladder, to be examples to the inferior classes.

The women of the warrior class were also expected to be exemplary. According to a manual for women, "a woman must be ever on the alert and keep a strict watch over her own conduct. In the morning she must rise early, and at night go late to rest. Instead of sleeping in the middle of the day. she must be intent on the duties of her household, and must not weary of weaving, sewing and spinning." The status of women during the Tokugawa period was anything but enviable:

> It is better for women that they should not be educated, because their lot throughout life must be one of perfect obedience . . . obedience to a father before marriage, to a husband when married, and to a son when widowed. . . . Yet, it is important that she should be morally trained, so that she will always be gentle and chaste, never giving way to passion inconvenient to others, nor questioning the authority of her elders. For her no religion is necessary either, because her husband is her sole heaven, and in serving him and his lies her whole duty.

Women were to abstain from luxuries such as tea and tobacco. and husbands were told that if their wives were "flighty and liked visiting temples (for example) to divorce them at once."

The influence of Neo-Confucianism and *Bushidō,* however, was confined for the most part to the warrior class. Among the farmers, artisans and merchants, Buddhism and Shintō continued to maintain their strength. There were able Buddhist leaders, such as Tenkai, Siiden. Nichijū, Genyo, Takuan, Ingen, Tetsugen and Keichii. but the majority of Buddhist monks lost their spiritual vitality and upheld the status quo, enjoying the prestige and financial subsidy accorded them by the ruling regime. The spiritual decadence of Buddhism promoted the gradual release of Shintō from its age-old domination by Buddhism. Many Neo-Confucian scholars in Japan (*e.g.,* Hayashi Razan and Yamazaki Ansai), despite the fact that they had previously received Buddhist training or because of it, reacted emotionally against Buddhism and befriended Shinto. The lord of Mito. Tokugawa Mitsukuni, tried to combine Confucian ethics with Shinto, even though his personal piety was influenced by Buddhism. The so-called Mito school of Neo-Confucianism, following in the footsteps of Mitsukuni, advocated nationalistic ideas and exerted a far-reaching influence on the loyalist movement in the later period. Greatly encouraged by the co-operation and assistance of Neo-Confucian scholars, Shintō leaders aspired to restore their faith as the national religion of Japan.

The institutionalization of religions during the Tokugawa period did not meet the needs of the common people, and the spiritual vacuum was filled by many popular, eclectic, semireligious movements led by such figures as Ishida Baigan Teshima To-an and Nakazawa Dōji. Ninomiya Sontoku, known as the "peasant sage," initiated the Hōtoku ("Repay the Indebtedness") movement among farmers, teaching the virtues of hard work, frugality and the sense of gratitude. Another such religious movement was an organization called Kō, a nonecclesiastical lay movement for the purpose of worshipping certain well-known Shintō deities or sacred mountains. Membership in the Kō required payment of dues, which were used for pilgrimages as well as for an emergency fund for members. Among the oppressed peasantry, many crude apocalyptic messianic movements arose toward the end of the period, attracting men and women with incantation, faith healing and the promise of this-worldly benefits. Some of these movements later developed into Sect Shinto denominations.

Modern Period.—After the appearance of four U.S. battleships led by Commodore Matthew Perry in 1853, Japan began to be exposed to the influence of the modern west. In 1868 the feudal regime was abolished and imperial rule restored; in the following year the capital was moved from Kyōto to Tokyo and the Meiji era began. The architects of the new Meiji government were fen er than 100 men, mostly lower warriors and a few courtiers, who were united in their practical policies to develop a modern nation-state without losing the traditional religious and cultural framework of Japan.

The combined pressures of western nations persuaded the Meiji government to lift the edict banning Christianity in 1873, and religious freedom was guaranteed in the constitution of 1889: "Japanese subjects shall, within limits not prejudicial to peace and order, and not antagonistic to their duties as subjects, enjoy freedom of religious belief" (art. 28). The modernization of Japan, however, was initiated by a paternalistic, authoritarian government, which attempted to revitalize Shinto as the national religion. Thus, the government separated Shintō from its close affiliation with Buddhism, and the department of Shintō was established to superimpose Shinto on the new Japan. The movement known as Haibutsu Kishaku ("Extermination of Buddhism") reached its climax in 1870–71, when in the Toyama district alone 1,730 temples were reduced overnight to 7. Such extreme measures elicited severe criticism and a series of local riots, and the government had to soften its anti-Buddhist policy. The department of Shinto was replaced in 1872 by the ministry of religion and education, which tried to advocate patriotism, reverence for Shintō deities and the emperor cult. Gradually Buddhism recovered its strength and, in order to gain emancipation from the government policy, Buddhists, even though they were against the introduction of Christianity. fought for religious freedom.

With the lifting of the ban against Christianity, various branches of Christianity initiated vigorous evangelical and educational programs. The Russian Orthodox Church started its work in Hokkaido and gradually pushed southward to Tokyo; the Roman Catholic Church started in Kyushu and pushed eastward to Tokyo; the Protestant churches concentrated their efforts in various urban centres. In addition to missionaries there were a number of devoted Christians among the foreign teachers employed by the Japanese government, and some of them had a lasting influence on their students. W. S. Clark, president of Massachusetts Agricultural college, was invited to develop the Sapporo Agricultural school in Hokkaido, and through his personal influence developed many prominent Japanese Christian leaders. The Christian movement found a great inspiration in the person of Joseph Hardy Niishima (Niijima), nho had risked his life to leave Japan before the official opening of the country, studied at Amherst (Mass.) college and returned to Japan in 1874 as the first native Christian minister. In 1876 Niishima founded the Dōshisha school, which remains one of the influential Christian universities. Protestants made notable contributions in education, especially among women, and in social and philanthropic works. In 1883 the Protestants reported 130 churches, 70 educational institutions and about 5,000 members.

At Kyushu, the stronghold of Roman Catholicism, many "hidden" Catholics had secretly observed their faith throughout the Tokugawa period In 1884 Catholics in southern Japan alone numbered 24,656, most of them living in Kyushu, and in 1891 Kyushu had 27,909 Catholics out of the 44,505 in all Japan. At first the Paris Foreign Mission society was the only Roman Catholic agency working in Japan, but after 1904 the Spanish Dominicans, the German Society of the Divine Word, German Franciscans and Jesuits, Canadian Franciscans and Italian Salesians started missionary nork in various parts of Japan.

Western science and philosophy also affected the religious situation in Japan. As early as the 1870s Mill, Darwin, Huxley and Herbert Spencer were introduced, and soon Voltaire and Rousseau

began to attract Japanese students. A little later Kant, Hegel and Schopenhauer became the intellectual idols in the colleges. Japanese Buddhists found their greatest inspiration in Schopenhauer, Spinoza and Hegel.

In 1889, the year of the new constitution guaranteeing freedom of religion, the Japanese government banned religious instruction in schools, although "moral teaching, if applicable to all religions, could be given" (ordinance 12). The ministry of education intended to give a special advantage to Shinto, by interpreting it not as a religion but as a patriotic cult; henceforth education became the means of inculcating an ethnocentric nationalism and strengthening the emperor cult. Thus in the imperial rescript on education of 1890 it is stated:

Our Imperial Ancestors have founded Our Empire on a basis broad and everlasting, and have deeply and firmly implanted virtue; our subjects ever united in loyalty and filial piety have from generation to generation illustrated the beauty thereof. This is the glory of the fundamental character of Our Empire, and herein also lies the source of our education. Ye, our subjects . . . should emergency arise, offer yourselves courageously to the State; and thus guard and maintain the prosperity of Our Imperial Throne coeval with heaven and earth. . . .

Following the spirit of the Imperial Rescript on Education, the government required a course on moral teaching in public schools and advocated obeisance at Shintō shrines by adherents of all religions as a nonreligious patriotic cult. Encouraged by these measures, extreme nationalists began to attack Christianity on the grounds that it was incompatible with nationalism. Meanwhile, the government applied the new category of Sect (Kyōha) Shintō to popular messianic movements in order to separate them from Shintō, which was to be kept nonreligious and suprareligious. Between 1882 and 1908, 13 such denominations were recognized by the government.

In the period of social ferment that characterized the first quarter of the 20th century, the demands for universal suffrage, organization of labour and other such movements for social justice came to be suspect as Bolshevik-inspired; in opposition to them, the emperor cult, Shinto, Yamato *Damashii* ("Japanese spirit") and national ethics were trumpeted as ideological weapons against all "foreign" and "dangerous" ideas. In the 1930s all liberal thinking and expression, in religion, philosophy, art or culture, were condemned as dangerous.

In 1936 Japan joined Germany in an anti-Communist pact, and the government began to press all religious bodies to cooperate with the national aim to extend the imperial rule abroad. The Roman Catholic Church, which previously had taken the position that obeisance at Shinto shrines was a religious ceremony, changed its stand under pressure. All religious bodies were asked to send their representatives to the front to pray for Japan's victory. In 1939 the Religious Bodies law was enforced, by which the government could control all aspects of religious organizations, and Buddhism and Christianity were urged to unite their respective denominations. Further, a Religious league composed of Christian, Buddhist and Sect Shintō federations was organized in 1941 to provide a spiritual bulwark for the nation.

After World War *II.*—Japan's surrender to the Allied powers in 1945 was followed by the disestablishment of state Shinto and the renunciation of the dogma of the emperor's divine nature. Assured of freedom of religious belief, practice and propaganda. the Buddhist, Christian and Sect Shinto denominations which had been forced into union during the war later declared their independence.

New Religious *Cults.*—Many splinter sects which were once identified with Buddhism or Shinto separated from them, and numerous New Religious Cults (Shinkō Shūkyō) emerged. The term New Religious Cults came to be used loosely in counterdistinction to religions already existing, and it included those movements which developed in the wake of World War II. They are usually classified into five categories: (1) those which stemmed from Buddhism; (2) those which accept a monotheistic belief or, more technically, monolatry; (3) those which accept henotheism (*i.e.,* recognize the existence of several gods but make one god the centre of worship); (4) those which are utopian-messianic; and (5) those which are primarily concerned with practical ethics. Some of the New

TABLE I.—New Religious *Cults* Deriving From Buddhism (*1957*)

Cult	Juridical persons			Teachers			Believers
	Temples	Churches	Total	Male	Female	Total	
Nakayama Shingo sect	47	159	206	179	335	514	294,040
Shinnyoen sect	10	4	14	55	53	108	153,500
Daijō sect	..	32	32	79	10	89	833,549
Risshō Kōseikai corporation	..	2	2	3,899	751	4,650	1,044,066
Reiyūkai corporation	..	3	3	403	190	593	3,262,059
Kōdōkai corporation		1	1	88	110	198	198,665

Source: Department of Education.

Religious Cults of course fit into more than one category; in addition, most of them are so new that their founders are still living, and some of them continue to receive new revelations, so that their doctrinal systems are not clearly defined. Each sect has an independent institutional structure and trains its own teachers, many of whom are volunteers. Members, however, are not always followers of one sect exclusively, and more often than not they consider themselves also Buddhists and adherents of Shintō.

TABLE 11.—Major New Religious Cults Emerging After World *War II* (*1957*)

Cult	Juridical persons		Teachers			Believers
	Churches	Total	Male	Female	Total	
House of Growth corporation	33	33	1,191	403	1,594	1,472,280
World Salvation sect	47	47	1,341	860	2,201	393,534
Perfect Liberty corporation		154	366	265	631	605,213
Zenchi Kōdō Zenrin society		1	170	97	267	390,493
Sun Goddess sect	13	13	166	55	221	110,124
Dōkai and 24 other organizations	156	156	1,730	1,730	3,460	451,096

Source: Department of Education.

Most of these sects are eclectic. Their teachings betray the influences of Buddhism, Shinto, Confucianism and Christianity. Their doctrines are characteristically simple, they are skillfully organized and their founders are usually charismatic leaders. Their simple teachings appeal to the masses, who do not feel at home with the complex doctrines of established religions but want simple. direct and practical teachings. For example, the P. L. (Perfect Liberty) corporation teaches: (1) every man is the son of God; (2) life is art; (3) the life of man is self-expression; (4) one must live brightly as the sun; (5) men are equal; and (6) perfect liberty must be the aim and guiding principle for every man and woman.

These sects give their followers a sense of belonging which they do not get elsewhere; newcomers are made to feel welcome, and the sects promote mutual aid and public welfare, several of them operating educational, medical and philanthropic institutions and some even having excellent museums and libraries. Unlike the older religions, these sects hold informal services and meetings, and they make use of the techniques of group psychology. All are highly centralized in structure, utilizing cell group systems as well as "incentive plans." Some have semimilitaristic disciplines and hierarchical systems. All use modern mass media of communication and have efficient methods of tithing.

What gives each of these sects its distinct character is the personality of the founder or organizer. Many of the founders boast unusual spiritual powers in divination, sorcery, incantation. fortunetelling and healing, and they have the capacity to attract and maintain rapport with a large number of followers. For the most part, they appeal to the lower middle class,. especially middle-aged or older women, although some claim followers among the intelligentsia, the upper middle class and young people. About 100 of these sects are members of the Union of New Religious Cults (Shin-shū-ren). In some ways they have much in common with the Sect Shinto denominations, and the relationship between them is complex.

Older Religions.—All this is not to suggest that the older religions are declining. The Grand Shrine of Ise alone averages

2,500,000 pilgrims annually, and the Sect Shintō denominations such as Tenrikyi, are growing rapidly. (For the contemporary development and statistics of Shintō and Sect Shintō denominations, see SHINTŌ.) The Buddhist sects are also holding their strength; as illustrated in Table III.

TABLE 111.—Buddhist Sects (1957)

Sect	Shrines, temples and churches	Teachers			Believers
		Male	Female	Total	
Tendai sect and 18 kindred sects	3,794	10,830	3,746	14,576	2,141,502
Shingon sects (Koya Shingon and 48 kindred sects)	12,912	17,498	3,630	21,128	7,530,531
Ritsu (Vinaya) sect	29	39	26	65	11,878
Jōdo sect and 14 kindred sects	8,260	8,362	836	9,198	4,231,342
Rinzai (Zen) sect's, (Myōshinji and 18 other sects)	5,845	5,473	500	5,973	2,983,727
Sōtō (Zen) sect and a other sects.	14,854	12,835	2,252	15,087	1,333,814
bbaku (Zen) sect–	482	422	29	451	166,540
Jōdo-Shin sects (Otani branch and 14 kindred sects	20,825	34,957	3,818	38,775	9,007,582
Nichiren sect and 36 kindred sects	5,913	13,271	2,711	15,982	9,120,028
Ji sect	426	397	7	404	40,349
Yūzū-Nembutsu sect'.	362	301	12	313	101,106
Hossō sect and 4 kindred sects	84	437	243	680	174,400
Kegon sect	52	174	329	503	57,620
Nondenominationals (Kōdō corporation and 3 other kindred sects	10	258	142	400	304,650

Source: Department of Education.

The strength of Buddhism in Japan lies in the intelligentsia and rural population. Buddhist scholarship is very high, as illustrated by the activities of the Association of Indian and Buddhist Studies. Many Buddhist scholars are well versed in Sanskrit literature as well as western philosophies and religions. The Young Men's and Young Women's Buddhist associations are active, and a nondenominational lay Buddhist movement (Zaike Bukkyō) appeals to both the intelligentsia and the masses. The rural populations are inclined to be ultraconservative and are susceptible to superstitious beliefs and practices. Many of the Sect Shintō denominations and the New Religious Cults have recruited their adherents from the traditionally Buddhist rural population.

Christianity.— Christianity in Japan, except for the Roman Catholic Church, has existed only since the opening of Japan to foreign nations. In the initial period it was both despised and admired. Prejudice against it lasted even after the edict banning it was lifted, and a majority of the Japanese people were both afraid and suspicious of this "alien" religion; on the other hand, a minority of "modernizers" were attracted to Christianity as an expression of western civilization. From the latter part of the 19th century to the 1930s, all branches of Christianity established churches, mainly in the urban areas. Although their numerical strength was less than 1% of the total population, Christians made notable pioneering contributions in educational, medical and social works. For the most part, however, Christian churches in Japan, which were heavily dependent on western missionary societies, did not make serious efforts to assimilate Christianity to Japanese culture, in spite of the series of compromises they had to make with rising militarism and nationalism. Among all religions affected by the Religious Bodies law of 1939, Christianity was the hardest hit. Most of the Protestant churches were forced by the government to join the Church of Christ in Japan (Kyōdan) in 1942, and in 1944 both the Roman Catholic Church and the Church of Christ joined the Japan Wartime Patriotic Religious association, along with the Shinto and Buddhist bodies.

TABLE IV.—*Christian Bodies (1957)*

Church	Churches	Teachers			Believers
		Male	Female	Total	
Roman Catholic Church	1,028	1,708	3,581	5,289	279,032
Greek Orthodox Church	33	62	.....	62	34,429
Anglican Communion	252	304	120	424	40,860
Protestant churches	1,425	2,742	1,349	4,091	150,444

Source: Department of Education.

After World War II, Christianity enjoyed full freedom. Notable features in the postwar period were the rapid progress of the Roman Catholic Church and the so-called fundamentalist wings of Protestantism; also, some of the denominations which joined the wartime union later broke away. Christianity in Japan suffers from its "foreignness" and lack of roots. Churches and related institutions congregate in cities, and very little work has been done in the rural areas; not until after World War II were programs for industrial and rural areas developed. Nevertheless, the Christian influence is growing among middle-class Japanese, especially through the church-related educational institutions.

See also BUDDHA AND BUDDHISM; MAHAYANA; ZEN; CONFUCIANISM; SHINTO.) (J. M. KA.)

4. Culture.— Japan's insular position, far removed from the crossroads of Asia, created a marginal cultural situation with the result that the Japanese tended to lag behind other Asiatic peoples in the development of their civilization. While the Chinese were writing by 1400 B.C., it was not until *c.* A.D. 400 that the Chinese system mas borrowed by the Japanese. Buddhism reached China from India in A.D. 65 but its first entry into Japan is not recorded until the 6th century A.D.; and it was not until 1700 that the popular drama was fully developed in Japan, while in China it relates to the Yuan dynasty (A.D. 1280–1368). The same general retardation may be shown with respect to the development of printing, philosophical schools, especially the Buddhist and Neo-Confucianist, and mathematics.

This cultural isolation had the further effect of hindering creativity. Japanese inventive talent has tended to concentrate on improving and adapting cultural elements from China and Korea to Japanese patterns. Dependent on the Asiatic mainland until 1868, the Japanese quickly readjusted following the Meiji restoration of that year and turned their energies to importation of ideas from the west.

Japanese culture is marked by the specialized adaptations, modifications and improvements of borrowed elements. With respect to writing, for example, they invented the syllabaries that accommodate the Chinese system to the Japanese language. In art, literature, the drama, architecture, etc., the Japanese have worked with Chinese or Sino-Korean prototypes but have adjusted them to their own styles and uses to create distinctive variations. Given Chinese Buddhism, the Japanese developed new sects, such as Shin and Nichiren, explored new avenues of Buddhist thought, as in Zen, and modified Chinese Buddhism on the popular level so as to identify it with ancestral reverence and a mortuary cult. As a result, Buddhism plays a more significant role in Japan than in China. Out of Chinese Neo-Confucianism the Japanese developed the warrior code or *Bushidō* (*q.v.*) of the medieval samurai and the highly ritualized tea cult (*chanoyu*). From the raw materials of Chinese poetry came the exquisite haiku and tanka forms (see JAPANESE LITERATURE); and related to the pattern of female entertainers of China and Korea arose the elaborated institution of the geisha (*q.v.*). The Japanese were selective in their borrowing of Chinese culture elements; for example, traditional Chinese concepts of government, such as the theory of the responsibility of the emperor, bureaucratic organization and the civil service system were not congenial to the Japanese. Japanese belief in the divinity of the emperor and their fairly rigid class structure prevented their adoption of Chinese political institutions despite the acceptance of much Confucian ideology and philosophy. Similarly, although after 1868 the Japanese adopted, in part, European legal codes, educational and military systems and western science and technology, they improved on much of what they borrowed. Modern Japanese contributions to the biological and physical sciences have been outstanding.

The ritual qualities of Japanese civilization have often been noted. Custom demands extremes of politeness, of great attention to formal ritual, as in modes of greeting, and creates a rigidity in social situations. It has been suggested that security in Japanese society rests on a high degree of conformity and homogeneity. While changes in Japanese culture have been rapid and revolutionary at times, social structure has remained remarkably stable. Japanese society has a facility in adapting itself fairly readily

to mobile external circumstances while remaining intact. For other aspects of Japanese customs and culture see BATHS; BED; JAPANESE MUSIC; JAPANESE PAINTING AND PRINTS; JAPANESE SCULPTURE.

Kinship and Marriage.—The Japanese, unlike the Chinese, did not develop the elaborate extended family. Kinship. even in the changing urban setting of modern times, remains very important but is confined to a relatively small circle. The kinship group is composed of the descendants of the great-grandfathers in the male line. A traditional household usually consists of husband and wife, their unmarried children and the eldest son and his wife and children. Women join the household of the husband's family as a rule but, as in China, a couple lacking sons may adopt a son-in-law not only to carry on the ancestral obligations of the family line but also to maintain the continuity of the lineage. The emphasis on the household and family requires a high degree of mutual co-operation and responsibility.

One characteristic of Japanese social organization is the extension of the circle of co-operative relationship. Japanese society has thus created a kind of quasi-kinship in bonds of association that lie outside the kinship circle, but are formalized, permanent and co-operative. Within the village these range from the kumi —groups of three to five households—to the more elaborated paternalistic structures in political and other local groups. The members of co-operative units within neighbourhoods, often called *buraku,* assist each other in arranging festivals, funerals and community affairs. A strong sense of co-operation exists within labour associations, craft guilds and temple memberships. An employer assumes special responsibilities for those in his charge; they in turn are bound to him and each other by customary obligations.

Co-operative associations apply generally across Japanese society as a whole. Urban life developed relatively late among the Japanese, essentially as a result of the adoption of western technology and industry, and even in cities the local neighbourhood comes to resemble the rural village organization, which is the backbone of Japanese society. The result has been a rigid social system with little mobility for the individual.

Marriage also reflects patterns of fixed obligations. The marital ties are not conceptually religious but are founded in social and economic relationships. Except in some of the more highly westernized urban areas that were subject to rapid change after the end of World War II, marriage is not a matter of individual choice founded in romantic ideals but rather an arrangement between families worked out on the basis of class and economic status. It furthers the co-operative bond between unrelated family and household groups and its associated customs involve a large number of individuals apart from the immediate families involved. Neighbourhood groups, labour associations and the wider community are all concerned. Included as an important part of the marriage preliminaries are the matchmakers who locate the eligible pair. The rites of marriage involve ritualistic gift exchange reflecting the economic and social status of the families involved and marking the formation of a new family unit. A marriage is customarily celebrated with feasting, special costumes and merrymaking. In rural Japan, a ritual drink is shared by the bride and groom to symbolize the marriage bond. Modern Japanese law requires only a registration of marriage and no specific ceremonies. Probably as a result of Christian influences, both the Buddhist and the Shintō sects have instituted marriage ceremonies.

See Agriculture: *Social* Conditions and Land Reform, below, for a discussion of rural life; and sections on Religion, History and Population. (R. F. SR.)

IV. HISTORY

Prehistory.— The origins of the Japanese people and the nature of early Japanese society are not firmly established. Until the introduction of the Chinese writing system the Japanese had no way of keeping records, and the oldest extant histories, the Records of *Ancient Matters* (Kojiki) and the *Chronicles* of Japan (*Nihongi* or *Nihon-Shoki*), date from 712 and 720 respectively. Since they cover a great span and in addition were written under the impact of the Chinese tradition, they are not always reliable guides. Archaeological evidence was not fully exploited before World War II because of the taboos that surrounded the official theories concerning the divine origin of the imperial family. After World War II intensive archaeological work helped to suggest promising lines of approach for the prehistory of the islands, but many problems remain unsolved. (See ARCHAEOLOGY.) In addition to archaeology and the early histories of Japan, the Chinese histories, which contain appendix discussions of China's less-developed neighbours, provide much information about early Japan.

No conclusive Paleolithic remains have been found in the Japanese islands which probably were first inhabited in the 2nd or 3rd millennium B.C. Analysis of shell mounds, tombs, pottery and house sites has made it possible to distinguish two principal Neolithic cultures. The first of these, named for the cord design (wavy mat markings) on its pottery, is known as Jōmon and is usually assigned dates extending from about 2500 to 250 B.C. Jōmon sites abound in many parts of Japan, and their similarity to sites in eastern Siberia has led to the belief that the peoples who left them came from the north. It was long thought that the Ainu (*q.v.*) were descendants of Jōmon peoples, but modern scholarship is less confident of this identity and contents itself with statements about a remote relationship between Jōmon and both Ainu and Japanese. Jōmon culture was that of a food-gathering, nonagricultural people who hunted and fished. They had no domesticated animals except the dog, no loom weaving and little carpentry; they did have polished stone tools. Their pottery, while not wheel thrown. was carefully and increasingly decorated with cord impressions. House sites reveal simple one-room dwellings, dug into the ground, with a central pole supporting a roof which contained an opening for smoke from the fire.

The later Neolithic culture is known as Yayoi for the street in Tokyo where the first site was discovered. Yayoi is clearly related in its techniques to the rice-growing areas of the Asiatic mainland, and probably reached Kyushu in streams of immigration from the south along the Ryukyu Islands, as well as from Korea. Archaeologists assign the approximate dates 250 B.C. to A.D. 250 to the Yayoi culture. Toward the end of this period a bronze culture reached Japan. and numerous archaeological discoveries testify to its spread. Yayoi sites show a pottery which is wheel thrown. Irrigated rice culture supported a growing population at a higher standard than had previously been the case, and tools of many kinds were developed. Overlapping with, and part of, the Yayoi culture was a movement of settlers from northern Asia who came to Japan by way of the Korean peninsula, possibly deflected from invasions of China by the strong frontier defenses of the Ch'in and Han dynasties. Chinese bronze culture reached Japan by way of this population movement from Korea before the Christian era and began to change and replace the Yayoi culture wherever the two made contact. The first points of contact were in all likelihood in southern Japan, especially on Kyushu, giving the groups residing there a considerable technological and military advantage in their competition with their neighbours.

The general cultural development up to the historic period with the characteristic associations of each period are summarized in Table V.

Early History.— Some time in the 3rd century A.D. further elements of Chinese culture, including iron, entered Japan from Korea, part of which had been a colony of the Han dynasty since 108 B.C. The possibilities which this opened up for the Japanese chieftains were very great, and it is apparent that frequent attempts were made to get in direct touch with the source of the superior tools, weapons and technology. There is a record of a visit of an envoy from Japan to China in 57 A.D. After the and century A.D. bronze implements found in the burial sites were replaced by more effective iron implements, and from the 3rd to the 8th century A.D. the archaeological sites suggest a greatly expanded social and political stratification. Great earth and stone tombs were thrown up in coastal areas from Kyushu and along the shores of the Inland sea, with the largest in the Yamato plain, the site of the first historic capitals. These give evidence of large-scale organization and a high degree of central control. Indeed, the tomb assigned to the emperor Nintoku is one of the largest of its kind in the world

TABLE V.—*Chronological Table of Japanese Prehistory*

Date	Culture	Period	Characteristics
?	Pre-Jōmon ?	Early prehistoric ?	Paleolithic-Mesolithic; hunting, nonagricultural base; core tools, blades, microliths ?
2500 1000 750 500 250	Jōmon	Middle prehistoric	Neolithic but nonagricultural; hand-made pottery; chipped and ground stone tools
B.C.	Yayoi	Late prehistoric	Rice cultivation; wheel-made pottery
A.D. 250	Yayoi	Protohistoric	Copper and bronze casting; iron (?); rise of social classes
500	Tumulus	Semihistoric	Iron weapons and tools; tombs of earth mounds; warfare
560	Asuka	Historic	Horses; "megalithic" tombs
710	Nara (historic)		Buddhism; Chinese writing, etc.

and probably required the labour of about 5,000 men for at least a year. The tomb or Tumulus period provides greatly improved weapons and ornaments and gives evidence of a society of conquest. Potteries and tools show competent forging and heating. Ornamentation includes the curved jewel, magatama, a comma-shaped object which became, with the sword and mirror, one of the three imperial regalia. Hollow clay figures, the haniwa, represent warriors, women, horses and even residences. The early histories state that haniwa were substituted for human sacrifices in tombs, but archaeologists have discovered no evidence that humans were in fact so used; most conclude that the clay figures decorated the outside of the tombs. The clothing of the haniwa provides clear indication that this society, which may be called semihistoric, was dominated by the mounted warrior on horseback, a figure whose clothing and armament resemble that of his counterparts in northern Asia. The entry of Buddhism in the 6th century ended the construction of the great tumuli, and the entry of the Chinese script made possible the transition from semihistoric to historic.

When the evidence provided by the Chinese dynastic histories is added to that provided by the archaeologists, it is possible to speculate in general terms about the process of unification and organization which the great tumuli suggest. The Wei history, which was compiled around A.D. 297, speaks of the Japanese as the "people of Wa, [who] formerly comprised more than one hundred communities." Relations with these groups began in Han times, and in the 3rd century 30 of them still maintained contact with China. "Wa" is described as a "queen country," with its seat of government located in Yamatai. It is not fully clear whether this was located in Kyushu or whether it refers to the great Yamato plain which became the site of the historic capitals and the centre of the imperial mausoleums and tumuli, but there is little doubt that the Wei records indicate a steady process of conquest and development under a dynasty which seemed to them matrilineal in its organization.

Further signs of development of central power and political influence are furnished by evidence from the middle of the 4th century indicating that Japanese soldiers were active in Korea. The small state of Karak (Mimana), near modern Pusan, alternately competed with and aided its northern neighbours Paekche (Kudara) and Silla (Shiragi) in the warfare that followed the fall of the Chinese colony in north Korea. Its origins are probably to be traced to a connection with clans that had crossed to Japan earlier, but there is little question that from the 4th century on the Japanese possessed the ability to send leaders and warriors back across the waters to give battle in Korea. The Kojiki credits an invasion around zoo to the empress Jingo, and even after this date is corrected to the 4th century with the help of the Chinese records, the expedition indicates a very considerable growth in power and unification of Japan. The Chinese records also indicate that the Chinese court on at least two occasions in the 5th century confirmed the Japanese "king's" claim to military supremacy in Korea. The annals of the Korean state of Silla confirm the fact that the Japanese invaded repeatedly in the 4th and 5th centuries. It is clear that Mimana was an important channel for the acquisition of the superior technology and learning of the mainland. Its loss to Silla in 562 A.D. helped bring on reforms in politics and society designed to prevent further military and diplomatic disasters. (M. B. J.; R. F. SR.)

From **Myth** to **History.**—The outlook and beliefs of the early Japanese are known through the myth cycles contained in the Kojiki. Early Shintō (*q.v.*) was little more than a polytheistic nature cult. It consisted chiefly of shamanistic practices designed to propitiate and honour the spirits or deities (kami) responsible for the agricultural fertility upon which life depended. The cult emphasized a ritual simplicity and lustral purity and its simple shrines contained no images.

The Shintō myth cycles of the Kojiki can be divided into five groups. The first deals with the cosmogonic myth. After seven generations of gods, two deities, Izanagi and Izanami, gave birth to the islands of Japan, the sun-goddess and other deities. A second cycle describes the descent of the "august grandchild of the sun-goddess" to Japan. A third cycle tells of the doings of the sun-goddess and her brother, Susa-no-6-no-mikoto (the storm-god). A fourth cycle deals with the deities in Izumo associated with the storm-god. A fifth and final cycle deals with the victorious campaign begun by the first emperor, Jimmu Tennō, and continued by his descendants, to unify the Japanese islands. The traditional dating gives 667 B.C. as the time he left the island of Kyushu to establish his primacy in 660 B.C. However, critical historians are inclined to date the beginning of the historic period of Japan in the 3rd or 4th century A.D.

The Kojiki and Nihongi contain evidence for the national outlook of an agricultural people who revered a beneficent nature with their seasonal taboos and ceremonies, a race which peopled the islands and their valleys with spirits to propitiate and appease and who saw in the sun-goddess the greatest of such deities. The close relation between Shintō and the government was evidenced by the fact that the emperor served as the high priest of the sun-goddess cult. Although the dates and longevities assigned to early emperors need to be corrected, there is sound reason to look behind the events as they are recorded in the Kojiki and Nihongi, however shadowy, to the formation of the early Yamato state. (See also The People: Religion, above.) (J. M. KA.)

The **Clan** Period.—The Kojiki and the Nihongi describe the emperors as absolute rulers, and treatment of their reigns is heavily affected by the Chinese pattern of historical writing. Thus the emperor Nintoku (c. 313–399) is credited with all the virtues of the Chinese sage-king, suspending taxes in difficult years, deferring palace repairs in order to keep from interfering with agricultural production and reflecting on the prince's responsibilities to his people, while the emperors Yuryaku and Buretsu (*c.* 456–479 and 498–506 respectively) are charged with offensive conduct clearly modeled on that of the last Chou emperors in the Chinese Classic of History. Despite this, the chronicles suggest a good deal about early Japanese society and government before the adoption of Chinese institutions in the 7th century.

This was a period of great clans (uji), descendants of the tribes that had come from Korea. The imperial clan head had a large degree of primacy over his fellow clan heads, but for a time it was probably based more upon his religious than his political importance. The other clan chiefs were charged with religious functions for the particular deities from which their clans claimed descent, so that although their pretentions were less lofty than those of the sun-goddess' descendants they were nevertheless considerable. Members of each clan worshiped a common deity which was held to be their progenitor, so that the society gained much of its strength from principles that may be related to ancestor worship. As the clans grew, sections or branches might break off and move elsewhere, but the pattern of worship usually remained unchanged. At the court in the Yamato plain there were a number of high officials, heads of supporting clans, who were charged with hereditary priestly and ritual functions, while others performed guard duties

or purveyed weapons and other necessities to the throne. Thus a small number of clan chiefs competed for favour and influence at court. Their rivalry was later an important element in the disputes over cultural, religious and political policy.

Specialty tasks were performed not by the clansmen but by hereditary guilds or associations of workers known as be or tomo. Five such had been commissioned to accompany the "august grandchild" when he descended to rule Japan, and others were established to fit needs as they arose. These guilds were attached to clans, and constituted their chief form of property and influence; often, as for the Imibe (ritualists or abstainers) or Mononobe (armourers), they gave their name to one of the great families which were important at court. The imperial clan, which was, theoretically, the only one capable of creating new units of this sort, had a consequent advantage in taking measures to extend its power and its agricultural and material income.

Although there was as yet no clear theory of government hierarchy or bureaucracy, the records indicate an approximate gradation wherein the greatest clan heads, great chieftains and great deity chieftains were in a position of such wealth and influence as to pose a potential threat to the throne, while lesser rural gentry, kuni-no-miyatsuko, controlled or, often, owned outlying areas. It is impossible to trace the pattern of administration with any degree of confidence, but it seems clear that the court faced a growing problem in its relations with great clans whose leaders possessed the wealth and power to rival its claims. It had many advantages in this struggle. Most of the craftsmen and scholars who fled to Japan from the confused warfare in Korea were commended to the imperial clan, and they provided it with some of its margin of technical superiority. When the Mimana foothold in Korea was lost in the 6th century, the Ōtomo clan, which had been charged with its defense, went into decline. There remained a sharp rivalry between two great clans, the Mononobe and the Soga, with the great ritual clans, the Imibe and Nakatomi, vitally concerned in the competition that ensued.

The struggle of the Soga (*q.v.*) for power can be documented with assurance, for after 400 the chronicles gain in reliability. Disputes between clans were made inevitable because there was no clear succession rule for the imperial clan; it was possible for clans to sponsor rival candidates for the throne. In 538 (some sources prefer 552) the Korean state of Paekche sent the Japanese emperor a Buddhist image together with sacred writings and assurances that this was the religion of the civilized world. Undoubtedly much knowledge of Buddhism had entered Japan earlier, but this convenient incident is usually cited as the introduction of Buddhism into Japan. Thereafter the Soga stood forth as sponsors of the foreign civilization. With responsibility for the imperial granaries and treasury, they enjoyed ready access to the learning and skills possessed by the Chinese and Korean immigrants. After some sharp struggles relating to the propriety of worshiping the imported images, the Soga came to the fore as sponsors of the new learning.

The Soga ascendancy over their Mononobe and Nakatomi rivals was consolidated in 592, when Soga Umako had the emperor Sujun assassinated and replaced him with his niece, the emperor's younger sister, who ruled as Empress Suiko from 593 to 628. The imperial clan was now in danger of being eclipsed. Soga daughters were married to emperors and Soga clansmen filled all important positions. As heir apparent and regent, Soga Umako selected Umayado, a young nephew of the empress, better known as Prince Shōtoku (Shōtoku Taishi). Under this remarkable man, who dominated the government from 593 to 621, Japan prepared to move from clan to imperial organization.

Shōtoku Taishi.—The work of Shōtoku Taishi (*q.v.*) foreshadowed the adoption of the Chinese pattern of government. His years as regent came shortly after the Japanese loss of Mimana and coincided with a period of massive unification in China, where the Sui dynasty was established in 589. Shōtoku and his Soga sponsors set themselves to promote the foreign learning and religion, improving contacts with the mainland, controlling the territorial magnates and clan heads in Japan and increasing the national strength and unification. Although it is difficult to distinguish the historical figure from the legends which surround him, it is clear that he must be credited with substantial achievements. He was a devout Buddhist, and did all he could to speed the growth of the foreign religion. Priests from Korea lectured at the imperial court, and the great nobles were instructed to build Buddhist temples. Shōtoku himself was responsible for the construction of the Shitennōji (in Osaka city), which was completed in 596, and the Hōryūji, near Nara city which still stands as one of the great monuments of early Japan; he is also credited with learned commentaries on the sacred scriptures of Buddhism, the sutras. He expected Buddhism to be a central element in reforming and civilizing life in Japan. In its train came masterpieces of sculpture, architecture and painting which opened new worlds for the Japanese. In addition, Buddhism seemed central to the Chinese pattern; Sui and T'ang times marked the height of Buddhist influence in China.

In political affairs Prince Shōtoku's administration showed a desire to substitute a bureaucratic hierarchy of the Chinese variety for the rivalry of the great clans. There is a good deal of doubt about the extent of his success, but these intentions are important evidence of the growing trend to look to China for guidance. In 603 hierarchic ranks were set up at court. Each bore the name of a virtue and was of two grades; the holders were entitled to wear particular colours and costumes. This was the first attempt to replace the hierarchy of heredity with one of appointment and service. That the idea faced many difficulties is clear from the Seventeen Articles, a set of injunctions issued in 604, exhorting the nobles to be true to Confucian principles of harmony, duty and decorum and emphasizing the importance of Buddhism, whose treasures "comprise the destiny of all living things and claim the supreme worship of all religions of the world. What man in what age can fail to reverence them? . . ." These injunctions, the so-called constitution of Shōtoku, thus attempted to establish moral foundations for national life. Undoubtedly, as the chronicles make clear, they received more lip service than they did compliance, but they demonstrated that the moral foundations Japan's rulers would seek to institute would be those of mainland China. The idealized picture of Shdtoku which has come down to us is that of a Chinese sage-ruler who sought to promote the unity and the welfare of his people by developing his own virtue and morality, devoting himself to study and to the arts of civilization and spending much effort in the task of collecting historical materials for a compilation that was to make clear the basis for imperial rule in Japan. This history has not survived, but it is probable that some of the materials collected found their way into the *Kojiki* and Nihongi.

After Shōtoku's death, however, it was clear that the ills of the times had not been reformed and that the system of clan competition was no longer adequate to Japan's needs. The Soga family departed from the pattern established by Soga Umako; his descendants began to seize the property of rival clans and to take for themselves imperial airs. As the Nihongi relates of the Soga clan head, "The people of the various clans came to his gate, and waited upon him. He called himself their father and them his boys." In the face of this undoubted danger to the imperial clan and the goals toward which Shōtoku had worked, men who had studied in China combined with members of competing clans to strike down the Soga pretenders.

The Chinese Influence. — By the 7th century much Chinese culture had entered Japan by way of Korea. Korean scribes had brought with them knowledge of the Chinese writing system and copies of Chinese classics and Buddhist sutras, and official favour for Buddhism in 7th-century Japan meant that there would be frequent interchange of ecclesiastical figures anxious to convey the true learning and proper ordination. Shōtoku's injunctions and commentaries on the sutras give evidence of a mastery of Buddhist and Confucian principles, and his court ranks show his awareness of some of the principles upon which the Chinese bureaucracy was based. The loss of Japan's Korean possessions and the desperate position which Paekche, Japan's old ally, faced in its struggle with its neighbouring state of Silla, however, put a new premium on contact with the mainland. Shōtoku had plans for re-

establishing Japanese control in south Korea, and he mobilized a large force in Kyushu for that purpose. The plans for the invasion miscarried, however, and thereafter internal reforms prevented further attention to foreign wars. But since it was increasingly important to establish direct relations with China, missions were sent to the court of the Sui emperor.

In 607 Japan's first official embassy, headed by Ono-no-Imoko, sailed for China. The ambassador returned the following year with a Chinese envoy. It was seven years before another official Japanese mission sailed, but there were groups of scholars and priests who went to China in smaller parties for study. Because of the disorder in Korea large numbers of Korean priests and artisans also came to Japan, so that the supply of learned men and technical knowledge grew steadily.

Those who studied in China were dazzled by the wealth and power of the country they saw. The Sui dynasty was overthrown by a palace coup in 618 and replaced by the T'ang, under which Chinese power and cultural eminence reached new heights. The Confucian pattern of bureaucratic hierarchy and examination for talent was more extensively developed than before, and at the same time the Sui and T'ang periods marked the apogee of official favouritism for Buddhism. As a result, the inherent contradictions between the creeds, contradictions that produced persecutions of Buddhism by the 9th century, were not yet evident to the Japanese visitors. The basis of the economic power of the new Chinese state, and one which the Japanese were to attempt to emulate, was a pattern of landholding wherein the state periodically divided the land into plots proportioned according to the family size; thereby it could claim as its own a proportion of the revenue of the rice paddies; additional taxes claimed handicrafts and labour. Great as the difficulties of applying this system were in China, where cultivation was dependent upon the efficient manipulation of the state-controlled irrigation works in the north China plain, it was to prove even more difficult to carry out in Japan. It required a large and dependable bureaucracy to administer it, as well as large tracts of level land. In spite of its inapplicability, the system was part of the pattern of dynastic power that the Japanese who studied in China admired, and they sought to copy it on their return.

The Taika Reforms.—One of the marks of the adoption of Chinese civilization was the utilization of the Chinese calendar. This was first done in A.D. 604 under Shōtoku, and since according to the Chinese lore great changes came in the 58th year of the twenty-first 60-year cycle, the scholars, by counting backward, established 660 B.C. as the proper date for the accession of Jimmu Tennc?. The introduction of Chinese governmental ideas was thus considered comparable to the divine establishment of the empire in its importance. Next came the practice of assigning appropriate names (*nengō*) to year periods, and in 645 the first such era was named Taika ("great reform") for the reforms which were inaugurated.

The Taika reforms began after a political coup d'ktat in which the Soga clan chief was killed. The leading figures involved were a member of the Nakatomi clan named Kamatari (who was later to receive the family name Fujiwara) and Karu, a brother of the reigning empress, who succeeded to the throne as the emperor Kōtoku (645–654). Also prominent were a priest, Bin, who had returned from China in 632, and a lay student and diplomat, Takamuku Kuromaro, who had returned in 624. Takamuku later served as ambassador to Korea and China, where he died in 654. Both were given the rank of "national doctor" (kunihakase), and it was undoubtedly they who instructed Kamatari in the Chinese patterns to be followed. The reforms began with the enunciation of general principles. In 645 the great nobles were summoned to the court to hear a proclamation of the new theory of absolute monarchy. The next year, after administrative preliminaries had been worked out, four sweeping articles set out the main lines of the new order. Private property in land or workers (the be or tomo) was abolished. The region around the capital was set up as an administrative district and governors were appointed. Registers of population were ordered to make possible the equitable division of land to cultivators, and old taxes and levies were canceled to make way for the new system that was to follow. This marked the beginning of a series of innovations that did not end until 702, when the code of Taihō (the era name) was promulgated. Thereafter the Chinese system of government was in effect, although there were some significant additions and deletions. A Japanese feature was the department of worship, which, concerned with the native shrines and ceremonies, was given precedence over the department of state. Throughout the bureaucracy, the hierarchy established was one of birth and not of merit tested by examination. The department of state, presided over by a chancellor assisted by ministers of the right, the left, and councilors and controllers, had eight ministries, of which four were concerned primarily with the affairs of the imperial house. A significant omission from the Chinese pattern was a central board of works, indicating that the central administration lacked the power or the need to command *corvée* labour for great projects in the way that the Chinese court carried out its responsibility for enormous irrigation and flood control projects. Public works large in scale for Japan were carried out, but it is significant that a number of revolts followed the imposition of projects which were felt to be excessive in cost and demand.

On the local government level, provincial and county divisions, within which village organization and government was prescribed, were laid out. Since the entire system depended upon the vigilance and fidelity of the local officials, to whom were delegated responsibility for census registers and land allotment, it is interesting to note that most posts on the county level were allotted to families of local eminence. This boded ill for the land system which was designed to replace the ownership of the clans with the authority of the court.

It is difficult to determine the degree to which the new laws and ordinances had effect in the countryside. Most of the bureaucracy and most of the efforts were devoted to the metropolitan or *kinai* provinces, and undoubtedly the Taika reforms made for very great changes there. In outlying districts, however, it is doubtful that the edicts can have served to expropriate the old landholders very effectively. The codes provided for a redistribution of land every six years, but this schedule was never rigidly maintained. In T'ang China, where there was a vigilant effort to prevent local loyalties from outweighing loyalty to the central government, the complex system of registration and redivision worked poorly after the early years of the dynasty. In Japan, where local posts were explicitly reserved for local grandees, the difficulties must have been magnified. The Taika plans, formalized by the Taihō code, nevertheless represented an ambitious and, in view of the difficulties, remarkably successful attempt to change the basic structure of Japanese government and society. They were perhaps too far in advance of the state of society, but it is clear that the clan system was dated and outgrown. Increasing development of new agricultural areas and new opportunities for settlement were bringing about a rapid dissolution of the old craft corporations or ***be,*** so that the Taika changes were in step with the trend of Japanese social development. In most respects, however, the outcome was neither Chinese nor pre-Taika Japanese, but a new combination of both. This is perhaps most clearly seen in the class structure. While the Chinese system was based, in theory, upon selection of officials of ability through examination of their learning, the Japanese system maintained a hierarchy of birth. A class and official structure with appropriate grades was carefully spelled out, and although some steps toward examinations for those of good birth were later taken it was clear that this was never meant to interfere with the priorities for those of proper lineage. This undoubtedly eased the transition period, since the old elite were not asked to give up their status but to exchange it for a new status in a new hierarchy with all the prestige of modernity. Whatever their limitation, the Taika reforms mark a turning point in Japan's institutional history.

A. The Imperial State

Nara.—Before the 8th century there was no permanent capital in Japan. The court moved from one town to another, probably

because in Shintij belief a sovereign's death would cause a ritual defilement. With the increasing complexity of government after Taika, such moves must have become more and more difficult. Basic to the Chinese system, moreover, was the great capital city which functioned as centre of government and visible evidence of the greatness of the state. In 710 the empress Gemmyō decreed the establishment of a permanent capital in the Yamato plain. Heijō-Kyō, or Nara (*q.v.*), was planned to be 23 by 3 mi. in area, and although never more than one-quarter built it was Japan's first great city. Like the Chinese capital of Ch'ang-an on which it was modeled, Nara was laid out mith careful attention to the requirements of geomancy. Great avenues ran south from the imperial palace, which occupied the north central position, and equally large avenues ran east and west. The principal thoroughfares were lined with the great monasteries and temples of the Buddhist sects and with the residences and palaces of the officials and aristocracy. Much of the national wealth found its way into the magnificent structures and works of art in Nara, and it was so incomparably superior in splendour to any other spot in Japan that this cultural and material eminence may have been an important factor in attracting the presence and the loyalty of the clan leaders. So long as the mastery of Chinese civilization was the order of the day, no one mith any aspirations to importance or eminence could afford to absent himself from the capital. Nara was the centre of a road network. Over 60 provincial units of administration were classified as central (kinai) or within the seven circuits (dd). Along the major routes post stations at intervals of about 12½ mi. provided fresh mounts for imperial messengers who sped to or from the capital. Evidence of the spread of central power and authority can be seen in the reduction and incorporation of the northern province of Dewa in 712 and that of Ōsumi in Kyushu in 713. The Kyushu station, with its strategic importance for communications with T'ang China, was particularly important for the court. Economically, the growth of population and occupation of frontier areas. as well as the discovery of gold and copper, contributed to the prosperity of the regime. A mint for coinage was decreed. and the first of 12 issues struck off; the court offered special rewards to encourage use of coins. In religion, provincial temples (kokubunji) served to suggest the power and influence of the central government.

The Nara period was formative for many cultural developments. The Kojiki and A7ihongi were compiled at Nara. Sometime after 760 there was also compiled the first anthology of poetry, the *Manyōshū.* In the main the poetry is Japanese as distinguished from Chinese in approach and feeling. Themes of love and of appreciation of the beauties of nature predominate. (See JAPANESE LITERATURE.) There is a famous statement of loyalty to the sovereign or clan leader which contains the lines, "By the sea our corpses shall steep in the water. On the hills our corpses shall rot in the grass. We will die by the side of our sovereign, we will never look back." This sentiment is ascribed to the Ōtomo clan, the hereditary bodyguard. but later generations of loyalists, for whom these became sacred words, lived up to them rather more fully.

The nobles who led the Nara government needed skill in politics as well as in poetry. The 74 years during which Nara was capital were remarkable for the large number of sharp succession disputes. During the period there were four reigns by empresses (two of them by the same lady, who abdicated only to return under a different name), and these opened up rich opportunities for intrigue and ambition, especially, in one case, for the empress' priestly adviser. The twice-empress in question, who ruled as Shōtoku from 765 to 770, was dominated by the monk Dōkyō until her death in 770, after which Dōkyō was banished. The council of ministers refused to allow a woman to succeed her, and thereafter there were no female rulers until the 17th century, by which time the throne lacked authority or responsibility for government.

There was also a military challenge to face from the Ainu, who were being pushed steadily to the north by the tide of Japanese immigration and settlement. The warfare revealed grave weaknesses in the national armies, shortcomings which could be ascribed to basic failings of the land and tax systems. The tax on paddy land had not proved particularly onerous, and the tax on produce or handicraft articles caused relatively little hardship. It was the labour tax, however, that produced the greatest dangers of official malpractice. According to the codes, every third man between the ages of 20 and 60 was subject to military service. He could be posted a year at the capital and three years on the frontiers, during which he was to furnish his own equipment and food. In idle times he could be used as labour by the officials in the areas he served. In addition, each file often had to supply and maintain six horses.

It was clearly an enormous burden for villagers to have family members called up. Gradually the Nara armies became demoralized and weak, little more than a sorry rabble. Worse than the military setbacks, however, were instances of oppression of conscripts by officials who were accustomed to dealing with subordinates as though they were their private property. Frequently, military levies were used as labour for private projects, particularly land reclamation. The codes encouraged this by providing for tax immunities to further the extension of cultivated land. Concessions so made by the government usually resulted in permanent alienation of what should have been public land. Officials also had other opportunities for mistreating their farmers. The government codes established "charitable granaries" (*gisō*) to ward off famines and they authorized interest-bearing loans of seed rice (suiko) to farmers whose crops had failed. These became instruments of exploitation, as the codes show by warning officials against forcing their people to borrow seed rice. The defects of this system could hardly have been corrected by legislation, although the court tried repeatedly to issue edicts on the subject; it was evident that families with long-standing interests and a proprietary attitude toward the areas they governed were not prepared to change their outlook to conform with one expected from civil servants. The farmers, caught between powerful officials and a government powerless to restrain them, either absconded or sought the protection of more powerful neighbours.

None were more powerful than the great Nara temples and monasteries. The recipients of special status and favour from the court, they functioned as a state church during the Nara period. Vast amounts of the imperial wealth were devoted to them by patrons like the devout Emperor Shōmu (701–756; reigned 724–749). In 752 he dedicated the Great Buddha of the Tōdaiji in a ceremony in which he publicly declared himself the slave of the Three Treasures — the Buddha, the law and the church. Many of the objects used in the dedication service are still preserved in the imperial storehouse at Nara, the Shōsōin. The great monuments of Nara ahich survive — the Tōdaiji, Yakushiji, Hōryūji and many other monasteries and temples — are all Buddhist, and they testify to the enthusiasm and fervour with which the court patronized the foreign religion. Buddhism also influenced the pattern of legislation. Imperial edicts constantly stressed the importance of Buddhism as the "wealth of the country," and each province was ordered to construct a seven-storied pagoda and to establish a guardian temple. Edicts were issued forbidding the sacrifice of retainers at the death of an important person, special amnesties were issued for criminals, at times it was forbidden to kill animals. It is not surprising that the monk Dōkyō should have attempted to take advantage of the favoured position which the clerics enjoyed.

The Heian Period. — In 784 the capital was moved from Nara to a place 30 mi. away called Nagaoka, and ten years later to a spot called Uda where a city. first named poetically "The Capital of Peace and Tranquility" (Heian-Kyō) and later, more simply, "The Capital" (Kyoto; *q.v.*) developed. Although the reasons for the move from Nara are not fully known, it is probable that the court's desire to escape the power and influence of the great Buddhist centres that had grown up around it in Nara was an important element. Kyōto, with its access to the sea by the Yodo river, was also more convenient for communications with the coastal ports. The new city, like its predecessor, was modeled on Ch'ang-an, and was laid out on a grid of 3 by 3½ mi. The geomancy of land forms and "wind and water" was judged favourable, and on Mt. Hiei, to the northeast, the new and growing monastery of the Enryakuji (founded 788) offered protection from the most

dangerous direction for demonic intervention. The city was never fully built up on the scale originally planned for it, but its eastern half became and remained one of the great examples of a planned administrative centre. The plan provided streets and wards for each artisan group to simplify control of standards and production; great markets, one in the west and one in the eastern sector of the city, functioned on set days for officially approved commerce; and the great thoroughfares running north-south and east-west were soon lined with the residences of the great. Most subsequent court leaders were known by the area of their residence; the Ichijō and Sanjō ("first avenue" and "third avenue") families of nobles were only two of numerous examples that might be cited. The Buddhist sects were not allowed to dominate the city with great structures close to the imperial palace, which again had the honoured and favoured position in the north central sector; temples were for long kept at a reasonable distance, and the area where they were permitted to build later became known as the "temple district" (*teramachi*) for its proliferation of temples. The expenses of the move to Kyōto were very great. Provinces were assigned set quotas of stones and wood and officials had to send quotas of labourers.

This vigorous activity bore the stamp of an able and energetic ruler, the emperor Kammu who reigned 781–806. He is one of the few sovereigns who stand out for the vigour of their purpose, and his measures were clearly designed to eliminate or lessen some of the evils that had developed in the Nara system. Although he was personally a devout Buddhist, he instituted measures to prevent the ecclesiastical hierarchy from seizing too much power and property. Edicts forbade temples from accepting land from farmers and from accumulating wealth in an unreasonable manner, while court support for t o new denominations which represented a break away from the old Nara sects proved a useful way of curbing the great monasteries. Other measures sought to stop the growing movement of farmers away from government fields and that of government fields from the tax rolls. Extant tax registers illustrate the degree of the danger: one district in the province of Bitchū had 20,000 males liable to conscription and taxation in A.D. 660 but reported fewer than 2,000 in 767. Court revenues had sunk, and when efforts were made to recoup government losses the farmers who remained were taxed more harshly, increasing the likelihood that they too would flee or commend their fields to powerful neighbours or temples. Edicts were now issued ordering absconders to return, fixing the rate of interest on seed rice loans at 30% and declaring, in "acts of virtue" (tokusei), a cancellation of debts.

Perhaps the chief problem the court faced was that of controlling local officials and to deal with this it called in genealogical charts to correct falsifications; other orders forbade the purchase of rank with money. Most of the decrees document the failure to establish a disciplined, dependable civil service. Emperor Kammu also tried to deal with the setbacks that the Ainu had given the Nara armies on the northern frontier. After several generals, equipped with the best arms the government could commandeer, were defeated, a special commission, sei-z-tai-shogun ("great generalissimo for the subjugation of the barbarians") was given to Sakanoue Tamuramaro, who scored impressive victories at the end of the 8th century. He did this by relying not on the conscript armies, which had proven useless, but by building up battalions staffed by sons of local magnates who had a direct interest in the victories. These new, smaller units contributed to victory but also, in the long run, to localism and disunity, for they were an indication that the military strength of the future would lie with local grandees rather than with central conscript armies. The title of sei-i-tai-shogun, which Sakanoue returned after his victories, later became the designation for the military lord who served as apex of the feudal hierarchy that was to come.

Kammu's successors failed to equal his achievements, but in their search for ways of restoring and maintaining the imperial prerogative and income they developed important modifications of the Chinese pattern of government that had been established in the Nara period. Modifications had already been introduced into the imported laws and bureaus in the Nara years, but in Heian times the process of adaptation was very much accelerated. The massive bureaucratic structure had from the first proved to be unwieldy and, in part, superfluous. As the realm of the public shrank in proportion to that of the private sector and as ranking offices became the preserve of titled courtiers who held them by reason of birth and not of ability, there was an obvious need to bypass the old boards. This was done by creating new offices, not incrusted with the honour and privilege of the others, by means of which the administrative procedures could be streamlined. The first of these, the *kuraudo* or archives bureau, was established in 810 to block an attempt that was being made by court bureaucrats to reinvest an abdicated sovereign with imperial power. The bureau gradually became an efficient channel for orders, ordinances and memorials, and it took over much of the function of the council of state. It is significant, however, that the old councils and their officers were not abolished or in any way disturbed; rather, their function, which had tended to become increasingly honorific, became entirely so. Around 820 a sort of police commission, the *kebiishichō*, was set up to help maintain order and dispense justice. In time it built up its own codes and customary law and, since it attracted men of courage and vigour, it speedily displaced in function the boards staffed by titled nobles who lacked both qualities. An audit office (*kageyushi*) also took over many of the functions of the former revenue and audit officials. These simplified and efficient boards functioned in somewhat the same way that comparable agencies served the interests of the great families and temples, and they suggest that the court, instead of being able to make good its earlier claims to absolute authority and full ownership of the land, was now only one among the great economic and political powers, dealing with its own problems in somewhat the same way its rivals dealt with theirs. It was some time before this was completely the case, but this aspect of the Heian administrative picture should be kept in mind in studying the modification of the pattern set up by the codes of Taihō.

The *Fujiwara.*—The most remarkable innovation of the Heian period, however, and the one that gives the greatest insight into political and social developments, was the rule of regents drawn from the Fujiwara family. Nakatomi-no-Kamatari, who had taken a leading part in the Taika reforms, had continued as a principal minister of the government that instituted the Chinese administrative system. He was later given the name Fujiwara, and his four sons were progenitors of the four branches of the Fujiwara house; of these the northern branch became most powerful, During the Nara period the Fujiwara failed to attain leadership, but early in the Heian period a series of able Fujiwara family heads emerged in control of the imperial government. They made no attempt to replace the emperor, but preferred to have him reign while they ruled. This pattern of indirect rule, with its separation of real and titular authority, was not entirely new; the Soga had practised it for a time, although the members of that clan eventually developed imperial pretentions. But the Fujiwara, and after them the several dynasties of shoguns, were content to maintain and honour the throne while seeing to it that its policies furthered their interests and desires. Their principal device was that of placing Fujiwara daughters in the palace as principal concubines or consorts of the reigning emperors. The emperors were often persuaded to abdicate at an early age—a decision that was not difficult to force on them since the throne carried with it onerous ritual duties with few of the rewards of decision making—after which a minor emperor would reign under the tutelage of his maternal grandfather or, at times, uncle, who would hold the title of regent. The Heian period and the centuries which followed are remarkable for the number of early abdications from the throne by emperors who preferred the leisure and comfort of "retirement" to the burdensome ceremony of "rule." The Fujiwara statesmen preferred for themselves two offices. That of *sesshō*, "regent," was of some antiquity and had been designed for incumbency during a ruler's minority. To this was now added the office of kampaku, which may also be translated as "regent" although some historians have rendered it as "civil dictator." Its holder was, for long periods of time, the first minister of the empire. The first member of the Fujiwara to take the title

kampaku was Fujiwara Mototsune, in 877. Between 858 and 1068 there were 15 emperors. of whom 7 were minors, while 8 abdicated. The Fujiwara power reached its height under Fujiwara Michinaga, who controlled the court from 995 to 1027. He was father-in-law to four emperors and grandfather of four. There was still no absolute succession rule, and Fujiwara regents had the power to determine succession.

The Fujiwara regents were responsible for most of the significant developments in the field of legislation during the Heian period. The Taihō code of 702 was amended and changed by compilations of kyaku and shiki, emendations and additions that were issued by official order. Fujiwara regents were also responsible for the development of the non-Chinese offices which gradually superseded the authority of the boards set up after the Taika reforms. Succession to the post of regent became considered a matter of Fujiwara family rather than state business, and there was not as yet any national sentiment strong enough to overcome the principles of family (or clan) interest. The regents saw their interests so closely intertwined with those of the imperial house that they had a direct reason for upholding the prestige of the latter. Yet theirs was at the same time a separate dynasty, following its own succession policy, concerned with its own landed interests, constructing its own ancestral temples and frequently staging entertainments more lavish than the court itself could afford. The authority of the court was becoming tenuous, and in a sense its continued primacy depended upon the prestige which the brilliant life at Kyōto gave the courtiers in the eyes of leaders in other parts of the country. The splendour had come to depend upon income from the rural estates of the nobility more than from tax revenue. So long as the cultural prestige of the capital continued unimpaired, its political decline was not immediately apparent.

Shōen.—The power of the Fujiwara and the cultural splendour of Kyoto are well known because of the histories, diaries and novels that document it. It is more difficult to study the process whereby the economic and political base of the Kyoto primacy was being eroded by changes in landholding and administration in the countryside.

The Taihō codes had been based upon the assumption that all land was the emperor's and that fields would be parceled out to farmers for occupancy subject to a periodic redivision, while officials and nobility were to receive fields whose income would support them during their tour of duty. But in actuality the redivision of farm plots was rarely carried out, even in the areas closest to Kyoto; in many outlying areas there are good reasons for doubting that it was ever done at all. Fields allotted to officials, furthermore, were seldom returned. During the Heian period, life at court became both more attractive and more venal. There were numerous devices for extending one's term in office and consequently lengthening the period during which income from the rank fields could be enjoyed. The records show that when new officials were appointed, they often had difficulty in taking possession of their office and especially of their office fields. This was particularly the case when the incumbent had good ties either with the Fujiwara in Kyōto or with local families who supported him. It also became common for newly appointed officials to remain in Kyōto instead of attending to their duties in the provinces. They could send deputies to collect their income. More and more, provincial offices were regarded as grants of income and status; not infrequently they were purchased outright.

As the private sector increased at the expense of the government rice lands, small parcels gradually were combined into larger units known as *shōen* or manors. These grew out of the fields originally given for office, merit, reclamation or, in piety, to temples. As the difficulties of farmers on government tax rolls multiplied, they tried to commend their allotment fields. which were gradually being recognized as their private property, to tax-exempt neighbouring estates. The *shōen* profited from this process of commendation (*q.v.*), similar to the European feudal practice. Typically, the *shōen* was controlled by local families who relied on the patronage of powerful nobles at court in whose name the manor was formally registered. In return for this patronage the farmers sent to Kyōto income that made possible the luxurious life of the court nobles. Within the shcien, farmers who had commended their fields or who had fled the burdens of life on government fields found that the incidence of labour tax tended on the whole to be lighter than the one they had known. There was less call for large-scale public works, and the dreaded conscription regulations no longer applied. Gradually the status of the small-holding farmer who worked his plot of government land changed as, dependent on the protection of powerful neighbouring families, he became attached to his land and approached a status of serfdom. There were, however, many varieties of status and of shcien, and it is difficult to speak with confidence of a national pattern. Many *shōen* were divided into several parcels of land, and sometimes rights of tax and income were shared by the managers with the Kyoto "owners," neighbouring temples and government tax collectors. But the government's role gradually declined. *Shōen,* which were first allowed a lower tax rate, gradually ceased to pay any taxes at all, and in time the estate managers denied government agents the right of survey, entrance and police jurisdiction. The great court families, and especially the Fujiwara, naturally led in the possession of such estates. which were scattered throughout the realm. The same was true of the great temples. By 1069, when the emperor Gosanjō tried to check the process of alienation of land by establishing a record office (*kiro*-kujo), he was quite unsuccessful. The remnants of the imperial realm, scattered throughout the provinces, had become only one among a series of national networks of *shōen.* Effective authority of the Heian court declined.

Heian *Buddhism.*—The two great figures in Buddhism during the Heian period were Saichō, posthumously called Dengyō Daishi, and Kūkai or Kōbō Daishi. Both studied in China. Saichō returned in 80j to establish the Tendai (T'ien-t'ai in Chinese) school in Japan; he erected the great Enryakuji monastery. While it began with cautious court favour as an implied alternative to the wealthy and powerful sects of Nara, Tendai became one of the great landed sects during the Heian period.

Kūkai returned in 806 from the T'ang capital of Ch'ang-an and established the Shingon ("True Word," Chinese Ch'en-yen) school; he founded his monastery (816) south of the Nara plain, on Mt. Kōya. Shingon doctrines of Buddhism introduced into Japan a great wealth of occult practices and colourful ceremonies which had great appeal for the Heian noblemen with their strong belief in spells and exorcism. Kūkai became a popular figure whose life is obscured by the legends surrounding him.

Both the new denominations attempted to reconcile Buddhism with Shintō, and both attracted the aristocrats at the capital. Thanks to the piety of the court and its nobles, their lands increased steadily, and by the end of the Heian period they found themselves subject to all the evils of worldly mindedness with which their founders had earlier reproached the Nara sects. The new sects, with their colourful ceremonies and impressive arts and rituals, changed the character of Japanese Buddhism very considerably. Insofar as can be judged from the literature of the Heian period. however, it is difficult to claim for the Kyōto courtiers any profound appreciation of the intricacies of Buddhist philosophy. Since Heian society was greatly concerned with portents and divination, the ceremonies seldom expressed more than a desire to appease the supernatural. In the main. religion was expected to protect the country. Buddhism ultimately became the national faith in the far more simple cult of Amida (Amitabha), Lord of the Western Paradise, whose aid and salvation could--be attained by a mere repetition of the proper prayer. It was in this manner that Buddhism. stripped of most of its philosophical subtleties, came to have a direct meaning for large numbers of Japanese after the 11th century. (See The People: Religion, above.)

Relations With China.—The gradual departure from the Chinese model in administrative techniques and organization did not indicate a lessening of respect for the T'ang empire. There were 12 official Japanese embassies to the T'ang court, and a number of projected missions that never reached their goal. These missions were large affairs, numbering as many as 600 persons, and

were costly projects for the Japanese government. The monk Ennin (Jikaku Daishi), who was attached to the last formal mission, which sailed in 838, describes in a diary the trip and its dangers, his experiences in T'ang China and his return to Japan, where he fell heir to Saichō's see, the Enryakuji monastery. In addition to formal missions there were private journeys by traders who also transported students. The Japanese court was eager to obtain such Chinese luxury goods as incense, perfume and medicines, and the early narrative, *Taketori monogatari,* in which a princess sets her suitors the task of procuring rare merchandise from China and India, shows that possession of these items was part of the world view of Heian society. However, the principal impetus to the contact with China mas the desire for religious and philosophical knowledge, and the most important items of import were Buddhist books and art objects.

It was natural that the urge to travel to China lessened after Ennin and other pilgrims brought word that Buddhism was on the decline there and that the T'ang empire was showing signs of weakness. In 894 the prominent minister and scholar of Chinese literature Sugawara Michizane, who had managed, by his ability and adroitness, to rival the Fujiwara in influence, was appointed ambassador to China. It was over 50 years since an embassy had been sent. Sugawara, who may well have feared that absenting himself from Kyōto would mean his eclipse by the Fujiwara, submitted a memorial which marks the end of the first period of borrowing from China. He pointed out that reports from previous Japanese visitors showed that China was in disorder. that Buddhism was being persecuted and that there was nothing to be gained by an official embassy; he advocated cutting off all intercourse with China. His memorial was accepted, and its author continued to grow in power and favour. His Fujimara rivals mould not brook his competition, however, and Sugawara was later "exiled" as viceroy to Kyushu. where he died in 903. Sugawara was later deified under the name of Tenjin and was revered by Japanese as the god of literature.

Heian Society and *Culture.*—The literary record for the Heian period is extraordinarily rich and permits close inspection of many of the most intimate aspects of life at the capital. It deals, inevitably. with the inner court aristocracy—a relatively small number of courtiers, numbering perhaps 4.000 or 5,000. Theirs was a society in nhich personal relations and family connections counted for a great deal. It was a society governed by rigid standards of taste though not of morality, and it was a society in which the ladies played a large role. The courtier was judged by his ability to cap a poem with a graceful couplet. by his taste in clothes and colour, his skill in music, incense burning, calligraphy and painting and by his ability to carry on romance with discretion. Force and courage mattered less than grace and gaiety. The monuments of literary excellence were mostly the work of the court ladies, and their prose played a large part in establishing a classical pattern of language. The author Murasaki Shikibu, whose Genji *monogatari* (Tale of Genji) ranks as one of the world's earliest and greatest novels, also wrote a diary, which, like the *Makura* no *sōshi* of Sei-Shōnagon, her contemporary, allows numerous and revealing glimpses into the life at court. (See JAPANESE LITERATURE.) These works, to be sure, give only one aspect of Heian society. and present a somewhat idealized picture of life at court around the year 1000. They make it clear that personal advancement at court depended on personal relationships. None were more sensitive to nuances of approbation and displeasure, gracious acceptance and graceful snub than the ladies who recorded the events of their daily life. Power at court had become concentrated in the hands of the Fujimara regents, while in the provinces new leaders were rising. In consequence, the role that remained for the functionaries in the older offices was largely a ceremonial one. It was probably inevitable that the rest of the aristocracy developed its extraordinary sensitivity to form and detail and its aptitude for amorous dalliance and graceful diversion. Human relations were the key to power and influence in court society. Matters of costume, of art and of romance furnished the surest indication of taste and breeding, and they had a political and social relevance that justified treating them with the loving care which the literature gives them.

Many diaries kept by the great Fujiwara ministers in Chinese are extant. These show that the ministers were far from pleasure-seeking dilettantes who ignored more important aspects of their work, but they bear out the importance of form and detail and personal relationships for the courtiers. They add other notes of simplicity, reserve and austerity which make it clear that despite the splendour of life in Kyoto, aesthetic tastes were modified by an asceticism and restraint that ultimately became the most marked qualities of Japanese art and architecture.

The religion that emerges from these literary records is concerned more with ceremony and ritual than it is with creed or morality, and it is not sectarian in any sense. The great nobles patronized shrine and temple, and invoked the aid of whichever seemed appropriate to the particular need or time. Their society believed deeply in spirits and in exorcism; the scene from the Tale of Genji in which Prince Genji's wife, the Lady Aoi, is exorcised may be considered a classic description of such a ceremony. It may be that it was the colour and the panoply of great Buddhist ceremonies, as it was the rich material for artist and sculpture in the Tendai and Shingon sects, that attracted the nobles most. Architecturally, the need for great halls for the ceremonies and rituals nhich the new sects emphasized added new, spacious halls to the temple complexes. The residences of the nobles showed that here too the rigid adherence to Chinese canons of the Nara period was undergoing change, as the formal architecture of Chinese inspiration was blended with the simpler lines of Japanese wooden-floored, thatched-roofed structures whose irregular lines and design complemented the garden settings in which they were placed. Indeed, it can be seen from the Tale *of* Genji that although great stress was placed on Chinese learning, so that Confucian texts and T'ang poets were part of the equipment of every literate man, the close reliance on Chinese precept was coming to seem rather old fashioned. When Genji's son reaches manhood the professors of Chinese learning are called in to go through the proper forms, but for the novelist and her readers those gentlemen seem faintly ludicrous. Chinese verse continued to be written, but the significant poetry was in Japanese. The second of the great anthologies, the *Kokinshū,* was completed around 905 and was prefaced by a famous discussion by Ki no Tsurayuki on the place and role of poetry. Its 1,100 poems were almost all short poems, 31-syllable tanka. Most dealt with topics of nature and love. In poetry, as in the prose of the court ladies, a classical style of Japanese had developed. It is clear that there was a large literature, of which only a small part has survived.

The court literature documents the distaste the civilized aristocrats felt for the countryside. It becomes clear why so many officials were reluctant to take up provincial posts, and why the appointment to Kyushu meant exile for Sugawara Michizane. The countryside seemed uncultured and even barbaric, and most of the nobles and their ladies could not imagine life away from Kyoto. Yet by the 10th and 11th centuries, during nhich the great masterpieces of Heian literature were being produced, the countryside was in large measure the private property of the nobles who lived on the income of their manors. That income was becoming less predictable as the estate managers came to realize that there was no real way of forcing them to contribute. Kyoto reflected the change. Fire and storm required constant expenditure to keep up the great buildings. By the 11th century parts of the capital were falling into decay, and the literature breathes a consciousness of change and decline. In part, this reflects a sentimental melancholy that had distinguished the Japanese outlook from the first, and in part it reflects the gentle despair of Buddhism that the law of change and decay, as of death and rebirth, is inexorable. But the fires that followed natural disasters were also indications' of declining standards of order and efficiency. As law and order declined depredations from the countryside became inevitable, and descendants of young men who had left the capital for the harsh life of the country because there was no opportunity for them at court returned to find that they now possessed the power to influence and change the society that had rejected them.

The Retired Emperors.—The emperor Gosanjō, who came to

the throne in 1068, had no Fujiwara connections and showed a strong desire to rule himself. Surprisingly, the Fujiwara seem to have been lacking in the daughters that had helped them in their rise to power. Equally important in the Fujiwara decline were rivalries within the family and the apparent dislike on the part of the new emperor. who had spent over two decades as heir apparent watching a Fujiwara regent rule the nation. Gosanjō tried to reform court procedures and expenditures, and in 1069 he established the *kirokujo* to verify claims of the nobility and temples to their *shōen*. It enjoyed only limited success, since it was impolitic if not impossible to attack the Fujiwara directly. Gosanjō died in 1073, to be succeeded by the emperor Shirakawa. Shirakawa continued his predecessor's attempts at personal rule, and abdicated in 1086 in order to continue his efforts from retirement.

There followed a period of government by retired and frequently cloistered emperors, which lasted until 1156. The practice of early retirement in order to avoid formal participation while retaining effective control was a common one in the familistic structure of Japanese society, and it is not surprising that the emperors, burdened as they were with empty ritual, should have sought to win the benefits of retirement for themselves. But while earlier imperial retirements, when not dictated by the interests of maternal Fujiwara relatives, had been motivated by a desire for greater leisure and ease, those of this period were motivated by the desire to bypass the authority of the Fujiwara regents in order to assume greater responsibilities.

The former emperors set up headquarters in their residences and worked through bureaus not unlike those used by the great families to manage their estates. An administrative centre or *mandokoro* dealt directly with official matters. The retired emperors dominated their sons who served as titular emperors, and as a result power shifted from the titular emperor's maternal to his paternal relative.

Perhaps the chief result of this was the decline of Fujiwara power and prestige. Early in the 11th century virtually all appointments of the highest rank had gone to members of the Fujiwara family, but by 1100 members of other families, especially the Minamoto, held a majority of important posts. In seeking personnel for the new posts the retired sovereigns tended to look to new groups, and they often relied on members of families which, although possessing considerable landed wealth, lacked the aristocratic pedigree of the men whom they replaced. As a result, there was for a time a decline in standards of learning, of deportment and of culture, for the Fujiwara, however self-seeking, had been magnificent patrons of the arts and of religion and models of courtly behaviour.

Despite the promising beginning made by Gosanjō, the retired emperors who followed him proved to be more interested in luxury and the advantages of power than in responsibilities and reforms. This was particularly true of the retired emperor Shirakawa, who patronized temples, particularly after he took holy orders. with a view to flaunting his wealth and magnificence. He encouraged venality by his dependence upon representatives of the new wealth, and spent enormous sums on Euddhist images and temples, seriously depleting what remained of the imperial resources. The system of rule by retired sovereigns (insei) also led to much confusion, for there was sometimes more than one retired emperor in addition to a titular sovereign. Under such circumstances competition for favour and revenue offered inviting opportunities for groups anxious to gain from a succession dispute. It was such a struggle that ended the period of imperial rule in the civil warfare of 1156.

B. The Development of Feudalism

Rise of the Military. — The process of the accumulation of large tracts of land in private hands made possible the rise of local administrators with confidence in their own abilities. As their lands were removed from the tax rolls the income of these classes rose. They gradually dared to withstand interference from provincial and national officials and developed their own forces for keeping order within their areas. It seems probable that most of the forces so recruited were drawn from the sons of landholding farmers who entered the *shōen* system in a relatively favourable position, but they found their leaders in aristocrats who came to the country to find greater scope for their ambitions and who, hardened by the vigour and the danger of their new life, were prepared to test their strength in contests with each other and with the national po er.

The 10th century was one of widespread disorder throughout Japan. The cultured aristocrats in Kyoto lacked all power to effect their desires outside the capital, for the old conscript armies had degenerated and the more recent *kebiishichō* had become a haven for well-connected nobles seeking sinecures. In some areas commoners armed for their own protection while in others police measures were undertaken by officials with special commissions as "pacification officials" (tsuibushi). But this did not result in an increase of strength for the central government, as the provincial governors could succeed in this program only by enlisting the support of local gentry, with the result that they speeded the process of fragmentization of power while trying to restore order.

On a number of occasions, government officials put themselves at the head of such groups and led insurrections that threatened to plunge the country into complete chaos. In 939 and 940 Taira Masakado, who had been sent to the eastern provinces in an official capacity, led a rising of local magnates that united, for a brief period, most of the Kwanto plain against the central government. Some sources credit him with imperial aspirations. The court hurriedly appointed a "subduing-the east generalissimo," but before his arrival Masakado met his death fighting with hostile groups of local warriors in 940. Fujiwara Sumitomo, who was dispatched by the court to deal with piracy, put himself at the head of pirate and dissident local bands to control most of the strategic areas along the Inland sea. A special tsuibushi was named, and Sumitomo was defeated in 941. Both risings illustrated the possibilities of leading the rural leaders. Both were put down, not by the central government, which was wholly dependent on the favour of its supporters, but by locally organized and led forces. Again, when an invasion from China was feared in 1019, those exhorted to resist were the gentry of Kyushu.

It was inevitable that the local leaders and estate managers should come to realize that there was no real necessity to send any surplus to the nominal owners of their estates at Kyoto, and that their Kyoto patrons were as dependent upon them militarily and politically as they were economically. Still, it required much time for this to penetrate their consciousness; the capital retained the prestige of cultural advancement and the regional groups were not yet sufficiently united to think beyond local issues. Ironically, it was the court nobles themselves who called the warriors in. They did so to solve their own police problems. The Fujiwara under Michinaga, for instance, maintained close relations with the Seiwa Genji (Minamoto) group of warriors; their help became particularly necessary in order to deal with the marauding groups of monkish warriors from the temples to the north and south of Kyōto. The depredations of these groups were usually aimed against each other but they proved destructive to the capital which lay between them. The great temples had become venal, powerful and secular. This had come about partly because of the aristocracy's action in placing its sons as abbots. Abbots numbered 7 in A.D. 819 and 57 in 1086. Accumulation of land and wealth had accompanied this growth of the hierarchy, with the result that the aristocracy, which first helped to secularize the temples, now found the new secular forces threatening its own interests. The warrior-monks frequently took advantage of the superstitions of the aristocracy to terrorize the court and enforce their demands. The rural leaders had fewer compunctions about dealing with these incursions, and their help was requested more frequently in the 11th and 12th centuries. Then, in 1156, a succession dispute brought the warriors into the capital to stay.

Taira and *Minamoto* — The great warrior leagues were headed by families which claimed imperial descent. It had long been the practice to send younger sons of the emperor to the country in the event that there was no place for them at court; by provisions

of the codes they were expected to change their name after six generations. Thus the principal branch of the Minamoto family was known as the Seiwa Genji (Gen being the Chinese reading of the character for Minamoto) because they traced their origin to the emperor Seiwa (858–876). They began as allies of the Fujiwara, and the relations between the two houses were particularly close during the time of Fujiwara Michinaga, the greatest of the regents. The first Minamoto served in official appointments in the provinces, and his descendants served at court as military officers and also as provincial officials. In these capacities they were well placed to gain support from rural families of importance, and they also rendered useful service to the Fujiwara. At first, the private holdings of the Minamoto were centred in western Japan, but the family members who settled in eastern Japan gave such a good account of themselves in frontier wars against the Ainu and against the rebel Abe Kiyowara that they came to have great holdings in the east. The other principal warrior league, that of the Taira family (or Heike, as the Chinese reading has it), descended from a grandson of the emperor Kammu. They began with large holdings in the eastern provinces, but because of Minamoto victories there and because of the eclipse of their rebel chief Taira Masakado in 940 their centre of strength shifted to the Inland sea area. The Taira helped the court by subduing the pirates who controlled the Inland sea in the 10th century. In so doing, they gained many retainers and the opportunity for trade and profit with Sung China.

During the 10th century the warriors of the country gradually affiliated with two great leagues headed by these families. Although the bonds of lord and retainer were based upon a pretense of family relationship, there was not necessarily any family connection between all the principal figures on either side. For many years the two "family" leagues were not closely united at all. In the early warfare of the 11th century there were Fujiwara, Taira and Minamoto on both sides of the struggle, just as there were members of the imperial family whose interests the warriors were professedly championing. Each victory resulted in a number of sharp reversals of policy for important warrior families and the bonds of absolute loyalty, although frequently avowed, were not always proof against the likelihood of defection.

Warfare erupted in Kyōto in 1156 and 1159. The first war, called that of the Hōgen era, was caused by a succession dispute. The retired emperor Toba, who died in 1156, had tried to elevate his fourth son to the throne as Goshirakawa instead of permitting his earlier son, Konoe, to remain as emperor. On Toba's death a struggle developed between adherents of a third son of Toba, Sutoku, and Goshirakawa. There were members of the Taira, Minambto and Fujiwara families on each side. The adherents of Goshirakawa were victorious, and the leaders of the opposition were slain.

After the Hōgen war Goshirakawa ruled until 1158, after which he abdicated to rule from retirement until 1192. By that time he had put two sons and three grandsons on the throne. In 1159 and 1160 resentment on the part of the Minamoto over the superior rewards that had been meted out to the Taira after 1156 resulted in a coup against the Taira. Although the Minamoto were at first successful, the Taira recovered to deal them a crushing defeat. This was the celebrated war of the Heiji era, the subject of the classic military tale *Heiji monogatari* and depicted in the narrative scroll housed in the Boston (Mass.) museum.

Taira Kiyomori.—Taira power reached its peak under Taira Kiyomori (1118–81). He became head of the Taira clan in 1153, and by the time of the Taira victory in 1160 he had shown political skill as well as ruthlessness and resourcefulness. Although Kiyomori possessed the power to make great political changes after the wars of 1160, he showed little liking for the task. Instead he chose to exercise his power through many of the techniques that the Fujiwara had used before him. He saw to it that his close relatives received titles and positions at court, while he himself was given the highest rank that could be given a subject. He married daughters into the Fujiwara family and into the imperial family; in 1180 he found himself in the typical Fujiwara position of having a grandson, Antoku [then aged two), on the throne. Kiyomori himself held high office (chancellor) only a short time, as he preferred to exercise his influence through a sovereign he could dominate. He maintained close relations with the retired emperor Goshirakawa, but neither trusted the other fully.

Kiyomori's ruthlessness came to the fore in the treatment he meted out when he discovered that conspiracies had been formed against him. He did not hesitate to use the death penalty, which had fallen into disuse under the Heian rulers, for monks implicated in one such plot. His attitude toward the warrior-monks was an important measure of the difference between the new military leader and the old court rulers. The Heian leaders had refrained from striking back against the monks who invaded Kyōto to capitalize on their psychological advantage in a credulous and superstitious society. Kiyomori, however, was not afraid to show force when his personal interests were threatened. Although he personally shared most of the outlooks of his contemporaries—he took the tonsure—he attacked and sacked the Tōdaiji and Kōfukuji monasteries in Nara.

At the height of his power Kiyomori decided to move the capital to his own city of Fukuwara, on the site of the present city of Kōbe (*q.v.*). He was apparently motivated by a desire for more ready access to the Inland sea and China trade routes, and he was also anxious to remove himself from the intrigue and backbiting of the Kyoto aristocrats who despised him as an upstart. The move was made, only to be reversed after six months, partly, it seems, because of the health of the then ailing emperor Takakura. After the court returned to Kyoto, Kiyomori took up headquarters in his Kyōto palace. He was by now thoroughly distrustful—not without reason—of the emperor Goshirakawa, and restricted his actions so closely that the system of government by retired emperors came to an end.

By the time of Kiyomori's death in 1181, the Taira partisans were in very strong positions, but no significant change had been made in the system they inherited in Kyoto. Many Taira retainers and relatives had been rewarded with estates and offices throughout the realm, but Kiyomori's principal power was still based on the products and trade of the Inland sea area. In other regions the local gentry, although formally committed to Kiyomori, were restive and discontented with the division of the spoils that had been made, and continuing loyalty was far from certain. The Taira interlude was important not so much for any changes as for the character and lineage of the new leaders. In one sense the Taira period was one of continual disaster as fire, pestilence and famine struck the nation. The mood of pessimism that resulted is well mirrored in the *Hōjōki* of Kamo no Chōmei. Its description of life in Kyōto with its hardships and alarms makes it clear that the glory of the Heian capital had come to an end.

Minamoto *Yoritomo.*—The Taira greatness was not of long duration. Minamoto Yoritomo (1147–99) had been spared after the Minamoto defeats in 1160, when he was sent to Izu to live under the guardianship of a Taira vassal named Hōjō. There he quietly gathered supporters and waited for a chance to restore his family's fortunes. In 1180 an imperial prince issued a mandate to the Minamoto to strike the Taira, and although the attempted rising failed in Kyoto, Yoritomo used the mandate as a justification for a foray immediately after. Despite early setbacks he was able to gain much support among Taira vassals in the east who were discontented with the policies of Kiyomori. In the years that followed Minamoto armies defeated the Taira at Ichinotani (1184), Yashima (Shikoku) and Dannoura (1185), a great sea battle in which the child emperor Antoku and his entourage were drowned. These celebrated battles provided material for military romances (*gunki*) and drama for future centuries. During the wars Yoritomo maintained his headquarters at Kamakura (*q.v.*) to the east, and left the fighting to his uncle Yoshiie, his younger brother Yoshitsune and his cousin Yoshinaka. It was not an age of trust, and Yoritomo's jealous and suspicious nature made him break with each of these after they had gained their great victories. The last to be hunted down was Yoshitsune, whose melancholy flight with his trusted retainer Benkei ended with his suicide in northern Japan after he was brought to bay. He became one

of Japan's great heroes, and Benkei was immortalized as a paragon of loyalty, courage and resourcefulness.

Minamoto Yoritomo was by instinct conservative and cautious, and although he made great changes in Japanese society he did so with the professed desire of restoring traditional ways. He showed great respect for the throne and the retired emperor Goshirakawa, which was not fully returned; it was not until the latter's death in 1192 that Yoritomo received the title he coveted of sei-i-taishdgun. He thus became the first shogun (*q.v.*) and began the line of feudal overlords who were to have effective political rule for the next 750 years. Although Yoritomo was deferential to the court, he saw that the military structure of the nation was under his control and that rewards would come only from Kamakura, which now became, as seat of the bakufu (camp office or military government), a second administrative centre.

Yoritomo did not try to sweep away the distinctions that had accumulated around shden and government offices, but he did take steps to restore some central control to a system that had become increasingly anarchic. He suggested to the court that the estates the Taira had confiscated or expropriated should be taken back again, presumably for distribution to his own retainers. Then. in 1185, before his military primacy was fully established by the elimination of possible competitors, he wrung from the court permission to place shugo (often translated as "constables" or "guards") in each province and jitd ("stewards" or "district headmen") in taxable areas. By this means he obtained part of the revenue of each area, and he influenced and to an extent directed its administration. Perhaps more important, he could reward the leading warriors whose loyalty he required with lucrative and prestigious appointments. But the lack of uniformity that characterizes any feudal order remained; in some areas the same family head served as official of a shden, as jitd and as an official in the provincial government. Such a person would in all probability be too deeply rooted in the loyalties of his supporters to make it advisable to antagonize or move him; his descendants were likely to become feudal lords of the locality.

The feudal order that developed under the Kamakura shogunate marked an important stage in Japanese social history. Generations of unrest had tended to convert the class lines that existed in the *shōen* system — owner, manager, owner of commended fields, tenant, labourer — into a pseudo-military order; all were expected to join in the common defense if necessary. The warfare of the 12th century separated out the upper levels of this hierarchy, who became mounted knights with an intense pride of class and family. They were the champions who rode out ahead of the host, announced their lineage and challenged their opponents to combat. It was the effect of the Kamakura order to link all such groups into an order which was modeled on that of the clans with their blood ties, so that the warriors or samurai were called *gokenin* ("men of the family"), and they repaid their lord for his protection with their loyalty and gratitude. The Confucian learning with its familistic emphasis translated these terms into those of family relationships, a trend that blended easily with the Japanese sense of family hierarchy. In Kamakura times there also developed other characteristics of the Japanese feudal code such as loyalty to death, suicide to save one's honour (see HARA-KIRI) and intense pride of honour and name. More than his European counterpart, the Japanese samurai owed his lord an unconditional and total loyalty; it was not limited to the stipulations of a contractual engagement. Although the warfare of the period is full of instances in which self-interest outweighed such claims and battles were frequently won by treachery instead of heroism, impressive evidences of the strength of these claims of honour remain. At the same time, however, the bakufu's claim of loyalty to the imperial court had the effect that little of the old hierarchy was done away with. Fujiwara regents continued to serve titular and often retired emperors at Kytito, although their area of authority had virtually vanished.

At the death of Yoritomo in 1199, the power of the Minamoto family (Genji in the Chinese reading) gravitated into the hands of the Hōjō (*q.v.*), the family who had first sheltered Yoritomo in Izu and who had provided him with a wife. They took the title regent (shikken) and dominated the councils of the *bakufu.* The Hōjō provided a series of exceptionally able administrators, and they showed vigour when the bakufu seemed threatened. In 1221 court nobles under the leadership of the retired emperor Gotoba conspired with temple armies and disaffected vassals to attack Kamakura. The Hōjō crushed their opponents on the field, exiled three former emperors including Gotoba and deposed the titular emperor. One of the benefits of this rising for the bakufu was that it provided an excuse for the confiscation of several thousand estates belonging to those implicated, with the result that the loyalties and gratitude of the armies who had put down the rebellion were ensured for some time to come. Thereafter the bakufu had the power to determine succession to the throne as well as the selection of the principal ministers in Kyōto.

The bakufu organization received its final statement in 1232 when its feudal code, the *jōei-shikimoku,* was issued for the guidance of the bakufu courts as well as for the constables and magistrates throughout the country. The code dealt in general terms with the functions of officials and principles of inheritance and succession; it gave many indications that the bakufu under the Hōjō had become a more truly national feudal administration instead of remaining narrowly concerned with the interests of the eastern warriors who had served Yoritomo.

Cultural Developments of the *Kamakura* Period. — During the Kamakura years Buddhism spread from the capital to the countryside. The older sects did not die out, but the principal developments in Buddhism concerned the spread of the Zen sect and of the popular faith sects.

The Zen (*q.v.*) or meditative sect flourished in south China during the Sung period of the 10th to 13th centuries. Zen was peculiarly suited to the needs of the military men uho were ruling Japan, and most of the great Hōjō regents had Zen advisers. Not a few Zen masters were also sword masters. Zen emphasized experience and discipline, and most of the Zen masters were highly learned men who brought with them much of the Neo-Confucian canon of Chu Hsi (see CONFUCIANISM). Zen also ushered in the idealistic and impressionistic monochrome art of the Sung period. With Zen came tea, used as an aid to meditation and a boon to health. and with the tea ceremony came great advances in the art of ceramics, whose connoisseurs held as their ideal the irregularity of the *temmoku* ware of Sung China, with its distinctive depth of glaze.

Among the commoners, Buddhism expressed itself in the popular faith sects of Amida and the Lotus. The Amida sect was implicit in much of Tendai, and it had its origins in the Heian period. Its simple message of salvation was well fitted to the needs of the common people in an age of crisis. It was taught by a series of evangelists of whom the greatest were Hōnen (1133–1212) and his disciple Shinran (1173–1262). The great image of Amida erected at Kamakura in 1252 symbolizes the faith that was adopted by most Japanese Buddhists.

An interesting variant of popular Buddhism was that of Nichiren (1222–82), who preached faith in the Lotus Sutra as the sole path of salvation. Nichiren warred against rival sects with an intolerance unmatched in Buddhist history, and warned that unless his teaching became the basis of the nation Japan would suffer a great disaster. The Mongol invasions which followed made him seem prophetic, and the sect he founded consistently tended touard nationalistic forms of expression. (See also The *People:* Religion, above.)

In literature the Kamakura period saw the end of the production by court ladies that had distinguished the Heian period. They gave way to epic tales of the great battles, often recited by traveling minstrels. The most famous of these, the Tale of the Taira Family (Heike *monogatari*), recounted the startling rise and fall of the Taira cause as an object lesson in the transitory nature of human glory. (See JAPANESE LITERATURE.) In architecture the distinctive developments were the monumental temple style associated with the great Zen monasteries and the large auditoriums required for the popular faith sect temples. (See JAPANESE ARCHITECTURE.) Art found new subjects in portrait painting, both of the strong political leaders of the time and of the dynamic Zen

abbots, while the first steps toward the idealistic monochrome paintings of the Zen style mere taken. (See JAPANESE PAINTING AND PRINTS.) In sculpture new techniques of joining released sculptors from their bondage to the individual block of wood and permitted figures of striking realism and extraordinary dimensions, a process which is inseparably associated with the name of Unkei. (See JAPANESE SCULPTURE.)

The Mongol Invasion. — Despite the rupture of formal relations with China in the 9th century, private trade and contact had continued as priests, students and merchants continued to make the trip. After the T'ang dynasty was replaced by that of the Sung in 960 a vigorous trade in books and cultural imports was carried on by Chinese merchants to the towns along the Inland sea; this trade had been an important source of money for the Taira cause. In 1279, however, the Sung were overthrown by the Mongol armies whose khan, Kublai or Khubilai, established himself as emperor of a new Yüan dynasty. (See KUBLAI KHAN.) Projects of conquest carried Mongol power to Korea and southeast Asia, and Japan inevitably came in for attention also. Marco Polo, who served in the Mongol bureaucracy for a time, described the island of Zippangu (a corruption of the Chinese reading for Japan) as rich in gold. In 1267 Korean ambassadors arrived with the khan's orders for submission, but the Hōjō regent Tokimune encouraged the court to take a strong line of refusal and mobilized his vassals. In 1274 a Mongol armada carried in Korean ships came to Hakata on Kyushu by way of the islands of Tsushima and Iki, whose defenders were overwhelmed.

Although the Japanese warriors fought well their tactics and weapons mere no match for the mass formations and longbows used by the Mongols. A violent storm that destroyed most of the Mongol fleet saved the day for the defenders, and the Mongols retired with enormous losses. A second expedition, staged from both China and Korea, approached Kyushu in 1281. Under Hōjō Tokimune's direction all possible warriors had been mobilized and a sea wall designed to obstruct the landings had been constructed. The invading forces managed to land at several points, but in vigorous fighting during the summer months the Japanese defenders fought on somewhat equal terms. The fall typhoon season providentially arrived and with it a divine wind or kamikaze that destroyed most of the invading fleet. The Chinese and Korean forces nere driven off with tremendous loss of life. The Mongols planned, and Tokimune expected, a third attempt, but despite general mobilization on both sides it never came.

The Mongol crisis became a national epic in which the national deities had intervened to save the sacred soil of Japan from the pollution of foreign conquest. It was the occasion for a revival of trust in the national deities and especially the sun-goddess and her shrine at Ise. Even the Buddhism of Nichiren reflected the martial vigour and nationalistic strains of the time. The invasion and the preparations made for the defense also had very important economic and political effects upon the bakufu. It was forced to make sweeping demands upon its vassals with no possibility of rewarding them with enemy lands or estates. There are numerous indications that by the end of the 13th century many of the warrior class were deeply in debt to moneylenders and the merchants whose growth in influence had been a significant feature during the peaceful years of Hōjō rule. In 1297 an "act of virtue" (*tokusei*) attempted to bolster the economic position of *bakufu* retainers at the expense of the merchant class by forbidding creditor appeals for the collection of debts and ruling out the foreclosure of mortgages on retainer estates. Such measures, however, defined the problems rather than solving them. As the bakufu was unable to reward its vassals they rewarded themselves, and the annals of the time are full of indications that *jitō* were seizing the manors to nhich they mere assigned while *shugo* were taking over the provinces in which they served. The lines between province and estate and Kyoto were strained and broken, and in the countryside a new and more truly feudal order of subinfeudation developed. It was not uniform, and it was not without its own dynamics; in many areas landholders were aggrandizing themselves at the expense of their neighbours and tenants, and rising as *myōshu* to challenge the authority of the *jitō*. It became clear that the ad *hoc* solutions Yoritomo had brought to the problem of order and income were no longer adequate. A rising vigour within certain sectors of Japanese society and a weakening of the bonds of loyalty and gratitude of the vassals had created a situation wherein ambitious men would use force to improve their position.

The Ashikaga Shogunate. — The Kamakura shogunate was overthrown early in the 14th century by the emperor Godaigo (ruled 1318–39), who mas able to rally support from discontented warriors. His first venture was crushed and he himself exiled to Oki, but he escaped, gathered a large following and defied Kamakura. The bakufu sent against him a large force headed by one of its vassals, Ashikaga Takauji, who, seeing that greater opportunities existed for him in the other camp, switched his allegiance and deserted to Godaigo's cause. The years 1334–35 are often referred to as a "restoration" of imperial rule. Godaigo attempted to make it such, but in his attempt to return to the system of imperial rule of an earlier day he alienated his warrior followers, who had expected generous rewards in land. As a result it was possible for Ashikaga Takauji to establish himself at Kamakura in 1335 and to drive Godaigo out of Kyoto that same year. Takauji set up an emperor from another branch of the imperial family, and was appointed shogun in 1338.

Until 1392 there were two imperial courts, for Godaigo retired with his loyal supporters to the mountainous country of Yoshino south of the Nara plain where he resisted all attempts to crush him. His Yoshino or southern court marked a significant point in Japanese nationalism, since his adherents rationalized their position by emphasizing issues of imperial divinity and continuity. *The* True Account of *Imperial Rule* (*Jinnō Shōtōki*) of Kitabatake Chikafusa. one of Godaigo's most important supporters. begins with the ringing phrase, "Great Japan is a divine country," and goes on to excoriate the pattern of shogunal usurpation of the imperial prerogative. Another of Godaigo's supporters, the great samurai Kusunoki Masashige, is credited with prodigious feats of valour in the warfare that took place; he earned an honoured place among models of virtue praised by partisans of the imperial house in later days. The southern line of emperors is recognized as the legitimate one, although it gave way to the northern at the time of unification in 1392.

Unlike the Minamoto, the Ashikaga established their capital in Kyoto, in the Muromachi district, for which the arts of the period are called. There they headed an administration modeled in most respects on that of the Kamakura bakufu; a Kamakura branch ruled the eastern part of Japan. This division is significant, for it showed that the east, which had formerly been less populous and less productive, was now so vital to any government that pretended to rule Japan that it could not be left to emissaries from Kyōto. Both the Kamakura and Kyoto headquarters of the *bakufu* were staffed by its leading vassals, and rivalry and jealousy between these great families weakened Ashikaga unity. The Ashikaga bakufu nas never as strong as its predecessor. Its priority was not based upon a series of great conquests comparable to those of Yoritomo, and it never established more than a general suzerainty over many of the great military figures. Its power and eminence were greatest during the shogunate of Yoshimitsu, who was shogun from 1368 to 1394 and who lived until 1408.

The political history of the Ashikaga years is turbulent and confusing, but there were important developments in social history. One of these was the rise in importance of the merchant class. The Ashikaga had numerous estates, but they were not able to exploit them fully. Instead, they derived a significant percentage of the large sums they required for their luxurious life in Kyoto from foreign trade. Outwardly this took the form of tribute missions to Ming China, in which the shogun styled himself "king of Japan" and accepted in form the status of tributary state. His chief service to his Ming overlord was to control the pirates or *wakō* that ravaged the coasts of Korea and China. In return for this the Ming gave to Yoshimitsu and his successors valuable gifts and large sums of coins which became the standard currency used in transactions in Japan. The shogunate reaped further benefits from the trade by leasing ships to the great Zen temples, to other lords and to merchant guilds. These ships mere permitted to

accompany the official missions and to sell their products in Chinese ports. Yoshimitsu's successors hesitated to accept tributary status as he had done. but they remained anxious for the Chinese copper coins. The importance of the trade as a stimulus to and mirror of economic growth in Japan was great. After official missions came to an end, private bands of traders and marauders continued to make the trip to China. There was a steady growth of merchant guilds and specialty groups in Japan, some licensed by the *bakufu* and some lesser lords; warrior indebtedness was so constant that shoguns found themselves issuing frequent "acts of virtue" canceling debts; such edicts, however, had less and less effect.

The China contact also made possible continued importation of the artistic products of Sung and Ming China, and Japanese ceramics and painting made important strides under the patronage of the art-loving shoguns and the great Zen temples of Kyoto. Some painters like Sesshū (1420–1506), whose monochrome landscapes mark a high point of the tradition, studied in China. In dramatic arts, Yoshimitsu patronized performers who developed the techniques and repertoire of the nō, Japan's great lyric drama (see NŌ DRAMA). Numerous architectural masterpieces survive to testify to the taste of the Muromachi patrons. Among them are some of Kyoto's greatest Zen temples and their gardens. Yoshimitsu's Kinkakuji or Golden pavilion (built in 1397), although burned and rebuilt after World War II, and his successor Yoshimasa's Silver pavilion (Ginkakuji. begun 1482) are among Japan's great treasures. A feature of the temples and residences of the period was the development of the tearoom, a small chamber in which the restful and meditative tea ceremony was held.

Many of the treasures of the Ashikaga period, and most of its great families, disappeared during and after the warfare which broke out in 1467 in Kyoto. For a decade fighting raged in and around the capital, and even after subsiding there it spread to the provinces as the urge for wealth and power that had brought the great vassals into conflict in Kyoto led them to try to unseat their rivals on their home grounds.

Social Change. — The disorder and warfare brought to light the evidence of very profound social changes that had been taking place, changes uhich help to account for the disappearance of so many eminent families and their vassals after 1467. In the countryside the development of a social organization approximating that of the modern village had given landholders and rural leaders an opportunity to mobilize their inferiors (small holders, tenants and servants) against their superiors when conditions became unbearable or when those superiors were absent from the province. In 1428, for instance, petitions were forwarded from village leaders in provinces close to Kyoto asking for remission of back taxes and a lighter tax burden in the future. When these petitions were ignored, rebellions broke out and spread among communication routes between the leading temple and trade centres. After further outbreaks. in 1485 leading farmers in the province of Yamashiro met to discuss a way of ridding themselves of the scourge of feudal armies that marched across their fields seizing "taxes" as they passed. They selected a committee of 36 to make decisions and managed to keep feudal levies out of the province for the better part of seven years. Under pressure of this sort, the old-style *jitō,* who had concerned himself chiefly with eliminating rival tax collectors and u-ho had established no real link with the peasants of his area, was doomed.

Even more striking was the case of the old shugo feudal lord Asakura in the Japan sea coastal province of Echizen. There popular faith Buddhism had first been introduced by Shinran in the 13th century. His successor Rennyō (1415–99), head of the Honganji church in the 15th century, preached in the same area, organizing churches which ministered directly to the needs of the villages. Soon the metropolitan temples in Kyōtō complained that their estates and branches were no longer transmitting income to them; when they enlisted the aid of the feudal lord Asakura the countryside rose in revolt. Organized and led by their priests and armed with simple weapons, the farmers proved more than a match for the sword-wielding samurai; their sect became known as Ikkō, "One Direction" or "Single Minded." Members met regularly for instruction in the faith and in discipline. Village leaders whose sons became priests had a natural claim to the loyalties of their members, and in battle the sectarians. certain of their salvation, proved that the superiority of the mounted aristocrat was nearing its end. The Ikkō sectarians spread along the Japan sea coast and into eastern Japan. The great Honganji temple at Osaka became their headquarters. Not until new methods of warfare were worked out in the 16th century were they to lose their power.

The difficulties of dealing with these new social forces were such that most of the old warrior types, who mere oriented toward competition on a national political scene and indifferent to the welfare of their farmers, were doomed to extinction. The first to go were those closely allied with the Ashikaga for they expended themselves in a losing cause. The wars that began in 1467 broke old loyalties. Throughout the country insubordination and disloyalty, expressed in the phrase *gekokujō* ("inferiors striking superiors"), became the rule.

The feudal lords who survived the change were usually on the outer fringe of the national scene. The future belonged to a new style feudal lord or *daimyō.* These often came from the lower ranks and began as retainers or estate managers for the *shugo* lords whom they replaced. They were usually men with strong ties to rural leaders, and before setting forth on national conquest they concentrated on securing the loyalties and services of the village leaders in their own domains. It required almost half a century of intermittent, small-scale warfare of consolidation before such figures, who began with a modest redoubt and a few followers, were able to gain the loyalty of neighbouring figures and move on to larger things. Then, just as units of control were becoming larger and unification seemed at least a possibility, new weapons from abroad helped to accelerate the process.

C. The Unification of Japan

The 16th century was a time of great upheaval and constant fighting, but by the end of the century Japan had achieved substantial unification or, at least, pacification. This was pre-eminently the achievement of three great generals. Oda Nobunaga, Toyotomi Hideyoshi and Tokugawa Ieyasu were men of exceptional ability; their military and political measures ended the disorder of the previous era and created a stable base for the measures of the Tokugawa shogunate which endured until 1867. Each of the three worked against the background of new foreign technology and religion. and thanks to the presence in Japan of Portuguese and Italian Jesuits and British and Netherlands merchants the period is unusually rich in illuminating side lights on the character and work of the great unifiers.

Arrival of **the** Europeans. — In 1543 a storm drove a Portuguese vessel bound for China north to the small island, Tanegashima. off the southern tip of Kyushu. The visitors mere well received, and the firearms they brought were soon dubbed *Tanegashima teppō* ("iron rods") and manufactured in Japan. The vessel was followed by others that traded in the Kyushu ports. In 1549 a vessel included Francis Xavier (*q.v.*) among its passengers. Xavier had with him two fellow Jesuits, two servants and three Japanese who had been won to the faith in south Asian stations. Xavier left two years later with the conclusion that it would be wise to attempt to win China to Christianity first, but he was enthusiastic in his appraisal of the Japanese he met. "It seems to me," he wrote his superiors, "we shall never find among heathens another race to equal the Japanese"; he praised the qualities of honesty, courage and respect for status which he found everywhere. By the time he left Japan, he referred to the Japanese as "the delight of my heart" and considered them superior to Europeans in many respects. He left behind him a Christian community of about 1,000 converts.

For the next half century the work of the Christian missionaries and their teaching (*Kirishitan-shū* or *Tenshu-kyō*) enjoyed a considerable success. The most dramatic chapters were written by the Jesuits who, under Portuguese patronage and Italian management, admired the emphasis upon class and hierarchy they found in Japan and suited their message to it. Themselves largely drawn from aristocratic backgrounds, the Jesuits felt that if they could

but make their message palatable to the samurai and *daimyō,* the other Japanese must necessarily be won. Within the Jesuit order. hierarchic ranks were rigidly maintained. and in dealing with their aristocratic Japanese hosts—who alone, among Asians, were permitted into the order—the Jesuits seemed equally the representatives of a military society, comparably schooled in self-mastery, courtesy and courage. Able linguists and interpreters who enjoyed the respect of the Portuguese captains, the Jesuits were also able to profit from the eagerness of the Kyushu *daimyō* for the trade the Portuguese brought. After the breakdown of Japanese relations with Ming China, the Portuguese mere the only sources of Chinese silk and Indian and Persian luxury goods as well as European firearms. Thus the power to influence the selection of a port of call was highly useful, and the Jesuit spokesman Valignano wrote his superior: "Your Reverence must understand that after the grace and favour of God the greatest help that we have hitherto had in securing Christians is that of the Great Ship."

The "great ships," usually carracks (galleons) of 600 to 1.600 tons, came annually from Macao. The Japanese regarded them with wonder and depicted the ships with their colourful passengers in the famous *namban byōbu* ("southern-barbarian screens"). In order to finance their far-flung activities, the Jesuits found it necessary to enter the trade themselves. They were allotted a regular share of the silk tonnage; in addition, under pressure from their *daimyō* converts. they also took part in the currency exchange that made it profitable to export Japanese silver to buy gold. At Nagasaki, which was to become Kyushu's great port. the Jesuits established a permanent base. The *daimyō* there ordered his retainers to become Christian, burned Buddhist temples and invited the Jesuits to establish their headquarters. This they did, and beginning with 1571 the "great ships" came regularly to Nagasaki, which thereafter, even after the expulsion of the missionaries and the proscription of Christianity, remained the only port for foreign trade until the 19th century. The Christian community grew rapidly, and the Jesuits' report of 1582 claimed 150,000 converts. Many of these were no doubt nominal, including forced conversions ordered by newly won *daimyō,* and many were surface, the work of opportunistic lords anxious to gain European trade and weapons. But the number of Japanese nho chose exile or death to recantation in later years shows that the missionaries also made major gains. During their most successful periods of work. they enjoyed the protection and favour of the newly emerging political leaders Xobunaga and Hideyoshi.

Oda **Nobunaga.**—The internal wars that had gone on intermittently since the outbreak of the Ōnin wars in 1467 had resulted in numerous changes in the political make-up of Japan. After the decade of warfare around the capital in 1467–77, most of the lords had had to retire to their provinces to put down revolts from below, whether from farmers (as in Yamashiro or in the case of the Buddhist sectarian rebellions) or from local magnates who had developed follonings that enabled them to erode the sources of support for the higher authorities. In the process most of the *shugo*-type *daimyō* who had derived from Kamakura and Ashikaga appointments had been removed. By the first half of the 16th century a process of reconsolidation had begun to take place as new powers emerged, first on the local level in opposition to the old shugo *daimyō,* and then on the county and provincial levels in opposition to competing neighbours whose lands and small fortifications were absorbed. The number of important military figures grew smaller, their areas larger, and it was inevitable that they would try again to achieve a national primacy. Some of the great figures with national aspirations were hampered by powerful neighbours. Takeda Shingen and Uesugi Kenshin, for instance, were in a state of virtually permanent warfare, as a result of which neither was able to devote himself fully to national ambitions. At Kyoto the court and the Ashikaga shogun had deteriorated in material well-being and political authority, but it was logical that newly ambitious men should try to capitalize on whatever legitimacy could be gained from authorization by these traditional forces.

The first steps toward unification were taken by Oda Nobunaga (1534–82), who may also serve as a representative example of the changes that had taken place. Nobunaga was the descendant of a man who had served as estate manager in the Japan sea province of Echizen under a shugo family named Shibata. When the Shibata moved to Owari (the Nagoya plain), the Oda family accompanied them, grew in power and influence and ultimately replaced them. Nobunaga began with four districts in Owari under his control. and he built these up until he had unified most of Japan. His first great victory came in 1560 when he defeated Imagawa, lord of Tōtōmi. Thereafter, allied with Tokugama Ieyasu and skillfully utilizing the new techniques and weapons of war, Nobunaga entered Kyoto. installed Ashikaga Yoshiaki as shogun and made a show of serving the emperor so that he could cite loyalty to emperor and shogun against any possible competitors. Several years later, in 1573, when Ashikaga Yoshiaki had become uneasy under his patronage and secretly asked a rival military figure for help against him, Nobunaga unceremoniously deposed the shogun and banished him, thus ending the Ashikaga shogunate.

Nobunaga met some of his most determined resistance from Buddhist sectarians of the Ikkō movement, and his efforts to subdue the great Osaka Honganji headquarters of the sect by force uere not fully successful. The sectarians, who had been in touch with Nobunaga's rivals throughout Japan, caused him much inconvenience until they agreed to a truce in 1580. Equally annoying to Nobunaga mas the conduct of the monastic armies of Mt. Hiei outside Kyoto, who allied with two of his most bitter enemies. In 1571 he assaulted the Enryakuji monastery on Mt. Hiei and, nith none of the compunctions that had deterred earlier enemies of the religious armies. burned every building and killed every inhabitant. Buddhist political power never recovered.

The Jesuits were recipients of Nobunaga's favour. He granted them permits to travel and preach anywhere in his provinces, welcomed them to his great Azuchi castle and showered them with instances of his favour. "In proportion to the intensity of his enmity to the bonzes and their sects," the Jesuits wrote their superiors, "is his good will toward our Fathers who preach the law of God, and he has shown them so many favours that his subjects are amazed. . . ." It mould seem that Nobunaga respected the character and courage of the Jesuits, and since he could trust so few of his contemporaries and equals he enjoyed talking with them. "Either you are thieves who are compassing some fraud." he told them once, "or this Gospel of yours is really a fine thing." The Jesuits in turn were pleased with Nobunaga's destruction of the centres of organized Buddhism. They despaired of his conversion, however. and concluded correctly that he was basically a skeptic: "he openly proclaims that there are no such things as a Creator of the Universe nor immortality of the soul, nor any life after death."

Nobunaga's distrust of his contemporaries and subordinates proved well founded. In 1582, when a body of troops led by Akechi Mitsuhide was filing through Kyoto on its way to the front in southern Honshu, Akechi turned to attack Nobunaga in his Honnōji headquarters instead. Hopelessly surrounded, Nobunaga committed suicide. At the time of his death he had conquered 30 of Japan's 68 provinces, most of them forming a compact area around the capital of Kyōto. Major problems remained in outlying areas on Kyushu, Shikoku and to the north, but Japan was well on its way to unification. Nobunaga received from the court the title of minister of the right in 1577, but his power and authority clearly rested upon his armed might.

Toyotomi Hideyoshi.—Leadership now passed to Toyotomi Hideyoshi (1536–98), a man of humble birth who had risen to become one of Nobunaga's most successful generals. Hideyoshi first crushed Akechi Mitsuhide and then entered into a compact with a number of other vassals. By 1584 Hideyoshi had achieved unquestioned mastery of Nobunaga's lieutenants, with Tokugawa Ieyasu acting as his principal ally. He now proceeded to complete the work of unification. His headquarters were established at Osaka. Campaigns in Shikoku (1585), Kyushu (1587) and Odawara (1590) completed the unification of Japan. After the fall of Odawara, Tokugawa Ieyasu exchanged his lands for those that had been gained and established his centre at Edo (modern Tokyo).

Hideyoshi then looked abroad for new laurels, and after bombastic warnings addressed to the rulers of Manila, Goa, Formosa, Ryukyu and Korea, set himself to the conquest of China. He planned to take Korea in the spring of 1592; by December Peking was to fall and two years later the imperial court would move from Kyōto to Peking, while Hideyoshi would establish in south China the headquarters for the construction of a vast Asian empire. His achievements were to fall short of these impressive plans. Great expeditions to Korea in 1592 and 1597 resulted in impressive victories, but Hideyoshi's supply lines were inadequate for his needs. Korean maritime superiority forced him to retreat. The second expedition was largely punitive in nature, and Hideyoshi died before it achieved its purpose. The principal cultural effect of the invasion was the forced migration of Korean potters to Japan in the train of the daimyd, in whose realms they developed the distinctive ceramics of the Tokugawa period.

Christianity.—Hideyoshi at first continued Nobunaga's policies of favour to the Jesuits. He was anxious for trade and welcomed commercial growth, as shown in his efforts to attract merchants from Sakai to his new city of Osaka. The Christian movement, in the 1580s, seemed to be making excellent headway, and among Hideyoshi and his followers the outward appearances of western dress and religion seemed to be becoming a fad. But complications came from within and without. The Jesuit-Portuguese domination of European contacts was broken by the appearance of Spanish galleons from Manila bringing with them Franciscan missionaries who challenged the propriety of the Jesuits' tactics of concentrating on the upper classes. Competition between the mission orders and between the Spanish and Portuguese interests made the Japanese suspicious of both.

At the same time Hideyoshi, after the subjection of Kyushu, was quick to entertain doubts about supporters who seemed to have a secondary allegiance to Rome. In 1587 he ordered the missionaries to leave, charging them with forcing Japanese to become Christian, teaching their disciples to wreck temples, eating useful animals and taking slaves to the Indies. The order to depart was not, however, obeyed. The Jesuits sent a few priests to China, but connived with their *daimyō* converts to continue their work. As competition between the Jesuits and other missionaries increased, however, it was more difficult to maintain the subterfuge of compliance with Hideyoshi's order, for Franciscans and Dominicans insisted on public services and preaching to attract the commoners. In 1596 the wreck of a Spanish galleon brought threats from its pilot that if his cargo was not protected the Spanish king would seize Japan, as he had other countries to which missionaries had first been sent. Shortly afterward came the first persecution of Japanese Christians. It was as yet small in scale, but it showed that the rulers of a united Japan would not favour proselyting for a foreign religion.

Development of Feudal Controls.—Hideyoshi's achievements were made possible by overwhelming military power. He utilized to the full the advantages of the new firearms. Military strategy changed as large bodies of troops, many of them nonsamurai. replaced the emphasis on the chivalric individual combat of earlier times. Defensive breastworks replaced individual bravado. Great castles, situated in the centre of the territories they controlled and erected on stone ramparts which allowed clear fields of fire, symbolized the power in the hands of Japan's new military despots. As order returned to the country, Hideyoshi directed his daimyd to guard against further upsets from below. The last years of the 16th century saw the production of many codes of law as the feudal lords followed Hideyoshi's lead in regularizing and rationalizing their administration and procedure.

Hideyoshi did not attempt to control all of Japan, but reserved large areas of the provinces nearest the Kyōto-Osaka plain for his own administration and income. The rest he parceled out to his vassals. Some whom he had conquered he left in control of their territories; others found their holdings reduced in size, nhile still others were dismissed in order to open up rewards for his close vassals. In somewhat the same manner, the *daimyō* invested their vassals with fiefs, retaining personal administration over only part of their realm. The vassals were responsible for duty in war and for providing labour service for public works, but the demands on them often went far beyond this. Loyalty was expected to be total, with no discernible contractual limitations. Each daimyd, on acceding to rule, was invested by Hideyoshi, and the same was true of the *daimyō* and their own vassals. Hideyoshi took steps to limit the type of defense works and the number of castles the *daimyō* could erect in their realms, lest they prepare for a trial of strength with him. The daimyd also followed Hideyoshi's lead by keeping near to them the persons or relatives of their principal vassals, as symbols of submission and guarantees of loyalty. They themselves spent a great deal of time at Hideyoshi's court. There were thus sharp limits to the degree of autonomy that accompanied subinfeudation. The daimyd expected his vassals to follow his example and general instructions, and Hideyoshi expected the same from his *daimyō*. As a result, late-16th-century Japan saw the establishment of similar, if not identical, procedures of institutional rationalization in all areas.

The first need was to see to the economic base of the system. To this end, land surveys were conducted in each area to determine the exact areas of tillage, patterns of landholding and average yield. These minute surveys were the first to be held in many years, and they furnished the basis for taxation procedures for centuries afterward. Hideyoshi used the statistics that were gained in these surveys as the basis for the assessments he made against his *daimyō* for the costs of the Korean campaign and the costs of the numerous building projects he carried on at Kyōto, Fushimi and Osaka. Henceforth the fiefs and areas were rated as to their kokudaka or koku (approximately five bushels) yield of rice. Uniform national units of measure were set forth, and a more or less uniform tax allowed the tiller approximately one-third of his yield. The uniform land system that resulted marked the end of the remnants of the *shōen* system.

Next came measures to control the commoners in order to guarantee production of the estimated yield and to guard against unrest. In 1588 Hideyoshi issued edicts ordering that arms should be collected from commoners. "The possession of unnecessary implements of war," the edict read, "makes difficult the collection of taxes and dues and tends to foment uprisings . . . perpetrators of improper acts against official agents shall be summarily punished, but in that event the paddy fields and farms of the violators will remain unattended and there will be no yield of crops." The edict went on to explain that the swords would be used as nails and bolts in the construction of a giant Buddha, which would benefit the people in the next life as well as in this. Thus the kind of social change that had made possible Hideyoshi's rise from farmer's son to ruler of the land was to become impossible. Further orders forbade change of status and residence; peasants who left their fields were to be punished, and the entire village with them. Surveillance was to be carried out by the institution of five or, at times, ten family units, in which all were responsible for the infractions or delinquency of any one. At the top of the network of mutual security units stood the village headman, the link between feudal administrators and the tax-producing peasant.

Nobunaga, Hideyoshi and their fellow daimyd did all they could to encourage merchant developments. They were eager to enjoy the fruits of commercial prosperity, and they prized the goods that could be produced only by artisan and merchant specialists. They ordered the dissolution of the craft guilds (*za*, as in *ginza*, the silver guild) that had proliferated in Ashikaga times, and struck down the toll stations that made internal shipping slow and expensive. Hideyoshi did all he could to attract merchants from trading towns like Sakai, and he offered them tax immunity in his new capital of Osaka. Merchants and artisans were graded in several ranks; those in the higher classifications mere particularly the recipients of his favour, but all benefited from the favourable conditions created by a larger regional market.

The *daimyō* followed Hideyoshi's example in this as in other respects; as they developed their new castle towns, regional merchant centres grew around them. The castle towns also became centres of administration; to them were drawn more and more of the samurai. including those who had been given fiefs to administer. The late Ashikaga class of warrior-farmer, the landed yeoman

whose tenants could manage his acres while he went to the wars, was replaced by a sharp distinction of class between farmer and fighter, with the latter increasingly occupied in the duties and delights of the castle town.

The exuberance of the new era with its urban development and self-conscious despots was reflected in its arts. Momoyama art, named for Hideyoshi's palace. is distinguished by the rich decorative techniques devised for the homes, temples and castles of the new magnates. A rapid and vigorous style developed that was far removed from the ascetic aesthetic of the Ashikaga charcoal ink masters. The dark recesses of the palaces and castles brought in the use of gold and silver foil as backing for screen paintings which needed strong colours to bring out their designs. Art of this sort was the work of professionals, and not something that could be done by the gentleman-scholar in his moments of contemplation. The magnificence and splendour of this tradition have largely perished, but its waning echoes can still be heard in the Tokugawa mausoleums at Nikkō (*q.v.*).

D. The Tokugawa Period

Hideyoshi was considered ineligible for the title of shogun because of his low birth, and instead he received the old rank of *kampaku* from the court. He planned to have his second son Hideyori (1593–1615) inherit his lands and titles, and he appointed a-group of five vassals as guardians. They quarreled soon after Hideyoshi's death. however, and Tokugawa Ieyasu (1542–1616) won a crushing victory over his rivals at Sekigahara in *1600*. Ieyasu mas appointed shogun in *1603*, and established his headquarters at Edo. This battle determined the political make-up of Japan for the next *250* years, as Ieyasu distinguished betneen his allies (*fudai daimyō*) and rivals (*tozama daimyō*) in apportioning offices and territories. Ieyasu strengthened and his grandson Iemitsu (1604–51) perfected the system of feudal controls nhich Hideyoshi had begun.

Centralized Feudalism. — Japanese historians often use this curious term to describe the degree of central authority the Edo *bakufu* retained despite its nominally feudal appearance. After Sekigahara and again after the fall of Hideyori's partisans at Osaka in 1615 the shogun reapportioned fiefs almost at mill. *Daimyō* were divided between hereditary retainers *(fzcdai)* of the Tokugawa family, of whom there were at first 145; related houses (*shimpan*), of which there nere *23;* and 98 "outside lords" *(tozama daimyō)*, who submitted after Sekigahara. The related houses included three family seats of Owari, Mito and Kii, which were to provide a successor if the shogun lacked an heir; together with the senior *fudai* houses they staffed the central councils of elders (*rōjū*) and the boards that conducted national affairs for the *bakufu*. The shogunate kept under its close control lands producing nearly 7,000,-*ooo* koku of rice, approximately one-fourth the national total, of which 3,000,000 were allotted to vassals of less than *daimyō* rank, the so-called bannermen (*hatamoto*). For its onn lands the shogunate maintained full responsibility through commissioners *(bugyd)*, deputies *(daiknn)* and inspectors (*metsuke*) appointed from among its retainers, while vassals of *daimyō* rank were free from close control except for certain supervisory functions concerned nith controls on Christianity and periodic visits by *bakufu* representatives.

The *daimyō* were controlled by a variety of means. Their marriages had to be approved, they were expected to contribute lavishly to *bakufu* building projects such as the Edo and Osaka castles and the Tokugawa mausoleums at Nikkō. They were forbidden to repair castles or fortifications without permission or to establish toll stations or check points *(sekisho)*, a privilege reserved for the *bakufu*. Most effective of all the controls was the system of alternate attendance (*sankin-kōtai*) whereby *daimyō* were required to reside in Edo in alternate years, leaving their heirs and wives as hostages nhile they returned to their fiefs. The processions to Edo came at specified times and involved vast expenditures; residence in Edo, usually in one of three great estates maintained by each lord, proved extremely costly and sapped military energies by ceremonial concerns. The duration and timing of the attendance was changed in later years, but the Tokugawa never relaxed their insistence on the Edo residence and hostage system. Codes governing the conduct of retainers and requiring regular oaths of loyalty were a further guarantee of good behaviour.

After the fall of Hideyori and his partisans, the shogunate also regulated with care the behaviour of the emperor and his court. A modest income placed the emperor on a standard of living suitable for a small *daimyō*. He was prevented from having contact with the feudal lords, and special injunctions urged the court nobles to concentrate on arts and letters. High shogunal officials stationed in Kyoto regulated the conduct of the court and kept its intercourse with feudal lords to a minimum. The shogunate also improved the institutions worked out in Hideyoshi's time to guarantee a stratified feudal society. Its codes of law mere echoed in the realms of its vassals. Society was thus organized on the principle that the samurai was its most honourable member, succeeded, in order, by the peasant who provided the rice, the artisan u-ho provided necessary goods and the merchant u-ho performed functions of exchange. Below these ranks were the dishonoured classes traditionally associated with contemptible vocations such as tanning. The various fiefs issued similar codes. Thus despite the formal division of Japan into autonomous fiefs the politics and power of the central feudal administration mere felt throughout the land. Only a few of the most powerful *tozama daimyō* were autonomous in any true sense, and even they found it necessary to devote more and more of their wealth and time to the ceremonial attendance in Edo.

Foreign Relations and the Exclusion System.—Tokugawa Ieyasu began with hopes of extending Japanese trade and commerce. He did little to enforce the ban on Christian activity and he negotiated with the Spanish to request technical help in developing mineral resources. Requests for trading arrangements were addressed to the countries of southeast Asia and unsuccessful efforts were made to reopen trade with Korea and China. From *1602* to *1636* about 350 Japanese ships. licensed by the shogunate, sailed to southeast Asian countries, and Japanese settlers in the trading towns of the Philippines, Siam and Cochin China came to number approximately 10,000 persons. For a time an adventurer-trader, Yamada Nagamasa (d. 1630), was an influential figure in Siamese wars and politics.

Gradually fears of Christian subversion outweighed Ieyasu's desires for trade. European rivalries transferred to Japan were a factor in his concern. The rival missionary organizations had continued to calumniate each other, and as the Franciscans and Dominican orders strove to outdo the Jesuits it was more difficult to overlook infractions of the laws against evangelizing. More important was the arrival in *1600* of a Dutch vessel, the "Liefde," piloted by an Englishman, Will Adams. The Portuguese and Spanish urged the Japanese to execute the newcomers as pirates, while the latter assured the Japanese that their countries in Europe had waged a long and difficult struggle against the religious and political imperialism of Catholic Spain. Ieyasu saw the possibility of having European trade without the disadvantage of European missionaries who might nin over his vassals. Several irregularities in the *bakufu* administration revealed the fact that fellow converts had been using each other as channels to official favour, and some of his retainers were quick to memorialize on the danger of a creed that seemed to teach obedience to foreign priests rather than to *daimyō*. In 1614 an edict ordered all missionaries to leave; all Japanese were ordered to register as members of Buddhist sects, and Buddhist priests were to check and report on their congregations annually.

The Osaka campaigns of *1614* and *1615* saw many of the remaining Christian *daimyō* siding with the cause of young Hideyori, who died in the flames of his castle. Tokugawa hostility toward Christianity now intensified. In *1617* foreign priests were executed for the first time, and under the third shogun, Iemitsu, persecution was carried on with savage intensity. By this time most of the missionaries had left, and many of their converts had emigrated to the Spanish colonies in southeast Asia. In *1624* the Spanish were expelled, and Japanese Christians were forbidden to go abroad; non-Christians could still travel, but not to Spanish possessions. The British East India company, which had not flourished, with-

drew from Japan in 1623. Individual Englishmen, however, had prospered; Will Adams stayed in Japan until his death in 1620, enjoying the status of a petty *daimyō* while he continued his trading ventures. After the departure of British and Spanish there remained the Portuguese, who were restricted in 1636 to an artificial causeway and island in Nagasaki harbour, and the Dutch.

In 1637 a great rebellion marked the last stage of the Christian movement for several centuries. On the Shimabara peninsula east of Nagasaki there had been numerous Christians, and dispossession of the previous *daimyō* had resulted in large numbers of masterless samurai (*rōnin*, "wave men") as well. These joined to rise in protest against brutal treatment and misrule in 1637. The first shogunal troops sent against them failed to crush the insurgents, who retired to a castle at the tip of the peninsula in hope of foreign assistance. The rebellion had begun for economic and political reasons, but it became increasingly Christian in nature as believers flocked to join the insurgents. After it was put down and the insurgents were slaughtered, all further contact with Portugal was forbidden. When an embassy from Macao arrived in 1640 hopeful of reopening relations, all but a handful of the emissaries were executed to discourage further efforts. Thereafter it was a capital crime for Japanese to attempt to leave the country or, having left, to return. The construction of ocean-going ships was forbidden, and the remaining Christian suspects were hunted down with ruthless severity. Japanese inquisitors contented themselves with apostasy, and their tortures sufficed to bring about the recantation of several missionaries. For the rest of the Tokugawa period regular investigations ascertained the beliefs of descendants of Christians, and the results were reported directly to the bakufu's commissioner of shrines and temples. From the temple surveys came later Tokugawa census figures. On the whole, the warrior converts who had been the Jesuits' principal concern were forced to abjure, and their descendants were under such careful surveillance as to rule out continued Christian belief. The commoners who had been the objects of the other missionaries showed surprising resistance to persecution and hardship. When Mass was held at Nagasaki by a French priest for the foreign community in 1865, foreigners and Tokugawa officials alike were astonished to see large numbers of fishermen from the village of Urakami appear for the Mass. They had carried on Christian services secretly for over two centuries.

During the rest of the Tokugawa period foreign contacts were limited to the Dutch, who were moved to the man-made island (Deshima) that had been constructed for the Portuguese in Nagasaki harbour. At first the Dutch lived under the closest scrutiny in conditions of great humiliation. The trading station, an outpost of the Netherlands East India company centred on Java, was at first sufficiently profitable to compensate for the humiliation. By the 18th century, when the profit lessened, the humiliation did too; thereafter Deshima achieved its greatest importance as a window on the world through which the Tokugawa regime. which eschewed any contact with the west, was nevertheless able to learn and to obtain what seemed useful and relevant in western culture. From the Tokugawa standpoint, the exclusion system served its purpose since, by excluding foreign interference and minimizing Japanese contacts with foreigners, it was possible to perpetuate social institutions and regulations of the 16th century into the 19th. In ruling out imports and foreign trade of any dimensions, however, the system made for a closed economy in which a Malthusian limit operated to keep the population below 30,000,000 and in which, after a great creative efflorescence in the 17th and 18th centuries, creative energies seemed to flag.

Cultural Developments. — The long years of the Tokugawa peace saw the development of cultural patterns that owed little to outside stimuli. These matured early, and the great works of literature and the theatre were produced during the Genroku era (1688–1703). It was a culture produced for the merchant class which had profited from the new opportunities offered by the urban concentrations and commercial patterns which grew out of the Tokugawa institutions. The great city of Osaka, with almost 500,000 inhabitants by 1690, was the first centre of this culture; serving as it did the needs of a national economic centre, it had the first and largest merchant developments. In the 18th century the centre shifted to Edo, which came to number well over 1,000,000 in population.

The merchants had many spheres of life closed off to them by the rigid class system the Tokugawa tried to enforce. but as they handled more and more of the rice and monetary transactions for the feudal classes they had abundant opportunity to prosper. There developed a special cult of pleasure for men who had no security before the law and who could not hope to rise politically or socially by their wealth. In Osaka and other great cities the licensed quarter became a city of lights and merriment, of music, pretty courtesans and crowded theatres — a city where a man's worth was judged by his wealth, and where he was temporarily liberated from the compelling Confucian values which surrounded him in home and work. It was a life best described in the naturalistic novels of Ihara Saikaku (1642–93), who detailed the rise and fall of wastrel sons and imperious courtesans with a cynical detachment and clinical precision.

The centre of the townsmen's interest was the kabuki theatre (*q.v.*), which was a Tokugawa development. The kabuki repertoire furnishes one of the best sources for the values and strains of Tokugawa society. Its themes were the same as those of the puppet (*Jōruri*) theatre, and the great playwright Chikamatsu Monzaemon (1653–1724) provided much of the repertoire for both forms. Kabuki offered martial fare for the adventurous, but for social history the domestic dramas are particularly valuable. These set values of human feeling against those of duty and obligation, and mirror the problems which beset the townsmen. Kabuki actors were the cynosure of the public eye, and although the shogunal moralists legislated against them and tried to discourage the actor worship that pervaded the towns, they succeeded only in testifying to their importance.

The comparable development in art was the woodprint, which was capable of large-volume production to grace the homes of the commoners. Beginning as single-colour prints, the woodprints grew steadily in inventiveness and variety during the 18th century, until the great Edo print makers developed the multicoloured "brocade print" (nishiki-e). In the last stage in this great tradition, print makers turned from ladies of the licensed city and actors of the stage to portray scenic points along the highways of the country, as in the familiar prints of Katsushika Hokusai and And6 Hiroshige (*qq.v.*).

In poetry the changes were less startling, although the 17-syllable haikai, perfected by Matsuo Bash6 (*q.v.*), reflected some of the same trends in its use of everyday language. Aside from the large volume of verse — some of it considered Japan's finest — produced in this tradition, there was also a large output of more traditional and Chinese poetry, just as there were important schools of artists who painted in the Chinese manner of the Ming dynasty. Official patronage went to artists who chose their subject matter in the Chinese tradition. The court school of Kano painters, however, combined many schools to develop a distinctive style and approach. In fiction the shogunate favoured the didactic novels of Kyokutei Bakin (1767–1848) which owed much to Chinese tradition. But while such works were important and numerous, they were overshadowed in interest for the historian by the materials that were produced to suit the tastes of the commoners in the towns.

Economic Problems. — The political institutions which had been set up to ensure the primacy of the Tokugawa family and the superiority of the warrior class brought in their train economic consequences that plagued administrators of the Tokugawa period. The enforced absence of the feudal lords from their fiefs while in residence in Edo meant that they had to sell a major portion of their tax rice on the Osaka market to defray the cost of travel to and residence at the shogun's capital, thereby placing them at the mercy of the Osaka rice dealers. The separation of warriors from the land meant that in castle towns as in Edo increasing numbers of retainers were forced to sell their rice incomes or stipends for the necessities of urban life. Everywhere the warrior class found itself dependent upon merchant assistance and services. By training and education the samurai were schooled in scorn of figures and calculations, which seemed the tools of shopkeepers, with the re-

sult that there was rising opportunity for the merchants in Osaka and in the castle towns. Though their political and social status was low this did not prevent them from accumulating money. and by the Genroku period large numbers of *daimyō* were in debt to Osaka merchants. The merchants had no security in law for their property, and so they were intent on the opportunity of the moment. In periods of irregularity or laxity merchants also attained considerable importance and favouritism from "corrupt" officials who neglected their Confucian standards. On the national level, such times often saw po er in the hands of shogunal favourites and chamberlains instead of the normal council of elders, while bribery and corruption tended to replace exhortations to frugality.

It is clear that the agricultural production of Japan increased steadily during Tokugawa days thanks to land reclamation and better methods of fertilization and cultivation. The ruling class, however, never realized a rise in land tax comparable to the new rise in yield; it is not clear whether tax requisitions remained standard because of inefficiency or because special tax benefits had been offered to encourage reclamation. In any event it would seem that the increased yield tended to go to the landowning farmers in the villages and that it sharpened the distinctions between them and their tenants. Tokugawa commentators deplored both the wealth and the poverty of villagers, many of whom were in such desperate plights that infanticide *(mabiki)* mas frequently resorted to in order to save food for the children who remained. Tokugawa laws against the sale of land show that the money economy was affecting agricultural relationships in many areas. Feudal lords devised numerous irregular and special tax levies to increase their income. When these became too burdensome, movements of protest and rebellion often broke out. There were several hundred rebellions during the Tokugawa years, and although most of them were localized protest movements they reflected dislocations in the economic picture.

The shogun and the *daimyō* tried to attack these problems in a series of reforms that usually came immediately after long periods of laxity and favouritism. These reforms included attempts to increase their income, economies to lessen expenditure and legislation designed to slow the erosion of rural values under the impact of the commercial economy. Income was increased by instituting new official monopolies of whatever crops within the domain could be sold at Osaka and other markets. Paper, lumber, cotton. wax and similar products were marketed under official auspices. To handle such affairs guilds, which had been discouraged in favour of "free trade" since the days of Nobunaga and Hideyoshi, were reconstituted in an effort to license and control merchant activities that affected official well-being. Economies included restrictions on display and ostentation for all classes, and they particularly sought to end excessive comforts and unnecessary consumption by the commoners. At such times clothing, cakes. candles and hairdressing were regulated. Reforms of this sort came in the first quarter of the 18th century under the minister Arai Hakuseki in 1710 and the shogun Yoshimune (1716–45), who sought to undo the excesses that had developed under the shogun Tsunayoshi (1680–1709). After *1787* the minister Matsudaira Sadanobu tried to reverse the corruption that developed during the sway of the chamberlain Tanuma Okitsugu (1767–86). In 1841 the minister Mizuno Tadakuni attempted to combat merchant influence that developed during the reign of the shogun Ienari *(1787–1837),* but failed utterly to achieve his purpose.

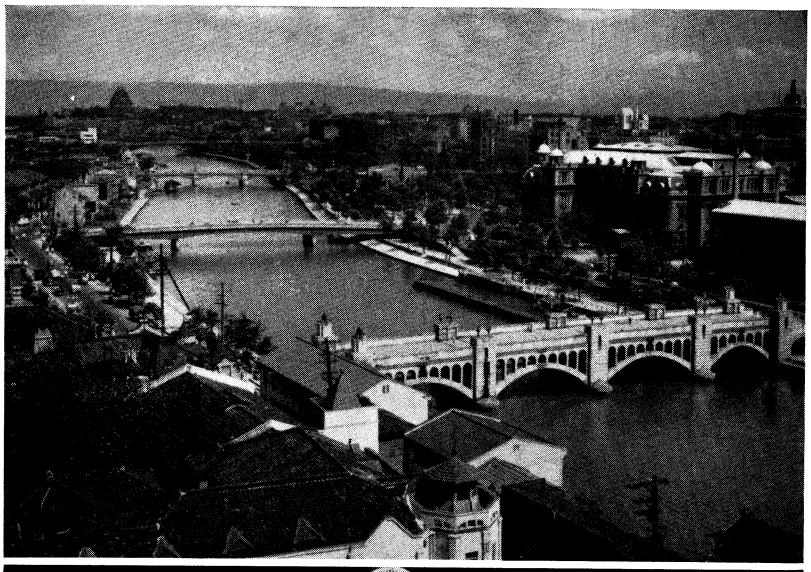
Each of these reforms was less successful than its predecessor, largely because the difficulties it was designed to correct had become more deeply rooted and the economic maladjustments had become more widespread. When Mizuno attempted to legislate against the guilds, he discovered that it was virtually impossible to provide for the food supply of Edo unless the shipping guilds were given their accustomed privileges. The shogunate and the fiefs thus continued to seek for solutions to the social change that had followed from the political measures of Ieyasu. Retainers' salaries were halved as "temporary loans," merchants were occasionally expropriated and large forced loans (*goyōkin*) were demanded from the merchants. On the whole, such reforms, designed to return to an earlier and more truly feudal social order, had the best success in outlying and remote areas. In the highly developed and sophisticated sectors which the shogunate ruled they were least effective. The reforms of the minister Mizuno Tadakuni in the 1840s, for instance, failed of their purpose, while simultaneous measures taken by *daimyō* in Satsuma in south Kyushu and in Chōshū on western Honshu enjoyed much greater success. There were few Tokugawa statesmen and scholars who did not realize that something was amiss with their society when feudal lords were in debt to despised merchants and when peasants were driven to flight or infanticide to maintain life. This consciousness of crisis was a significant element in the readiness to consider sweeping changes when the appearance of the western powers added a new intensity to their concern. It was logical for them to conclude that much of their poverty could be traced to the requirements for attendance in Edo, and that the shogunate had sacrificed national well-being to its own political purposes.

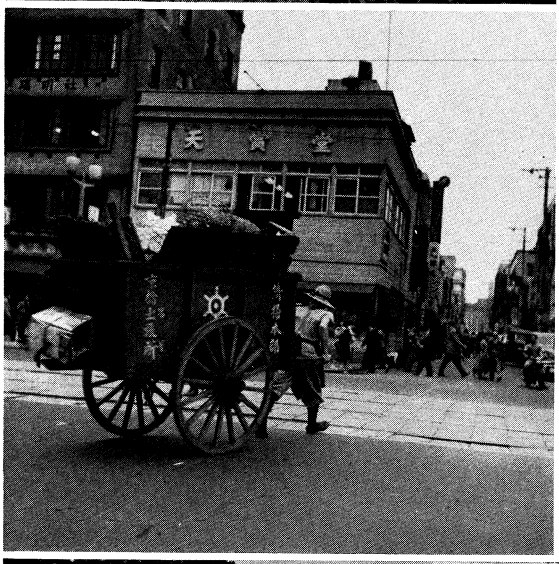
Intellectual Trends. — Ideas about political and social reorganization formed against a background of intellectual speculation that took many forms. During the long Tokugawa peace the samurai administrators and scholars turned their thoughts from war to the arts of peace. Ieyasu encouraged Confucian studies at the outset of his family's dominance, and the bureaucratic needs of the years which followed encouraged the trends that he inaugurated. Confucius and Confucianism were never more honoured than under Tokugawa feudalism; and each *daimyō* appointed Confucian tutors and advisers to acquaint him with the lessons which the past had to offer.

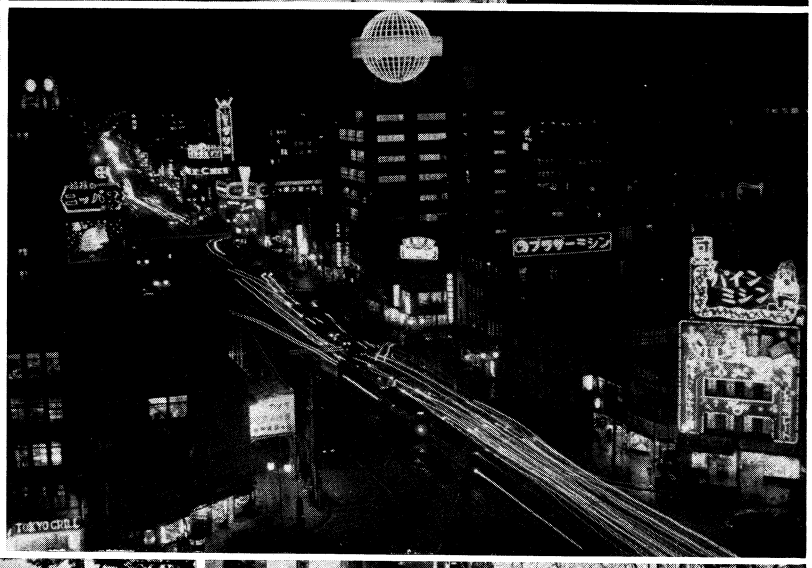
A number of Confucian schools flourished. The Sung Neo-Confucianism of Chu Hsi. with its Buddhist and Taoist elements, mas the most favoured school; its emphasis on loyalty was appropriate to Tokugawa times. It was not ruled the official teaching until 1790, but it had great influence from Ieyasu's time on. There were Neo-Confucian scholars in all parts of Japan. Their rationalism, humanism and history-centred approach played an important role in the development of a large body of scholarly learning. The proclamation of Neo-Confucian orthodoxy did not carry with it proscription of other schools, of which there were many. The school of Wang Yang-ming, with its emphasis on the primacy of the moral sense and intuitive knowledge, played an important role in offering a variant to the official school. These and other interpretations often existed in combination, and in some of the great fiefs of the southwest a nominal adherence to Neo-Confucianism left room for a strong skepticism toward the China-centred cult of the capital.

The Confucians' interest in the past was shared by scholars who sought to learn of their country before it had been changed by Chinese thought. These *kokugakusha* or national scholars began their work with rigid textual studies of the first great poetry anthology. the *Manyōshū,* and they ended with vigorous polemics against the Confucian and Buddhist influences which, they felt, had clouded the virtue of an earlier and purer time. The most important of many scholars of this tradition was Motoori Norinaga (1730–1801). The national or Shintō scholars were not always at loggerheads with the Confucians, and elements of their teaching were to be found in combination with other strains. The school of historians subsidized by the Tokugawa house of Mito wrote their works in a spirit which combined the Confucian loyalty to the emperor as true ruler with Shintō reverence for his supernatural characteristics.

A third major variant was the school of western or Dutch learning. *Rangaku,* as it was known. began to filter slowly from the Dutch trading station at Deshima during the 17th century. But for long the proscriptions on literature that might be Christian— including translations done by the Jesuits in China — and the general restrictions on the movement and influence of the Dutch kept *Rangaku* from having much effect. These restrictions were relaxed after 1720. Interest grew in western medicine, particularly after a dissection in 1771 established the accuracy of a western treatise on anatomy, and in military science, which had made great advances during Europe's intermittent wars. As more European works were imported into Japan and the number of scholars who could read them grew, the way was open to learn of European af-







BY COURTESY OF (TOP RIGHT CENTRE RIGHT) JAPAN TOURIST ASSOCIATION; PHOTOGRAPHS, (TOP LEFT) EVANS FROM THREE LIONS, (CENTRE LEFT) ORLANDO FROM THREE LIONS, (BOTTOM LEFT) EMMA GENE HALL, (BOTTOM RIGHT) H. ARMSTRONG ROBERTS

CITIES OF JAPAN

Top left: Tokyo, the building of the Japanese national diet (parliament), erected in 1936

Top right: Osaka, a view over the Dojima river, Nakanoshima park section. The large building at the right is the Central Public hall

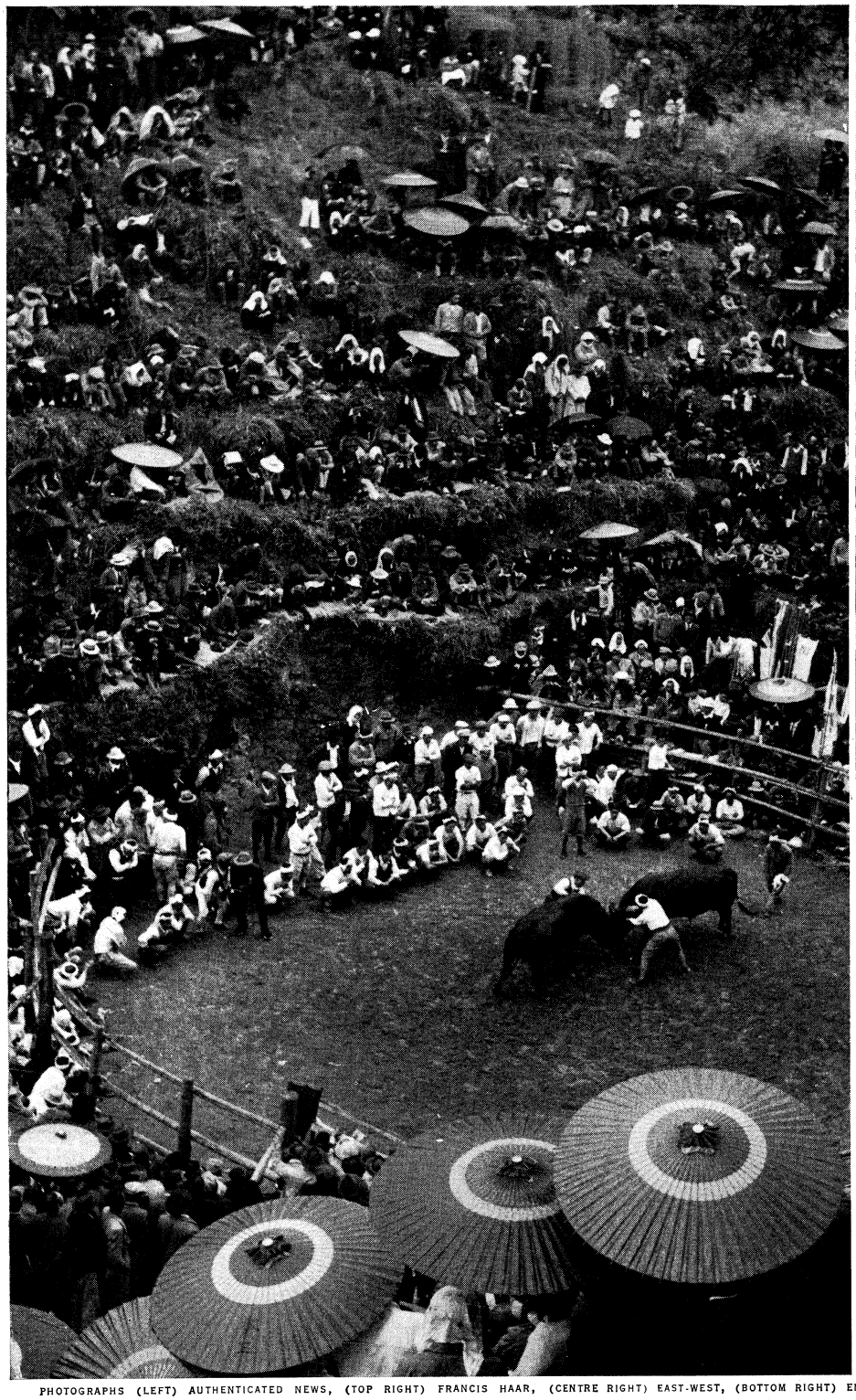
Centre left: Tokyo, a garbage collector pulling his cart across a busy street

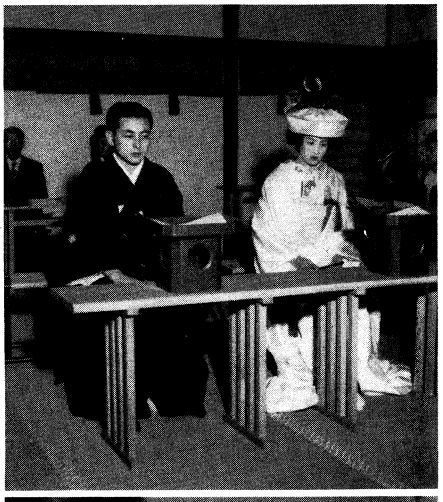
Centre right: Tokyo, the Ginza-Shimbashi area, centre of the business district, at night

Bottom left: Nara, a street of shops on a hill. The capital of Japan from 710–784, Nara remains a carefully preserved city of antiquities

Bottom right: Tokyo, Ginza street, a principal thoroughfare of the Japanese capital

JAPAN





PHOTOGRAPHS (LEFT) AUTHENTICATED NEWS, (TOP RIGHT) FRANCIS HAAR, (CENTRE RIGHT) EAST-WEST, (BOTTOM RIGHT) EMMA GENE HALL

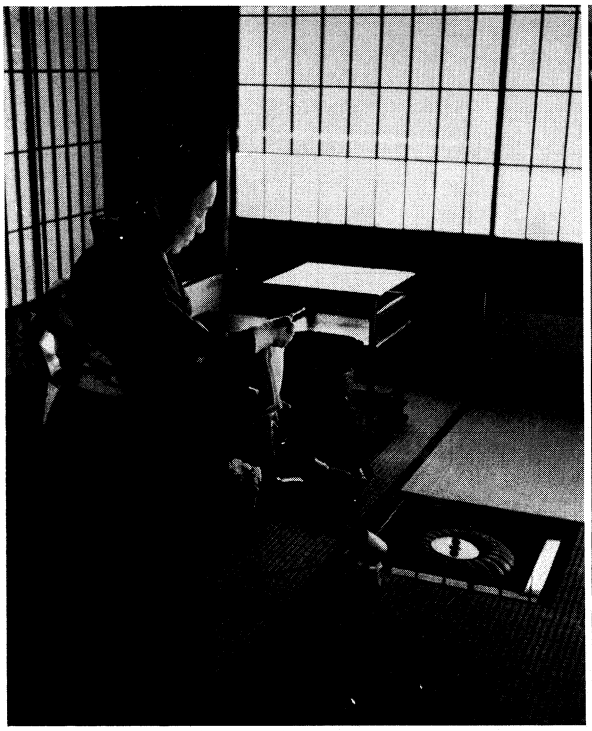
TRADITIONAL JAPAN

Left: Ox-fighting at the summer festival of the Waryo shrine near Uwajima city, Shikoku

***Top** right:* Folk dancers of Sado island off the west coast of Honshu. The island was a famous place of exile during the Middle Ages

Centre right: Marriage ceremony in a Shinto temple. Shinto is the ancestral religion of Japan although it was supplanted by Buddhism in pooularity for about 1,000 years until its restoration in 1868. The strong nationalistic attitudes associated with Shintoism were modified after World War II

Bottom *right:* An actor of the Kabuki theatre applying the characteristic porcelain-white make-up. Kabuki theatre in its present form dates roughly from the Genroku era, the latter part of the 17th century



PHOTOGRAPHS, (TOP LEFT, BOTTOM) EMMA GENE HALL, (TOP RIGHT) EVANS FROM THREE LIONS

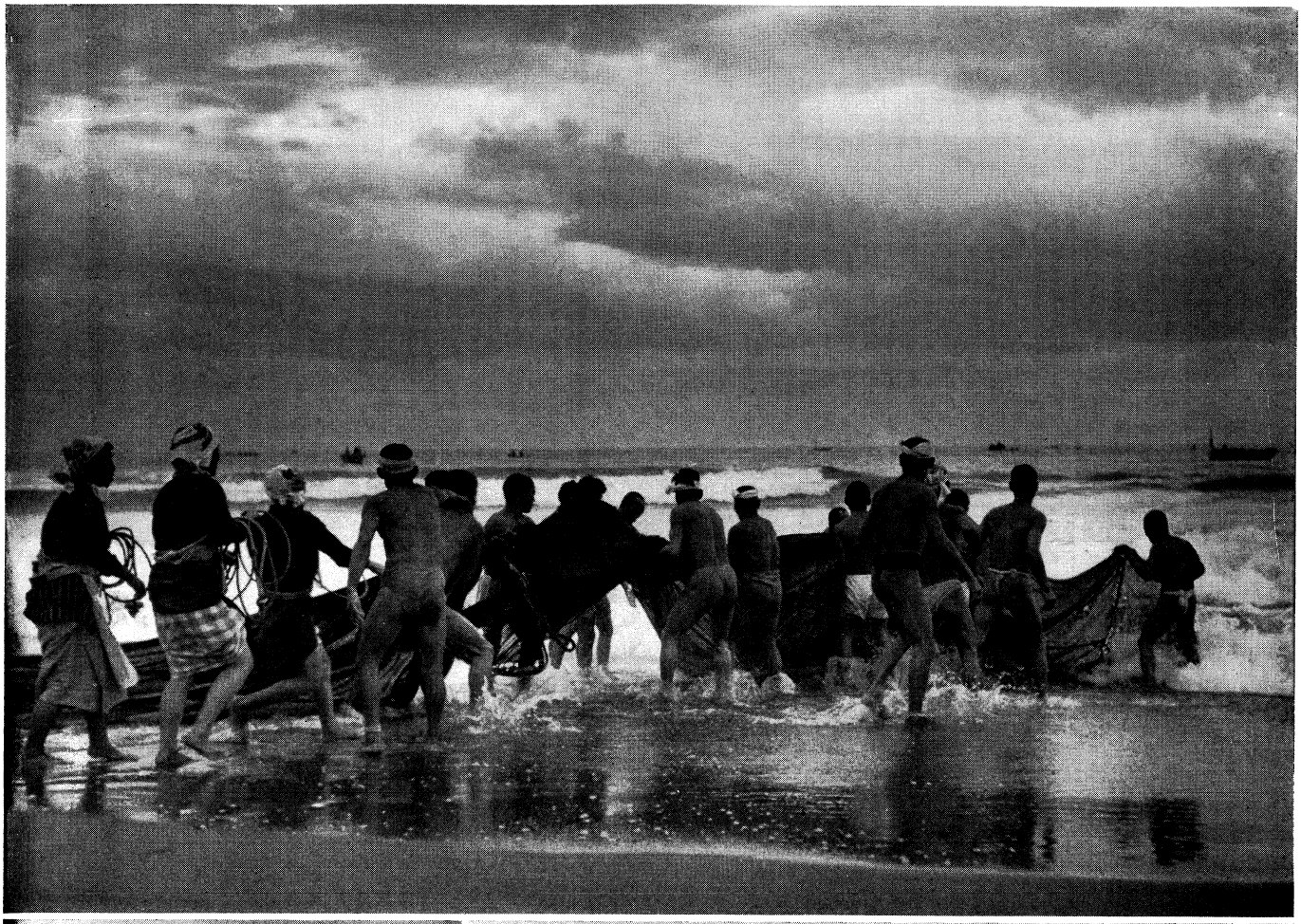
TRADITIONAL JAPAN

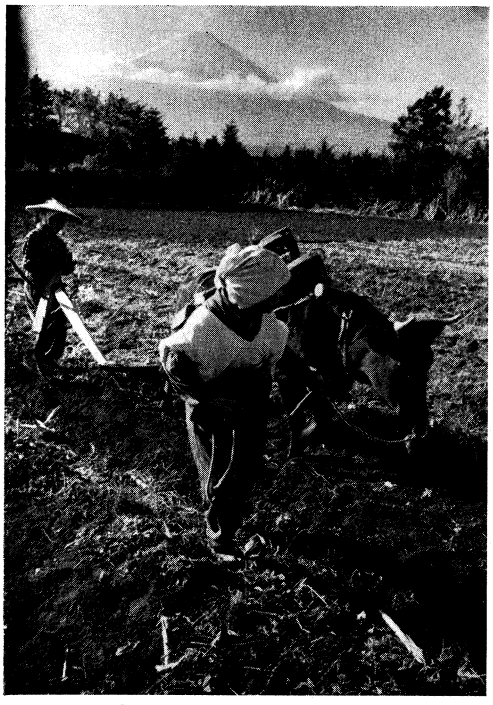
Top* left:** The tea ceremony, ***Cha-no-yu, symbolic to the Japanese of the aesthetic way of life, was founded in the 15th century. Special houses or rooms are constructed for the ceremony. The water is boiled in the sunken fire-pit shown at the right. The utensil used to whip the tea leaves may be seen in the bowl to the left of the fire-pit

Top right: A Geisha fan dance. The fan, ***Mai-Ogi,*** a part of the dance since the 17th century, is used symbolically to represent a variety of objects and events such as the rising of the sun or a cup of wine

Bottom: The gate or torii at Hakone shrine on Lake Ashi, Fuji-Hakone National park. The shrine was founded in the 8th century. The district is known for its giant cedar trees, some of which may be seen in the background, behind the torii

JAPAN





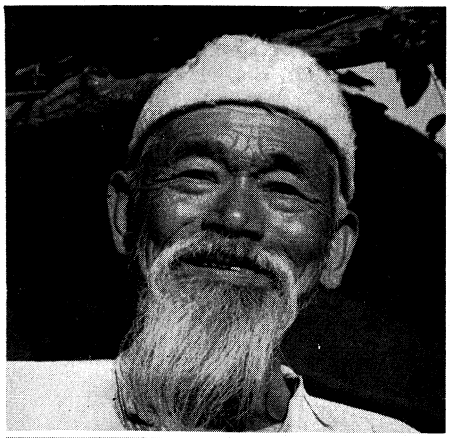
PHOTOGRAPHS, (TOP, BOTTOM RIGHT) EMMA GENE HALL, (BOTTOM LEFT) WERNER BISCHOF FROM MAGNUM

FISHING AND AGRICULTURE

Top: Fishermen of Kamogawa, a Honshu village, pulling in their nets. Fishing is a principal industry of Japan: the country was the leading fishing nation of the world in the 1930s

Bottom **left:** Women helping with the plowing on a farm near Mt. Fuji. In both fishing and agriculture women do much of the bard labour. Japanese farmers are among the most skilled in the world, producing per-acre yields that compare favourably with countries using more advanced equipment

Bottom *right:* Threshing rice in the fields. Japan is one of the world's largest producers of rice. Few farms, however, have mechanical threshers such as that shown in the photograph

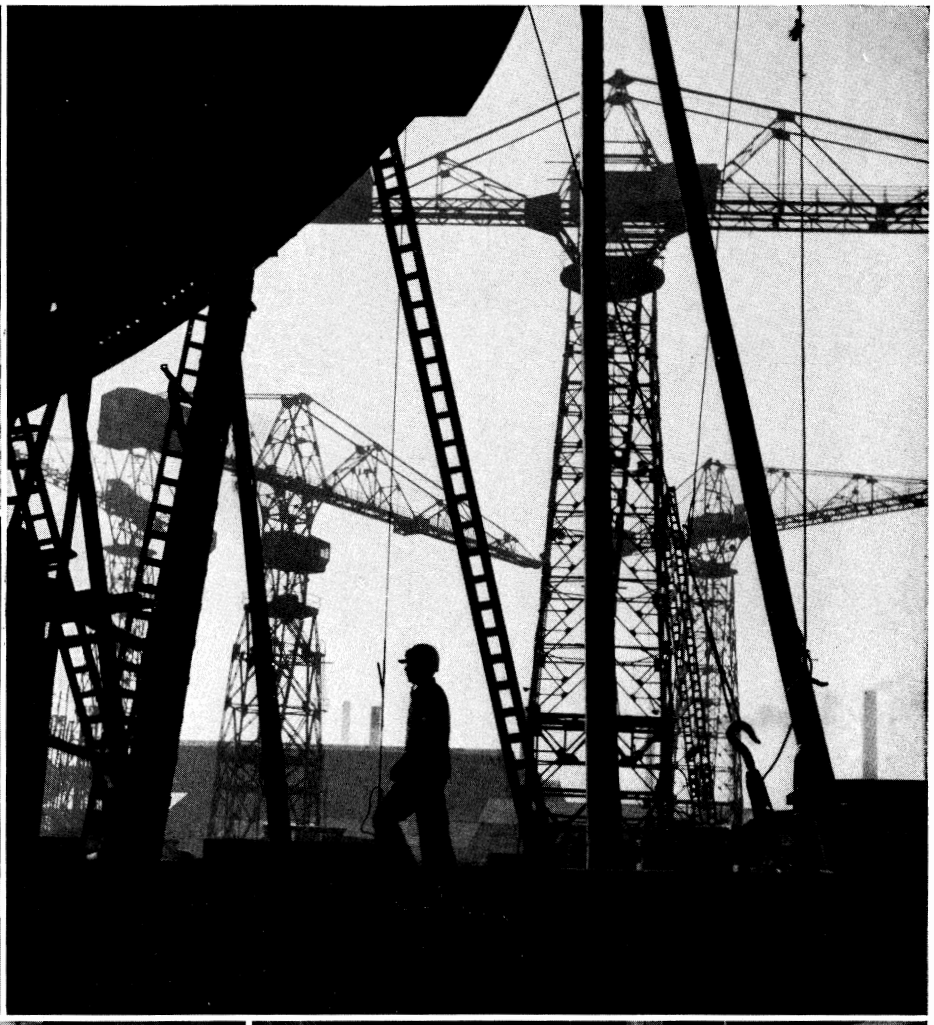


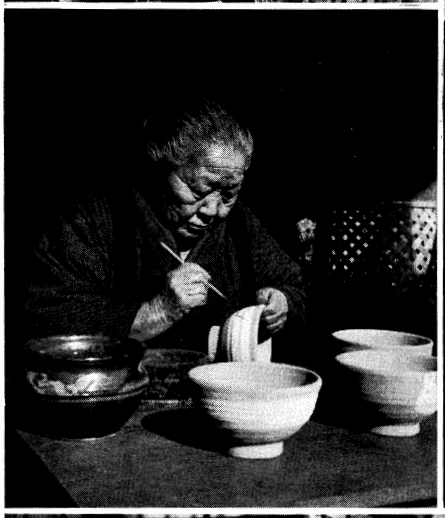
PHOTOGRAPHS, (TOP LEFT) EAST-WEST, (TOP RIGHT, CENTRE LEFT, BOTTOM RIGHT) EMMA GENE HALL, (BOTTOM LEFT) H. ARMSTRONG ROBERTS

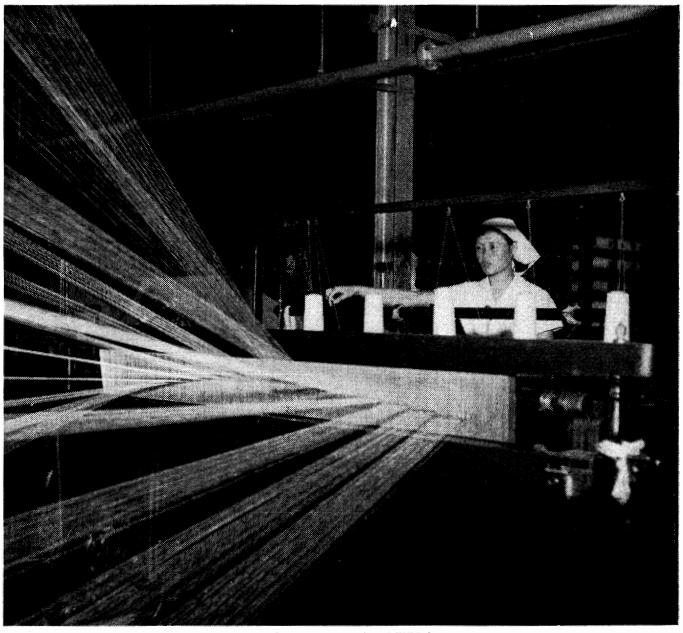
PEOPLE OF JAPAN

Top left: A white-bearded farmer
Top *right:* Little girl carrying her younger brother in a shoulder harness
Centre left: Faggot seller
Bottom left: *Komuso,* Buddhist mendicants. Every member of the *Komuso* must be proficient in playing a special flute, the Shakuhachi. It may be seen in the hand of the man on the left
Bottom *right:* An upper class family preparing to enter the tea house

JAPAN







PHOTOGRAPHS, (TOP LEFT, CENTRE LEFT) EMMA GENE HALL, (TOP RIGHT) WERNER BISCHOF FROM MAGNUM, (BOTTOM LEFT, BOTTOM RIGHT) EAST-WEST

HANDICRAFTS AND INDUSTRY

Top left: Weaving a bamboo basket
Top right: Tokyo shipyard. Although virtually destroyed by the end of World War II, the shipbuilding industry rapidly regained its importance as one of the world leaders
Centre left: Deccrating a pottery dish
Bottom *left:* Assembling toys in a small factory
Bottom right: Winding cotton thread on a large drum to be used on **the** looms

fairs, power and influence. By the late 18th and early 19th centuries Japanese "Dutch scholars" were aware of the power of the west and the folly of trying to withstand it without taking basic steps to strengthen Japan. Many feudal lords employed such scholars as physicians, and by the 19th century the larger fiefs had begun to sponsor western studies in hopes of strengthening their military and material potential.

There was thus a wide choice available in the intellectual climate of Tokugawa Japan, and the several schools that have been mentioned existed in a variety of combinations. On the whole the shogunate permitted intellectual inquiry so long as it mas not Christian and did not question or discuss policies openly. The ideologist-activists of the mid-19th century combined elements of several schools in forming their program of action. Thus Yoshida Shōin (1830–59), who became, by his martyrdom after the arrival of the foreigners, one of Japan's modern heroes, began with Confucian values and outlook, dabbled in western learning sufficiently to develop a lively curiosity and alarm about the prospects for Japanese independence, and stressed a doctrine of loyalty to the emperor who was, for him. both Confucian ruler and Shinto priest-king. The specialized teachings of the intellectuals and scholars thus became simplified in the course of their transmission downward. Under the crisis brought on by the foreigner's revelation of the shogunate's weakness, theories became slogans which served as rallying cries for programs of action.

The Opening of Japan. — In the last quarter of the 18th century the occasional arrival of foreign ships in search of trade or supplies startled the Japanese and alarmed the scholars of western learning, who saw in the ships evidence of significant intentions menacing Japan's independence. The Russians, whose expansion overland had brought them to the Pacific shores in the 17th century, approached from the Kurile Islands north of Japan. In 1787 an expedition to Japan was authorized by Catherine the Great. This and future efforts were inconclusive, and in 1811 a naval officer, V. M. Golovnin, was captured and imprisoned by the Japanese in retaliation for damage Russian sailors had done in coastal raids. The shogunate reacted by placing the undeveloped northern island of Ezo (Hokkaidoj under its direct administration, and a number of scholars, among them Hayashi Shihei (1738–93) and Honda Rimmei (1744–1821) wrote booklets in which they discussed ways of improving Japan's defenses against the menace from the north.

Great Britain renewed its interest in Japan during the Napoleonic Wars when. with Java under British rule. Deshima was the only spot which continued to fly the Netherlands flag. In 1808 the "Phaeton" entered Nagasaki harbour and, receiving an unfriendly reception, seized hostages, secured its supplies and escaped before countermeasures could be taken. Far more startling were the stories that came via the Deshima station of Britain's victory over China in the first "Opium War" of 1839–42. Scholars aware of this assumed that Japan would be the next to be tested; and Takano Chōei (1804–50) published, and was punished for, a pamphlet highly critical of the shogunate's obscurantist tactics.

During this period the role of the Netherlands trading station increased in importance, and the imports of books and weapons grew steadily. The Dutch, and especially the scientists who were attached to the station as doctors, received better treatment and had far more opportunity to contact and instruct Japanese friends than ever before. Philipp Franz van Siebold, who mas in Japan from 1823 to 1829 and again in the middle of the century, played a significant role in instructing young Japanese scholars, but when King William II of the Netherlands wrote the shogun in 1844 to advise the wisdom of opening Japan before the western maritime powers should force the issue the letter was not accepted. The shogunate, preoccupied with the reforms being carried out in those years and conscious of its military weakness, preferred to delay foreign relations as long as possible.

It fell to the United States to force the opening. Great Britain had led in China and was more than willing to step aside, while U.S. policy makers were anxious to anticipate what they felt was an inevitable British advance. Japan was in any case of more importance to the United States than to Great Britain, since it lay athwart the great circle route to China and because U.S. whalers who fished the North Pacific needed sources of shelter and supplies. Every motive of commercial advantage, as well as the powerful promptings of manifest destiny, thus contributed to the expeditions to Japan. The first: in 1846, was commanded by Commodore James Biddle. Biddle presented copies of the new treaties with China and requested a similar arrangement with Japan, but his requests were ignored. His peaceful departure after some rude treatment seemed a victory to the Japanese, but they had been much impressed by the size of his ships. It was realized that such warships had the capability of coercing Edo by blocking its ocean-borne food supply from Osaka.

In 1853 a new mission commanded by Commodore Matthew Calbraith Perry (*q.v.*) was sent. He presented his demands in the summer of 1853, announced he would return for a reply the following year and sailed for China. The C.S. ships caused consternation in Edo. The Japanese had known, through the Dutch, of Perry's coming, but they were powerless to prepare adequate defenses. Later in the summer the Russian envoy, Adm. E. V. Putiatin, came, and Perry, hearing of this, advanced his date of return, arriving in Feb. 1854. At Kanagawa, near modern Yokohama, conversations were held which led to a treaty signed on March 31. Japan agreed to open the ports of Shimoda and Hakodate to U.S. ships in need of supplies, to extend relief to shipwrecked mariners and to permit a U.S. consul or agent at Shimoda.

The treaty had no clear provisions for trade. envisaged the procurement of supplies through shogunal officials and opened two poor and remote ports. It was, however, the first step in a process that was completed by Tomnsend Harris, the consul general, who arrived in 1856. Harris worked with the greatest patience and tact. He had no ships at his disposal. but he made effective use of the news of Chinese reverses in renewed warfare with England and France. He insisted on presenting his credentials personally to the shogun in Edo, and in 1858 he worked out the first modern treaty calling for trade. Its provisions governed duties, coinage exchange. extraterritoriality and freedom of religion for Americans with right of residence in six ports, of which the last was to be opened by 1863. The treaty-port system, developed in China, was now established in Japan. The most-favoured-nation clause extended America's benefits to the other powers who followed in short order to claim their treaties. The treaty was unwelcome to the Kyōto court, but shogunal officials ratified it on their own authority in 1859.

Thereafter foreign representatives and traders played an important role in Japanese politics until the end of the shogunate in 1867. Atrocities against them by antiforeign fanatics resulted in punitive steps, as when the British shelled Kagoshima in 1863 and a foreign flotilla shelled Shimonoseki the following year. Foreign traders disrupted old patterns of trade and provided new commercial opportunities for merchants previously at a disadvantage in competing with the traditional guilds. And the foreign ministers entered the political scene with advice and threats. The Cnited States, which led in opening Japan, was soon outdistanced in trade and influence by Great Britain. French minister Léon Koches saw the possibility of a favoured position for the second empire by sponsoring a program of technical and military aid for the shogunate. British minister Sir Harry Smith Parkes and his knowledgeable interpreter Sir Ernest Satow, however. realized that the future lay with the great fiefs of the southwest which had begun to show signs of hostility to the shogunate.

E. The Meiji Restoration

The term "restoration" is commonly applied to the political changes that returned power to the throne during the reign of Mutsuhito, who took the reign name Meiji ("enlightened rule," 1868–1912). The slogan of "return to antiquity" (*fukkō*) made it possible, to interpret sweeping changes as traditional in motivation. Actually the Meiji changes constituted a social and political revolution that began before 1868, and political innovations ended only with the promulgation of a constitution in 1889.

Fall of the Tokugawa.—The arrival of the foreigners in the 1850s provided a new issue for domestic politics and a nem measure for effectiveness of the feudal administration. When it became

clear that the "barbarian-subduing generalissimo" was unable to protect Japan from the barbarians, and that his concessions to them were made in spite of their known repugnance to the imperial court in Kyōto, the two shogunal boasts of loyalty to and protection for the court proved spurious. The slogan *sonnō-jōi* ("Revere the emperor! Drive out the barbarians!") was first raised by men who sought to influence shogunal policy, and then taken up by others who wanted to embarrass the Tokugawa. The shogun's ratification of the Harris treaty and others which followed was carried cut in the face of strong opposition from the Kyoto court, and it brought to the surface antagonisms that had developed during the long years of peace and study. They did not immediately centre in distant fiefs, but in the Tokugawa house of Mito which had done much to sponsor Confucian scholarship. The Mito *daimyō* made vigorous attempts to involve the Kyōto court in affairs of the *bakufu* with a view to establishing a nation-wide program of preparedness. For this he was punished by the head of the Edo council of elders, Ii Naosuke. In 1860 Ii mas assassinated by men from Mito and Satsuma. This bold assault upon the chief of the Tokugawa administration inaugurated years of violence, Many of those nho took part mere young samurai who had become friends during periods of study in Edo fencing academies. Their swords availed little against the foreigners' guns, but they took a heavy toll of political enemies.

The pears which followed were a time of extremism. The Tokugawa shogunate, anxious to rally support among its feudatories and to help them to prepare their defenses, relaxed its controls and regulations concerning attendance in Edo, and thereby increased the opportunities for intrigue and conspiracy. In many fiefs young enthusiasts now tried to push their feudal superiors into a less cautious and more strongly antiforeign position. It soon became obvious to most men that expelling the foreigners by force was impossible. Each antiforeign act provoked stern countermeasures and diplomatic indemnities which tightened the foreign hold on the country. After the bombardment of Kagoshima and Shimonoseki there could not be any doubt of the foreigners' military superiority. Thereafter the slogans of antiforeignism and exclusion continued to be used chiefly as a means of obstructing and embarrassing the shogunate. The Edo policy makers were forced to make surface concessions to the antiforeign elements which succeeded only in arousing the hostility and distrust of the treaty powers. After the arrival of the British minister Parkes in 1865, Great Britain in particular began to tire of the difficulties of negotiating with a *bakufu* which stood between them and the Kyoto court and began to consider ways of dealing directly with the latter. It gradually became clear that ultimate authority and moral supremacy lay in Kyōto.

In some fiefs the young extremists who tried to alter the policies of their superiors found themselves unable to budge them from their conservative positions. From Chōshū (now part of Yamaguchi prefecture). foreign shipping in the Straits of Shimonoseki was shelled in 1863. This drew the foreign bombardment the following year. Samurai opinion grew so vehement that after the fief authorities submitted to Tokugawa discipline in 1864 a swift military coup brought to power. as the *daimyō*'s counsellors, a group of men who had led the radical antiforeign movement. But they were no longer blindly antiforeign; several had secretly traveled to England. Their aims had become national — to overthrow the shogunate and create a new government headed by the emperor. The same men developed new militia units based on western training methods and arms, units which included commoners as well as samurai. Chōshū became the centre for discontented young samurai from other fiefs who were impatient with their leaders' caution. In 1866 Chōshū allied itself with the great fief of Satsuma in expectation of a Tokugawa attempt to crush all *tozama daimyō* opponents and erect a centralized despotism with French help.

When the Tokugawa armies attempted to crush Chōshū in 1866 they were successfully repulsed and the shogunate lost power and prestige swiftly as a result. The death of shogun Iemochi in 1866 brought to power Hitotsubashi Keiki (who took the name Yoshinobu), a man whose long service in national affairs had made him fully aware of his ambivalent position and the pressing needs for national unity. He spumed suggestions of his advisers that he seek French help to put down his enemies When he was urged by the lord of Tosa to resign his powers, he did so rather than risk a full-scale assault by Satsuma and Chōshū, confident that as lord of eastern Japan he would emerge as an important figure in whatever new political organization should develop. But his enemies were not put off so quickly. The young Meiji emperor, who had succeeded to the throne in 1867. was guided by the counsels of several nobles in close touch nith leaders of Satsuma and Chōshū, and the last shogun mas skillfully maneuvered into a choice between giving up his land, which would risk revolt from his vassals, or appearing disobedient, which mould justify punitive measures. Keiki's armies advanced on Kyoto, only to be defeated. Satsuma, Chōshū and Tosa units, now the "imperial army," advanced on Edo, which was surrendered without a battle. Fighting continued to the north until the summer of 1869, but the Tokugawa cause was doomed. Early in Jan. 1868 the principal lords were summoned to the imperial palace in Kyōto to hear a proclamation announcing the restoration of imperial rule. The next year the capital was moved to Tokyo, and the building of the modern state began.

From Feudal to Modern State. — The Meiji government began without a clearly enunciated program of political policy, but its goals were reasonably clear. The leadership group was dominated by the Satsuma, Chōshū and court figures who had outmaneuvered the shogun. They were convinced that Japan would need a unified national government in order to achieve military and material equality with the western powers. Most of them, like Kido Kōin and Itō Hirobumi of Chōshū and Saigō Takamori and Ōkubo Toshimichi of Satsuma, were young samurai of modest rank, but they did not therefore represent in any sense a "class" interest. Indeed, their measures destroyed that class. In order to gain backing for their measures they enlisted leaders of fiefs with which they had worked — Itagaki and Gotō of Tosa. Ōkuma and Soejima of Saga, Yuri of Echizen — and maintained their co-operation with court nobles like Iwakura and Sanjō.

The co-operation of the impressionable young emperor mas essential to their purposes. They had come to power at a time when it was taken for granted that western strength depended on constitutionalism, which produced national unity; on industrialization, which produced material strength; and on a well-trained military. The new slogan of the day became *fukoku-kyōhei* ("rich county, strong arms"). Knonledge was to be sought in the west, whose good will was in any case essential if the "unequal treaties" were to be revised. Therefore a number of missions to the west were organized. In 1871 Iwakura Tomomi (*q.v.*) led a large number of his fellow government leaders to visit Europe and the U.S. The experience gained abroad strengthened convictions already formed as to what was to be done.

The Meiji leaders began with measures to lessen the feudal decentralization on which they blamed much of Japan's weakness. In 1869 the Satsuma, Chōshū, Tosa and Saga leaders persuaded their *daimyō* to return their lands to the throne, and after this petition was accepted other lords hastened to follow suit. The court took steps to regularize and make uniform administration in the fiefs. but it appointed the former lords as new governors. In 1871, with the war against the Tokugama won the government was prepared to take its second step; it had been realized that the decentralization had been ended only in name. The governor-*daimyō* were now summoned to Tokyo, and feudalism was declared abolished. The approximately 300 fiefs became 72 prefectures and 3 metropolitan districts, and in future years this number was further reduced by one-third. For the most part the *daimyō* lost all contact with administration, and although they were rewarded with titles in the new European-style peerage that was set up in 1884 their political importance was slight.

It was equally necessary to take steps to put an end to the complex system of social stratification that had existed under feudalism. The feudal lords could be given titles and reasonably generous pensions, but it was far more difficult to make arrangements for the samurai, who numbered, with dependents, almost 2,000,000. In 1869 laws were issued replacing the old hierarchy

with a new and simpler division whereby court nobility and feudal lords were termed aristocracy (kazoku). samurai were termed *shizoku* and all others were called commoners (heimin), including even the previously unlisted pariah groups. The samurai, now that their old administrative function was lost, were given pensions equal to a part of their old income. When the regime found these pensions too heavy for its treasury to carry, the pensions were changed to interest-bearing but nonconvertible bonds. During the same years, laws were enacted to discourage the samurai's special hairdo; the wearing of swords, the former badge of class, was later banned.

The pensions and bonds were soon lost, since few of the warriors had had occasion to develop commercial aptitude; even where they were not lost, the inflation that accompanied government expenditures lessened their value greatly. In 1873, moreover, a system of nation-wide conscription was instituted, depriving the samurai of their traditional monopoly of military service. There were a number of samurai revolts. The most serious centred in the great fiefs of the southwest which had led in the restoration movement, and where warriors previously had reason to expect the greatest rewards. Some revolts, as in Chōshū, were expressions of discontent against administrative measures that deprived samurai of their importance while in Saga the dissidents championed a proposed foreign war to employ samurai.

The last and greatest revolt came in 1877 in Satsuma, led by the restoration hero Saigō Takamori (*q.v.*). The new conscript levies were hard pressed to defeat Saigō, and the government found it necessary to enlist former samurai and empty its military academies in order to put down the revolt. Fortunately for the government. the revolts expressed regional discontents and were never co-ordinated. Even in the case of the Satsuma war, the malcontents enlisted only part of the support they expected; loyalties of most of the Satsuma men in the central government remained with the imperial cause. (See SATSUMA REBELLION.)

The abolition of feudal principalities and the expropriation of the feudal classes made it possible to do away with the old land system and institute a predictable and regular national tax. In 1873 land surveys were begun to determine the amount and value of land on the basis of average yield in recent years. A tax in money of 3% of the value was then set as the land tax. Out of the same surveys came certificates of ownership of land for farmers, who were also released from feudal controls which had hindered their choice of crops as well as their freedom to move or to change vocations. The land measures were some time in being completed, and as they involved basic changes there was widespread confusion and uncertainty among the farmers, frequently expressed by short-lived revolts and demonstrations. The establishment of private ownership, added to the energetic measures the regime took to promote new technology, fertilizers and seeds, soon produced a striking rise in agricultural output. The land tax, supplemented by printed money, was the principal source of the government's income.

Although it was hard pressed to find money to meet its obligations for pensions and administrative costs, the government went forward with a program of industrialization a-hich had been part of its original plan. Aside from military industries and strategic communications, the program was carried out in private hands, although it had the advantage of subsidies and administrative encouragement. Trade and manufacturing benefited from the new national market and legal security which the government had created. In addition, disorder in China made it possible for Japanese traders to sell on international markets without serious Asian competition.

The pattern of government encouragement through pilot plants and experimental stations changed in the 1880s when a fear of excessive inflation resulted in a decision to sell most of the new plants to private investors. These were usually persons who had close relations with government officials. The small number of individuals who came to dominate many enterprises in this manner were known as the zaibatsu or financial cliques. With tremendous opportunities and few competitors, the same firms appeared in enterprise after enterprise. Their aims were close to those of the government leaders, and there were often close friendships between them. The house of Mitsui, for instance, had close relations with several Meiji leaders, while that of Mitsubishi was founded by a Tosa samurai who had been a colleague of the restoration leaders.

Equally important for the building of a modern state was the substitution of national for feudal loyalties. The latter had already gone into decline with the abolition of the feudal classes, but true national unity required the propagation of new loyalties among the masses previously inarticulate and powerless. The early restoration government was influenced by the Shinto revival. It elevated a bureau of Shintō, the state cult, to the highest position in the new political hierarchy and it strove to replace Buddhism by a strong cult of the national deities. Christianity was legalized in 1873, with great reluctance, after the Iwakura mission reported from Europe that this would be necessary, and thereafter it seemed particularly important to bolster traditional outlooks without risking foreign condemnation by forcing a state religion upon the Japanese. The education system proved to be an ideal vehicle for ideological orientation. A system of universal education was announced in 1872. It began modestly. and for a time its organization and philosophy were western inspired. During the 1880s, however, as the government leaders saw their countrymen turning to western ideas and as they learned of the new nationalist orientation of schooling in Europe, the Japanese system was altered to include emphasis on "ethics"; and in 1890 an imperial rescript on education laid out the lines of Confucian and Shinto ideology which were to constitute the moral content of later Japanese education. By this means, loyalty to the emperor. who was hedged about with Confucian teaching and Shintō reverence, became the centre of the citizen's ideology. At the same time the state distinguished between this secular cult and religion to avoid charges of indoctrination. As a result, the government leaders could permit "religious freedom" at the same time that they required a form of worship as the patriotic duty of all Japanese subjects. The uniform system of mass education so oriented was also utilized to project into the nation at large the ideal of samurai loyalty that had previously been the heritage of the ruling class.

The Constitutional Movement. — In late Tokugawa days it was widely believed that constitutions provided much of the unity that gave western countries their strength, and the Japanese leaders were eager to bring themselves abreast of the world in this respect. An early government plan of 1868 experimented with a two-chamber house, but it proved unworkable in view of the government leaders' preference for having their own way. The emperor's so-called charter oath of April 1868, however, committed the government to seek knowledge and wisdom throughout the world, abandon customs of the past, allow all subjects to fulfill their proper aspirations and determine government decisions by reference to a broadly based opinion.

To these statements of intent were added protests from below. The democratic movement grew out of a split in the leadership group over government policy in domestic and foreign matters. Itagaki Taisuke (*q.v.*), Gotō Shōjirō and other leaders of the Tosa faction combined with Etō Shimpei and others of the Saga fief in 1873. Their demands for a punitive expedition against Korea, whose obscurantist government had insulted Japanese envoys, had been refused because domestic reforms were to come first, and they resigned their positions. The same debate had cost the government the services of Saigō Takamori, who retired to Satsuma prior to leading the Satsuma rebellion in 1877. Instead of championing the old order, however, Itagaki and his friends called for a popular assembly so that future decisions would reflect the will of the people (by which they initially meant their fellow samurai) and thus preserve unity. Some of those who joined the group were more angry than democratic; Etō Shimpei was killed after leading a group of Saga followers in revolt in 1874. Itagaki and his Tosa followers organized themselves into discussion and mutual-help groups and, gradually growing in political confidence and ability, organized themselves on a national basis as the Liberal party (Jiyūtō) in 1881. It should be noted that the movement

had only a narrow social and regional base at this time, and that its purposes were to promote effective national unity rather than tolerance of diversity and dissent.

New divisions within the narrowing leadership group brought a second political party into the field. When the remaining Meiji leaders were asked to submit their opinions on constitutional problems in 1881, Ōkuma Shipenobu (*q.v.*), a Saga leader who had sided with the peace party in 1873, revealed a relatively "liberal" draft instead of first submitting it for the scrutiny of his colleagues. At the same time that he did this, he revealed sensational evidence of corruption in the disposal of government assets on Hokkaido. Ōkuma was forced out of the government, after which he organized his Progressive party (Kaishintō) in 1882. Itagaki's Liberal party had a predominantly rural backing of former samurai and village leaders, many of whom objected to government taxation policies; the new party of Ōkuma had a predominantly urban base and attracted much support in the business and journalistic worlds. (See *Administration and Social Conditions: Political Parties and Pressure Groups*, below.)

The government, stung by Ōkuma's defection, countered with a promise by the emperor that a constitution would be instituted in 1889; the populace—by which was meant the parties—were urged to await the imperial decisions quietly. The constitution was prepared behind the scenes by a commission headed by It6 Hirobumi (*q.v.*). The period of constitution writing coincided with one of intense economic distress as the government sought to stem the inflation caused by the spending of the 1870s. Finance Minister Matsukata Masayoshi's policies succeeded in this purpose, but his deflationary measures caused hardship in the countryside and provided a situation in which party agitation could easily kindle direct action. After being embarrassed and frightened by several instances of this and hampered by severe government repression in the form of police and press controls, the parties dissolved temporarily in 1884. Itagaki and Got6 traveled to Europe, and returned more than ever convinced of the need for national unity in the face of western condescension.

It6 Hirobumi also traveled to Europe to get help in the preparation of the new constitution. In Prussia he found what seemed an appropriate balance of imperial power and constitutional forms; this seemed to offer modernity without sacrificing effective control. Several German jurists assisted him and his commission. As a counterweight to the influence of a popularly elected house. It6 first organized a new European-style peerage in 1884. The government leaders, military commanders and former *daimyō* were given titles and readied for future seats in a house of peers. A cabinet system was installed in 188 j and a privy council, designed to judge and safeguard the constitution, was set up in 1888. It6 resigned as premier to head the council and thus saw his document safely through.

The constitution was completed by 1889, and elections for the lower house were held to prepare for the initial diet which met in 1890. The constitution took the form of a gracious grant by the emperor, and it could be amended only upon imperial initiative. Its provisions were couched in general terms. Rights and liberties were granted "except as regulated by law." As in the Prussian system, if the diet refused its approval of a budget the previous year's could be followed. The emperor was "sacred and inviolable"; he commanded the armies, made war and peace and dissolved the lower house at will. Effective power thus lay with the executive, which could claim to represent the imperial will. The education rescript, also introduced in 1890, was to guarantee that future generations would accept the imperial will and authority without question. In spite of these and other antidemocratic features, the constitution provided a much greater area for dissent than had previously existed. The lower house had the power of initiating legislation. Private property was inviolate and freedoms, even when subject to legislation, were greater than none at all. Even the budgetary arrangements meant that increased support for the military could be had only with diet approval. Initially a tax qualification of 15 yen limited the electorate to about 500,000. This qualification was lowered in 1900 and 1920, and in 1925 universal manhood suffrage came into effect. The difficulty the government leaders had in controlling and manipulating the lower house, despite their power of dissolution and their resources for intimidation and bribery, illustrated the manner in which the constitution had altered the political picture. In turn, the way the party leaders co-operated with their erstwhile enemies when given a reasonable amount of prestige and patronage illustrated what large areas of agreement they shared with the Meiji oligarchies.

With the promulgation of the constitution the Meiji restoration and revolution came to an end. Thereafter the government leaders, who would soon retire behind the scenes to influence the political world as "elder statesmen" (*genrō*), acted to maintain and conserve the balance of ideological and political institutions they had worked out.

F. Imperial Japan

Foreign Affairs.—With internal reforms completed, the Japanese government set itself to achieving equality with the western powers. This had been one of the major goals since the beginning of the Meiji period. Treaty reform, designed to end the humiliating judicial and economic privileges the foreigners enjoyed by virtue of extraterritoriality and fixed customs rates, had been attempted as early as the Iwakura mission of 1871, but the western powers refused to consider it until Japanese legal institutions had been brought into line with those of the west. The Japanese made several attempts for compromise arrangements in the 1880s, but these were denounced by the press and opposition groups in Japan; in one case a nationalist extremist threw a bomb at Foreign Minister Ōkuma, nearly killing him, The treaty provisions for extraterritoriality were formally changed in 1894, after the completion of the Meiji institutional reforms; tariff autonomy came into effect in 1911, at the end of the Meiji period.

Asian matters took second place to internal problems during most of the Meiji period, as the government leaders held to a policy of caution; even those calling for a "positive" policy justified their arguments by pointing out that foreign adventures would provide an outlet for samurai energies and a focus for national unity. The government withstood pressure for such a course during the debate about Korea in 1873, although it lost the services of some of its most popular leaders. In 1874 a punitive expedition was launched against Formosa to chastise the aborigines for murdering Ryukyuan fishermen. This lent support to the Japanese claim to the Ryukyus, which had been under Satsuma influence in Tokugawa times; the islands were incorporated into Japan in 1879 despite Chinese protests. Adventures in Korea, however, although they were espoused by nationalists and, on occasion, liberals who sought to advance their cause in conjunction with Korean reformers, were avoided by the government, which was conscious of its need for internal reform and foreign approval. The matter was complicated by a growing Chinese readiness to resist Japanese interference in the affairs of China's most important tributary state. Chinese interests in Korea were represented by Yüan Shih-k'ai (*q.v.*) after 1883, and he was alert to the danger of Japanese gains. Incidents in 1882 and 1884 which might have led to war with China and Korea were instead settled by compromise. It6 met with the Chinese statesman Li Hung-chang at Tientsin in 1885 to work out an agreement in which China and Japan agreed that neither would send troops to Korea without first informing the other.

By the early 1890s it was increasingly clear that Chinese influence in Korea was becoming predominant. At the same time, the Meiji leaders found themselves hard pressed to maintain control over the diet in the early years of its operation. In 1894 a rebellion in Korea provided the occasion for a Korean request to China for assistance in putting it down. When the Chinese informed Tokyo of this, Japan quickly rushed troops to Korea and, after the rebellion was crushed, showed no inclination to withdraw. Hostilities between Chinese and Japanese forces broke out first at sea and then in Korea in July–Aug. 1894. Japan's modernized forces were everywhere victorious. The Japanese navy sank or captured much of the northern Chinese fleet, which had been dogged by bureaucratic inefficiency and corruption in the supply services.

A peace treaty was negotiated at Shimonoseki between It6 Hirobumi for Japan and Li Hung-chang for China on April 17, 1895. By its terms both powers recognized the independence of Korea; China ceded Formosa, the Pescadores Islands and the Liaotung peninsula, granted Japan all rights enjoyed by European powers and made significant new economic concessions as well; new treaty ports were opened, and Japan received an indemnity of 200,000,000 taels in gold in two installments. A subsidiary treaty of commerce signed in 1896 gave Japan freedom to engage in trade, manufacture and industry in China's treaty ports, and provided for tax exemption within China for all goods so manufactured. Japan thus marked its own emancipation from unequal treaties by imposing even harsher terms on its neighbour. But the European powers were not yet prepared to welcome Japan as a full equal in the imperialist scramble in China. Germany, France and Russia forced Japan to return the Liaotung peninsula to China; in 1898 Russia forced China to grant it the lease of that peninsula with its important naval base at Port Arthur. The war thus demonstrated that even though Japanese arms sufficed to win Asian victories they could not maintain them without western sufferance. The war nevertheless proved a tremendous source of prestige for Japan, and it brought the Tokyo government much internal support; it also strengthened the hand of the army in national affairs. Army leadershi;, rested with Yamagata Aritomo (*q.v.*).

Although Chinese influence had been removed in Korea the Japanese found that they still met resistance; instead of accepting Japanese leadership, Korea sought the help of the Russians as a counterweight. During the Boxer rebellion (1900) Japanese troops took a major part in the work of the allied expedition that rescued the foreign nationals in Peking, but Russia took advantage of the emergency to occupy south Manchuria, thereby strengthening communications with Korea. Realizing the need of protection against a possible combination of European enemies such as the one that had blocked earlier gains in Manchuria, the Japanese government began talks that led to the Anglo-Japanese alliance (*q.v.*). By its terms each signatory was to come to the aid of the other in the event of an attack by two or more powers while remaining neutral if the other was at war with a single power. With this safeguard the Tokyo government nas prepared to take a firmer line with respect to Russian advances in Manchuria and Korea. In 1904 Japanese ships attacked the Russian fleet at Port Arthur without the formality of a declaration of war. Japanese arms were everywhere successful; the most spectacular victory was that in Tsushima strait when the ships of Adm. Tog6 Heihachirō (*q.v.*) destroyed the Russian Baltic fleet, which had sailed around half the globe in an effort to tip the scales. But Japanese armies, despite victories at Port Arthur and in Manchuria, were strained to their utmost. and it was with relief that Japan accepted Pres. Theodore Roosevelt's offer of good offices for the negotiations that led to the peace signed at Portsmouth, N.H., Sept. 5, 1905. By its terms Japanese primacy in Korea mas recognized, and Russia surrendered to Japan its economic and political interests in south Manchuria (including the Liaotung peninsula), as well as the southern half of the island of Sakhalin. The victory over Russia represented a tremendous achievement for Japan. It altered the balance of power in Asia, and its demonstration of Asian ability to cope with a great European power, albeit a backward one accelerated the development of nationalist movements in Asia. Within Japan, however, the failure to secure a Russian indemnity to cover the costs of the war made the treaty unpopular. (See RUSSO-JAPANESE WAR.)

After the conclusion of the war Japanese leaders made new efforts to guide the course of reform in Korea. They now had a free hand, and Korean resistance was met with force. Itō Hirobumi was sent to Korea as resident general; he forced through treaties which gave Korea little more than protectorate status and forced the abdication of the Korean king. In 1909 Itō mas assassinated, and the following year Korea was formally annexed to Japan. Korean liberties and resistance were crushed under military rule. By the end of the Meiji period Japan had thus achieved equality in every sense with the west, and had in fact succeeded its rivals as the strongest military and imperialist power in Asia.

Japan had abundant opportunity to use its new power in the years that followed. World War I found the western powers fully occupied in Europe. Japan took part in the war in compliance with the Anglo-Japanese alliance, but except for some convoy assistance it limited its participation to the seizure of the German Pacific islands and the German holdings on the Shantung peninsula. When China pressed for return of these, the Japanese government presented the so-called 21 demands in Jan. 1915. After several months of negotiation, Pres. Yüan Shih-k'ai reluctantly agreed to provisions which extended the duration of the Manchurian leases and to joint control of the Han-yeh-p'ing company's steel- and ironworks in central China. The German Shantung holdings were to be settled by agreement between Japan and Germany at the time of the peace treaty; subsequently Japan agreed to hand back the territory in return for further commercial privileges. China promised not to alienate harbours in Fukien province to any other power without Japanese approval. The Chinese successfully resisted group v of the 21 demands which would have reduced China to the status of a Japanese ward. The new privileges brought Japan abundant opportunity for the exploitation of Manchuria. But the ill-feeling aroused by the negotiations, together with Chinese chagrin at failure to recover these losses in the treaty of Versailles, cost Japan whatever hopes there might have been of Chinese friendship. Subsequent Japanese sponsorship of corrupt war-lord regimes in Manchuria and north China helped to confirm the anti-Japanese nature of modern Chinese nationalism.

Japanese behaviour during the Allied intervention in Siberia in 1918 after the Bolshevik Revolution furthered the impression of Japanese rapacity. It was generally concluded that the underdog had now become the bully, and one of the principal results hoped for from the disarmament conference held at Washington, D.C., in 1922 was a lessening of Japanese influence. The network of treaties that was worked out replaced the Anglo-Japanese alliance with a set of treaties designed to restrain Japanese ambitions while guaranteeing Japanese security. Japan, Great Britain, the United States and France concluded a four-power pact which replaced the Anglo-Japanese alliance, while in the five-power pact for disarmament limitations were set up for capital-ship construction on a ratio of five for Great Britain and the U.S. to three for Japan. Parallel guarantees against fortifying advanced bases assured Japan of safety in Pacific waters. The nine-power pact would, it was hoped, protect China from further unilateral demands. Subsequent to the official conference sessions Japan agreed to retire from Shantung, and shortly afteru-ard Japanese armies also withdrew from Siberia and northern Sakhalin. In 1925 a treaty with the Soviet Union extended recognition and brought to an end the active hostilities with the Soviet government.

The mid-1920s thus saw the end of Japan's great surge forward in the Pacific and brought hope that a new quality of moderation and reasonableness. based on the absence of irritating reminders of inferiority and weakness, might characterize Japanese policy. Under the administration of Foreign Minister Shidehara Kijūrō that followed these hopes seemed well founded.

Constitutional Government. — The inauguration of constitutional government in 1890 found the government having difficulty achieving its purposes because of a vigorous and often obstreperous opposition in the lower house of the diet, and it was probably due to the general determination to prove to a skeptical world that parliamentary institutions could work in Japan that the party and government leaders co-operated sufficiently to make the system work. The first cabinets, led by Yamagata, Matsukata and Itō, attempted to maintain the principle that the government, which in their view represented the emperor, should be aloof from parties, and that it was the duty of the lower house to approve government requests. This policy failed, for the parties were desirous of increasing their power and patronage and therefore sought cabinets responsible to the lower house. After several struggles which were resolved by the use of money and force on the part of the government, it was only the Chinese-Japanese War of 1894–95 that produced the kind of unity the constitution makers had envisaged. In the years that followed the oligarchs formed alliances

with the two parties, usually exchanging a cabinet seat or two for support in the lower house. These arrangements proved to be unsatisfactory as the party leaders soon raised their sights. In 1898 Itagaki and Ōkuma combined forces to form a single party, the Kanseitō, and since this ruled out successful administration by a nonparty cabinet they were allowed to form a government. But their alliance was of short duration, as long-standing animosities and jealousies made it possible for antiparty forces among the bureaucracy and oligarchy to force their resignation within a few months.

There now developed a discernible division in the ranks of the dwindling group of Meiji leaders. Yamagata Aritomo, the Chōshū restoration hero, dominated the army and much of the bureaucracy. During the two years he held power after the fall of the Kenseitō cabinet in 1898 he strengthened legal and institutional safeguards against political party rule and secured an imperial ordinance to the effect that the service ministers should be career officers on the active list; this gave the army or navy power to break a cabinet. Partly in reaction to this growth of institutionalized power, the other outstanding member of the oligarchy, It6 Hirobumi, also of Chōshū, formed his own political party in 1900, the Rikken Seiyūkai, enlisting most of the former followers Of Itagaki. who thereby abandoned a good many of their political principles and all their autonomy of action in return for power and patronage.

After 1901 both It6 and Yamagata retired from active participation in politics; until 1913 cabinets were led by their protégés Saionji Kimmochi (1849–1940; *q.v.*) and Katsura Tar6 (1847–1913). Basic decisions of politics and policy, however, continued to be made by the core group of elder statesmen. They advised the emperor on all important decisions and selected prime ministers by rotating power between the two principal factions. Saionji was the last to be recruited into this extraconstitutional body, although prime ministers in the 1920s and 1930s were often consulted as "senior servants" (*jūshin*).

With the death or enfeeblement of the first generation of leaders, the pattern of political manipulation changed. No subsequent group could match the prestige the Meiji leaders had enjoyed. The death of the Meiji emperor in 1912 ended a remarkable reign. He was succeeded by a son who took the reign name Taishō ("great righteousness," 1912–26); his mental illness prevented him from approximating his father's fame. The growth in power of new social forces like those of the world of business found expression in their control of the political parties and resulted in an increasing role for professional party politicians. The *genrō*'s last attempt to seat Katsura in 1512 ended in failure. while his successor, Adm. Yamamoto Gombei, was discredited by scandals in naval procurement. Ōkuma Shigenobu emerged from retirement to head a cabinet during World War I, and was succeeded by a military cabinet under Gen. Terauchi Masatake. In 1918, however, discontent with Terauchi's reactionary posture and his administrative incompetence combined with the rising power of the party professionals to bring about the appointment of Hara Kei (Takashi: *q.v.*) as prime minister. Hara was the first nontitled person to hold their office, and his appointment marked the first "party cabinet." His assassination in 1921 cut short his cautious efforts to reduce the power of the military and the bureaucracy and to extend the franchise. After several short-lived cabinets headed by nonparty figures, a highly successful party cabinet was organized in 1924 by Katō Takaaki (1860–1926). Under him universal manhood suffrage was introduced. The army was reduced in size, moderate social legislation was enacted and universal manhood suffrage extended the franchise to some 14,000,000 voters. In these same years Katō's foreign minister, Shidehara Kijūrō (*q.v.*), withstood demands for stronger steps in China's civil war and pursued a conciliatory course in Siberia, despite demands from nationalists who utilized presumed outrages in China and the discriminatory United States Immigration act of 1924 to warn of the futility of appeasing or co-operating with other poners.

But while the parties scored significant democratic advances in some respects, in other ways they showed themselves thoroughly distrustful of popular freedoms. As the parties grew in power they tended to look to bureaucrats for leadership; important party figures like Hara, Katō, Takahashi Korekiyo and others entered the parties from the bureaucracy. The businessmen who supported the parties and the bureaucrats who led them shared a fear of the social movements that followed industrialization and the importation of foreign ideas. The growth of the labour movement had already been checked by a Peace Preservation law introduced under Yamagata in 1900. This mas strengthened under Katō in 1925, as conservatives generally began to fear subversion in labour and tenant movements. A small Communist party was organized by a group of intellectuals in 1922, and the general interest in Marxist thought contributed to more fears of subversion. Under the Meiji constitution party governments had to make their peace with the military, with the house of peers and with the conservatives close to the throne; whatever ideas for reform they had therefore had to be worked out with the utmost caution. Frequently the diet found itself virtually powerless and this encouraged an irresponsibility evidenced by frequent corruption and disorders in the chamber. This did little to win popular respect for the machinery of representative government. There were no institutional changes to make it possible for a government to be firmly based on popular support. The Meiji constitution. which was never changed, was so ambiguous in its provisions for the executive that the party prime ministers could achieve little unless they secured, through compromise, the co-operation of forces which were quite antagonistic to their supposed purpose of democratic government.

Social Change.—Changes in the social and intellectual scene outstripped those in the political. Many of them were related to the development of industry. After the treaty of Shimonoseki the government utilized the Chinese indemnity to subsidize the Yahata (Yawata) steel- and ironworks, which were established in 1897 and began production in 1901. Yahata depended on China for its ores. After 1900 Japan's population exceeded the capabilities of domestic food production with the result that there was need for import of food as well. The growing textile and other consumer-goods industries expanded both to meet Japanese needs and to earn the credits required for the import of raw materials. Heavy industry was encouraged by government-controlled banks which provided capital where needed. Strategic industries, notably steel and the principal rail trunk lines, were in government hands, but in the main the new growth was in the private sector, albeit somewhat concentrated in the hands of the zaibatsu financial and industrial giants. (See The Economy, below.)

The enlarged urban population produced movements of social inquiry and protest. In 1895 the industrial labour force numbered about 400,000. Several efforts were made to organize socialist movements, but they speedily ran afoul of police repression. Peace Preservation laws were passed in 1900 and 1925, and in 1528 a revision of the law passed under Katō made it a capital crime to agitate against private property or Japanese state polity (kokutai). In 1903 a small group organized the Heimin *Shimbun* ("Commoner's Newspaper"), which published the Communist *Manifesto* and opposed the Russo-Japanese War in the name of the workers of Russia and Japan before it was forced to cease publication. The Christian pacifist Cchimura Kanzō joined in these protests, but later parted company with the socialists. The labour and socialist movements gained in strength after World War I, but had many handicaps. Leadership was usually theoretical and doctrinaire with little real contact with the workers. Police repression and the difficulties of organizing the labour force of diverse industrial empires like those of Mitsui and Mitsubishi also kept the labour movement from making headway. The increasing confidence and power of management, which came to influence and at times control the political parties, were in marked contrast to the slow progress of the labour movement. The Katō cabinet of 1924–26 was sometimes referred to as a "Mitsubishi cabinet" because of its close relations to Mitsubishi interests and families.

In the countryside the principal reflection of the new trade patterns was the additional impetus to silkworm production to augment the farmers' income. The farm villages also provided the

bulk of the labourers for the new industries! and farm daughters were to be found in many of the textile plants. The early decades of the 20th century were not years of agricultural prosperity. The farmers mere handicapped by growing fragmentation of holdings and increasing tenantry. The rising number of tenants resulted in the growth of tenant organizations, especially during and after the prosperity of World War I. Government efforts to encourage voluntary reform measures brought only a law for mediation of disputes in 1924. This made little real impact. and the financial panic of 1927 aggravated rural conditions and indebtedness even before the collapse of the U.S. silk market in 1929 spelled disaster for the farmers and workers alike. (See *The* Econonzy: *Agriculture,* below.)

The most lasting social changes were those found in the great metropolitan centres where the growing labour force and the new middle "salary" groups were concentrated. The Tokyo-Yokohama area was devastated by a great earthquake in Sept. 1923, and its rebuilding as a modern metropolis symbolized the growth and orientation of the urban society. The currents of enthusiasm during and after World War I, in which Japan joined the Allied cause, were uniformly international and largely American in inspiration. Western music, dancing and sports became popular, and the rising standards of living and expectation produced the need for more and better higher education. Women shared in the changes. The participation of women in office work in the new enterprises and the rise of a feminist movement, however unsuccessful, marked the beginning of changes in the family system.

The educated class grew in numbers and in vigour. Currents of thought included western-style democracy and the new radicalism of the Soviet Union; the influence of Marxist thought and analysis went far beyond the ranks of the struggling Communist party—which was, in any event, soon crushed by the police. Political liberalism was championed by the Tokyo university figure Yoshino Sakuzō (1878–1933), who formed student and intellectual groups whose title — Shinjinkai. "New Peoples Associations" — symbolized the self-conscious break with tradition. Minobe Tatsukichi (1873–1948), a distinguished constitutional theorist, introduced the idea that the emperor was an "organ" of the state and not, as conservatives had it, the sole source of sovereignty. Such men came in for sharp criticism and had, in time, to resign their positions, but they had great influence and symbolized as well as stimulated the more advanced currents of thinking.

Unfortunately the base for these new currents of liberalism was a precarious one. Politically and institutionally no advances —beyond the universal manhood suffrage of 1925—were scored, while under the Peace Preservation laws of 1928 a special police corps was established to seek out "dangerous thoughts." Economically the urban classes were dependent upon the continuance of the favourable trade patterns of the 1920s. When the great depression at the end of the decade wrecked Japan's foreign markets and removed the possibility of the villagers' augmenting rice income with that of silk, and when the irresponsibility and occasional corruption of diet representatives contrasted with poverty elsewhere in Japanese society. there were many prepared to listen to charges that the political party government, dominated by selfish *zaibatsu* interests, had neglected Japan's markets in China. imperiled morality and decency at home and allowed subversive trends to flourish while the politicians reaped personal gains at the expense of the taxpayers and the nation.

The Rise **of the** Militarists. — The notion that expansion through military conquest would solve Japan's economic problems had some currency before the great depression of 1929, but the hardships that both rural and city workers experienced thereafter gave the idea new plausibility. One of the key arguments advanced to support it was that of surplus population. Japan's population had grown from 30,000,000 at the time of the Meiji restoration to almost 65,000,000 in 1930. Each year the problem grew worse and the imports of needed foodstuffs increased. It was also argued that emigration to many areas was cut off because of discrimination against oriental peoples. Emigrants to the United States had suffered from prejudice in the San Francisco school exclusions in 1906 and they had been the targets of the discriminatory act of 1924 as well as numerous state laws forbidding the purchase of land by persons ineligible for citizenship. Japanese were barred from Australia altogether. Efforts made by Japan and China to secure a racial equality clause in the League of Nations covenant had been frustrated by western statesmen who feared the anger of their constituents. So the argument ran that there was no recourse to be expected without resort to force.

To these economic and racial arguments were added a distrust of party government. The armed services had opposed several international agreements which the party governments had accepted. The Washington conference had allowed a smaller ratio of naval strength than the navy had desired, and the government of Prime Minister Hamaguchi Osachi in 1930 accepted the London naval conference limitations of cruiser strength and forced them through a reluctant diet and privy council over the service objections. The Katō government had cut the army strength by four divisions. Many service leaders had also bridled under the moderation Foreign Minister Shidehara had shown in China during the Kuomintang northern expedition in 1926 and 1927, and they would have preferred a much stronger stand. The Seiyūkai cabinet under Prime Minister Tanaka Giichi (*q.v*), mho had been invited to head that party, reversed Shidehara's policy by intervening in Shantung in 1927 and 1928. Tanaka was forced out in 1929 and replaced by Hamaguchi, under whom Shidehara returned to control of the foreign office. It could be seen that such vacillation earned Japan ill-will and expensive boycotts in China without gaining any advantage.

Significant numbers of military leaders were inclined to resent the restrictions the civilian governments had placed upon them, and since they had direct access to the throne and possessed the ability to break a cabinet by refusing their co-operation, their power was considerable. It would be wrong to attribute such views to all or even most of the high command. Many senior figures knowledgeable in politics approved of party government, and navy leaders tended to be more discrete. But enough army officers in particular held this position to furnish a possible focus for dissatisfaction among other groups in Japanese society. The idea of the frugal, selfless samurai was peculiarly useful as a contrast to the stock characterization of the selfish party politician.

These economic pressures and political misgivings were exploited by civilian groups of ultranationalists who opposed parliamentary government as "un-Japanese." Since Meiji times there had been a number of rightist organizations dedicated to the theme of internal "purity" and external expansion. They sought to preserve what they thought unique in the Japanese spirit, and therefore fought against excessive western ways and ideas. There were many such organizations, the most important of them associated with the life of Tōyama Mitsuru (1855–1944). Some originated in the Meiji period when nationalists had felt obliged to work for a "fundamental settlement" of differences nith Russia; the Kokuryūkai ("Black Dragon" or, more accurately, Amur society) was one such, while others. like the Seisantō (Productivity society). were frankly keyed to labour and social problems. The National Purity society (Kokusuikai) worked to preserve just that, while the Retsumeidan or Blood Sworn league was terrorist. Most of the organizations attracted rootless young men nho were willing to risk their lives in the tactics of terror and suicide that traditionally stirred emotions in Japan. Their leaders were against political parties and big business as they were against acculturation and westernization, and by allying with rightist forces. civilian and military, they alternately terrorized and intimidated their presumed opponents. A number of business leaders and political figures lost their lives as victims to members of these groups, and the assassins' success in publicizing and dramatizing the virtues they claimed to embody had a considerable importance in the ethos of the troubled 1930s. It is clear, however, that the terrorists never had as much influence as they claimed or as the west thought they had.

The principal motive force for the reaction against parliamentary government was provided by junior officers in the armed services. Largely from rural backgrounds, distrustful of their senior leaders, ignorant of political economy and contemptuous of the poli-

ticians with their urban luxuries, the young officers were ready marks for a number of rightist theorists. Many of them were animated by goals that were national socialist in character. Kita Ikki (1883–1937), a former socialist who had passed through the Kokuryūkai's organizations which sought to help Chinese revolutionaries in 1911, wrote in his *Outline Plan for the Reconstruction of Japan* that the Meiji constitution should be set aside in favour of a revolutionary regime advised by "national patriots" and headed initially by a military government which should nationalize major forms of property, place limits on wealth, end party government and peerage systems, and then prepare to grasp the leadership of a revolutionary Asia. Kita helped persuade a number of young officers to take part in the violence of the 1930s, and in large measure their plots were designed to create a disorder so great that military government would follow. Once this had been achieved, they thought. "the army" would know what to do next.

The Kwantung army, which invested the Kwantung (Liaotung) peninsula and patrolled the South Manchurian railway zone, provided a rich harvest of officers keenly aware of Japan's continental interests and prepared to take steps to further them. Their incidents were designed to place the civilian government in an untenable position and to force its hand: the Tokvo terrorists similarly sought to change foreign as well as domestic policies. The pattern of direct action in Manchuria began with the murder of Marshal Chang Tso-lin, the war-lord ruler of Manchuria, whose train was bombed in June 1928. The action was not authorized by the Tanaka government, and helped to bring about its fall. Tanaka's cabinet, however, dared not investigate and punish those responsible, and this contributed to the feeling of extremist officers that their lofty motives would make retribution impossible. The succeeding government of Prime Minister Hamaguchi (Hamaguchi was mortally wounded by an assassin in 1930) showed intentions of restraining military activists and powers, however, and the next plots centred around plans for replacing civilian government altogether. In March 1931 a coup involving highly placed army generals mas planned to terrorize civilian politicians into a grant of martial law, but it was abandoned because of lack of agreement among the principals.

On Sept. 18,1931, came the Manchurian incident which launched aggression in east Asia. A Kwantung army charge that Chinese soldiers had tried to bomb a South Manchurian railway train (which arrived at its destination safely) resulted in speedy and unauthorized capture of Mukden followed by the occupation of all Manchuria (*q.v.*). The civilian government in Tokyo found itself powerless to stop the army, and even army headquarters was not always in full control of the field commanders. Prime Minister Wakatsuki Reijirō gave way, in Dec. 1931, to Inukai Tsuyoshi (Ki; 1855–1932). Inukai's efforts to stop the armies by imperial intervention were frustrated when the army discovered them beforehand. In 1932 naval officers took the lead in extremism; after the resolution of an incident at Shanghai there was a terrorist attack in Tokyo in May that took the life of Inukai. The terrorists failed to fell their other targets and they failed to secure a proclamation of martial law. The army, however, now announced that no party cabinet would be acceptable to it. To forestall its desires for power the last *genrō,* Saionji, recommended retired Adm. Saitō Makoto (*q.v.*) as prime minister. Plotting continued furiously, culminating in the revolt of a regiment about to leave for Manchuria. On Feb. 26, 1936, a large number of outstanding statesmen (including Admiral Saitō and Finance Minister Takahashi Korekiyo) were murdered; Prime Minister Okada Keisuke escaped because the assassins mistakenly shot his brother. For several days the rebel units held much of downtown Tokyo, and it required great care to convince the conscripts that their junior officers had acted without warrant and in violation of their proper loyalty. When the insurrection was put down on Feb. 29 the ringleaders were quickly arrested and executed, and with them fell their mentor Kita Ikki. Therewith the influence of the young extremists, often referred to as the Imperial Way faction (Kōdō ha), gave way before that of the more cautious Control faction (Tōsei ha), which had less sweeping plans for internal reform but shared many of the foreign policy goals of the young fanatics.

In view of the disesteem for the party politicians and the forces of big business, the only possible source of prestige sufficient to thwart the military lay with the throne. The senior statesmen, however. were cautious lest they imperil the imperial institution itself. The young emperor Hirohito (*q.v.*) had succeeded to the rule in 1926, taking as his reign title Shōwa. His outlook was more progressive than that of his predecessors; he had traveled in the west and his interests lay in marine biology, a scientific attachment the ultranationalists felt unfortunate in one whose role it was to embody the Japanese mystique. Saionji and the other palace advisers feared the radicalism of the young extremists and thought a strong stand by the emperor mould only widen the search for victims. Saionji himself was on almost every assassination list, and he feared that the extremism might lead to dethronement of the monarch. Therefore he chose to bide his time, hopeful that national or international currents would shift in such a way as to change or thwart the extremists' plans. Unfortunately this was not to be. As international criticism of Japan's aggression on the mainland grew in volume many Japanese rallied to the support of their soldiers.

The Road to World War 11.—Each advance by the military extremists resulted in a new compromise concession to them by more moderate elements in the government, and each of these in turn brought greater foreign hostility and distrust. Manchuria was fully occupied early in 1932, and rather than attempt to thwart the military the government agreed to reconstitute it as the "independent" state of Manchoukuo. The last Manchu emperor of China, Henry P'u Yi, was first declared regent and then enthroned as emperor in 1934. Actual control lay with the Kwantung army, however; all key positions were held by Japanese with surface authority for co-operative Chinese and Manchus. The League of Nations appointed a committee headed by Lord Lytton which, on the basis of an on-the-spot investigation, recommended in Oct. 1932 that Japanese troops be withdrawn, Chinese sovereignty in Manchuria recognized and a large measure of autonomy granted to Manchuria. The League accepted these recommendations and called upon member states to withhold recognition from the new puppet state. When this was passed the Japanese delegation, led by Matsuoka Yōsuke (1880–1946), walked out of the League chamber; shortly afterward, in March 1933, Japan formally withdrew from the world body. Thereafter Japan poured technicians and capital into Manchoukuo, exploiting its rich resources to establish the base for the heavy-industry complex that was to undergird the ne order in east Asia. The military planners avoided contacts with the old *zaibatsu* firms whose ties with the political party governments they had deplored, and worked through new firms of their own selection and creation to develop the plants that were seized and dismantled by Soviet forces at the end of World War II.

Aggression in Manchuria was supported by moves in north China, where boundary areas were consolidated in order to enlarge the economic basis of the "co-prosperity sphere." In the winter and spring of 1932 the Japanese navy precipitated an incident at Shanghai in order to put an end to a boycott of Japanese goods there. Japan was not yet prepared to challenge other powers for control of central China, however, and a League of Nations commission arranged terms for a withdrawal in May 1932. Frustrated naval officers returned to Tokyo to carry out the violence that cost the life of Prime Minister Inukai on May 1j. More important militarily was the move south from Manchuria into Jehol in Jan.. 1933. This led to the T'ang-ku truce in May, whereby a demilitarïzed zone was set up between Peking and the Great Wall. This brought the fighting to a temporary close. In 1934 a statement by the information chief of the Tokyo foreign office made it clear that Japan would brook no interference in its China policy, and that Chinese attempts to procure technical or military assistance elsewhere would bring Japanese opposition.

From then until 1937 external ambitions had to wait for the resolution of domestic crises. Feb. 1936 saw the military revolt in Tokyo that marked the high point of the extremist faction and the consolidation of power by the Control faction within the army. Finance Minister Takahashi Korekiyo (1854–1936), whose policies of reflation had brought Japan out of its depression slump, was

killed, and his opposition to further inflationary spending stilled. Further efforts by the palace advisers to defer full pomer for the military brought short periods of rule under Hirota Kōki and Hayashi Senjūrō. When these failed, the leadership went to the popular but ineffective Konoe Ayamaro, scion of an ancient court family. in June 1937. The same years saw the kidnaping of Chiang Kai-shek (*q.v.*) by Chinese border armies at Sian in Dec. 1936 and his agreement to a consolidation of Nationalist and Communist efforts into an anti-Japanese front. To this alarming development was added the evidence that the Japanese people were not yet prepared to renounce their parliamentary system. In the spring of 1937 general elections showed a startling strength for a new Social Mass party, which received 36 seats out of 466, and a heavy majority for the two parties (the Seiyūkai and its rival the Minseitō) which had combined forces against the government and its policies. The time seemed ready for new efforts by civilian leaders, but the field armies anticipated them.

In July 1937 Japanese troops opened fire on Chinese units at the Marco Polo bridge near Peking. Thus began the "China incident." Japanese armies took Nanking, Hankow and Canton despite vigorous Chinese resistance; to the north, Inner Mongolia and the provinces of Shansi and Shensi were invaded but not fully invested. After the fall of Nanking, the Konoe government began peace feelers. On discovering that the Nationalist government, which had retired to Chungking in Szechwan, refused to compromise, the Japanese installed a more co-operative regime at Nanking in 1940 under the former Kuomintang leader Wang Ching-wei. Meanwhile, in Nov. 1936, the anti-Comintern pact had been signed with Germany and later with Italy. This was replaced by the tripartite pact in Sept. 1940. The Axis allies recognized Japan as the leader of a new order for Asia, and the three signatories agreed to assist each other if any one was attacked by a power not then at war. This was directed against the United States, since the Soviets and Nazis were then allied; Soviet Russia was, indeed, invited to join in the tripartite pact later in 1940.

Japanese relations with the Soviet Union were considerably less cordial than those with Germany. The Soviets entered the League of Nations in 1934, after the Japanese had left. The Russians consented, however. to sell their Chinese Eastern railway holdings to the South Manchurian railway in 1935, thereby strengthening Manchoukuo. In 1937 the Soviet Union signed a nonaggression pact with China, and in 1938 and 1939 Russian and Japanese armies tested each other in two full-scale battles along the border of Manchoukuo. The Soviet-Nazi pact of Aug. 1939, however, was followed by a neutrality pact between the Soviet Union and Japan in April 1941. Foreign Minister Matsuoka Yōsuke was taken aback by the German invasion of Russia in June 1941, and lost his position after an unsuccessful attempt to persuade his government to join in the German attack.

The German-Japanese tie was never a close or effective one. Both parties were limited in their co-operation by distance, distrust and claims of racial superiority. The Japanese were uninformed about Nazi plans for attacking the Soviet Union, and the Germans were not told of the Pearl Harbor plans. Nor, despite formal statements of rapport, did Japan's state structure approach the totalitarianism of the Nazis. A National Mobilization law (1938) gave the Konoe government sweeping economic and political powers and in 1940, under the second Konoe cabinet, an Imperial Rule Assistance association was established to merge the political parties into one central organization. Yet the institutional structure of the Meiji constitution was never altered, and even the wartime governments never achieved full control over interservice competition. The Imperial Rule Assistance association and its fronts never succeeded in mobilizing all segments of national life around a leader. The emperor remained but a symbol, albeit an increasingly military one, and no *Führer* could compete without endangering *kokutai*, the national polity. Moreover, wartime social and economic thought retained important vestiges of an agrarianism and familism which were in essence premodern rather than totalitarian.

During the events which have been described, Japan's relations with the democratic powers deteriorated steadily. Both the United States and Great Britain did what they could to assist the Chinese Nationalist cause. The Burma road, constructed with great difficulty. permitted the import of minimal supplies to Nationalist forces. Japanese efforts to close this route were constant, and successful briefly in 1940, when the British, facing desperate odds in Europe, felt they could not risk a second war. Anti-Japanese feeling had strengthened in the United States, especially after the sinking of a U.S. gunboat, the "Panay," in the Yangtze river in 1937. In 1939 Secretary of State Cordell Hull denounced the 1911 treaty of commerce with Japan, with the result that embargoes became possible in 1940. Pres. Franklin D. Roosevelt's efforts to rally public opinion against aggressors included efforts to stop Japan, but even after the outbreak of war in Europe in 1939 public opinion in the U.S. was averse to courting war by stronger measures.

The European war presented the Japanese with tempting opportunities. After the Nazi attack on Russia the Japanese were subjected to German urgings to join the war against the Soviets and their natural inclination to seek richer prizes from the colonial powers to the south. In 1940 Japan had occupied northern Indochina in an attempt to block access to supplies of the Chinese Nationalists. and in July 1941 it announced a joint protectorate with Vichy France over the whole colony. With this new base for action in southeast Asia the way was prepared for'further moves.

The United States reacted to the occupation of Indochina by freezing Japanese assets and declaring an embargo on oil to Japan. Japan's stock-piling had been inadequate, and the cutoff of U.S. petroleum presented the government with the alternatives of conciliating the U.S. by withdrawing from at least Indochina and possibly China or seizing the sources of oil production in the Netherlands East Indies. Negotiations with Washington were carried on under the second Konoe cabinet which had come to pomer in 1940. Konoe was willing to agree to a withdrawal from Indochina, and he sought a personal meeting with President Roosevelt, hopeful of some U.S. concessions or favour with which he might convince his military leaders. The state department refused to agree to a meeting without prior Japanese concessions. Pressed by his war minister, Gen. Tōjō Hideki (*q.v.*), Konoe resigned in Oct. 1941 to be succeeded by Tōjō. A deadline laid down by the military for agreement with the U.S , first set for October, was now advanced to Nov. 29. Secretary of State Hull refused to agree to Japan's "final offer": Japan would withdraw from Indochina after China had come to terms, in return for U.S. promises to resume oil shipments, cease aid to China and unfreeze Japanese assets. Hull also decided against a previously worked out counter-offer lest the United States position seem to be weakening. Japan's decision for war made, the negotiators Nomura Kichisaburō and Kurusu Saburō received instructions to continue to negotiate. Preparations for the opening strike against the U.S. fleet at Pearl Harbor were now set in motion. The Japanese military, presented with great opportunities for solving problems of material and strategic needs and forced to retreat or advance by their previous aggression and alienation of western opinion, elected to try to establish, through a "new order in east Asia," a sphere in which Japan, as the centre of an industrial bloc of Manchuria. Korea and north China, would draw from the rich colonies of southeast Asia the raw materials it needed, while inspiring them to friendship and alliance by destruction of their previous masters. But in practice, "east Asia for the Asiatics," Japan's slogan, turned out to mean 'east Asia for Japan."

World War II and Defeat. — The attack on Pearl Harbor on Dec. 7, 1941, achieved complete surprise and success. It also unified U S. opinion and made possible the determination to see the war through to a successful finish. This invalidated a major premise upon which the Japanese had based their decision. They had expected that once they invested and fortified their new holdings a reconquest would be so expensive in lives and treasure that it would discourage the "soft" democracies. Instead the U.S. fleet was rebuilt with astonishing speed and the chain of defenses breached before these riches could be effectively tapped by Japan.

The first years of the war brought Japan astounding victories. Japanese troops occupied Manila Jan. 2, 1942, although Cor-

regidor held out until May 6; Singapore fell on Feb. 15, the Netherlands Indies were taken early in March and Rangoon on March 8. The Allies had difficulty maintaining their communication lines to Australia and the loss of the British battleships "Repulse" and "Prince of Wales," added to the U.S. Pacific fleet disaster, seemed to promise the Japanese navy freedom of action. In Japan Prime Minister Tōjō grew in confidence and popularity and began to style himself somewhat in the manner of a fascist leader. In the months that followed, however, it developed that the U.S. navy had not been permanently driven from the South Pacific. The battle of Midway on June 4–6, 1942, cost the Japanese fleet aircraft carrier strength it could ill afford to lose. (See MIDWAY, THE BATTLE OF.) The battle for Guadalcanal in the Solomons ended with a Japanese withdrawal in Feb. 1943.

After Midway, Japanese naval leaders began to analyze shipping and battle losses and concluded that Japan's outlook for victory was poor. Their conclusions were carefully kept to themselves. When the fall of Saipan in July 1944 brought U.S. bombers within range of Tokyo the Tōjō cabinet was doomed. It was replaced by that of Koiso Kuniaki (1880–1950). Koiso formed a Supreme War Direction council which was designed as a link between the cabinet and the high command. By this time it was becoming evident that Japan was losing the war, but no group was ready with a program acceptable to the military leaders. It would require efforts to reach the emperor in order to alert him, for no one else could hope to dissuade the military. There mere also grave problems about breaking the news to the Japanese people, who had been told only of victories. The great fire raids of 1945 brought destruction to every major city except the old capital of Kyōto. Even then; the generals held out for continuing the mar, confident that a major victory or a protracted battle would be the best way of gaining honourable terms. The Allied talk of "unconditional surrender" provided a good excuse for continuing the fight. By Feb. 1945 the emperor was meeting with a group of senior statesmen, including Konoe, Okada and other former premiers, to discuss steps that might be taken. When U.S. landings were made on Okinawa in April 1945 the Koiso government fell. The new premier, Adm. Suzuki Kantarō (1867–1948), a veteran of the Chinese-Japanese War (1894–95), had been on assassination lists in the 1930s and severely wounded once. His problem was not whether to end the war but how best to do so. The first plan advanced mas to ask the Russians, with whom Japan was still at peace. to intercede with the Allies. Konoe was to travel to Moscow. The Soviets, however, were planning to enter the war themselves, and they delayed a reply while their leaders took part in the Potsdam conference in July. The Potsdam declaration of July 26 offered the first ray of light with its statement that Japan would not be "enslaved as a race nor destroyed as a nation." The path to an honourable surrender seemed to open.

On Aug. 6 and hug. 9 the atomic bombs took their toll of life in Hiroshima and Nagasaki. On Aug. 9 the Soviet Union declared war and marched into Manchuria. where the Kwantung army, whose best units had long since been withdrawn, could offer only slight resistance. The Japanese government now attempted to gain as its sole condition for surrender a qualification concerning the maintenance of the imperial institution. After the Allies replied that the will of the Japanese people would be respected, the emperor insisted on surrender. The Pacific war came to an end on Aug. 14. The formal surrender was signed Sept. 2, 1945, in Tokyo bay aboard the U.S.S. "Missouri." Military extremists made a last attempt to block the radio broadcast of the emperor's announceinent to the nation: but they were unsuccessful. There were a number of suicides among the military and nationalists who felt themselves dishonoured. but the emperor's prestige and personal will, once expressed, sufficed to bring an orderly transition. To increase the appearance of direct rule the Suzuki cabinet was replaced by that of Prince Higashikuni Naruhiko.

Investigators who studied the political and economic setting in which the surrender was adopted concluded that neither atomic bomb nor Russian entry was involved in the decision, although they probably operated to advance the date. It was concluded that the submarine blockade of the Japanese islands had brought economic victory by preventing exploitation of Japan's new colonies. sinking merchant tonnage and convincing Japanese leaders of the hopelessness of the war. Air strikes brought the consciousness of defeat to the people, while military operations had destroyed the Japanese navy and air force so that the home islands could be threatened. Japan's largest armies. however, were never defeated. and this influenced the army's eagerness to fight on for better terms. Occupation found Japan's cities destroyed, its stock piles exhausted and its plants gutted. The Japanese government, whose boasts and guarantees had proven hollow. stood without prestige or respect. An alarming food shortage and spiraling inflation threatened what remained of national strength. The time was ripe for changes. (See also WORLD WAR II.)

G. Japan After War World II

The policies that were to be followed in occupying Japan had been the subject of sharp debate in Washington during the war. Although some advocated doing away with the influence of the prewar Japanese "moderates" altogether, in the end a great deal was left to the initiative of the supreme commander. The Potsdam declaration had held out for the Japanese promises of freedom of speech, of religion and of thought and of fundamental human rights, and specified that the Japanese government was to remove all obstacles to the revival and strengthening of democratic tendencies among the Japanese people. Subsequently. on Aug. 29, a document outlining Cnited States initial postsurrender policy nas worked out by the departments of state, nar and the navy; this became the basic statement of principles. As ultimate objective it envisaged a Japan no longer a menace to the United States or to the peace and security of the world, ruled by a responsible government which would respect the rights of other states and support the objectives of the United States as reflected in the charter of the Cnited Nations. It was hoped that Japan would conform as closely as possible to principles of democratic self-government, and the U S. would not impose any form of government not supported by the freely expressed will of the Japanese people. Japan would be limited to the four main islands and such minor islands as were to be specified at a later date, and it was to be disarmed and demilitarized, with the authority of militarists and militarism "totally eliminated" from political, economic and social life. The Japanese people would be encouraged to develop a respect for individual liberties and human rights, and they would be given opportunity to develop an economy adequate to meet the peacetime requirements of the population.

Power to carry out these objectives was given to Gen. Douglas MacArthur, supreme commander for the Allied powers (SCXP), who received his directives through U.S. military channels. By agreement of the U.S., British and Soviet foreign ministers, a Far Eastern commission representing all the Pacific allies mas established for the formulation of policies and review of MacArthur's actions, but whatever recommendations and directives ensued would reach him through normal military channels. An Allied council for Japan representing the Soviet Union, China. the British Commonwealth and the supreme commander sat in Tokyo to furnish on-the-spot advice and consultation. The supreme commander was to consult this council before issuing orders, the exigencies of the situation permitting, but the final decision was his. In practice SCAP paid the Allied council little heed and acted swiftly to forestall Far Eastern commission directives. As a result he was little hampered by outside interference. The occupation was thus largely a U.S. affair. SCXP became a huge headquarters containing several thousand persons, including both the headquarters staff of the Pacific campaigns and personnel who provided the technical, administrative and bureaucratic staffs. MacArthur worked through the Japanese government and made his wishes known by directives or more discreet suggestions. He had to be consulted on all major decisions of policy or politics, and thus functioned somewhat in the manner of the *genrō* of an earlier day.

The efforts at "democratizing" Japanese society seemed successively radical and cautious, and they were criticized as doctrinaire and halfhearted by turn. Japanese writers have often pointed to a change in the political and economic climate during 1947 and

1948 in which, they feel, the spirit of reform gave way to a concern for rebuilding and resuming production. Some have suggested that fear of excessive social and political change brought about a sharp turn in SCAP policies. It is evident that the fall of China to Communism altered the U.S. view of Japan's role in international affairs and increased the desirability of speeding Japan's economic recovery. But while there was a shift in emphasis there was none in long-range goals. The original goals had often been tentative and general in nature, and the success of some reforms made it desirable to re-evaluate and moderate at a later date. The SCAP attitude toward Communism, labour and deconcentration underwent decided changes. A decade later, however. historians were largely agreed that the measures taken by SCAP had created an open historical situation in which new forces could and did rise; such trends proved successful and lasting in areas where occupation measures had coincided with trends toward change long present, though suppressed, within Japanese society.

The early months of the occupation saw SCAP move swiftly to remove the principal supports of the militarist state under which Japan had gone to war. The armed forces were demobilized; state Shinto was disestablished; nationalist organizations were abolished and their members "purged" from holding important posts. Other purges removed from active roles all individuals prominent in wartime organizations and politics. including commissioned officers of the armed services; later the purge was extended to include all high executives of the principal industrial firms. In Tokyo an international tribunal tried General Tōjō and other war leaders, sentencing 7 to death, 16 to life imprisonment and 2 to shorter terms. Millions of Japanese were repatriated from the former colonies and from southeast Asia. The home ministry, which had controlled wartime Japan through its appointive governors and national police, was abolished and the education ministry was deprived of its sweeping powers to control compulsory education. Since central control and military influence were being attacked by a military government which needed centralized powers in order to be effective, the occupation's role was often a contradictory one. In the course of issuing instructions to the Japanese government to make certain that changes were being carried out. SCAP ensured the survival of that government as one intimately concerned with the pattern of local events in all parts of the country. And since in most cases factors of geography and economic rationality reinforced the logic of centralization, many of the moves toward decentralization were modified or reversed a half decade later.

Political Reform.— The new political structure of Japan centred around a new democratic constitution. The indirect rule, unseen cliques and shadowy nature of real power behind the façade of imperial rule made the Meiji constitution clearly inadequate and SCAP inforrned leading Japanese citizens that constitutional reform should receive first attention. The veterans of earlier decades of parliamentary government proved unable to grasp or accept the kind of reform that was intended. Between Oct. 1945 and Feb. 1946 a cabinet committee headed by Matsumoto Jōji prepared revisions in the hleiji constitution, but when submitted to SCAP its draft proved to contain few and superficial changes. General MacArthur's government section rushed a nen draft to completion in six days. 'This mas then submitted to the Japanese government as basis for further Japanese deliberations. Despite the misgivings of conservative statesmen, it was approved by the emperor and submitted for amendment to the first postwar diet, which had been elected in April 1946. In these elections women had voted for the first time. The constitution, slightly modified. nent into effect on May 3, 1947. Its preface stated in ringing tones the intention of the Japanese people to ensure peaceful co-operation nith all nations and the blessings of liberty for themselves and their descendants. The constitution included a 31-article bill of rights, and art. 9, with its famous renunciation of war as a "sovereign right of the nation" pledged that "land, sea, and air forces, as well as other war potential, will never be maintained." The emperor was described as the "symbol of the state and of the unity of the peoplc, deriving his position from the wil! of the people with whom resides sovereign power" The prewar Meiji constitution had described him as "sacred and inviolable." Earlier, on Jan. 1, 1946, the emperor had, by proclamation. renounced claim to divinity. The constitution provided for a bicameral diet, with the greatest power for a house of representatives nhose members served for four-year terms. The old peerage was dissolved, and the house of peers replaced by a house of councilors whose members served six-year terms. The prime minister was to be chosen by the diet from among its members and an independent judiciary, as in the U.S., had the right of judicial review.

The new constitution thus reversed the Meiji pattern which had reposed all sovereignty in the imperial institution, whence power could be drawn by imperial household officials, service heads and the privy council as well as by the cabinet head. Instead, with the exit of the service heads, the privy council and the peers and with a nonpolitical role laid out for the emperor, authority clearly lay with the elected diet which selected the executive from its ranks. For the first time in modern Japan the nature and role of the executive mere clearly defined. Parallel changes made prefectural governors and other local officials elective, so that the government could be responsive to the popular will. (See *Administration and Social Conditions,* below.)

The 1947 constitution was drawn up hastily, and subsequent research by Japanese scholars led to the conclusion that SCAP had rushed to anticipate the recommendations of the Far Eastern commission. But despite its unfamiliar concepts and foreign inspiration the constitution worked well and it gained widespread support in Japan. Since its implementation coincided with the purge of most of the leaders of prewar and wartime Japan, conditions were favourable for the development of new ideas and methods.

However, politics continued to be controlled largely by SCAP. By the time the San Francisco peace treaty went into effect in 1952, several elements of the political pattern had changed. Decentralization in some fields had proven expensive and inefficient. The police, for instance, while less centralized than in home ministry days, had returned to a substantially national organization. Despite the announced goals of local decentralization, changing patterns of communications and administration had shown the logic of incorporating many small units of administration into larger units, a trend particularly marked in the countryside where villagers merged to form "towns" with a more rational tax structure. Art. 9 of the constitution had been compromised by the decision taken by SCAP to form a "police reserve" of 75,000 men during the Korean nar emergency. The force, later renamed the self-defense forces, came to number about *200,000.* Inevitably the desirability of amending the constitution by rewording art. 9 was argued, and as this became possible, talk arose of amending other sections of the document as well. The socialist opposition prevented such moves, however, and the revisionist forces were unable to muster the two-thirds majority necessary to force revisions through the diet.

Perhaps the most important development in the political structure was the emergence of a strong executive. With the abolition of competing forces that beset the premiers of the 1930s, the postwar prime ministers found themselves in charge of the administration and, nith rearmament, the armed forces as well Thus responsible leadership replaced the ambiguous claims of imperial rule of earlier days, and prime ministers were limited only by their control of their party

Economic and Social **Changes.**—SCAP's political democratization was reinforced by economic and social changes ahich were designed to create interest groups prepared to use their new rights to safeguard and protect the new political and economic structure Changes in the countryside in industry and in social legislation all had the same purpose of breaking or weakening the old pattern of hierarchic control that had distinguished the "family state" ideal of the Meiji leaders.

In agriculture the occupation moved to carry out a land reform to convert tenants into owner-farmers. Tenancy had risen during the years aiter World War I. and the measures taken by the prewar Japanese government had proven ineffectual. Since the political parties nere based largely on a rural electorate dominated

by landowners, it is not surprising that they were slow in turning to agrarian reform. Japan's wartime governments, however, made important changes in land relationships. In their attempts at national unity and equal sacrifice, they created agricultural associations to collect all rice. Absentee landlords received the lowest rate of payment, and the tenant's relations with his landlord became much less important. Moreover, peasant sons in the armed services had been able to send part of their pay home, while the shortage of labour had made it possible for many farm family members to secure gainful employment in factories. Thus important preliminaries in rural well-being, not least among them the opportunities of the black market, had taken place prior to SCAP's instructions to the Japanese government to prepare a land-reform plan. The government plan proved inadequate in the opinion of occupation authorities, and in the spring of 1946 a SCAP plan was drawn up; it became law in October. By its terms village and prefectural land commissions were elected with tenant, owner-farmer and landlord representation to select land for purchase and to select eligible purchasers from among tenants. The government then bought the land at preinflation prices and sold it to the tenant. Four years later the reform had changed the ownership pattern of over two-thirds of Japan's cultivated acreage and advantageous tax and price arrangements had enabled the majority of the new owners to pay for their land. Absentee landlords were forced to sell all their holdings, while cultivating landlords were limited to 2½ ac. of land, with a low ceiling on rent. Cultivating farmers were restricted to 7.35 ac , in addition to which they could rent out 2½ ac. The average family holding. however, remained slightly under 2½ ac , and in view of the continued population rise and the change in laws covering primogeniture, there was an increase of the fragmentation of land. Nevertheless. the reform revolutionized patterns of landholding and helped produce a striking rise in rural well-being. (See *The Economy: Agriculture,* below.)

Plans for changes in the industrial sector at first contemplated ruinous reparations. In the thinking of the Pauley report, Japan nould have lost most of its heavy industries and received the lowest priority in Asia for assistance. Disturbances elsewhere in Asia and the economic crisis in postwar Japan, however, brought about a reconsideration of the wisdom of such moves. With the exception of Japanese assets overseas, and a small number of war plants. reparations mere very nearly limited to agreements worked out between Japan and each of its Asian victims after the San Francisco peace treaty of 1951.

A similar moderation marked the course of planning for deconcentration of the great *zaibatsu* firms. At first they were seen as Japan's chief war potential and later as essential elements in economic recovery. Of 325 concerns marked for investigation and possible dissolution in 1948, only 30 became the subjects of SCAP action. The major units of the *zaibatsu* empires, the holding companies. were liquidated and their securities made available for public purchase. New legislation sought to enforce fair trading and to guard against a return of patterns of monopoly. War profits taxes wiped out many large fortunes and hit at all large concentrations. while capital levy, inheritance and graduated income taxes were designed to equalize the tax burden. The extension of the purge of wartime leaders to the business world removed the top executives of 250 concerns from action for most of the occupation years. By 1950 extensive changes, although far short of those initially proposed, had taken place in the industrial norld The large banks, however, had not been broken up, and they proved to be the centres for a measure of reconsolidation in the years after the occupation.

The balance of economic power was also affected by measures which produced a strong and vigorous labour movement which contested political and economic primacy with management in postwar Japan. After the home and welfare ministries were dissolved, a new labour ministry nas established in 1947. The release of all political prisoners. carried out in the early months of the occupation, freed the core of the Japanese Communist party, and most of those released turned their attention to organizing the labour movement, hoping to use it as a path to power. Trade-union, labour relations and standards laws modeled on New Deal legislation in the United States were passed, and soon a strong union movement showed 6,500,000 members in 33,940 unions. The early union movement mas led by men with strong political ambitions. When a general strike was announced for Feb. 1947 with the avowed purpose of overthrowing the government, SCAP issued an injunction against the move. Thereafter occupation policy was concerned with reconstruction and no longer exclusively with liberation. and steps against inflation, political radicalism and Communist control of labour unions followed. Under the Socialist cabinet of Prime Minister Katayama Tetsu there was an emphasis on labour education, and in July 1948 SCAP ordered the government to take steps to deprive government workers—who included the communications unions--of the right to strike. A new labour organization, the General Council of Trade Unions (Sōhyō), was sponsored as a counterweight and gradual replacement for the Congress of Industrial Labour Organizations (Sambetsu), which had become leftist dominated. After 1951, however, Sōhyō too became increasingly antigovernment and anti-American. Although some of the occupation measures deprived labour of useful weapons for fighting its way to power, the strength of organized labour expressed through the Socialist party remained a significant difference between the pre- and postwar social and political scene in Japan. The government's failure to carry through a police law designed to curb labour radicalism and sabotage in 1958 demonstrated the powerful support that labour could command in the diet, in the press and in public opinion generally.

The social legislation of the postwar era saw energies and hopes long repressed by the Japanese government spring to full flower. The civil code. which had buttressed the power of the male family head with numerous legal supports, was completely rewritten to allow for equality between the sexes and joint inheritance rights. Feminism was expressed in the right to vote and in the presence of women as elected diet representatives. The abolition of the peerage created in Meiji days symbolized the modernization of society.

The years after the peace treaty of 1951 saw a number of changes in the pattern of occupation reforms. The land system remained unaltered, and rural well-being was at record heights. Industrial reconsolidation reunited many of the earlier financial empires which required maximum efficiency in order to compete on international markets. Proportionately, however, the old firms had not regained their former power, nor was their management family centred as had once been the case. Social legislation, moreover, had created such strong interest groups that prospects of substantial reversals of the postwar changes seemed slight. For many of the newly liberated generation, the new order was symbolized by the matrimonial match between Crown Prince Akihito (b 1933) and a commoner, Shoda Michiko, in 1959

(For educational reform see *Administration and Social Conditions: Education,* below.)

International Relations.—Japan's return to international relations at the end of the occupation found it stripped of its former colonies of Formosa and Korea. Both of these. in fact. had military effectives far superior in number to those maintained by Japan Japan's sovereignty did not extend even to the islands traditionally claimed by it, as the United States maintained its occupancy of Okinawa while the Soviet Union laid claim to the Kuriles International relations were not be conducted on the pacifist lines envisioned by the 1947 constitution with its pledge of disarmament. The Korean war, which broke out in June 1950, resulted in the establishment of Japan's postwar armed forces by General MacArthur. This made more urgent the negotiation of a peace treaty. Since there was little likelihood of securing agreement with the Communist bloc, arrangements were worked out between the principal allies before and during the command of Gen. Matthew B. Ridgway, who succeeded General MacArthur as supreme commander in April 1951.

The San Francisco conference convened in Sept. 1951 to sign the treaty that had already been worked out. By its terms Japan recognized the independence of Korea and renounced all rights to Formosa, the Kuriles and south Sakhalin; Japan agreed to ac-

cept United Nations assignment to the U.S. of trusteeship over the mandated islands in the Pacific as well as the Bonins and Ryukyus, and accepted all obligations of the United Nations charter. The treaty recognized Japan's "right of individual or collective self-defense," which right was exercised in the simultaneous enactment of a security pact with the United States whereby U.S. forces would remain in Japan until such time as Japan could "assume responsibility for its own defense." Japan agreed not to grant similar rights to a third power without U.S. approval.

The treaty went into effect in April 1952. India and Burma did not attend the San Francisco conference, but India signed a similar document in 1952 and Burma in 1954. The San Francisco treaty made no arrangement for reparations with Japan's Pacific victims, but provided that Japan should negotiate subsequently with the countries concerned.

Effective resumption of relations with the nations of Asia came only after treaties covering reparations had been worked out; these were signed with Burma in 1954, with the Philippines in 1956 and with Indonesia in 1958. At San Francisco neither Nationalist nor Communist China was present, and the thorny question of which China Japan should recognize was left to later Japanese determination. Shortly after regaining independence, Japan negotiated a peace treaty with the Republic of China on Formosa which did not, however, prejudice Japan's freedom to negotiate with the Communist People's Democratic Republic if it so desired. However, Japan's negotiations with the Formosa regime, its security arrangements with the U.S. and its consequent adherence to the United Nations list of goods embargoed to Communist China made treaty relations with the Peking government very unlikely. In 1953 an unofficial trade pact was signed between private Japanese groups and Communist Chinese authorities, and this proved to be the first of a number so negotiated. Subsequently Japan, together with the industrial countries of western Europe. relaxed the list of goods embargoed to Communist China in hopes of improving its trading position. The Peking government, houever, made skillful use of trade for political purposes, encouraging it and stopping it at moments most calculated to embarrass Japan's conservative governments. Thus in 1958 trade was cut off altogether because of an insult to the Communist Chinese flag at a trade fair in Japan. It was clear that to satisfy Peking's demands for large-scale trade would endanger Japan's relations with the U.S. and the Republic of China, with which a sizable and favourable trade balance had developed, and there was little prospect for overcoming these difficulties.

The Soviet Union attended the San Francisco conference but failed to make its objections to that treaty heard, In 1956, however, Japan and the Soviet Union restored diplomatic relations, and in Dec. 1956, with the Soviet veto no longer invoked, Japan became a member of the United Nations. Subsequently Japan took an active part in United Nations meetings and the specialized agencies; Japan also became a contributing member to the Colombo plan group of nations for economic development in south and southeast Asia. With the China market in its prewar dimensions and profits permanently lost, posttreaty Japanese governments made vigorous efforts to maintain and enlarge their share of trade with the U.S. and the west, while numerous plans for the development of raw materials and markets in India and other non-Communist Asian countries were set in motion.

In 1960 a ten-year treaty of mutual co-operation and security was negotiated with the United States to replace the 1951 treaty. Numerous concessions to Japan were made, but the U.S., under the treaty, was to retain the use of military bases in Japan without time limit; the two nations also pledged to co-operate economically and to settle any disputes by peaceful means. Public demonstrations and rioting in protest against the treaty were unsuccessful in preventing its ratification by the diet. These demonstrations, led by student and left-wing groups, however, greatly embarrassed the government of Kishi Nobusuke (1896–) which canceled an invitation for a state visit by Pres. Dwight D. Eisenhower in June 1960 because it was feared that the U.S. president would be in danger if further rioting broke out.

Post-World **War 11** Politics.— After the surrender in 1945 Japanese politics at first returned to the pattern that had been interrupted by the militarist domination of national life. Extremists of the right were discredited by their identification with the loss of the war. Their major figures were purged or arrested, and until 1952, when mass "depurges" permitted all but those convicted by the international tribunal to resume their careers, little rightist organization was possible. Thereafter some of the figures of the 1930s re-emerged, including some assassins who had escaped punishment and who now sought to rally "patriotic" forces. The rightists proved to have little unity, however, and they could offer no program of leadership in Asia as they once had done. They were handicapped by the decline of influence in the military business sector that had formerly helped to underwrite their activities. Most importantly, rightist ideology found few listeners among the postwar generation accustomed to its new freedoms. As a result, the rightists were often limited to efforts to revive national holidays like Feb. 11 ("Foundation day" for Emperor Jimmu) and demonstrations against the Soviet Union and Communist China.

Extremists of the left fared better for a time. With the surrender and release of political prisoners and with the repeal of the Peace Preservation lams that had hampered political organization in prewar days, prominent Communist party leaders like Tokuda Kyūichi (1894–1953) and Shiga Yoshio (1901–) returned to action, and the popular Nozaka Sanzō (1892–), who had spent the war years with the Chinese Communists at Yenan, returned to Japan. Although the land reform deprived them of an issue they used elsewhere in Asia, the postsurrender years, with their confusion and economic hardship, provided a favourable climate for Communists. The high point of Communist influence at the polls came in the general election of 1949, at a time when restlessness under the occupation yoke was compounded by the economic slowdown that had followed the imposition of the deflationary policies recommended by Joseph Dodge. In that year the Communists placed 35 candidates in the house of representatives and received nearly 10% of the vote. The next year came the Korean war with its revelation of Communist purposes. It was accompanied by a steady improvement in economic conditions as Japan provided numerous services for the United Nations military effort. In 1950 SCAP ordered the purge of Communist leaders from politics under the same directives that had earlier banned the rightists as "undemocratic forces." Most chose to go underground, reappearing after the end of occupation control. By that time popular sympathy with the Communist cause had declined markedly. Communists placed no candidates in the 1952 elections for the house of representatives, one in 1953, two in 1955 and one in 1958. The steady rise of living standards, the unco-operative attitude the Soviet Union had shown in negotiating over the Kurile Islands and in fishing treaty discussions, a popular distaste for the Communist opposition to the imperial institution and widespread dislike for the extremist tactics shown by leftist labour unions all combined to create an unpromising climate for Communist politicians.

The vicissitudes of right and left thus left the way open for the prewar "moderates," who were in any event the only groups immediately acceptable to occupation authorities since, by disassociating themselves from the politics of the 1930s and the war years, they had not become liable for the purge. Thus figures of the 1920s and early 1930s re-emerged, as did also the remnants of the party organizations of those years. The cabinet which was formed shortly after the U.S. arrival mas headed by Shidehara Kijūrō, who was replaced in May 1946 by Yoshida Shigeru (1878–). Both were career diplomats and bureaucrats, and both possessed the ability to work with SCAP authorities, a quality naturally essential during the occupation years. In 1947 and 1948 there was an interval of rule under Katayama Tetsu, a socialist who headed a coalition cabinet but who was unable to carry out a socialist program. In 1948 Ashida Hitoshi held office for five months. but he was forced out after the revelation of scandals implicating his administration. Yoshida returned as prime minister in 1948 and remained in his posl until Dec. 1954, thereby setting a record for modern Japanese prime ministers. It was he

who negotiated the peace treaty and security pact in 1951, and who set Japan's postsurrender course of close co-operation with the democratic powers.

Independence and the return of purged politicians resulted in the candidacy of Hatoyama Ichirō (1883–1959) for Yoshida's position, and the Liberal party was split between their followers as a result. The San Francisco treaty and security pact also split the Socialist party into two factions: the left opposing both the treaty (because it did not include the Communist countries) and the security pact with the United States, the right wing favouring the treaty while opposing the security pact. Yoshida's replacement by Hatoyama in 1954 failed to heal the divisions in the Liberal party, and the following year the Socialist parties reunited. The conservatives, threatened with a united assault from the socialists, now followed suit and formed the Liberal-Democratic party in Nov. 1955. Hatoyama remained in office until the Soviet peace and United Nations entrance had been achieved, after which he resigned to be replaced by Ishibashi Tanzan in Dec. 1956. On Ishibashi's retirement for reasons of health, Kishi Nobusuke succeeded in Feb. 1957. Kishi, a former bureaucrat who had been arrested. though not tried, as a war criminal, illustrated the political acceptability of prewar leadership. He made no change, however, in the policies whicn Yoshida had inaugurated of close co-operation with the U.S. and the UN. Kishi resigned in July 1960, following demonstrations and riots protesting the Japanese-U.S. mutual security treaty. Ikeda Hayato, a leading economic authority who had served as Kishi's minister of international trade and industry, was then elected prime minister by a special session of the diet.

The principal issues which agitated Japanese politics in the years after the return of independence were international and national. In international affairs the socialists were strongly critical of their government's reliance upon United States direction and its failure to pursue a more determined course toward recognition and trade with Communist China. They reproached the government with violating national honour. In national affairs, however, the charges were reversed. as the conservative governments probed for ways of revising and moderating the U.S.-inspired changes in administrative, educational and legal institutions, insisting that an independent country required its own integrity of tradition, while the socialists, fearing a return to the police controls of the 1930s and 1940s, fought each proposed change bitterly. In the general elections of 1952, 1953, 1955 and 1958 the socialist strength in the house of representatives rose from 111 to 166 while conservative strength fell from 324 to 287. Conservatives were thus unable to force constitutional changes which required a two-thirds majority of the 46;-member house of representatives. *See* also FAR EAST: RELATIONS WITH THE WEST. (M. B. J.; X.)

V. POPULATION

Japan is a land of high population density. In the 1961 census the population was 93.418.501. and the density per square mile was 654 5 The 1955 population was 89,275,529 with a density of 625.3 and a ratio of 96.6 males to 100 females. The density is not relatively high compared with some industrialized countries of western Europe, but considering the prevailing importance of agriculture and primary production in Japan and the limited area of arable land (about 15% of the total), a severe population problem pertains. The average rural population density of many lowland areas exceeds 1,000 per square mile; if urban populations are included, the average density is doubled. Japan. with an area of 142,727 sq.mi., less than that of France or the state of California. has a population more than half that of the U.S. The future of Japan may well depend on how this population problem is solved. In contrast to the highly congested lowlands, many mountainous areas show remarkably small populations and these are tending to decline. This is in part due to the rugged character of the terrain but even more to the traditional dependence on rice paddies and the increasing capacity of the lowlands, because of growing industrialization, to support large populations.

Lowland densities of agrarian population are greatest in southwestern Japan and gradually decrease northeastward. A belt of remarkably high rural density stretches from the Kwanto plain into northern Kyushu. The agrarian villages of this area include many nonagricultural activities. but the rise of commercial agriculture, such as truck gardening and fruit production, and the resulting intensive use of land have demonstrated that these dense populations can be supported without lowering the standard of living Rural living standards there are the highest in Japan. An important characteristic of agricultural villages is their elasticity of population capacity. This has frequently been shown during times of industrial crises and after periods of war, when villagers returned home.

Estimates vary as regards population figures in successive periods of Japanese history. It is generally conceded that there was a total population of about 18,000,000 at the beginning of the Tokugawa period (1615–1868) Under conditions of prevailing peace and rapid land reclamation, population had risen by the middle of the 18th century to 30,000 000. It remained around this figure until the Meiji restoration (1868). The principal natural check was a high death rate. and the principal artificial one was provided by the social structure, whereby younger sons were dis-

TABLE VI.—*Area and Population (1955 Census)*

Prefecture	Area (in sq mi)	Population	Density per sq.mi.
Aichi	1,953	3,769,209	1,929.9
Akita	4,483	1,348,871	300.9
Aomori	3,711	1,382,523	372.5
Chiba	1,940	2,205,060	1,136.6
Ehime	2,182	1,540,628	706.1
Fukui	1,647	754,055	457.8
Fukuoka	1,892	3,859,764	2,040.0
Fukushima	5,321	2,095,237	393.8
Gifu	4,045	1,583,605	391.5
Gumma	2,445	1,613,549	659.9
Hiroshima	3,255	2,149,044	660.2
Hokkaido	30,372	4,773,087	157.2
Hyōgo	3,210	3,620,947	1,128.0
Ibaraki	2,347	2,064,037	879.4
Ishikawa	1,618	966,187	597.1
Iwate	5,911	1,427,097	241.4
Kagawa	718	943,823	1,314.5
Kagoshima	3,549	2,044,112	575.9
Kanagawa	912	2,919,497	3,201.2
Kōchi	2,747	882,683	321.3
Kumamoto	2,906	1,895,663	652.3
Kyōto	1,789	1,935,161	1,081.7
Mie	2,226	1,485,582	667.4
Miyagi	2,813	1,727,065	613.9
Miyazaki	2,986	1,139,384	381.6
Nagano	5,262	2,021,292	384.1
Nagasaki	1,578	1,747,596	1,107.5
Nara	1,425	776,861	545.2
Niigata	4,843	2,473,492	510.7
Oita	2,385	1,277,199	535.5
Okayama	2,727	1,689,800	619.7
Ōsaka	699	4,618,308	6,607.0
Saga	928	973,749	1,049.3
Saitama	1,468	2,262,623	1,541.3
Shiga	1,551	853,734	550.4
Shimane	2,558	929,066	363.2
Shizuoka	2,999	2,650,435	883.8
Tochigi	2,490	1,547,580	621.5
Tokushima	1,600	878,109	548.8
Tōkyō	780	8,037,084	10,303.9
Tottori	1,347	614,259	456.0
Toyarna	1,640	1,021,121	622.6
Wakayama	1,820	1,006,819	553.2
Yamagata	3,600	1,353,649	376.0
Yamaguchi	2,346	1,609,839	686.2
Yamanashi	1,720	807,044	469.2
Total	142,767	89,275,529	625.3

TABLE VII.—*Population of Principal Cities (1955 Census)*

City and prefecture	Pop.	City and prefecture	Pop.
Akita, Akita	190,202	Nagoya, Aichi	1,336,780
Amagasaki, Hyōgo	333,513	Niigata, Niigata	261,758
Chiba, Chiba	197,962	Nishinomiya, Hyōgo	210,179
Fukuoka, Fukuoka	544,312	Okayama, Okayama	235,754
Fuse, Ōsaka	176,052	Ōmuta, Fukuoka	201,737
Gifu, Gifu	259,047	Ōsaka, Ōsaka	2,547,316
Hakodate, Hokkaido	242,582	Otaru, Hokkaido	188,448
Hamamatsu, Shizuoka	268,792	Sakai, Ōsaka	251,793
Himeji, Hyōgo	252315	Sapporo, Hokkaido	426,620
Hiroshima, Hiroshima	357287	Sasebo, Nagasaki	258,221
Kagoshima, Kagoshima	274,340	Sendai, Miyagi	375,844
Kanazawa, Ishikawa	277,283	Shimonoseki, Yamaguchi	230,593
Kawasaki, Kanagawa	445,520	Shizuoka, Shizuoka	295,172
Kōbe, Hyōgo	979,305	Takaoka, Toyama	131,531
Kōchi, Kōchi	180,140	Tōkyō, Tōkyō	6,969,104
Kokura, Fukuoka	242,240	Toyama, Toyama	170,495
Kumamoto, Kumarnoto	332,493	Toyohashi, Aichi	202,985
Kure, Hiroshima	199,304	Ube, Yamaguchi	160,020
Kyōto, Kyōto	1,204,084	Wakayama, Wakayama	220,021
Matsuyama, Ehime	213,457	Yahata, Fukuoka	286,241
Miyazaki, Miyazaki	140,782	Yokohama, Kanagawa	1,143,687
Nagasaki, Nagasaki	303,724	Yokosuka, Kanagawa	279,132

couraged from marrying and begetting children unless the oldest son was childless. Infanticide, known as *mabiki* or "thinning of the crop," though not widespread was not uncommon and served as an additional check. Under the powerful and positive policies of the Meiji government, agriculture. fishing and mining were rapidly expanded and manufacturing was inaugurated; means of transport and of communication were improved; banking facilities were established; and progress in medical care and sanitation was made. This led to a rapid and steady increase in population and four major periods of change can be identified.

The first is the period 1868–97, when drastic measures were taken toward modernization. The development of Hokkaido became an urgent national policy. No important changes, however, occurred in the rural economy, and the agricultural villages continued in size and economy much as they had in feudal times. Accelerated reclamation of underdeveloped areas led to significant increases in agrarian populations on the lowlands of Kwanto, Tohoku (northern Honshuj and southern Kyushu. Urbanization was in its infancy and it was not until the end of this period that cities began to absorb surplus populations from the villages. Hokkaido and newly reclaimed areas began to fill up.

The second period, 1898–1918, marks the first stage of important industrialization in Japan. There were phenomenal increases in urban population and a decline in rural areas. In the first half of the period, light industries, especially spinning, grew rapidly. In the latter half, heavy industry had its beginnings. Growing industrial cities, mining districts and sericultural areas created large demands for labour, inducing migration from agrarian communities. An excellent example is the population increase in the Chikuhō mining area of northern Kyushu. Absolute decreases occurred in rural Kansai, Hokuriku, northern Shikoku and wide areas of mountainland in Chūgoku. Only the rural districts of Tohoku and southern Kyushu still retained powers of absorption. Tokyo and Osaka grew rapidly, while the large cities of Yokohama,, Nagoya, Kyoto and Kōbe and the northern Kyushu conurbation developed.

During the third period. 1919–45, industrial stagnation followed World War I, after which there was phenomenal expansion. Cities absorbed population at an accelerated rate, and the rural areas of absolute decrease expanded. Most of the cities increased in population from three to five times and new cities sprang up. There were striking population increases in the four major industrial areas centring around Tokyo, Osaka and Kōbe, Nagoya and in northern Kyushu. Smaller cities elsewhere suffered decline. The concentration of population in the core industrial belt of Japan was the most significant feature of this period.

The fourth period began during the abnormal years of World War II. There was a marked shift in the relation of urban to rural population. During 1944 and 1945 the principal Japanese cities were subjected to repeated and disastrous aerial bombardment. Many inhabitants were killed and great numbers fled into the rural centres or onto farms. Population figures for the major cities, as a result, showed a startling decrease. Tokyo, which had about 7,000,000 inhabitants in 1940, had less than 3,000,000 in 1945; Osaka: with more than 3,000,000 in 1940, had about 1,000,000 in 1945. Most of the other cities showed corresponding decreases. After 1945 there was a reversal of the trend. Thus Tokyo rose from 3,000,000 in 1945 to 4,500,000 in 1949 and by the early 1960s had over 8,000,000 inhabitants. A repatriated population of nearly 7,000,000 had to be absorbed and there was a short but explosive increase in the birth rate. In 1950 the rehabilitation of the manufacturing industries was well under way and the reconcentration of urban populations proceeded at an accelerated rate,

Soon both birth and death rates showed remarkable declines and the most rapid drop in birth rate ever recorded occurred between 1947 arid 1957—from 34.3 (per 1,000 population) to 17.2. However, the birth rate rose to 18 in 1958. This startling decrease in births could not have resulted solely from deferred marriages. continence and the usual economic pressures of industrialization and urban life. The Eugenic Protection act of 1948 (with later amendments) was primarily a health measure but permitted by extension legalized abortions and birth-control measures. By the mid-1950s the number of induced abortions was reported to be approaching 2,000,000 annually and sterilization of women was also on the increase. In review Japan's population has increased threefold from 1868 (*see* Table VIII).

TABLE VIII.—*Growth of* Population

Date	Total population (in 000s)	Birth rate (per 1,000 persons)	Death rate (per 1,000 persons)	Rate of increase (per 1,000 persons)
1868	30,000	...	...	...
1874	35,154	24.6	20.5	4.1
1890	39,902	28.3	20.4	7.9
1910	49,184	33.9	21.1	12.8
1920	55,391	36.3	25.4	10.9
1925	60,210	35.0	20.3	14.7
1940	71,400	29.0	16.2	12.7
1947	78,101	34.3	14.6	19.7
1955	89,276	19.4	7.8	11.6
1958	91,760	18.0	7.5	10.5

In 1872 the agrarian population constituted 78% of the total. By 1950 it was reduced to 45%. This does not indicate an absolute decrease in farm population and production; most of the rapid total increase was absorbed by the growing industrial cities.

(R. B. H.)

VI. ADMINISTRATION AND SOCIAL CONDITIONS

The political institutions of mid-20th century Japan are strikingly different in many respects from those existing before 1945. When Japan was defeated in World War II and occupied by Allied forces, there were two initial objectives of overriding importance. first, to punish those judged responsible for war crimes and to level the Japanese war machine; second. to lay the foundations for a democratic government and society. Both of these objectives were entrusted largely to U.S. authorities. The military forces stationed in Japan were almost wholly American, although there were small contingents of British and Australian troops. hfore importantly. while both the Far Eastern commission in Washington and the Allied council in Tokyo had some nominal supervision and control. in fact U.S. authorities made the basic policy decisions Thus Japan came under the strong influence of U.S. ideas and institutions. Many of the reforms undertaken bear the clear imprint of the New Deal.

1. The Constitution. — The major political landmark of the reform period was a new constitution which went into effect on May 3. 1947. This constitution replaced the old Meiji constitution of 1889. Both Japanese and Americans participated in its drafting, but there can be no doubt that the American role mas a crucial one. Under the new constitution the emperor was deprived of his absolute monarchial power and became a mere symbol. the peerage was abrogated, women were permitted to vote and the voting age for adults was lowered to 21. conscription was abolished and war renounced, academic freedom was guaranteed and a "bill of rights" on western lines was drawn up. Any constitutional amendment must first be approved by a two-thirds majority of the diet and then submitted to popular referendum, a rather difficult procedure.

Upon Japanese surrender, the supreme commander for the Allied powers (SCAP—a term also used to designate the occupation as a whole) decided to work through a Japanese government and follow legal procedures in making basic changes rather than to rule directly and by fiat. Japanese leadership of this period was provided mainly by conservatives. Their ideas on such matters as constitutional revision rarely satisfied C.S. reformers. Conservative draft constitutions providing minimal changes were rejected or returned for further amendment. Ultimately. U.S. authorities took a very active part in the drafting process. Some unofficial Japanese constitutional drafts circulating during this period suggested even more basic alterations than mere finally made. Conservatives continued to agitate for amendments and set in operation a committee to study constitutional reform. They were especially anxious to repeal the so-called antiwar clause and to modify the provisions concerning the emperor. the house of councilors and some other parts. They were also critical of the fact that the constitution of 1947 contained too many American

ideas and maintained that it was not feasible for Japan unless various modifications were made. The Socialists, however, had no desire to accept any conservative amendments.

2. The Emperor. — Under the 1947 constitution, supreme power is vested in the people. The preamble, which resembles the American Declaration of Independence, contains a forceful statement commending popular sovereignty, representative government and peace. This is a significant contrast to the Meiji constitution in which complete sovereign power mas acknowledged to belong to the emperor. Indeed, that constitution was interpreted as a gift from him and hence conservative theorists frequently asserted that he was above any constitutional restrictions. This doctrine was the closest approximation of a divine-right theory to be advanced in any modern nation during the 20th century.

The Meiji constitution was drafted at imperial request after considerable political tension. Opposition to the Sat-chō oligarchy reached a climax in 1881, and to reduce political pressure, the emperor was caused to proclaim that within nine years the Japanese people would be granted a constitution. Then a group headed by It6 Hirobumi set to work, borrowing heavily from German practice and theory. The Prussian constitution was a very definite model for the constitution of 1889, and certain German scholars and technicians rendered assistance in the drafting process itself. Heavy emphasis was placed upon the absolute powers of the emperor. To him were given the rights of all major political appointments including that of the prime minister. The cabinet was made responsible to him rather than to the diet, and military leaders also drew their authority and power directly from him. Only he could initiate amendments to the constitution.

In fact, the emperor did not wield these powers himself. The political genius of Japan was expressed more in oligarchy than in personal absolutism. But the importance of the throne as the supreme symbol of modern Japanese nationalism cannot be overestimated. Essentially this was a recent phenomenon. Prior to the Meiji restoration of 1868, the imperial institution had long been severely circumscribed and even neglected. Few Japanese of an earlier period would have considered the emperor as the apex of their political institutions and society. Many would not have known of his existence. When western pressures accelerated the decline of the old order, however, the emperor was available as a rallying point for the anti-Tokugawa nationalist movement. The court nobles and young samurai who took over the government after 1868 invoked the name of the emperor on every possible occasion to produce a spirit of patriotism and unity. Through such means as Shintoism, mass primary education and military indoctrination, an image of the emperor as father of his people, head of the nation and symbol of the totality of Japanese history was developed. Such an image was potent at nearly every level of society although precise interpretations naturally varied. Many Japanese were too sophisticated to accept mythological explanations without question, but this does not necessarily mean that they depreciated the imperial institution. It is probably misleading in any case to assert that the Japanese people thought of the emperor as a living god ruling over them. The Japanese term *kami,* usually translated as "god," does not have all the connotations of the western word. It means supernatural in a sense, but not omniscient, omnipotent and omnipresent. In addition, according to Japanese mythology the entire Japanese race was descended from various *kanzi,* with the emperor being in direct lineage from the highest *kami,* the sun-goddess. Thus all Japanese were in some degree "supernatural" and possessed of a superior culture. (See *History,* above.)

It is true, however, that elaborate pageantry surrounded the emperor and great homage mas paid to him. His public movements were carefully regulated; under no circumstances was a subject allowed to gaze down upon the emperor when he passed. Direct contact with him in any form was rigorously excluded, and his personal name could never be spoken. The emperor was even given a special word for the personal pronoun "I" which he alone could use. Many incidents of superpatriotism have been recorded, such as those of people risking their lives to carry his picture out of burning buildings. There can be no doubt that the ritual surrounding the emperor was highly effective, serving to create an extraordinary loyalty on the part of the Japanese people to the state. Among simple folk like the peasants, a reverence for him akin to worship existed, and the peasant boys were the central core of the modern Japanese army.

Even prior to World War I, the political powers of the emperor were largely conducted in his name by high-ranking officials. The emperor Meiji (reigned 1867–1912) did play some political role in his mature years. The use of his name and authority became an issue in the middle and late Meiji era. When he died, however, he was succeeded by his mentally incompetent son, Taishō. This fact, together with broad sociopolitical changes developing in Japanese society, tended to remove the emperor further from direct political involvement. Taishō's son, Hirohito, received a fairly liberal education and was personally prepared to accept parliamentarism. Thus the decision-making process in prewar Japanese politics did not involve positive imperial participation. All elements of the Japanese nationalist movement, however, continued to utilize the name of the emperor in forwarding their programs. The legal powers of the emperor, moreover, remained, and in one moment of supreme crisis, at the time of the Japanese decision to surrender at the end of World War II, the emperor did take a personal position that proved decisive.

The 1947 Constitution and the Status of the Emperor. — Under the constitution of 1947, legal imperial powers were reduced to those of ceremony and symbolism. The emperor appoints officials only after they have been designated by responsible authorities in the same manner as the British throne. His other duties pertain to such ceremonial actions as promulgating constitutional amendments, cabinet orders and treaties after these have been properly enacted; convening the diet; attesting to certain appointments and the remission of penal sentences; awarding of honours; and receiving of foreign representatives. In all cases, the initiative in these matters lies with the political leadership and it is held responsible.

Among many Japanese conservatives there was a certain nostalgia for the former imperial system and a fear that the new order had weakened the bonds of loyalty, unity and patriotism. Thus some effort was being made to revise the constitution so as to enhance the emperor's position. A partially successful drive was also conducted to reintroduce into the primary-school curriculum courses on *shushin* or "ethics" that would include such themes as filial piety and respect for the emperor. Meanwhile, a considerable "democratization" of the imperial family and institution took place. At the economic level the vast pre-World War II holdings of the imperial family were greatly reduced. The throne mas made much more dependent financially upon the government. The new imperial family council that governs such affairs includes as members two representatives of the imperial family, the president and vice-president of each house of the diet, the prime minister, the chief of the imperial household office and two judges from the supreme court.

From a political standpoint, at the very outset of the occupation the emperor was caused, in his New Year's day message of 1946, to deny his divinity and any racial superiority of the Japanese. His statement emphasized the point that "the ties between us and the people have always stood upon mutual trust and affection." This remained a most important factor. In its political position, the Japanese throne moved closer to its British counterpart. To assist in continuing the trend, Hirohito's son was well tutored in democratic values. Moreover, in the early occupation, a considerable effort was made to "humanize" the emperor, sending him out among the people. Despite these changes, or perhaps in some measure because of them, the Japanese monarch retained a deep hold upon the people. It is true that members of the younger generation generally took a more relaxed or casual attitude toward the imperial institution than did their parents, but there were many indications that this institution still commanded overwhelming support from almost all segments of Japanese society.

3. The Executive. — Under the 1947 constitution, chief executive power at the national level is vested in the cabinet, headed

by the prime minister. The ministries represented in the cabinet indicate the main functional divisions of government: attorney general, agriculture and forestry, commerce and industry, communication, construction, education, finance, foreign affairs, health and welfare, labour, and transportation. The diet must select the prime minister from among its own members. If the house of representatives and the house of councilors disagree and no adjustment of the differences can be made, the decision of the former prevails. Through the early 1960s the prime minister was always the leader of the majority party or of one party in a coalition, as is normal in parliamentary government. The prime minister has the right to select his own cabinet, although naturally this is a matter for serious political consultation. The constitution does state that all ministers shall be civilians and that a majority shall be diet members.

The powers of the cabinet as stipulated in the constitution are of wide scope. To this body accrues the ultimate responsibility for supervising the entire civil service, administering all laws and directing both domestic and foreign policy. It is specifically charged with preparing the national budget and submitting it to the diet. Beyond constitutional provision, moreover, is the major function of lam-making. because the cabinet continues to be the central source for basic legislation. Few important laws are initiated within the diet, although amendments may occur in the course of diet committee hearings or floor debates. Generally, significant laws are drafted by the subordinate bureaucracy under cabinet order and supervision. These become the heart of national policy. It must be remembered that centralization of power at the national level remains strong. Hence the cabinet is, in many respects, the focal point of institutional power in Japanese politics.

The cabinet is definitely responsible to the diet, however, and particularly to the house of representatives (this was not usually true under the Meiji constitution when cabinet members were responsible individually to the emperor). If the lower house passes a nonconfidence resolution or rejects a confidence resolution, the cabinet must either resign or dissolve the house within ten days. As long as the government holds a secure majority in the diet there is no likely threat. but each general election is a test for the prime minister and his cabinet, and in cases of narrow margins for the majority party or coalition government, challenges from the diet are frequent. The most intimate contact between top executive and legislative branches probably comes during committee hearings or floor debates and question periods, when ministers must be present to defend their policies. After 1945 the diet became the main political arena, and every postwar Japanese government was cognizant of that fact.

After 1945 a certain shift could be noted in the criteria for successful leadership, which was previously confined to councils of senior statesmen, the leader-follower groups within parties, the bureaucracy and the military, and in general political behaviour. Some political leaders attempted to project their personalities to the voting public, borrowing extensively from western techniques. There was somewhat greater emphasis upon individual leadership and the human qualities of the leader. Campaign tours at the grass-roots level came to be considered essential; the old distaste for public speaking and personal contact with the masses receded somewhat. Public-opinion polls were closely watched. Public relations work received more attention. There remained strong "traditional" factors in Japanese politics, and even the so-called "modern" leader had a mixture of traits, as might be expected. There was little doubt, however, that this was an era of considerable transition.

History of the Bureaucracy.—Discussion of the Japanese executive cannot be limited to top leaders such as the prime minister and his cabinet. A vital part of the national executive is the vast body of subordinate officials and civil servants who man the ministry, bureau and commission staffs. Historically. the badge of office in Japan has carried with it both social prestige and great power. In the Tokugawa era, immediately prior to the modern period, all officials came either from the military class or from the traditional aristocracy that surrounded the imperial court. One of the most significant developments of this period, indeed, was the bureaucratization of the military class. In a period of enduring peace and isolation there was little need for the warrior. Consequently, he was given a Neo-Confucian education and turned into an administrator. Confucianism (*q.v.*) taught that the function of the official was an all-embracing one, including the duty of being both model and mentor to his people. In theory, the proper official was to be benevolent and loving, solicitous of the public welfare and willing to listen to the voice of the people. In practice, however, there was usually a considerable falling off from this high standard. Military-class officials were prone to act in a very officious manner—the traditional term to express this fact was *kanson mimpi* ("officials honoured, people despised")—and whether his position was hereditary or won through some type of prowess, the official usually took full advantage of his opportunities. He expected and received deep respect from all other classes. He was often generously rewarded for favours granted to private parties such as merchants and, within limits, no stigma was attached to such conduct. On the contrary, it was to be assumed. Within their own definitions, moreover, most Japanese officials of the traditional type had a relatively high ethical code but, for many, arrogance was not incompatible with a simple, even austere, mode of life.

In the modern period also, the military class played a prominent initial part in the Japanese bureaucracy. When the Meiji restoration occurred, the military class numbered about 2,000,000 out of a total population of 28,000,000 to 30,000,000. Economic and social change had brought hardships to many of this group, and their unrest was a source of worry for the new Meiji government. Whenever possible, former samurai were given government or police positions. In many cases, of course, personal favouritism was involved. The great bulk of top Meiji leaders came from the old military class, and representatives of the former Satsuma and Chōshū fiefs were especially powerful. As a result, many of the new appointees to both the civil and military branches of the bureaucracy came from these regions. By its opponents. the early Meiji officialdom was sometimes called *hanbatsu* ("clan clique"). Nevertheless, the military class, by virtue of education, training and general social status, was best equipped for holding official positions at this time.

Shortly before the Meiji constitution was promulgated, a civil service system modeled after that of Germany was installed. From this time, the trend was in the direction of officials trained in one of the major educational institutions, particularly Tokyo university. To study under the law faculty of Tokyo university became the dream of most young aspirants to government careers. The new term for the Japanese bureaucracy became *gakubatsu* ("university clique"). The exclusive emphasis upon Confucianism as the proper preparation for officialdom was altered, but the new training was heavily legalist in character, with German principles predominating. This undoubtedly encouraged the tendencies toward formalism and rigidity in Japanese administrative procedure. The officialacted largely "by the book" and was seldom willing to use his discretion or imagination in applying the law. Involved procedures and officiousness continued to be prevalent. On the other hand, in terms relative to the rest of Asia and perhaps to the western world as well, the Japanese officials were efficient, well disciplined and largely uncorrupted. This was true despite the fact that their social status, relative economic position and general morale had tended to decline after the Meiji period. New socio-economic classes like the industrialists increasingly acquired a portion of the prestige and power that had formerly accrued to the officials. It should be noted, however, that some interchange of personnel between these two groups had begun by the mid-Meiji era.

The background of the Japanese bureaucracy is not complete without reference to events after 1920. By the end of World War I the ranks of the *genrō* had been depleted by death and old age. With their prestige and unifying force largely gone, the new era was one of mounting competition for power between various bureaucratic groups and the political parties. Sometimes this period has been denoted as the era of quasi-liberalism, because democracy was given its greatest opportunities in the years be-

tween 1918 and 1931. The political parties rose in influence and most of the prime ministers were party leaders. The cabinets, however, continued to have a quota of nonparty men, most of them career government officials, and all cabinets had servicemen appointed as ministers of war and the navy. No basic changes were made in Japanese constitutional law or practice. Hence important legal powers remained in the hands of nonelective officials.

The attitude of the prewar bureaucracy toward the parties was generally one of ill-concealed hostility. To be sure, some higher officials joined and even led parties when it seemed important to their careers. The great majority, however, remained alooi and tended to regard most party men as ignorant or corrupt. If one interprets the prewar Japanese executive broadly to include all elements charged with some responsibility for executing lam and policy, perhaps the main problem after 1920 was that of serious internal conflict and the inability to find a successful mechanism of co-ordination to take the place of the *genrō*. Important parts of the civilian bureaucracy fought against party power and undermined party politicians whenever possible. The military bureaucracy was more flagrant in defying party or civilian control. Army firebrands perpetrated such crimes as the murder of the Manchurian war lord Chang Tso-lin in 1928 and the so-called Manchurian incident in 1931. Prime ministers were not only unable to prevent such events from occurring, but they could not get the chief military officers to take proper remedial action or to abide by the policy established by civilian leaders. By the early 1930s Japan presented a classic spectacle of a government divided against itself. This could not be admitted to the outside world, however, and the military were able to take full advantage of a series of *faits accomplis*. (See History, above.)

During this troubled period there were repeated efforts to attain some greater degree of co-ordination within the government. The Meiji constitution had given supreme powers to the emperor, but in reality those powers were shared by a multiple executive. The prime minister and his cabinet represented the central administrative and policy-making unit, but they were handicapped by being "infiltrated" with extraneous elements like the military and by the lack of loyalty to their policies on the part of some of their subordinate bureaucracy. The military arm of the Japanese executive was headed up by the Supreme War council, but neither this body nor groups subordinate to it were united. Another executive element, the imperial household officials, found increased pressures upon them to act as co-ordinators as the *genrō* era faded out. Standing alone, however, they had little real power. There were also certain quasi-executive bodies like the privy council whose functions of advising on policy and determining the legality of actions enabled them to block the cabinet on occasion.

One method of seeking co-ordination among these various executive elements was to hold periodic imperial conferences, presided over by the emperor and with the leading executive sections represented. Such conferences, however, were not held regularly enough to meet the needs involved. Liaison councils were established, and some of these were important. Moreover, in the 1920s and early 1930s another body of senior statesmen known as the *jūshin* gradually emerged to take the place of the *genrō*. The *jūshin* included as members former prime ministers, imperial household officials, the president of the privy council and the last surviving *genrō*, Saionji Kimmochi. They took over the task of advising the emperor on the selection of prime ministers and other matters of serious consequence. However, they never attained the power and authority of the *genrō*, and the absence of a truly unifying agency was keenly felt during the hectic period after 1931. The situation produced not only conflict within executive ranks but deep irresponsibility. With power widely dispersed and total policy control impossible, a sense of individual or even group responsibility within the executive was difficult to acquire. This was brought out very clearly in the war crimes trials after World War 11.

The Modern Bureaucracy.—After 1945 the Japanese executive was greatly streamlined and made much more cohesive. Up to the early 1960s the military had played no role of consequence, despite the emergence of a national defense force. Such bodies as the privy council were abolished, and the powers of imperial court officials were closely circumscribed. The executive became without question the prime minister, his cabinet and the large body of appointees and civil servants under them. Almost all of the key executive personnel were party leaders as a result of the new constitutional system. It was not easy for the Japanese career civil servant to adjust to this new order, especially for those trained under the old system. Many of them saw a decline in their authority, a deterioration of discipline in the government service and troublesome challenges from the government-worker groups through the new labour unions. An additional complication for many senior officials, moreover, was the significant gap existing between prewar trainees and new recruits.

Very few civil servants were purged after 1945, especially from ranks below the top policy-making levels. There was some attempt, however, to make substantial organizational changes in the bureaucracy and to infuse in it a new spirit. In the new constitution, the central theme of officials being the servants of the people rather than the emperor was clearly set forth. After the occupation was well established, surveys of Japanese officialdom were made, the most important of which was conducted by a specially appointed American Personnel Advisory mission in 1946–47. Out of this work came a new National Public Service act and a National Personnel authority having continuous supervision over the civil service. The old ranks and the former examination system were substantially altered.

Accompanying these legal changes were innovations in training and education. SCAP itself set up some training programs for men already in official service, and in various forms such training institutes continued to be significant. On a broader level, the postwar civil servant was naturally affected by the extensive alterations in secondary school and university curricula. His education became less legal and contained more emphasis upon the various social sciences. It was also less the monopoly of Tokyo university, although that institution retained great prestige. Beyond general education for government service, moreover, the opportunities for advanced specialized training both in Japan and abroad increased considerably. Most promising officials had some chance for further study or observation, and many were exposed to new techniques and procedures in use abroad. Technical assistance was imported into Japan in the occupation era, special conferences and concentrated training programs were utilized and overseas visits ranging from 30 days to a year or more were arranged.

The post-World War II Japanese public official was probably better equipped technically than at any time in history, although it should be pointed out that many of the foreign procedures with which he had become familiar were not feasible for Japan and nearly all required some modification. For the most part, Japanese officials matched their competence with hard work and, in addition, their personal integrity was relatively high compared with officials of other societies. There were some indications, however, that the problem of corruption had increased after 1945, due in part perhaps to the rather weak economic position of the civil servant. Nor had the old officiousness disappeared; a goodly quota still existed even among the younger generation of officials, indicating the stubborn nature and deep cultural roots of this force. There were still many officials who took an antagonistic or at least ambivalent attitude toward party politicians. This was to be expected and was by no means unique to Japan. Perhaps the more important fact lay in another direction. The Japanese bureaucracy, as a group, appeared to have accepted parliamentary supremacy and its major implications.

There was even a tendency on the part of many career officials to identify themselves privately with one or the other of the two main party groups, the conservatives and the socialists. The bureaucracy was well organized, and with all of its difficulties and divisions it had a certain esprit de corps. Many prewar traditions and biases remained, but the new elements infused into the scene were also impressive.

4. The Legislature.— The power of the diet (parliament or national legislature) increased considerably after the promulgation of

the Meiji constitution in which the emperor was regarded in theory as the absolute ruler of Japan. Under the 1947 constitution, however. the diet became the highest organ of the state and the centre of legislative power. The history of the diet merits discussion.

Historical *Background.*—Under the Meiji constitution, the diet was established on the basis of two houses with coequal powers. The upper house, the house of peers, was almost wholly appointive. Initially, its membership was slightly less than 300, but it was subsequently increased to approximately 400. Six categories of peers existed. First were the princes of the royal blood, followed by other princes and marquises; the third category was lesser nobility, counts, viscounts and barons; finally, there were three additional types of imperial appointees: those selected for special state service or merit; representatives of the highest taxpayers; and representatives of the Imperial academy. The first two categories, together with the merit appointees, were eligible for life membership. Individuals representing the other groups sat for seven years. The peers were intended to represent the top rank and quality of the nation and to serve as a check upon the lower house

The pre-World War II house of representatives was originally composed of 300 members, all elected, but gradually this number was increased to 466. Suffrage began on a very limited basis, restricted to those males who paid 15 yen or more in direct taxes. It has been estimated that this enfranchised only about 6% of the adult population. As time passed, suffrage requirements were liberalized. and in 192j the diet enacted a Universal Manhood Suffrage act. Women were not permitted to vote prior to World War II. Japan did some experimenting with different types of electoral systems On occasion the single-district system was used, whereby the electorate voted for only one candidate. In general, however, the medium-district system was used. Three to five candidates were elected from each district, depending upon its size, on the basis of the highest number of votes, with each voter having only one vote.

In the early period a very high percentage of diet members were landowners or in occupations connected with agriculture. This mas to be expected, since this group comprised the great bulk of enfranchised voters and, indeed, a considerable part of the Japanese population. With the passage of time, urban commercial-industrial elements rose in importance within the diet and in the broader political scene as well. Before 1945 labour and other loner-economic-class representation was extremely limited. (See Political Parties and Pressure *Groups,* below.)

The powers of the pre-World War II diet were in many respects largely negative. Without diet approval, no bill could become law, and diet power stemmed essentially from this central fact. The government did have the right to issue imperial ordinances in case of an emergency, but if these were to remain in effect the diet had to approve them at its next session. There was one significant limitation upon the traditional legislative control over the purse strings. If the diet did not pass the budget in a manner acceptable to the government, the government had the right to apply the budget for the previous year. This provision was borroned from Prussian practice The diet did not initiate important legislation, this was chiefly the function of the executive. Its committee system underlined this fact. There mas no extensive reliance upon standing committees, whereby a member became an expert on some field over the years if his tenure in the house continued. Rather. as in Great Britain, the chief reliance was upon ad *hoc* committees, newly formed at each session. Unlike the British parliament. however, the diet did not have great prestige with the executive branch. Since the executive was not legally responsible to the diet, and since it was comparatively easy to dissolve the diet and "guide" the elections on behalf of one's party or candidates, the prime minister and cabinet members tended to take interpolation and question sessions in the diet with supreme casualness. Indeed, on many occasions the diet was treated very ignominiously.

Thus the historical traditions of Japanese parliamentarianism have not been glorious ones. Early in its development the house of representatives developed a popular reputation for venality and rowdyism. This kind of accusation is easy to inflate, but there was enough evidence to influence the Japanese public toward such generalizations. Elections were costly, especially since vote buying and its near equivalents were common practices. It was tempting to gain advance funds or recoup by accepting gifts and fees for political services rendered. This is a problem in every society, and Japan had added reasons for difficulty. The traditional relation between official and citizen, for example, represented a dangerous precedent in some respects. In any case, scandals involving diet members were commonplace. and the impression mas built up in many Japanese minds that politics was inevitably a disreputable business.

To transfer Japanese politeness and decorum into the diet setting also proved enormously difficult. Parliamentary practice represented in certain ways a direct procedural challenge to the historic Japanese methods of indirection, intricate negotiations and ultimate consensus. The acceptance of direct majority decisions adverse to one's own views or position has never been easy in Japan. In a broader sense, it can be said that the rules governing the parliamentary "game" as it is played by a few western societies have not been fully accepted by all Japanese players. Even the concept of peaceful change has been difficult to establish, and the problem of personal relations between political opponents has been exceedingly troublesome. Some element of violence has always been close to the surface of Japanese politics. In the early years, many Japanese politicians had their own bodyguards or strong-arm men. Physical violence both in the diet chambers and outside was not uncommon. The diet was often called "the zoo." and this epithet suggested another element of public distrust or disgust concerning Japanese democracy in action.

The Diet After *1947.*—Under the constitution of 1947 the diet was drastically altered both in structure and in powers. There remained two houses, the house of representatives and the house of councilors.

The latter takes the place of the old house of peers and has a membership of 250 consisting of two categories: 100 councilors elected from the nation at large with the remaining 150 elected as prefectural representatives. Every voter may cast a ballot for one candidate in each category, giving him a total of two votes. The house of councilors cannot be dissolved and its members serve for six years, with one-half of the members standing for election every three years. In structure, the house of councilors is unique among parliamentary bodies, and it has been under criticism by many Japanese. The decision to abolish the house of peers was based upon its appointive and ultraconservative character. It had become an anachronism, especially when viewed against democratization hopes, and there seemed little nisdom in merely reducing it to near impotence as had been done to the British house of lords. On the other hand. there mas a fear of an omnipotent unicameral legislature and the desire for some type of legislative check-and-balance system. It was not easy to determine a method of selecting upper-house members that would differentiate them from the lower house. The decision to have one portion of the membership sit as national representatives was motivated by the hope that this would induce the selection of nationally prominent individuals. The prefectural representatives give geographic and sectional coverage similar to U.S. senators.

It is possible under this constitutional system for the government to be divided against itself. The house of councilors cannot be dissolved in case of conflict betneen it and the executive branch. Elections for this house, moreover, are at fixed times, irrespective of political conditions, as is the case with the U S. system. To mitigate this possible difficulty. the balance of power was shifted on several important matters to the lower house where general agreement with executive policy must prevail. In case of a deadlock between the two houses over the selection of a prime minister, the vote of the lower house takes precedence. The budget must be submitted first to the lower house, and if the two houses cannot agree. the position of the lower house prevails after 30 days. This same provision applies to treaties. With respect to other legislation, if the councilors reject a bill or refuse to act upon it within 60 days, the house of representatives can make it

into law by repassing it by a two-thirds majority of the members present.

The house of representatives has 467 members elected from 118 electoral districts. Each district has from three to five representatives, but the voter casts only one ballot, with the candidates receiving the highest number of votes elected. Laxer-house members are elected for a term of four years, but the house can be dissolved at any time by the government in which case elections must be held within 40 days.

As in the past, the Japanese diet rarely initiates important legislation; such laws ordinarily come to the diet under cabinet sponsorship. However, individual member's bills can be introduced in the lower house if they have been signed by 20 or more members, and in the upper house with the signature of 10 or more members. Under diet law, the committee system has been drastically altered to accord more with U.S practice. Each house has slightly over 20 standing committees dealing with such subjects as foreign affairs, finance and education. Government legislation goes first to the appropriate committee where it is examined and often vigorously debated. Membership on these committees is determined by the diet in rough accordance with the party ratios in each house. A member normally retains his assigntnents as long as he sits in the diet. Thus he develops some detailed knowledge and may provide a challenge to government policy makers of opposing parties or convictions.

Japanese politics in the postwar period revolved around the diet. That body was no longer on the periphery as it was under the Meiji constitution. Moreover, with all adults over 21 eligible to vote, the diet could claim to be representative of the public will to a greater extent than at any time in the past. Certain historic problems remained, however. Large-scale diet scandals, though somewhat fewer, were not lacking; the basic causes of corruption had not been solved. Diet procedure also left much to be desired, a number of riots and wild melees having occurred on the floor of the house of representatives. Even provided with constitutional support, the diet had not truly established itself as a respected body in the eyes of the Japanese people.

5. The Judiciary. — Few political changes in Japan after 1945 were as drastic as those pertaining to the national judiciary. The old court system was modeled after the European continental system, especially that of Germany. It was clearly subordinate to the executive branch, and court administration was in the hands of the ministry of justice. There were two broad divisions in the court system: ordinary courts and administrative courts. Heading the ordinary court structure was the supreme court, a large body of 4; justices, most of whose work was done on the basis of j-man divisional units. The supreme court did not determine the constitutionality of legislation. Its main function was to hear cases on appeal from the courts of appeal and to hear special cases such as those involving treason. Below the supreme court were 7 high courts operating in different districts encompassing the nation, and below them, about 50 lower courts. At the local level, approximately 300 courts serviced minor cases. The administrative court was taken from the German model, and was empowered to make decisions on Japanese administrative acts or rulings where some claim had been raised. This court was particularly active in decisions involving taxes, licences, properties and similar issues.

This constituted the Japanese court system prior to World War II. Apart from it, there was also the privy council, which had been given quasi-judicial powers. It was entitled to give advice to the emperor on Japanese organic law when requested. With this grant of authority, it might have evolved into a regular constitutional review body. Despite the fact that the council used its position on occasion to apply heavy pressure to the government, however, it did not emphasize its judicial role.

The constitution of 1947 freed the judiciary from the legal control of the executive and established it as an independent branch of government. Once again, the court system is headed by a supreme court, but one with vastly greater powers than previously. The constitution specifically grants it the right to determine the constitutionality of any law or regulation as a court of last resort. The new supreme court consists of 15 justices, headed by a chief justice who is appointed by the emperor upon nomination from the cabinet. The other justices are appointed by the cabinet. Another innovation is the provision that each supreme court justice shall be reviewed by the people at the first general election after his appointment and again ten years later. If rejected by popular vote, a justice cannot hold office. Judges of the inferior courts are appointed for ten-year terms and are eligible for reappointment. All judges may be impeached by a court composed of 14 members elected equally from the two houses of the diet. Under the supreme court are 8 higher courts and 49 district courts corresponding roughly to the U.S. superior courts. In addition, about 570 local courts complete the judicial network.

Clearly, the Japanese ,supreme court was patterned after the U.S. model. It was argued that since Japan had had little experience with effective constitutionalism and the protection of civil liberties, a judicial body empowered to define and defend constitutional lines was highly desirable. The Japanese supreme court: however, proved to be exceedingly timid in touching upon any issue of constitutionality or in upholding individual civil rights against state infringement. In spite of its new powers, the court continued to act very much in the old pattern. In no area of Japanese constitutional change, perhaps, were there such meagre results. One can understand this, however, when it is recalled that not only is judicial review of legislation largely foreign to Japan, but public litigation itself tends to have bad connotations in the Japanese public mind.

6. Civil **Liberties.**—Ch iii of the 1947 Japanese constitution sets forth the basic rights of the people in about 40 articles. In many respects, these articles represent the most comprehensive grant of rights to be found in any modern constitution. They include not only all of the political rights to be found in British and U.S. organic law, but also economic and social rights usually associated with the constitution of the U.S.S.R. and similar documents. For example the right to work is guaranteed, as are an equal education for all persons in accordance with their abilities, the rights of collective bargaining for workers! marriages based upon free choice and equality of the sexes, and academic freedom. The rights incorporated in this document are far different from those in the Meiji constitution, where fewer rights were listed and those were of the more conventional political type. More importantly, Meiji constitutional rights were all subject to the phrase "except as regulated by law," meaning that any statute passed by the diet could restrict them. Thus laws like the Peace Preservation acts could be interpreted so as to seriously restrict constitutional guarantees.

However, the protection of civil liberties depends upon more than lofty phraseology in some document. It depends upon the interest that the government and people have in these rights, the training given to police and other law-enforcement agencies, the willingness of the courts to stand firm against violations and the ability of the press and other public organs to point out dangerous trends. In these respects, the postwar Japanese scene was not wholly adequate, but it was greatly improved over the era before World War II.

7. Local Government. — The history of modern Japan is in one sense the history of a continuous movement toward the centralization of political power. The 1947 constitution provides for local self-government with a fair degree of autonomy.

Historical *Background.*—After the Meiji restoration, the autonomy of the local districts was constantly whittled away. Indeed, this was one of the principle causes for political unrest and was involved in such events as the Satsuma revolt of 1877. The process of centralization began immediately after the restoration, when the old fiefs were "returned to the emperor" by their military-class rulers and an integrated system of prefectures was established in their place. Ultimately. Japan was divided into 46 prefectures with the Tokyo metropolitan area having a separate form of administration. The minister of home affairs appointed all prefectural governors and they were a part of the centralized bureaucracy, as were the prefectural police. Each prefecture had an elective assembly but the appointive officials

dominated the political scene, usually by virtue of their connections with the national government. This was particularly true since local financing was weak and most large-scale expenditures were dependent upon aid from the central government.

Below the prefectural level, the traditional gun or county-type office was ultimately abolished but city, town and village units were maintained. The offices of mayor and councilman became elective after the Meiji era. Urban government at the local level, therefore, acquired a democratic flavour. The jurisdiction of most local urban units, however, was very limited, and it cannot be said that public interest in municipal elections was high After the onset of the militarist era, perhaps the aspect of local government calling forth the greatest participation from the average citizen was the neighbourhood association. This association, which had ancient roots, pooled families living in close proximity for a variety of purposes. They could be used as outlets for government propaganda, as units for fire fighting and defense activities and as extended families accepting joint responsibility for all types of political and social obligations. In many respects. the neighbourhood association was the most natural expression of Japanese society and politics beyond the familial group.

Throughout most of the pre-1945 era, more than one-half of all Japanese citizens lived in rural areas, and rural government at the local levels must not be ignored. In agrarian Japan, the traditional. informal institutions and instruments of control retained a very deep significance prior to World War II. The overwhelming majority of rural Japanese lived not in single, isolated homes surrounded by their fields, but in small, rural hamlets called buraku where 20, 30 or more families lived together. The social structure of the buraku differed considerably from one region of Japan to another, and even within regions, depending upon the type of cultivation or occupation (for example, fishing) emphasized and upon other factors. In general, the regions of northwest Honshu produced the most backward, "feudal-type" buraku while some of those in the region of the Inland sea were noted for being "advanced" and relatively egalitarian.

Political power or influence at the buraku level, however. generally flowed down two channels, the village headman or elder system and the traditionally prominent, affluent family. Sometimes these two channels were fused; almost always they were interrelated. On occasion, a pattern of power akin to political bossism prevailed; often the mechanism was much more subtle. In any case, within the Japanese rural scene. the interactive forces of hierarchy and paternalism tended to be extremely strong. Generally the rural "common man" accepted the guidance of the acknowledged leader of his community and even solicited it. Elections in rural areas merely confirmed a power structure that already existed. Thus scions of prominent landowning families were elected to the diet because their families had always held power. In turn. many of these families engaged in various paternalistic acts toward the community, or individuals therein, assuming a certain responsibility for tending to their "flock" in true Confucian manner.

Local Government After 1947.—Local rural politics after World War II retained much of the pre-1945 flavour despite the changes that took place. The country is divided administratively into 46 prefectures (see Population: Table, above), 42 of which carry the suffix *ken* while the remaining 4 are suffixed to, *dō* or fu (Tokyo-to, Hokkaido, Kyoto-fu, Osaka-fu). The prefectures are subdivided into cities (shi), towns (*chō*) and villages (son, mura or *machi*). The U.S. occupation had among its major objectives the decentralization of political power and the strengthening of democracy at the grass-roots level. To this end, many statutes were enacted and local government teams worked tirelessly. The single most important piece of legislation was the Local Autonomy law of 1947. The immediate effect of this program was to reduce sharply the power of the central government to control prefectural and local affairs. Prefectural governors and other local officials had their posts made elective. Both the police and educational systems were decentralized. A local civil service system was established, and there was a sustained attempt to train local officials.

The decentralization program, however, encountered major obstacles. Opponents of local autonomy claimed that Japan contained neither the financial resources nor a sufficient number of trained personnel to operate local governments on a largely autonomous basis. They charged that such a system caused inefficiency, inequity and discontent. It might be added that Japanese political subdivisions as constituted after 1947 did not evoke in themselves the sentiment of loyalty. Sectionalism remained a factor of some importance, although it diminished greatly after the restoration, but sectionalism was not coterminous with political boundaries and was not really connected with their development. Thus emotional support for self-government at the local levels was not strong. Under conservative leadership there was an intensive and partly successful drive to re-establish many centralized controls. In the early 1960s the socialists put up determined resistance on some fronts. but the pendulum definitely began to swing toward augmented national controls. The Local Autonomy agency, established in 1949 to assume certain functions of the old home ministry. acted as a co-ordinating and policy-making body at the national level.

8. Political Parties and Pressure Groups.— In the Japanese diet political parties have assumed supreme importance.

Background —Japan has had a longer experience with western-style parties than any other Asian nation. In 1874, shortly after the Meiji restoration, the Aikokukoto (Public Party of Patriots) was formed, dedicated to the establishment of a national assembly and to party government. Its leaders, headed by Itagaki Taisuke, were former samurai from the Tosa area who were dissatisfied with government policies and the distribution of political power. The first full-fledged party movement, however, got under may in 1880–82, after the failure of the Satsuma rebellion had made it abundantly clear that the national government could not be challenged successfully by military means.

Three parties emerged during this period. Each had a small membership, essentially former samurai. and in certain respects operated more in the fashion of a club than a modern party. Yet these parties sought to have some impact upon the broader public through their publications and the speeches of their leaders. The Liberal party (Jiyūtō), successor to the Party of Patriots, was again led by Itagaki. For their philosophic basis. the Liberals borrowed heavily from Rousseau and the ideas of the French Revolution. "Liberty, equality and fraternity" were emblazoned upon party banners. Constitutional government and "civil rights" were central party principles. The Liberal party drew its strongest support from diverse agrarian elements — landowners. landed entrepreneurs and some peasants. Initially it was also heavily sectional in composition, with the Tosa men occupying all leadership posts. Within the party there mas no complete commitment to peaceful change; violence was often used or close to the surface, and this gave the government an opportunity to use suppression.

The second "popular" party, the Progressive party (Kaishintō), was more moderate and drew most of its political inspiration from British utilitarianism. Like the Liberals, the Progressives championed constitutionalism and party government, thinking especially in terms of the British model. The Progressive leader was Okuma Shigenobu, and around him clustered many bright young university students and urban intellectuals. But the Progressive party also showed a strong sectional trait, since Okuma and a considerable number of his supporters were from the old fief of Hizen (Saga). When the Satsuma-Chōshū-Tosa-Hizen coalition split, it is significant that men from the former two areas continued to dominate the government while men from the latter two launched the party movement.

Emerging at a time when the emphasis was upon nationalism with the emperor as its symbol, the popular parties had certain serious problems in espousing the western liberal creed in its entirety. In some measure, they had to adhere to the themes of solidarity and complete loyalty to the imperial institution. The former theme caused them to argue the case for liberalism on the basis that it would unite the people into a solid bloc. augmenting the power of the state. In this argument. minority rights and the concept of individual dissent were given little attention. The second theme caused the Meiji liberals to vie with the conserva-

tives in asserting their loyalty to the throne, only to see the imperial institution used repeatedly against them. The third party of this period was the staunchly conservative Imperial Rule party (Teiseito). Its leadership came mainly from government officials, Shinto priests and some newspaper editors who had an interest in promoting the government position. With its slogan "revere the emperor, love the country," it advocated a general go-slow policy and one that would make constitutionalism an adjunct to imperial rule.

For a time after 1885 the parties lapsed into inactivity. There was no national diet and the constitution was being prepared in secret: without opportunity for public debate. Before the first diet opened in 1890, however, party lines had been re-established. and the two popular parties carried their struggle against the oligarchy into the diet arena. Government leadership soon became divided over the question of how to handle the party problem. Men like Yamagata Aritomo, famed Chōshū military statesman, favoured "transcendental" cabinets. above party. They abhored the concept of party as a factional device, unrepresentative of the nation at large, and they refused to contemplate union with any party. But it was impossible to conduct policy without some party support, and if oligarchic leaders would not participate in parties, they at least had to form alliances with them on the basis of some concessions, or offer special inducements for votes including bribes. Some members of the oligarchy like It6 Hirobumi recognized the inconvenience and danger of these conditions, and ultimately determined to join the party movement. From the party standpoint also there were advantages in having oligarchic sponsorship, because this was the only avenue to power.

Thus the old Liberal party came under the leadership of It6 in 1900 and was renamed the Rikken Seiyūkai (Friends of Constitutional Government association). Ōkuma's party, the Progressives. also came under increasing bureaucratic influence in later years. When the era of party supremacy finally arrived, therefore, the two major parties had mixed bureaucratic-"pure party" elements. Sometimes these were in conflict and, indeed, this characteristic continued within conservative party ranks into the postwar era.

The era between 1918 and 1931 may be called the era of party government in prewar Japan. Actually, as has been noted. there were some nonparty prime ministers during this period, and the principle of party government was never firmly established. Rut there can be no doubt that the two major parties, the Seiyūkai and the former Progressives, finally calling themselves the Minseitō or Democratic party. did hold a substantial amount of power. It was also in this period, however, that the attractiveness of party government. began to fade for many Japanese citizens. Earlier, the advent of universal manhood sufirage and the movement to abolish "clan government" had been widely heralded as progressive steps. Once so-called party government was established, however, the public was treated to a continuous succession of stories about political corruption, close party-*zaibatsu* (big business) ties and general political decadence. The era of the 1920s, moreover. was a period of intermittent economic crisis. When the depression finally struck Japan with full force after 1929, the political parties bore the full brunt of a savage assault upon democracy, parliamentarianism and capitalism.

After 1925 the first labour parties were established. From the beginning, the left-wing political movement in Japan was fragmented by personal and ideological differences. Leadership was provided by intellectual and labour elements. The moderate wing was represented by the Social Democratic party, patterned strongly along the line of British Fabianism. The Japan Labour-Farmer party. closer to Marxism occupied a centrist position The legal left was represented by the Labour-Farmer party, strongly Marxist and serving as a popular front organ for Communism. In addition. an illegal Communist party existed in Japan after 1922 on an intermittent basis Pre-World War II leftist groups nere constantly in flux. Mergers and splits were common occurrences. After 1930 deflections into the National Socialist movement also developed. Sans ultranationalist and Communist elements. the bulk of the socialists managed to combine in 1932 into the Social Mass party which lasted until the party era came to a close.

Prior to 1945 the Japanese left-wing movement was extremely weak, never able to elect more than a handful of candidates or poll more than a few hundred thousand votes. Many reasons mere involved. State oppression. especially against the far left, was of course one factor. More important perhaps were the underlying weakness of organized labour during this period: the strength of traditional institutions and conservatism in the rural areas and, in general, the limited interest and participation in parliamentary politics by the Japanese "common man." Also involved were the inability of intellectual left-wing leaders to communicate with the people and their tendency to take highly theoretical positions divorced from reality and subject to bitter factional dispute.

As the militarist era began to emerge in 1931, the political parties gradually lost power and public support. In 1940, under pressure, all of them went through the ritual of "voluntary dissolution." One large party, the Imperial Rule Assistance association, was launched in their place. Its function was partly in line with the original hope of many Japanese conservatives: to "assist the emperor" by maintaining the unity of the Japanese people, serving as an outlet for Japanese government propaganda. and being available for various services. As a modern mass-man organ, neither the Imperial Rule Assistance association nor its 1945 successor, the Greater Japan Political association, achieved notable results. Japanese leaders were reluctant to attempt. on any full scale the techniques of modern totalitarianism. The era of competitive parties in the modern western tradition, however, had come to a temporary halt.

Post-World War *II* Trends.--The reorganization of political parties in Japan got under way almost from the moment surrender was announced on Aug. 15, 1945. Leaders from the old conservative parties undertook to re-establish their groups under Meiji era labels. Thus the Liberal and Progressive parties emerged shortly after the U.S. occupation began. Personal and power rivalries precluded a unified conservative movement. Meanwhile, the Socialist party (Shakaitō) was launched as a united party of the non-Communist left. Subsequent events. however, were to demonstrate the difficulties of maintaining that unity, and later splits did occur. The first legal Communist party in Japan was also established in Oct. 1945, shortly after the release from prison of veteran Japanese Communist leaders. Another party, the Co-operative party, was organized on a national basis, but it later disappeared. There mere also a profusion of district or regional parties. almost all of which quickly succumbed.

The postwar Japanese party movement can perhaps be summarized in terms of three basic factors: first, the continued dominance of the conservatives in the over-all political scene; second. the establishment of a two-party system, but one that proved precarious and possibly temporary; third, continued uncertainty in the Japanese public mind about affiliation with parties and about the concept of party itself. Turning to the first factor. Japan in the early 1960s remained a basically conservative society despite postwar upheavals. The conservatives, whether divided or united, tended to poll about two-thirds of the votes in post-1945 elections. The socialists made definite gains over their prewar position but they remained a distinctly minority parly. The reasons for conservative dominance were many. The conservatives had most of the "name" leaders, men of broad political and administrative experience whose local political ties were also extensive in many cases. The advantages of intimate contacts with various district elites were often considerable, and in some cases the old prewar organizational structure of the Seiyūkai and Minseitō remained largely intact.

For a variety of reasons, the Japanese rural areas continued to be a bulwark for the conservatives despite socialist inroads in some regions. Trends among the younger farm generation were not completely clear; but most agrarian districts appeared "safe" for the conservatives. Conservatives were also aided by having greater access to campaign funds, and Japanese elections require large outlays of money in most cases if the candidate is to succeed. Labour unions provided increasing campaign funds for the socialists, but these did not match conservative war chests. Moreover,

the socialists were gravely hampered by internal strife. Major ideological differences existed between the right and left wings of the socialist movement, and even within these groups. The validity of Marxism and the issue of "class party" versus "mass party," not to mention wide divergencies on foreign policy, plagued the Japanese socialist camp from 1945. After a serious split in Oct. 1951, the Socialists remained as two separate parties until the fall of 1955 at nhich time they were reunited. The conservatives also organized a united Liberal-Democratic party (Jiyū-Minshutō) in Nov. 1955 to meet the socialist challenge. Thus, at least temporarily. Japan achieved a two-party system, the Communist party vote and that of other minor parties being negligible. Internal difficulties, especially within the Socialist party, continued to be grave, however, and the conservatives and socialists were in actuality two loosely joined federations.

The third factor in postwar Japanese party politics relates to the position achieved by the parties in the public mind. The constitution of 1947 indirectly granted the Japanese parties an unprecedented position of power by clearly establishing parliamentary supremacy. Legal change alone, however, was not sufficient to assure the position of the parties in Japanese society. Many of the traditional sins and weaknesses connected with party organization and tactics continued. Clique and factional divisions, inadequate grass-roots organizations, leadership weaknesses and problems of corruption all existed in some degree. Party membership continued to be a relatively formal procedure, hence the average Japanese did not think of himself as a Liberal-Democrat or Socialist in the same sense that an American or British voter might. In these terms, party roots continued to be relatively shallow. The concepts of party government and parliamentary supremacy were still, in a sense, on trial before Japanese public opinion. At the same time. however. there were some encouraging signs. In the later elections voter interest was high. running close to 80% for the house of representatives; more intensive campaigning and grass-roots work was undertaken; and the Japanese citizen frequently began to think of himself as loosely affiliated nith a given party, even though he would not contemplate membership.

Pressure Groups.—Any analysis of political parties and voting trends must involve some discussion of pressure groups and socioeconomic political blocs. Prior to World War II conservative dominance, as noted earlier. stemmed from support given by the landed class and the agrarian element generally, on the one hand, and assistance rendered by the rising commercial-industrial class on the other. The Japanese countryside retained a strongly traditionalist flavour of hierarchy and paternalism, and this was reflected in conservative voting patterns. It would be inaccurate. however, to suggest that rural conservatism followed a uniform course or that it contributed on balance to successful parliamentary government. The Japanese agrarian class, comprising nearly one-half the total population even after intensive industrialization, was divided into a number of categories. In general. landholdings were not large scale but, naturally. the absentee owner and resident landlord groups tended to hold primary economic and political power, especially the wealthiest segment of them. Approximately 37% of all agrarian families were owner-cultivators, and mostly owned small plots. It was difficult to distinguish their problems and status from the tenant categories. An equal percentage of farm families were classified as part owner, part tenant. Within this group, about 17% of all Japanese farm families rented more than 50% of the land they tilled, but owned more than 10%. The purely tenant class. onning less than 10% of their land. represented approximately 27% of all farm families, so about 44% of all Japanese farmers were either mainly or wholly tenant farmers.

The agrarian group, of whatever category, tended to have grievances in the context of a rapid march toward industrialization. In considerable measure, the peasant paid the price for the industrial revolution without reaping a sufficient number of its benefits. If he owned the land. his taxes were relatively high and only a small amount went for rural development. His operating expenses were heavy. but the prices obtained for his products were usually inadequate except in times of war. At the close of the 1920s almost all Japanese farmers were operating at a deficit. In this climate some agrarian radicalism sprouted. flying, for the most part, antiurban, anticapitalist and antiliberal banners. Usually these movements hinged upon a romantic desire to reestablish the soldier-peasant alliance and a fervent urge to attack the iniquities of urban. industrial life. But in reality few farmers participated in these movements. For the most part, their political activities were limited to exhibiting loyalty to the emperor and. when the occasion demanded it, becoming soldiers of blind obedience and extraordinary bravery in the Japanese army. This pattern of loyalty and belief in primeval myths was sustained by both the socioeconomic conditions of rural life and the indoctrination and primary education provided by the modern state.

After the end of World War II. many changes took place in Japanese rural life. The program of land redistribution was one of the most far-reaching reforms attempted in the early postwar era. (See The Economy: Agriculture, below.) The land-reform program represented a great leveling process. and at least temporarily injected a much higher degree of equality into the Japanese rural scene.

Along with this major reform went many other changes that had a potential effect on the political and economic position of the agrarian class. Laws providing for equal inheritance instead of primogeniture were enacted; legal equality for women was established; substantial changes in primary schooling were made; and, of course, conscription was abolished. Few of the legal changes could be applied completely; some could only acquire validity over a period of time and others might be unfeasible for Japan. Collectively, however, they represented some additional pressure toward sociopolitical change in the rural areas. In addition, after 1945 many factors contributed to the relative prosperity of the Japanese farmer: land reform. heavier dependence on domestic foodstuffs, improved agrarian technology and similar developments Perhaps this was the chief reason why the Japanese farmer continued to vote strongly conservative and, since he represents about 45% of the Japanese electorate. to be a pillar of strength for the conservative parties. The unansnered question was whether the younger people of the rural areas, products of a different education and environment. would perpetuate the conservative pattern of their parents. There were some indications that political behaviour in the rural areas, while remaining basically conservative, might be subject to more variations and shifts than had formerly been the case.

Since Japan is the only Asian society with some heritage of industrialization it is important to note the political tendencies of the commercial-industrial groups. First. however, the broad structure of Japanese industry must be drawn. At its base, modern Japanese industry continues to be supported by myriads of small- and medium-sized enterprises, ranging from the simplest handicraft-type operation nhere worker and employer are undifferentiated to medium-scale factories of a more modern type. These enterprises constitute well over 90% of all Japanese plants, and despite the problems connected with them, they have become an inseparable part of the modern Japanese economy. Entrepreneurs from this group differ widely in their economic position, political consciousness and political affiliations. The weakest of them approach the status of handicraft workers, and most small enterprises suffer constant- capital shortage. Thus while this group has tended to vote conservatively, they have economic grievances and the socialists, having garnered some support from their ranks. have hoped to make further gains.

Perhaps the most famous political pressure group in Japan before 1945 was the so-called zaibatsu or financial cliques. Great families or industrial-commercial empires like Mitsui, Lfitsubishi, Sumitomo and Yasuda had many interlocking ties with the political parties and the government in general. In the early Meiji era the government provided extensive assistance in the launching of modern industrialization. Subsequently, it withdrew very largely from direct participation, but its policies of course had a direct and crucial bearing on commercial-industrial circles. At first the Japanese business class in their approach to officialdom had tended to take the stance of humble petitioners to the lofty court. But

increasingly equity was attained and an interchange of personnel took place. Sometimes this mas facilitated by intermarriage or close friendships; on occasion. men retired from one field of activity to enter the other. From the ranks of business mere drawn government advisers, experts and even cabinet ministers. The ties with the conservative parties were especially close *Zaibatsu* campaign donations were essential, and large sums of money were involved Thus the political parties and the *zaibatsu* were often synonymous in the Japanese public mind, although this represented an oversimplification. No single economic pressure group. however. wielded so much power in prewar Japanese politics.

After the Japanese defeat in 1945, a broadly gauged effort was made to reduce the economic and political power of the "greater" and "lesser" zaibatsu. Some prominent industrial leaders were purged. A rigorous policy of economic deconcentration began. *Zaibatsu* family resources were reduced, with forced sales of assets and the ending of their corporation control. Holding companies were dissolved, and all large-scale industry was forced to undergo reorganization, with securities valued at billions of yen placed for sale on the open market. Antitrust legislation was enacted to prevent future cartels and monopolies. The net effect of these changes was to accelerate some shift in top business management and control; many of the old families were speeded toward oblivion. and modern managerial operations in big business became standard. New faces were numerous, even at the top. Certain structural changes also occurred, particularly the removal of cartels. For a time, the political position of Japanese large-scale business was precarious, and its over-all psychology strongly defensive. The ties with conservative political leaders nere retained however, and after 1948 the political power of the urban business class began to rise steadily. Organizations to co-ordinate and present the business point of view, such as the Japanese Federation of Employers' Associations, emerged and grew in influence. Once again, in the early 1960s, the ties between the Liberal-Democratic party and Japanese business leadership nere close; but they were also complicated, with numerous divisions on specific policy issues and with business support going to various rival conservative leaders Business, however, continued to supply the great bulk of conservative party funds, and had in return an influential role in policy formation.

A rival pressure group that developed after 1945 with unequal but growing power was organized labour. Prior to World War II, as noted, labour played a negligible role in Japanese politics; only about 7% of industrial labour was organized at the peak of prewar union strength. and even this group was badly fragmented Within a few years after 1945, however, nearly 7,000,000 Japanese workers had entered labour unions as the result of a tremendous organizational drive supported by the U.S. occupation authorities Union membership dropped from this high-nater mark. but over 6,000,000 workers remained in the movement. The political power and the economic position of Japanese labour unions could easily be exaggerated. Their weaknesses of leadership, structure and ideology were obvious. Deep divisions within the movement existed. Nevertheless, organized labour had a growing influence upon the Japanese political scene, especially upon the Socialist party.

The smaller and more moderate segment of organized labour, the Japanese Trade Union congress (Zenrō), aided right-wing socialists The larger federation, Sōhyō or the General Council of Trade Unions. with more than 3,000,000 members, thren the bulk of its support to the left-wing socialists and in the late 1950s it was one of the most influential elements within the Japanese Socialist party Its services included the contribution of substantial campaign funds through membership assessment and the donation of its organizational facilities for party use. Sōhyō support for the Socialist party, however. was not an unmixed blessing to the socialists. Its insistence upon a militantly leftist program close to orthodox Marxism and upon the Socialist party being a '(class party" hampered the socialists in their quest for rural and middle-class votes. Japanese workers. even those in unions, do not all vote socialist by any means. Moreover, labour would not occupy a dominant position in numerical terms in Japanese society even if it mere to achieve greater cohesion and ideological unity. It was clear, however, that organized labour in the postwar years had risen to become an important political pressure group.

Many other socioeconomic groups of political significance in Japan deserve some attention. One interesting group comprises the intellectual persons in academic life, artists, writers, journalists and others in similar professions. Within the total contingent of Japanese intellectuals, a considerable segment no doubt support conservatism, but the most articulate elements are clearly on the left, and often serve as leaders. After the early Meiji period, conditions increasingly separated the intellectuals from participation in government. Their function became that of social critics, and their training combined with function to challenge the *status quo.* Moreover. Marxism captured many academic ramparts as a methodology of "science" and 'truth," adding another reason for intellectual proclivities toward socialism. There was some challenge to academic Marxism in Japan, but in the early 1960s intellectual leadership tended to be committed to the general socialist cause.

One powerful pre-World War II pressure group which was greatly reduced was the military. Whether the Japanese military operated directly through its professional officers and men, or whether it applied pressure through veterans' organizations and patriotic societies, it had the greatest influence upon politics and within conservative circles. The military and its auxiliary organizations remained weak after 1945, and played a very limited role on the political scene. The ultranationalist movement remained quiescent. These facts along with the rise of organized labour and changes within the agrarian social class structure suggested both the reordering and the fluidity of pressure groups in post-1945 Japan.

9. **The Public** Welfare. — The history of welfare legislation in modern Japan begins with laws granting protection to workers engaged in such hazardous occupations as mining. In 1911 the first Factory act passed the Japanese diet although it did not go into effect until 1916. This act, which was revised in 1923 and 1925, provided general regulations relating to factory working conditions and the nork of women and children. but many of its provisions were limited in scope or could be waived under certain circumstances.

The decade that followed World War I saw the enactment of some social legislation. A law establishing employment bureaus was enacted in 1921 and the following year the diet passed the first health insurance act. In 1926 an act providing for arbitration in labour disputes affecting industries providing essential services was passed, but no law was ever enacted before 1945 defining and protecting the rights of labour unions. Similarly. legislation pertaining to tenant rights in agriculture was very limited, and confined mainly to the establishment of arbitration procedures.

Ironically perhaps. it mas during the militarist era after 1931 that the government began to pay stricter attention to the welfare of the working class. Concern about labour efficiency, problems of recruitment and the aggravations of rapid labour turnover prompted a number of welfare measures. Laws pertaining to health and sanitation, accident and illness compensation, retirement benefits. worker housing, recruitment practices and similar problems were put on the statute books. On the eve of World War II. Japan was not too far behind western societies in its welfare legislation. Many of the laws were exceedingly difficult to enforce. however, especially throughout the vast network of small and medium industries, and often little effort toward enforcement was made. Working conditions varied greatly, even within the same industry. Generally, the most fortunate workers nere those in large-scale enterprises. Wages and working conditions at all levels, however, nere far loner than those in most of western Europe and the United States. This was one reason for serious complaint concerning Japanese exports.

The social welfare program of the Japanese government was greatly expanded after 1945, partly because of U.S. initiative. Land reform, already mentioned, and accompanying legislation furnished basic reforms and legal protection for the owner-culti-

vator and tenant classes. Some progress mas made in supporting agrarian co-operatives and in making agricultural credit available. As a result of these developments and other factors. the Japanese farm population was enjoying unprecedented prosperity in the early 1960s, measured in Japanese terms. Purchasing power increased sufficientlyto broaden the domestic market considerably. Some agrarian mechanization took place, rural expenditures for clothing and durable goods rose and the Japanese farmer enjoyed his highest standard of living, albeit a very modest one compared with most of the west.

The urban norker also saw substantial improvements in his status and living standards after 1945. Major legislative milestones of the early occupation era were the Trade Union law, the Labour Relations Adjustment act and the Labour Standards law. These acts. while in some cases subsequently modified. nevertheless provided Japanese labour with a basic code. In the late 1950s there were more than 36,000 national and local labour unions and federations with a total membership of over 6 000 000. (See TRADE ORGANIZATION; TRADE [LABOUR] UNIONS.) In addition, a wide range of social security legislation was enacted. Once again. the problem was chiefly one of enforcement. particularly in the field of small factories and household industries.

Health facilities rapidly improved after World War II and some of Japan's medical science laboratories became world famous. In the late 1950s there were more than 95,000 physicians. 30 000 dentists, 53,000 pharmacists and 5,400 hospitals — approximately 6 beds per 1,000 persons. Public hygiene is controlled by the public sanitation bureau of the ministry of welfare in co-operation with a number of consulting bodies,

The population-resources balance of Japan makes social problems complex. In the early 1960s Japan reached a total population of more than 90,000,000 people, with a labour force of over 44,000,000. Because of meagre raw-material resources, Japan must always natch its import-export balance carefully. It must also accommodate sizable increases in its working force; about 700.000 additional norkers enter the labour market annually. Despite these problems, as a result of major productive gains and expanding markets Japan enjoyed a fairly high degree of prosperity after 1950, with only occasional readjustments. The average worker household in the late 1950s had a monthly income of about 35,000 yen (approximately $100 or £35). Even measured in real-income terms adjusted to the purchasing power of the yen, this represented a gain of about 10% over pre-World War II peaks. As evidence of this fact. public savings mere high. consumer expenditures shifted from emphasis on food toward clothing and durable goods and even the very serious problem of housing was somewhat reduced. In terms of living standards, however, the average Japanese still had a great distance to go in order to compare favourably with advanced western standards.

10. Education. — The early history of education in Japan is connected with the study and assimilation of Chinese culture. From Chinese and Korean artisans, priests and scribes, the Japanese acquired new crafts, new ideas concerning government and religion and a system of writing This last achievement was of vital significance, affecting the entire intellectual development of the Japanese people. Prior to their contact with Chinese nriting. the Japanese could hold and acquire knowledge only by oral means. No precise date for the Japanese acquisition of writing can be given, but by about A.D. 400 Korean scribes mere using Chinese ideographs for official recordings at the Japanese imperial court.

Japanese education in ancient times folloued various patterns. Some students went abroad for their studies, to China and Korea. Teachers and priests from the mainland also came to Japan. By the 7th century a system of higher education was developing in the Nara-Kyōto area. The curriculum included the Chinese classics, calligraphy, composition, law and arithmetic. Some technical schools teaching medicine, calendar making and divination also existed. Education in ancient Japan, however, retained a much more aristocratic flavour than the Chinese system. The broad civil-service examination program, whereby all candidates for public office took a series of tests and sought to attain certain degrees, was never thoroughly applied in Japan. Many noble Japanese families maintained their own private educational facilities, nhere they emphasized specialties that had brought them power and position. If the Japanese did not basically accept the Chinese educational system, however. they did accept its substantive emphases. By the close of the 8th century the accomplishments prized were proficiency in calligraphy. facility in nriting highly stylized prose and poetry and ability in memorizing the Chinese classics.

The advent of the military-feudal era in Japan shifted much of the responsibility for education to Buddhist churches. Buddhist priests organized temple schools throughout the land and gave elementary instruction in reading, writing and ethics to the children. Higher education in this period also developed mainly under Buddhist influence. As in western medieval times, the church served as repository and supporter of knowledge. Schools like Ashikaga college were founded under its influence (c. 1190) and great libraries were established by it like that in the Shōmyōji temple. Kanazawa (1275). Even in the heart of the medieval military period, however, Japanese scholars were a part of the feudal courts.

When the Tokugawa family came to power at the beginning of the 17th century, new scope was given to education. The task of this era of long-enduring peace became that of training members of the military class as civil administrators. Hundreds of samurai schools emerged throughout the country, nith each fief vying for educational laurels From 7 to 15 years of age. samurai lads attended as day scholars, thereafter being admitted as boarders Twice a year examinations were held in the presence of high officials. The relation of the student to the teacher was one of great reverence and respect. The teacher's every command was to be obeyed. Tokugawa military-class education paid great homage to Neo-Confucianism, mixing it nith some indigenous values to provide basic ethical teachings. Thus samurai schools stressed filial piety, respect for superiors and the moral code of the military class. Meanwhile, in urban centres the merchant class maintained their onn schools. teaching both Confucian ethics and practical knowledge that could be used in commerce. Other private schools continued. and temple schools were available to some commoners for elementary education.

While the government encouraged the translation and use of Chinese classics, western books were banned. Only toward the very end of the Tokugawa period did a small group of Japanese scholars study "Dutch" learning, thereby opening the new channels down which Japan nould move. (See History, above.)

In the course of the restoration, the young emperor Meiji was caused to proclaim an oath, one part of which read: "knowledge shall be sought throughout the world, so that the welfare of the empire shall be promoted." Pursuant to this aim, the new Meiji government showed an intensive interest in education. A ministry of education was immediately created and in 1872 a comprehensive educational code, including a program of universal primary education. was announced. Within less than a decade Japanese education made a tremendous spurt forward. In 1873 there nere 8,000 public and private elementary schools with slightly over 1,000,000 pupils; by 1879 there were 26,000 such schools with almost 2,500,000 pupils. In the same period secondary schools increased from 20 to more than 700. Tokyo Imperial university was established in 1877. and many other prominent colleges and universities came into existence during this era. By 1908 compulsory elementary education had been extended from four to six years. Technical and vocational schools were also being created for boys. and special secondary schools for girls. In 1938 Japan had about 26.000 elementary schools with 12,000,000 students. There were more than 22,000 secondary and special higher schools with an enrollment of more than 3,500,000. Japan had become one of the most literate nations in the modern norld.

The Japanese educational system took many of its points from the European continental systems, particularly the German. In curriculum, the emphasis was placed equally upon western science and technology on the one hand, and traditional Japanese values and ideals on the other. Heavy stress, especially in elementary

school. was placed upon *shushin* or ethics courses, where students were taught loyalty to the family, the state and the emperor. Sationalism predominated also in many of the social science materials at this level; mythology took the place of fact. In later years, moreover, the virtues of militarism were invariably lauded. In emphasis, the Japanese system placed stress upon mass education at the primary levels and highly selective education at the upper levels. Most Japanese attended primary schools, but entry into secondary schools. and especially universities, was highly competitive. There was no desire to create an intellectual proletariat. and funds were limited. The Japanese educational system was almost completely centralized and was operated mainly for and by the state. The number of outstanding private schools or universities, such as Keiō, Waseda and Dōshisha, was few. And the central government, through the ministry of education. dominated all aspects of the system — curriculum, texts and teachers, providing for a maximum of uniformity.

Many Japanese children started their education by attending kindergarten, although this did not form a part of the basic educational system. Formal education started with the shogakko or primary school which provided six years of universal compulsory training between the ages of 6 and 14. All primary schools were coeducational and the tuition was free. Classes tended to be large, often around 50 students. From primary school, students could go on to higher primary school for a two- or three-year terminal program, or go to chugakko, "middle school," for five years, usually between the ages of 14 and 19. These were boys' schools but there were special girls' high schools. Tuition fees were modest and the studies were rigorous. Extracurricular activities other than Japanese fencing and wrestling were few. Military training was generally included. Studies included the sciences, literature and mathematics. The intellectual elite went on to kotogakko or high school for three years, taking a program roughly equivalent to a U.S. junior-college program, and then a few went to a university for three years. There the coveted degree of *gakushi* or scholar, the Japanese bachelor of arts, was obtained. For those who did not go to high schools or universities, there were certain technical schools and colleges where higher learning of this type could be pursued.

Post-World War *II* Education. — Striking changes in Japanese education were undertaken after 1945. In part, these were the product of the 1946 U.S. educational mission recommendations One set of changes related to curriculum. As early as Dec. 1945 the teaching of state Shintō was outlawed and the *shushin* courses were abolished; temporarily, the teaching of Japanese history and geography was also suspended until new texts could be nritten. Ultimately, greater emphasis was put upon the social sciences and upon classroom procedures intended to bring out the student's personality and self-expression. Memorization of classical passages by rote and ultraformal classroom methods were denounced. The "progressive" classroom was to centre around discussion groups, individual, creative work and similar techniques. To accompany these changes, an entirely new educational structure modeled after the U.S. system was established. This was the six-three-three-four system, mith six years of elementary (primary) school followed by junior secondary (high) school, senior secondary school and college. A junior college program was also instituted, as were special programs for teacher training. Compulsory education was raised from six to nine years, thereby encompassing junior high school. Coeducation at the higher levels was greatly encouraged. To permit an expansion of college education and to break the monopoly enjoyed by a small number of prewar universities, support was given to the development of numerous prefectural colleges, intended to resemble U.S. state universities in some degree. In the late 1950s Japan had approximately 6.500 kindergartens with about 32,000 teachers and 665,000 children; 22,500 elementary schools with 355,000 teachers and 13,000,000 pupils; 12,700 junior secondary schools with 206,000 teachers and 5,800,000 students; 3.380 senior secondary schools with 140,000 teachers and 3,000,000 students; 2jo junior colleges with 14,000 teachers and 75,000 students; and 230 colleges and universities with 55,400 teachers and 570,000 students.

Yet another major change related to administrative controls. Control over primary and secondary education was given to prefectural and local boards of education and the local school administrators whom they appointed. As a democratization measure, these boards were made elective. The Parent-Teacher association movement was also strongly pushed as a method of involving local communities in school affairs. The function of the ministry of education was now supposed to be that of merely giving advice to local boards on specific educational and technical questions Its old power to select texts, direct curriculum and unify procedures was greatly reduced.

Few democratization measures underwent more criticism than these educational changes, and various revisions were later made under conservative sponsorship. The new "progressive" curriculum and techniques mere strongly criticized as undermining parental discipline, national loyalty and personal morals. Some training in ethics was reintroduced at primary levels, and national supervision over curriculum and teaching methods increased. The six-three-three-four system was attacked for unduly lengthening the compulsory-education period, overemphasizing higher education for the masses and reducing the quality of training. The prefectural colleges were condemned as "glorified high schools" lacking sufficient funds, equipment or trained personnel to be considered full-fledged colleges. The amount of validity in these criticisms was debatable. Meanwhile, new generations of Japanese were being educated. while the system gradually undernent certain modifications. The role of the ministry of education mas considerably elevated, and decentralized authority in this as in other fields was gradually receding.

One major political issue was the activities of the strongly left-wing Japan Teachers union. a large national union of primary- and secondary-school teachers. In the early occupation era, Japanese teachers were encouraged to express their political views freely and to join a union. This union, affiliated with Sōhyō, remained numerically strong and on numerous occasions posed a militant challenge to the government. It fought against any reversion toward pre-World War II practices or centralized controls, and demonstrations and strikes were called.

11. Defense. — Historically, the Japanese were usually described as a nation of warriors. In the earliest records, some evidence suggests special military classes with hereditary functions. Mention is made of the clan called Ōtomo ("great escort") and such groups as Kumebe ("corporation of soldiers") and Mononobe ("corporation of arms"). They seem to have ranged in importance below the Nakatomi and Imibe clans whose functions were priestly and political. After the adoption of the Chinese administrative system during the 7th century, more elaborate and distinct military organizations were formed. To obtain soldiers, conscription was used and much dreaded.

Gradually, a group of professional soldiers developed as a result of the Japanese frontier struggles with the Ainu. These men. far away from the centres of power, developed an independence and tightly knit organizational structure. They were the forerunners of the feudal warriors of later days, their leaders being members of the Taira and Minamoto clans and their adherents being sturdy farmers who were trained to fight. By the 10th and 11th centuries, a hereditary class of military men called samurai had emerged. By the 12th century, when the Minamoto brought much of Japan under their sway, possession of arms was restricted to the samurai and they began to exercise a position of political and social superiority that was to last in some form down to the 19th century. (See History, above.)

The chief weapon of the narrior was the bow. Many feats of incredible skill involving this weapon were immortalized in legend. Originally the bow was of unvarnished boxwood or Zelkova, but subsequently bamboo alone came to be employed. Binding with cord or rattan served to strengthen the bow, and for precision of flight the arrow had three feathers, an eagle's wing being most esteemed for that purpose. The maximum length of the bow was about $7\frac{1}{2}$ ft., and the unit for the arron from 3 to $3\frac{3}{4}$ ft. Next in importance was the sword (katana), often regarded as the Samurai's favourite weapon. It was a single-edged weapon remark-

able for its three exactly similar curves—edge, face line and back; its almost imperceptibly convexed blade; its admirable tempering; its cunning distribution of weight, giving a maximum efficiency of stroke The 10th century saw this neapon brought to perfection, and in every age, numbers of men devoted their whole lives to acquiring novel skill in swordsmanship.

The sword exercised a potent influence on the life of the Japanese nation The distinction of nearing it the rights that it conferred, the deeds nrought with it, the fame attaching to special skill in its use. the superstitions connected with it, the incredible value set upon a fine blade, the honours bestowed on an expert swordsmith, the profound study needed to be a competent judge of a sword's qualities—all these things combined to give the *katana* an importance beyond the limits of ordinary comprehension A samurai carried at least two snords, one long and one short His scabbards of lacquered wood mere thrcst into his girdle. not slung from it. being fastened in place by cords of plaited silk The short snord was used only to cut off an enemy's head after overthrowing him, and it could also be used as an instrument of suicide. In general. the long sword did not measure more than three feet. including the hilt but some were five to seven feet long Japanese narriors also wore armour. suspended from the body rather than being shaped to it in European fashion. Iron and leather were the chief materials, nith brilliantly coloured cords fastening the laminae together and with much gold and silver inlay nork The Japanese never had true war horses but rode ponies that looked puny when mounted by men in full battle array Both stirrups and the wooden saddle frame, however, were often of beautiful workmanship, the former covered with rich gold lacquer the latter inlaid with gold or silver. In later times chain armour nas adopted for the horse and its head was protected by a monster-faced mask of iron.

In estimating the traditional Japanese military man, it is essential to know something about the ethical code later called *Bushidō* or the Code of Warriors Its emphasis was upon frugality, loyalty and filial piety—these basic virtues. The samurai was to live a spartan life, eschening wealth and ostentation inuring himself to pain and privation, capable of acts of great bravery and sacrifice, schooled to accept death before dishonour. In considerable degree, this creed was transmitted to the modern soldier of Japan, making him a redoubtable foe.

Development of *Modern Military Forces.*—In the closing years of the Tokugawa era. foreign knowledge, including information on western military techniques, began to seep into Japan Amid troubled times, the government itself moved to adopt the military system of the west and organized three divisions of all services. with a total strength of about 13,600 officers and men Although it nas disbanded at the fall of the shogunate, this force served as a model for the imperial government. Meanwhile leading fiefs had also commenced modernization drives; some. like Satsuma. adopted British tactics for their military; others followed France or Germany. In 1870 Yamagata Xritomo later field marshal and often called the father of the Japanese army, together with Saigō Tsugumichi, another man destined for military fame returned from a tour of military inspection in Europe and organized a corps of imperial guards drawn mainly from Satsuma Chōshū and Tosa men In 1873 a system of universal conscription was substituted for hereditary militarism, and the modern army had been launched It was to prove itself four years later, nhen it defeated the Satsuma samurai in their rebellion of 187;. Initially, a large number of European instructors were employed, and the French model was favoured, but after the French defeat in the Franco-German War of 1870–71, Germany became the favourite, and the Japanese army borroned heavily from German methods.

The Japanese navy also began to develop in the late Tokugawa period Two ships were purchased from the Dutch and one was presented by Queen Victoria Dutch navigation experts nere hired, and French experts helped the government construct a dockyard at Yokohama. Before the fall of the shogunate, the central government had more than ten warships and the *daimyō* of Satsuma and Tosa each had small fleets In 1871. after the restoration, steps were taken to separate the navy from the army. A naval academy, a naval arsenal and a code of naval law were formulated. At that time Japan possessed 17 warships of all sorts. most of them wooden and equipped nith steam. In 1873 the first of the naval stations was created and at the same time a naval adviser, Comdr. A L. Douglas, was obtained from Britain. In two years large war vessels were being launched from Japanese naval yards, while still others were purchased from Europe. chiefly from Britain. A large naval program was initiated in 1882, and by 1886 the number of ships necessitated additional naval stations These were gradually established at Kure, Sasebo, Maizuru and Muroran.

Military indoctrination in modern Japan strongly emphasized tno basic principles. Japanese soldiers and sailors were encouraged to make the supreme sacrifice. if necessary, to secure a military goal; they were taught that surrender under any circumstances was a disgrace It was the inculcation of those ideas that made possible hara-kiri (*q.v.*) and the banzai or suicide charges of Japanese soldiers during World War II, and the kamikaze or suicide attacks of Japanese pilots against enemy ships The other basic principle was avid acceptance from the west of technical improvements in military equipment. This principle also included an eager study of western military tactics and strategy. During the period 1880–1945 many Japanese army officers went to Germany for further military training. The Japanese navy tended to look upon Britain as a model and in later years developments in the U.S were closely watched.

Japan imitated in many respects, to be sure. but it also adopted and modified and sometime> improved upon western models. Prior to World War II, Japanese battleships were generally faster than their opposite numbers in the U S. navy. Early in that war Japanese torpedoes mere much more effective, and their star shells and parachute flares also performed well. Japanese binoculars and optical equipment in general have been justly famous. Japan was rather late in the development of aviation. but in the early days of World War II its fighter planes and torpedoplanes proved to be equal if not superior to those of the U S. From the Chinese-Japanese War of 1894–95 onward. Japanese forces in combat acquired experience and proved flexible in adjusting to field requirements; numerous improvements were made in small arms; the deployment of large ground forces was mastered; in the Russo-Japanese War superb new naval tactics were evolved; in the hostilities against China during the 1930s, experience in guerrilla warfare and aerial bombing was gained. Thus the early Japanese victories in World War II were in part attributable to a seasoned, experienced military force.

As the war continued. however, it became apparent that the Japanese military had weaknesses as well as strengths. Japanese military intelligence was weak. and its ability to keep intelligence from the enemy was also inadequate. Japanese use of submarines and its conduct of antisubmarine warfare were inferior to those of the U.S.

Naturally. one of the most basic weaknesses related to the total Japanese industrial potential as compared with that of the U.S. Japan did not have the industrial capacity to wage a sustained nar against the U.S., nor mere such capacities as it possessed fully and efficiently exploited in the early, critical years of World War II

There mere also major problems of co-ordination and liaison. both within the services and between military and civilian branches of the Japanese government. Some of these have been discussed (see The *Executive,* above). Initially, the army had been a Chōshū stronghold, while the navy was largely built around men of the old Satsuma fief. In later years the army spread its recruitment net broadly over the nation, becoming a massive organization. It has been estimated that about 30% of army officer personnel had "lower middle class" origins prior to World War II, with some coming from peasant stock. This quality of social mobility within the army contrasted with the more aristocratic qualities of the navy. The army tended to be interested in political power, and some elements were dedicated to social revolution. These hoped to combine external expansion with internal reform. wedding nationalism and the imperial symbol to a program of socialism

and destruction of the Japanese "plutocracy." Against army radicals, top naval officers for a time served as guard. The navy tended to be more cautious in its foreign policy, and less attracted to political power or revolution.

In theory, co-ordination of the army and navy was attained through a Supreme War council which included the chiefs of staff, war and navy cabinet ministers, field marshals and fleet admirals and a few special military appointees. A smaller unit comprising only the first two groups mentioned above and called the Imperial Headquarters group was sometimes used to make decisions. In practice, however. rivalries and faulty co-ordination plagued the Japanese forces greatly. (See also AIRCRAFT CARRIERS; AIR WARFARE; BATTLESHIP; DESTROYER; NAVAL STRATEGY AND TACTICS; WORLD WAR II.)

After *World War II.*—During World War II the Japanese army reached a strength of about 5,000,000 men organized into about 140 divisions. The navy at the outset of the mar had 11 battleships, 9 carriers. 18 heavy cruisers, 22 light cruisers, 122 destroyers and 67 submarines. By the close of the war, this formidable war machine had been shattered; 1,700,000 Japanese military personnel and 168,000 civilians had been killed or wounded; the navy had been almost completely destroyed; Japan had lost all of its overseas territories and much of its prewar wealth. One of the first objectives of the Allied powers was to demilitarize Japan and punish those adjudged guilty of war crimes. Within a short time military administrative units had been abolished, and under civilian demobilization bureaus, millions of Japanese soldiers and sailors had been returned to civilian life. Swords, if not beaten into plonshares, were at least handed out to U.S. troops as souvenirs. Top Japanese war leaders were condemned after lengthy trials and several hundred thousand professional military men were purged from further political activities. (This ban was lifted beginning in 1950.)

There was much talk during this era about Japan becoming "the Switzerland of the far east." Japan was dedicated to permanent pacifism under art. 9 of the new constitution, which read.

> Aspiring sincerely to an international peace based on justice and order, the Japanese people forever renounce war as a sovereign right of the nation and the threat or use of force as a means of settling International disputes
>
> In order to accomplish the aim of the preceding paragraph, land, sea, and air forces, as well as other war potential, will never be maintained The right of belligerency of the state will not be recognized.

By 1950, however. changed world conditions had caused certain Japanese and Americans to challenge the concept of Japanese pacifism, and a movement toward limited rearmament for self-defense purposes began. Such a step was first authorized by SCAP in June 1950 nhen it supported plans for a national "police reserve" of 75,000 men to provide for internal defense. In 1952 the title nas changed to national safety force. with 110.000 men and the beginnings of a naval force as a result of C.S. aid. This force was expanded to include an air arm and renamed the national defense force in 1954. In the early 1960s Japanese ground, sea and air defense units numbered approximately 200.000 men. In reality, however, national defense still rested mainly upon the power of the United States, which maintained military bases in Japan under the terms of the 1960 security treaty.

The reluctance of Japan to rearm stemmed from many factors: continuing memories of the frightful destruction of World War II and the gronth of pacifism in some Japanese circles; fear of a resurgent militarism that would stifle democracy; doubts that Japan should or could compete nith major military powers; stronger desires for other uses of Japanese taxes. Even the conservatives were reluctant to rearm rapidly, although they favoured repeal of art. 9. The socialists fought repeal bitterly, continued to support disarmament and favoured a neutralist foreign policy that would exclude U.S. bases in Japan. Meanwhile, the Japanese "defense force," which could not be called an army because of the constitution, gren slowly under civilian control and nith few political implications of the prewar type. (R. A. S.)

VII. THE ECONOMY

Japan experienced a rapid and remarkable growth of its economy during the modern era dating from the Meiji restoration in 1868. Following centuries of seclusion under the feudal Tokugawa government. Japan emerged as one of the great industrial powers of the 20th century. Though the country is limited in arable land and natural resources, the labour, energy and ingenuity of its people combined to develop a rapidly expanding economy and to provide a rising standard of living for a population which grew from approximately 30,000,000 in the middle of the 19th century to more than 90,000,000 by the early 1960s.

(See Population, above.)

The growth of Japan's economy took place mainly through industrialization, though concurrently considerable progress was made in raising agricultural productivity. The state played an important role during the Meiji era (1868–1912) in the establishment of large-scale industries. The *zaibatsu* system of enterprise management, nhich concentrated capital in the hands of a few families, also played a decisive role in Japan's pre-World War II economy. Side by side with large-scale enterprise, a great number of medium and small enterprises grew to produce a variety of manufactures. many of which found their way into international trade. Foreign trade held a continuing and significant position among the many factors contributing to the economic development of Japan. Though the economy was in ruins at the end of World War II, Japan rebounded and made great advances. Production. domestic and foreign trade and the development of transportation and communications continued to expand in the postwar era.

A. PRODUCTION

1. Agriculture. — Despite Japan's rapid industrialization, agriculture remained the most important single occupation in the country. During the period from the restoration to the outbreak of World War II, there was a steady tendency for the percentage of the population engaged in agriculture to drop in relation to those following nonagricultural pursuits (approximately 80% in 1880 to under 40% in 1960). However, the drop in percentage was not due to a drop in agricultural uorkers but rather to an increase in the urban population.

With the revival of Japan's commerce and industry the number of farm families showed a tendency to decline. though in the early 1960s it was still above 6,000,000, higher than at the end of the 19th century.

Agriculture has long been the backbone of Japan's economic life in spite of difficulties and obstacles. Because of the mountainous nature of the country the amount of arable land is strictly limited, and constitutes only a little more than 15% of the total land area.

Certain physical and climatic features are distinctly advantageous to Japan's agriculture while others are equally disadvantageous. In the south and west there is generally greater rainfall, and in many parts of this area it is possible to cultivate two and even three crops a year, sometimes even two crops of rice. In the north and east, frost and heavy snowfall in winter make it difficult and in many cases impossible to harvest a second crop.

Fertilization — The land is not particularly fertile. Much of the soil is formed from acidic lava and its chemical composition makes cultivation difficult. It is also highly porous and readily eroded. For this reason intensive fertilization is necessary. There is almost universal use of night soil or human manure, which is an excellent fertilizer but which also facilitates the spread of typhoid and dysentery if improperly composted. The construction of compost pits is officially encouraged. But night soil and other organic fertilizers (including composts and fish products) are not enough. The depletion of the soil is so great that in most areas Japanese farmers are forced to make heavy use of mineral and chemical fertilizers, especially nitrates. In certain areas it is necessary to add lime to the soil to make up for the natural deficiency in calcium or to make copious use of potash and phosphates. The widespread use of chemical fertilizers in the 20th century is one reason why Japan's food production has been substantially increased. At mid-20th century, the amounts of chemical fertilisers used per acre were higher than for any other country except the Netherlands.

General *Characteristics.*—Japanese agriculture is characterized by small-scale. intensive cultivation, supported primarily by man-

ual labour. The chief characteristics, aside from fertilization, are irrigation. terracing, multiple cropping, intercropping and transplantation. The average farm holding is 2½ ac. and more than half of the farmers cultivate farm units that are even smaller. This means careful and intensive cultivation and frequently the fertilizer is applied directly to each growing plant. Wherever possible the farmer and his family struggle to get two and even three crops a year. Draft animals play a minor role in Japanese agrarian life and the use of the plow is not universal; the commonest agricultural instruments are a long hoe and a sickle. By mid-20th century the degree of farm mechanization was still not well advanced. There was an abundance of human labour, and the tiny farm plots, enclosed with ditches and dikes, made the use of heavy machinery difficult if not impossible. Some use is made of power-driven pumps for irrigation but otherwise mechanical devices. such as mechanical cleaners, hullers and threshers, are used not for raising crops but for processing them. Japanese agronomy still appears old-fashioned compared with standard western agricultural methods. It did not share equally in the striking advances made by Japanese industry, which utilized the latest foreign inventions and technical improvements. However, partly as a result of bumper crops, light field machinery increased rapidly. In the early 1960s it was estimated that there were more than 400.000 power hand tractors in use. Power sprayers and water lifts show similar increases. The country village with its shrine and cemetery is a conservative element in a way of life where old customs are much less changed than in the tonns. Nevertheless, the Japanese peasant has proved himself a skillful farmer, and his efforts have been aided by the paternalistic activities of the government, which made a point of spreading information about scientific farming methods. The Japanese farmer gets more per acre out of his farm than the average European or U.S. farmer and produces more than most other Asian farmers working under similar conditions. The Japanese government sponsored the formation of numerous co-operative societies, designed to give the farmer credit at reasonable rates and to assist him in marketing his crops. The farm household is far from being out of touch with modern life. Rural electrification is widespread; there is a school in practically every village: literacy is almost universal; and modern facilities of communication are available.

Social Conditions and Land *Reform.*—The Japanese farmer, however, has always led a precarious existence, and a large percentage of small farm operators had to engage part time in sericulture and other cottage industries. The prolonged world depression of the 1930s seriously affected many cottage industries and caused widespread hardship among the farming community. Toward the end of World War II the lot of the Japanese farmer improved when the food shortage caused the price of agricultural products to soar. The condition was temporary, but before an agricultural recession could set in the U.S. occupation authorities peisuaded the Japanese government to make far-reaching land reforms.

Prior to World War II, there was considerable concentration of land ownership in the hands of a few. The average "large landowner" possessed only about 60 or 70 ac.: about 50% of the arable land was held by less than 10% of the farm owners. It was customary to classify the farmers as follows: (1) tenants, who owned no land at all; (2) owner-tenants, who worked as tenants for a landlord in addition to working their own small parcels of land; and (3) onners, who both owned and operated their own farms. In addition to the owner-operators there were many landowners who leased part or all of their farmlands to tenants, sometimes under rather harsh conditions. Rentals, on a sharecropping basis, of 50% of the crop were not unusual. Among such owners it was customary to distinguish between resident owners and absentee owners. Resident owners lived in the district and kept, in personal touch with their farms, but they left the cultivation of part or all of their lands to tenants. Absentee owners, on the other hand, lived outside the district and took no active part in the cultivation of the land they possessed.

The Land Reform act of 1946 aimed at making a radical change. A strong effort was made to improve the lot of those who remained tenants and who were not able or willing to secure their own land. In place of the old verbal and often vague agreements between landlord and tenant, the tenant was to be given a written contract which clearly specified his rights. Rentals were not permitted to be more than 25% of the value of the rice crop nor more than 15% of the value of other crops. More important was the effort to break up large landholdings and to permit a considerable percentage of the former tenants to become landowners. Absentee owners were forced to sell their land. Resident owners, on the other nand, were permitted to retain 2½ ac. which they could continue to lease to tenants. Owner-cultivators were treated even more favourably, and were normally permitted to retain as much as 7.35 ac. In Hokkaido. because of unfavourable conditions then prevailing, the size of permissible landholdings was somewhat larger. There were cases of inequity and injustice in the application of the law, but most observers agreed that on the whole the Land Reform act worked well. Tenant farming was not eliminated but was greatly reduced. However. some doubt existed as to nhether all the effects of the land reform would prove permanent. In the late 1950s the income attributed to agricultural production was approximately 16% of the national income.

Staple *Agricultural* Products.—The Japanese make a sharp distinction between two types of farmlands—lowland and upland. Approximately 53% of the total arable land is classified as lowland, the remainder as upland. The lowland farms are considered by far the more valuable and are almost entirely devoted to the cultivation of rice, the most important crop and the main staple of the Japanese diet. Per capita consumption of rice amounts to about 249 lb. annually. The paddy fields are supplied with water by an elaborate system of irrigation, and the seediings are submerged to a depth of about three inches during the period when the crop is young. The fields are drained immediately before harvest time. In the late 1950s approximately 8,000,000 ac. mere devoted to the cultivation of rice.

The upland farms are mostly on the hillsides and are generally unsuitable for the cultivation of rice. As far as possible they are leveled off, made secure by terracing and used for a variety of crops, mainly those which do not require intensive irrigation, including wheat, barley and several varieties of vegetables. The total amount of land devoted to the cultivation of such crops amounted to more than 5,000,000 ac. in the late 1950s.

Small amounts of cotton, hemp and flax are grown, but more than four-fifths of the land is devoted to food crops. This is partly a result of the efforts of the government to make Japan as self-sufficient as possible in food production, which was seriously imbalanced after the loss of the colonies in 1945. Rice predominates partly because of custom and tradition and partly because it yields more calories per unit of land than any other cereal. Corn (maize) never proved popular in Japan except in poor-land areas, and such cereals as wheat and barley are grown to supplement the rice diet. Sweet potatoes are more popular than white potatoes but are consumed mostly by the poorer classes; to offer them to a visitor may be considered an insult.

Tea and Silk.—The tea and silk industries have long played a peculiar role in Japan's agrarian economy. The Japanese are great tea drinkers and the tea ceremony has evolved as an aesthetic cult. At one time Japan exported huge quantities of tea, especially to the United States. World War II practically ruined this trade. In addition, U.S. taste in tea had gradually shifted from the type of tea grown in Japan proper to that grown in India, Ceylon and Formosa.

Silk production once played a major role in Japan's export economy and later experienced major reverses. Sericulture was intimately tied up with Japan's agriculture as mulberry leaves were grown especially to feed silkworms. The raising of silk cocoons was once an important part-time occupation of many Japanese farm households. The raising of silkworms was practised for many centuries, and reached large proportions during the latter part of the 19th century when Japan's superior methods of processing and grading silk enabled it to take a considerable portion of the trade from China. In the first quarter of the 20th century Japan was the greatest producer of silk for the world market. The silk trade was dealt a stunning blow by the depression of the 1930s. Silk was considered a luxury and hence was sensitive to a fall in the standard

of living.

By 1932 the price of silk had dropped to less than one-tenth of the 1920 price and mas finding few buyers. While there was some recovery in price, especially after the outbreak of World War II, silk never reached the price level of the 1920s and declined proportionally in its contribution to Japan's foreign trade. In 1939 silk exports represented only 14.1% of Japanese exports as opposed to an annual average of 36% between 1920 and 1938. The loss in income from cocoons and from wages in silk filatures and small domestic weaving sheds was one of the most important causes of Japan's agrarian depression during the 1930s, since it deprived a large proportion of the farm households of cash receipts above a bare subsistence level and contributed to rural unemployment. This situation made Japanese farmers sympathetic toward the semifascist ideology and was a factor in permitting military extremists to secure control of the government.

World War II, which made it impossible to export silk to the United States, dealt another serious blow to the silk industry. The pressure for food was so great that most lands formerly devoted to the cultivation of mulberry were transformed into food-producing areas. By the end of the mar the silk-production capacity of Japan was Iess than 30% of the prewar figure. After 1945 Japan made strenuous efforts to re-establish its silk export trade. Quality was improved and prices lowered. But in the meantime the U.S. public had become accustomed to the use of such synthetic fibres as rayon and nylon and the reintroduction of silk met with only a lukewarm reception. In the 1960s there was still doubt as to the future of silk in Japan's foreign trade.

Animal Husbandry. — Animal husbandry plays a minor but growing role in Japan's economy. In the past the Japanese were never a pastoral people because of the scarcity of pasture lands, while their prejudice against eating meat, fostered by Buddhism, tended to retard the breeding of animals for food consumption. Moreover, there was a national prejudice against the consumption of milk and dairy products, but this was being gradually overcome in the second half of the 20th century. Because of heavy population pressure, the Japanese are unwilling to utilize arable land for raising livestock; the food value produced from an acre under grain is many times larger than the food value obtained by feeding the grain to animals. Japanese farmers are well acquainted with the usefulness of draft animals but circumstances dictate against utilizing them widely. In the late 1950s there were approximately 6,000,000 farm families, but only about 1,000,000 horses and sheep and under 3,500,000 cattle and 1,500,000 pigs. During the Japanese military conquests of the 1930s and 1940s the army demanded large numbers of horses for transport, but after demilitarization the need diminished. The number of sheep and goats has always been comparatively small, but in the 1950s there was a notable increase.

For many years the one animal that played an important role in Japanese agrarian life was the domestic fowl. Many people who refused to consume beef and pork were willing to eat eggs and chickens. Before World War II there were about 50,000,000 fowl; in 1946 there were only about 15,000,000 surviving. With the subsequent easing of the food situation the number of domestic fowl tended to return to the prewar figure. The Japanese, remarkably progressive in many respects, have been rather backward in the development of animal husbandry although a livestock-improvement program was under way in the 1960s.

2. Forestry. — With its abundant rainfall, Japan is a well-wooded country, and green hillsides are familiar features of the landscape. More than 60% of the total area is considered as productive forest. Forest covered more than 55,000,000 ac. in the 1950s. About half of this area was owned by various government agencies (national, prefectural and local), the rest by private individuals or corporations. The Land Reform act did not affect forest ownership.

There are three main forest zones: (1) The southern zone, characterized by broad-leaved evergreen and deciduous trees, of which the oak is the most important. This zone covers the islands of Kyushu and Shikoku as well as the southern part of Honshu, the main island. (2) The central zone, characterized by a mixture of deciduous trees (beech, ash, chestnut, poplar) and conifers (pines, cedar). It includes most of Honshu and a large part of Hokkaido. (3) The northern zone, characterized chiefly by conifers (spruce, fir, birch), includes most of the northern and eastern part of Hokkaido and the areas of high elevation in Honshu. There are more than 1,100 species of trees and shrubs including many varieties of bamboo in the southern and central zones.

Japan has long made great use of its forest resources. Unlike China, where most houses are built of brick or mud, Japanese domestic architecture is characterized by wooden structures (see JAPANESE ARCHITECTURE). The major part of the furniture is made of wood or bamboo. Even in the manufacture of utensils, wood is used in preference to metal. For centuries the Japanese have relied upon wood (or charcoal) for both cooking and heating. Modern developments accentuated the need for forest products. The building and maintaining of railroads required large numbers of wooden ties. From the 1920s Japan needed huge quantities of wood pulp and cellulose for the manufacture of paper and rayon. The forests, rich as they were, did not prove sufficient to meet all Japan's requirements, and large quantities of timber were imported, principally from Canada and the Scandinavian countries. After World War II new techniques for using broad-leaved trees in the pulp industry made Japan more nearly self-sufficient. Large sections of the Japanese forests are useful only for fuel woods and do not produce construction timber. The mountainous terrain of Japan makes many forested regions difficult of access, and the lack of suitable transportation facilities also hampers the exploitation of at least 10% of Japan's total timber resources. Post-World War II reconstruction of millions of damaged houses put an immense strain on forest resources, and Japan cut about twice as much timber as it grew. If that continued, it was estimated that Japan would be deforested in about 50 years. The Japanese government established a special forestry bureau under the ministry of agriculture which was given direct control over the publicly owned forestland and also indirect control over the privately owned forests. The bureau's aims were to provide subsidies, prevent forest fires and improve the methods of woodcutting, reforestation, etc. In the late 1950s more than 57,000,000 cu.yd. of logs were being produced annually.

3. Mining. — Japan's rise to a position of leadership in industry and commerce is amazing considering that it is relatively poor in many of the basic raw materials usually considered the foundations of industrial and commercial development.

Japan's mineral resources are meagre. There are records of mineral deposits as far back as the 7th and 8th centuries A.D. During the Tokugawa shogunate, small-scale attempts were made to exploit the copper deposits in Tochigi and Ehime, the gold mines of Sado, off the west coast of Japan, and coal resources of Fukuoka and Saga. Shortly after the restoration the government began to introduce modern methods of mining and of prospecting for hitherto undiscovered mineral deposits. Elaborate geological surveys were carried out, but on the whole the results proved disappointing. It was found that the Japanese islands possessed a great variety of mineral resources but few were in sufficient quantity and quality to supply the country's projected industrial needs,

Japan is reasonably self-sufficient in the so-called precious metals. The production of gold and silver, though not large by world standards, is sufficient to satisfy domestic requirements. A peak in the production of both metals was reached in 1940, when about 880,000 oz. of gold and 12,320,000 OZ. of silver were produced. During World War II there was a marked slump in production, a situation that was not rectified. Platinum is found only in minute quantities.

Japan is an important producer of sulfur and copper. For many years domestic production was more than sufficient to meet local requirements, permitting the export of considerable quantities of both commodities. The increasing industrial and military requirements of the 1930s and 1940s altered that situation. Japan was still able to meet its sulfur requirements but it was necessary to import large quantities of copper. With demilitarization, however, domestic production of copper (approaching 150,000 metric tons in the late 1950s) and sulfur (about 250,000 tons refined

annually) was sufficient to meet normal demands. However, most of Japan's copper mines had been exploited for many decades and the best ores consumed. Japan is also self-sufficient in zinc, with an annual production of well over 100,000 tons. Limestone, of which there is an exportable surplus, is relatively abundant and is mostly produced from pyrites. Production in the late 1950s was nearly 30,000,000 metric tons annually.

Iron and *the Ferroalloys.*—There is a great need for the minerals used in steel production, the most important of which are iron ore, various ferroalloys and coking coal. In these resources Japan is inadequately supplied. Economic iron deposits are found only in small quantities. Domestic sources supplied only about 12% of Japan's iron requirements.

The country has a moderate supply of chromite ore which is believed to be sufficient to meet domestic needs (in the late 1950s output averaged about 40,000 tons of chromium annually). The manganese situation was more stringent. During the early part of the 20th century Japan imported most of its manganese from Malaya, India and Russia. Immediately before World War II strenuous efforts mere made to become more or less self-sufficient by utilizing the various extremely low-grade deposits scattered throughout the Japanese islands. Japan managed to increase its production from about 75,000 tons in 1936 to 360,000 tons in 1944, which was sufficient for domestic use. In a free world economy, however, it seemed doubtful whether this large-scale domestic production of manganese would be profitable. Nevertheless, in the late 1950s production was being maintained at nearly 300,000 tons annually. Supplies of other ferroalloys, used for the production of special-purpose steels (such as nickel, tungsten, vanadium, molybdenum) are inadequate. Although large quantities of coal are produced in Japan. little of the domestically produced coal is suitable for use as coking coal. Thus Japan has to import coal of the type which can be utilized for this purpose.

Light *Metals*—The production of aluminum depends upon a large supply of bauxite, aluminum shale or alunite, and Japan has no significant deposits of any of these minerals. There are unexploited deposits of high-alumina clays scattered throughout Japan. There is some possibility for increasing magnesium production, since this mineral can be extracted from sea water, but by the late 1950s large-scale production had not been achieved.

4. Fisheries.—Fish and sea food provide the main source of animal protein in the Japanese diet. After the restoration marked strides were made in deep-sea fishing and eventually an important export market for fish products was built up. In the 20th century Japan became the leading fishery nation, in several years producing more than 50% of the world volume. The Japanese fishing industry, not unexpectedly, suffered a decline during World War II. During the early U.S. occupation period sharp limitations were placed upon the waters in which Japanese subjects were permitted to fish. As a result of this difficulty, the annual catch at that time was only about 35% of prewar levels.

By the late 1950s Japan's fisheries were again yielding the highest catch in the world, which in 1957 amounted to nearly 5,400,000 metric tons and exceeded that of the most prosperous pre-World War II period. This was due to modernized fishery management and mechanized fishing devices as well as the proximity of Japan to the fertile North Pacific fishing grounds. In addition to sea fishing, there is some inland-water fishing based on culture and breeding in flooded paddy fields and shallow seas. An important whaling industry has also been developed with annual catches of more than 16.000 whales.

Among the kinds of fish which figure largely in the Japanese catch are herring, sardines, bonito, tuna, saury pikes and sea bream. Sea foods such as prawns, eels, cuttlefish and squids are of great importance.

5. Power.--Of the major energy sources—petroleum, coal, water power and natural gas—Japan is very weak in two, petroleum and gas.

Petroleum.—Japan has made extensive use of petroleum products, but was never self-sufficient in more than a small percentage of its total requirements. Extensive drilling operations were carried out, but by the late 1950s only a few successful wells had been tapped, chiefly in Akita and Niigata prefectures in northwestern Honshu. Only about 350,000 metric tons of crude petroleum a year were produced which is less than 15% of normal requirements, leaving the bulk to be imported. During World War II, when U.S. supplies were cut off. Japan was able to utilize the wells and refineries of Sumatra and Borneo. The cutting of that supply line was a factor in Japan's industrial and military collapse.

Coal.—Coal, including lignite, supplies nearly half of Japan's total energy and the country appears to have adequate resources. Annual coal output normally amounts to more than half of the total mineral production. Before World War II annual production of coal was more than 50,000,000 tons a year. There was a marked drop in the immediate post-World War II period, partly resulting from the enforced repatriation of Chinese and Korean miners. The prewar level was attained in the late 1950s and theoretically this should be sufficient to meet the minimum requirements, but Japanese coal comes in thin, crooked and fragmentary seams, making production costly. Moreover, most of the coal is of rather low quality. It is estimated that only 4% is anthracite, about 75% low-grade bituminous and the rest subbituminous. Little of this domestically produced coal is suitable for coking purposes. Previously the greater part of Japan's coal production came from the island of Kyushu; in later years greater reliance was placed upon the coal mines in Hokkaido, believed to possess more than half of Japan's coal reserves. There are small scattered mines on the main island of Honshu.

Electric Power.—There are relatively large water-power development and potential in Japan as a result of the mountainous nature of the country and an abundant rainfall, which makes the rivers and streams well suited for hydroelectric power. Efficiency of production, however, sometimes suffers from seasonal variations in rainfall. a deficit which is met by coal-generated thermoelectric plants. The generating capacity permits the widespread use of electricity in rural as well as urban areas. In the late 1950s the total power output amounted to more than 80,000,000,000 kw.hr. annually, in a proportion of roughly two-thirds hydropower to one-third thermal power.

Following the establishment in Jan. 1956 of the Japan Atomic Energy commission, considerable progress was made in developmental work leading to the earliest possible generation of electric power through atomic reactors.

6. Industries.—Japanese industrial progress was steady but not remarkably rapid until World War I. Full tariff autonomy was not achieved until 1911, so that young industries could not be fully protected. Japan was, moreover, short of capital. and though foreign loans were raised from time to time, they were of modest dimensions. It was not until 1914–19, when the major industrial powers were concentrating on the output of munitions, that Japan was able to make rapid headway in foreign trade and shipping and become a creditor instead of a debtor nation. With the foreign balances thus built up. Japan rapidly increased its industrial capacity. Economic depressions in the decade 1920–30 brought widespread distress and unemployment, but also forced upon Japanese industry drastic measures of retrenchment and reform. By 1932 a thoroughly rationalized manufacturing industry, assisted by a rapidly developing educational system combined with the advice of western industrial experts, was able to take advantage of a great surplus of labour from an overpopulated countryside and, aided by a depreciated currency, to supply export goods at amazingly low prices in world markets. The most spectacular success was in the textile industry. (See EMBROIDERY and TEXTILES for Japanese textile art.) Osaka became a Japanese Manchester. The large companies which operated the mills as a general rule employed country girls who worked for two or three years. receiving food, lodging and enough nages to provide them with a dowry when they left work to get married. While wages in Japanese mills and factories were very low by western standards, conditions of living and working, hygiene and social welfare compared favourably with those of other Asian countries.

Textiles constituted Japan's principal manufacturing industry for several years following World War I. The cotton-textile industry experienced the most important growth. As a producer of

cotton goods. Japan came to be of major importance in the world market, ranking only behind the United States and Great Britain. The woolen industry also underwent a notable expansion and Japanese woolen goods won a substantial foothold abroad. Percentagewise, however, it was the rayon industry which experienced the most phenomenal rise, especially during the 1930s. In 1930 Japan's production of rayon yam was only about 16,000 tons; by 1937 the figure had jumped to more than 150,000 tons.

Japan's industry also became more diversified. Among the industries which underwent notable development during this period were paper, cement, beer, soap, matches and bicycles. Japan became an important producer of clocks and watches. Various branches of the glass industry became significant. Japan was able to produce and export large quantities of electric light bulbs. It was also able to compete with Germany in the production of high-grade optical lenses. Certain old traditional crafts, such as lacquer work and ceramics, were put on a modern industrial basis. The great expansion of Japanese industry at this period was identified with light and consumer industries rather than heavy and producer industries. The latter, however, were not entirely neglected. This was especially true of the chemical industry. Japan became a major producer of chemical fertilizers, sulfuric acid and caustic soda.

During the period 1914–37 most of Japan's industrial development was characterized by the prevalence of the free-enterprise system, with the government playing only a minor role. The government did, indeed, provide tariff protection, and in some cases gave direct or indirect subsidies to infant industries, but compared with the period of the 1880s, government sponsorship and control were relatively insignificant. Because of their possession of capital and technical experience, the *zaibatsu* or big industrial combines were able to secure an important share in Japan's newly expanded industry. But the *zaibatsu* were never able, either individually or collectively, to monopolize the field. Many important manufacturing firms arose completely independent of *zaibatsu* control. Some of these firms carried out large-scale production in big factories, as with the paper industry. In other cases production in any one enterprise was on a relatively small scale and was centred in factories with only a dozen or so employees. Of great importance was the fact that even Japan's tiny cottage industries were able to take advantage of the country's industrial expansion. In 1936 there were approximately 3,000,000 persons working in factories having five or more operatives, but an equal number of persons were also employed in workshops with less than five operatives, many of them working with their families in their own homes. Cottage industries were prominent in the spinning and weaving of silk and cotton and in such traditional crafts as the production of ceramics and lacquer. They also played an important role in the manufacture of bicycle parts and in many other branches of Japanese light industry, small jobs often being assigned on a subcontracting basis.

Development From 1937 to 1945.—During the middle 1930s, and especially after 1937, there was a marked shift in the development of Japanese industry. The militarists had secured control over the government and, with the beginning of the so-called "China incident" in 1937, Japan was placed on a war basis which lasted until the end of 1945. A significant development in this connection was the enactment of the National Mobilization law which gave the government unlimited power to utilize the manpower, industry and natural resources of the country.

By 1937 it was clear that because of expansionist plans Japan might become involved at any time in a major war with the western powers. This meant that industrial reorientation was necessary since Japan still had to import many essential items from the west and these would be cut off in the event of war. Above all, it was essential that greater emphasis be placed on the heavy and producer industries.

Japan was still relatively backward in the production of steel, machines and machine tools, to say nothing of the airplanes, tanks and trucks which were vital for war. Under government auspices strenuous efforts were made to meet those deficiencies, and on the whole they were strikingly successful. Thus in 1930 Japan was producing only a little more than 2,000,000 tons of steel annually; by 1941 steel production was about 7,000,000 tons; by 1944 plants had been enlarged to provide a capacity of 14,000,000 tons, a production level that was never attained. The Japanese proved to be first-rate ship designers and constructers, and by the beginning of World War II had completed two of the largest and most powerful battleships in the world. In 1930 the motor-vehicle industry was in its infancy and almost all cars and trucks were imported; by 1942 Japan was producing more than 40,000 trucks. In 1941 Japan was producing about 5,000 aircraft annually; by 1944 the figure rose to over 25,000. The year 1944 marked a peak in Japan's industrial production. By 1945 its factories were already suffering serious bomb damage and were no longer receiving the raw materials necessary to keep them in full operation.

Conditions After World War II.—By the time of Japan's surrender in Sept. 1945 its industry was a shambles. Larger factories and mills were either destroyed or rendered inoperable and required thorough rehabilitation. Many factories which remained could produce only war equipment, the manufacture of which was prohibited. Factories which had once produced large amounts of peacetime consumer goods, such as textiles, had gone to ruin. Only about a quarter of the approximately 10,000,000 spindles in use in 1937 were still in operation. There was a lack of raw materials and money. It is not surprising that early in 1946 Japan was operating at only about one-third of the 1930–37 level.

During the early period of Allied occupation the rehabilitation of industry was handicapped by political considerations which included controls, purging, reparations and decentralization, the latter aimed at breaking up the *zaibatsu;* for a while serious thought was given to the deindustrialization of Japan.

In the late 1940s the threat of Communist expansion in the far east caused the United States to promote the industrial rehabilitation of Japan, then regarded as a potential ally. The more controversial aspects in the program of reparations, of purging and of decentralization were quietly shelved. The Japanese began to resent the constant regulation of industry by bureaucratic agencies, and in 1946 chose Yoshida Shigeru, the leader of the Jiyūto (Liberal party), as premier. The occupation authorities co-operated with the trend and permitted the gradual weakening of controls. (See *History,* above.)

Japanese industry was quick to respond to these developments. Factories were rehabilitated and put back into operation. The long-neglected consumer and light industries were especially prompt in re-establishing their prewar standing, and Japanese exports once more began to play an important part in world markats. Beginning in the mid-1950s, the military campaign in Korea carried out under United Nations auspices had a iavourable effect on Japanese industry. The U.S. government placed large orders with various manufacturing firms and this helped to rehabilitate some of Japan's heavy industries.

By the early 1960s great strides had been made in over-all industrial production. The all-industries index of industrial production not only reached its prewar level but far surpassed it. Japan's industry kept pace with the adjustments necessitated by the changing demands of foreign trade. Such adaptations were quick and reflected a great diversification of industry. However, the economy of Japan continued to be dependent on raw-materials imports and plagued by a chronic shortage of capital. Great advances were made in the older consumer-goods industries such as textiles, china, paper and food processing. Products of these industries are manufactured at low cost and compete easily in foreign markets. Spectacular progress was made in the shipbuilding industries. Other industries which showed rapid growth include heavy electrical machinery, rolling stock, radio and television, optical goods, sewing machines, motor vehicles, petrochemicals, fertilizers and plastics.

Japan's industries are concentrated in the highly industrialized area between Kwanto and northern Kyushu. There are four main industrial agglomerations: the most important is located on the Kwanto plain around Tokyo; the second centres about Osaka and Kōbe; the third area focuses on Nagoya; and the fourth, in northern Kyushu, consists of a group of medium-sized cities—Moji, Shimonoseki, Kokura, Yawata, Tobata, Wakamatsu, Fukuoka, Nagasaki, Ōmuta, Saga and Kumamoto. (See also *Transport and*

Communications, below, for further aspects of the motor vehicle, railway, shipping and aircraft industries.)

B. Trade and Finance

1. Trade. — Trade during the Tokugama period was of a very restricted character because every feudal chief set up barriers around his own fief and opposed commercial intercourse outside its borders. The central government, during the period of Japan's seclusion from the outside world, forbade any commercial contacts with foreigners except for limited trade with China and with the Dutch. (See History, above.)

However, some commercial arrangements were necessary, and the origins of Japanese trading and banking are remotely connected with the practice which developed of tradesmen taking over the disposal of the surplus rice from the various feudal principalities, selling it to the highest bidders, transmitting the proceeds to the feudal chiefs and receiving commissions for their services.

An embryonic form of modern capitalism can also be detected in the arrangements which were worked out for trading companies, with shareholders in the provinces and an authorized representative in Tokyo. The number of merchants who could reside in the capital was regulated, and the granting of a trading licence was a valuable privilege worth a considerable sum of money. A big guild of Tokyo fish dealers was organized in the 17th century. In return for loans which the guild advanced to the fishermen for boats and nets, the latter had to sell their fish exclusively to a designated wholesale merchant, who in turn sold the fish at prices fixed by the guild. Another guild was formed for the purpose of promoting the coastal shipping which alone was permitted under the regulations of that time.

Money operations were also brought under the control of guilds, and in Osaka forms of commercial credit came into use and received legal sanction. Promissory notes, bills of exchange, storage delivery receipts and various forms of money orders came into general use. The guild system operated in favour of its wealthy charter members and led to a good deal of jealousy and discontent, with the result that the guilds were abolished by a sweeping decree of 1841, although they were permitted to reorganize on a somewhat broader basis in 1851. Such trade and money-exchange arrangements as existed before the restoration mere largely confined to the capital, Tokyo, and to the commercial centre. Osaka. The great majority of the Japanese lived under a very simple form of economy, paying their feudal dues and sometimes receiving compensation in rice and other commodities, while everyday needs mere supplied by small local industries.

Japan's foreign trade made slow progress at first, even after the country had begun an accelerated industrial-development program. There were financial difficulties because the relation of silver to gold was much more favourable in Japan than in the west. It was also difficult to get rid of the old tradition of bureaucratic regulation of every detail of trade, a situation not favourable to the free flow of commerce. Japan had comparatively little to offer in exchange for the manufactured goods, equipment and machinery uhich were needed to develop the country industrially. Principal exports during the first decades of contact with the outside world were silk, tea, porcelain, curios, copper and marine products.

Japan's foreign trade, which was valued at a little less than $7,500,000 in 1870, was about $27,500,000 in 1890. After 1885, however, Japanese diligence and methodical organization began to yield fruits in export trade. By 1910 Japanese exports were about $223,000,000; by 1920, $945,000,000. Japan gradually began to export commodities which it had formerly imported — flour. sugar, leather, hardaare and clothing. By the time World War I broke out Japan was beginning to compete vigorously with Great Britain in Asian markets.

Throughout the 1920s and in the early 1930s Japan was on the offensive in the field of foreign trade. The big Japanese combinations of capital, Mitsui. Mitsubishi, Sumitomo and others, created powerful sales organizations and shipped their manufactured products to all corners of the world in privately owned ships. Swamping of U.S. and European markets with Japanese goods did not occur, partly because of tariff and quota restrictions and partly because Japanese products, apart from a few specialties, were not of sufficiently high quality to appeal to western customers. But in the markets of Asia and Africa, where many people were too poor to buy the more highly priced and durable European and U.S. products, the cheap goods of Japan made tremendous inroads, especially after the world depression had reduced purchasing power still further. Between 1928 and 1935 Japan became the leading textile exporter in the world. During the same period there was a cut of approximately 50% in British textile exports. Price was undoubtedly a main factor in this shift of markets. It was estimated that the Japanese were selling textiles at half the British price.

After Japan went on the gold standard in 1897 there were few years when its balance of merchandise payments was not unfavourable. Throughout the 1930s Japan was running up unfavourable balances of foreign trade, which were covered by earnings from shipping and by exports of gold.

Foreign Trade, *1937–45.*—By 1937 Japan was a leading contender in world market. Foreign trade played a major role in sustaining the domestic economy and was essential for economic survival. Imports grew more rapidly than exports, and there was a chronic adverse balance of trade. In most cases, however, this trade deficit was more than offset by net earnings on shipping and on foreign investments.

Japan had built up its huge foreign trade during the period when international commerce was organized on a fairly free and competitive basis. In 1937, however, a great change took place in national policy, a change reflected not only in industry but also in the, conduct of commerce. At that time the militarists in control of the government were deeply imbued with a semifascist statist philosophy. Thus Japan was converted to a belief in economic nationalism, economic imperialism and the rigid regulation of all commerce by governmental agencies. The government imposed restrictions on imports, especially from the western world, with the result that in 1938 and 1939, for the first time in many years, exports greatly exceeded imports. Japan was determined to strengthen its trade position in China by securing military and political control over that country. Houever, Japan was still heavily dependent upon materials and markets in areas controlled by the United States, by the Netherlands and by Great Britain. This situation came to a head in July 1941 when these powers embargoed all trade with Japan pending a political settlement. Japan decided upon a desperate gamble. If it could conquer and hold the Philippines, Malaya and Indonesia it would become economically self-supporting. Even trade with the United States, once so rewarding, could be sacrificed without major damage. War was, therefore, decided upon with the announced economic goal of the "greater east Asia co-prosperity sphere[x] — though the real goal was to secure an area dominated by Japanese industrial and commercial organizations. Governmental control over these organizations became complete. In 1943 previous control agencies were consolidated into a newly established Foreign Trade corporation completely dominated by the government. It practically monopolized all Japanese export trade facilities during the remainder of the war period. In some of the newly conquered areas special development companies were organized in order to establish and maintain Japanese economic control. (See History, above.)

Foreign Trade After *World* War 11. — The surrender of Japan in 1945 resulted in the collapse of the entire economic and commercial structure. In 1946 the Foreign Trade corporation was dissolved, and its place was taken by the board of foreign trade. which was completely under the control of the occupation authorities. For nearly two years all imports and exports were conducted on a governmental basis. During the same period there was also a tendency to place restrictions on the size of Japan's foreign trade. In 1947 that policy was altered. Governmental and occupation controls were slowly relaxed and in Aug. 1947 Japan's private trade was reopened.

Instead of demanding tribute or reparations, the U.S. government granted to Japan nearly $2,000,000,000 during the occupation period (1945–51). Much of the money was given in the form

of emergency food supplies to prevent disease and starvation, but it greatly eased Japan's economic situation. In addition the U.S. government made large grants of credit to permit the importation of raw materials for processing and re-export. As a result of these measures Japan's international commerce began to revive, and by 1951 Japan was again a major factor in the world market. Principal export markets were the United States, southeast Asia and India. Japan still restricted its trade with the People's Republic of China. Communist control of southeast Asia, effected, could reimperil the whole economic structure of Japan.

In the late 1950s Japan's trade with the U.S. amounted to about 20% of its total exports and 40% of its imports. This represented a considerable decrease from 1946 when exports totaled 65% and imports 88%, but nevertheless the later figures are still higher in proportion compared with annual averages for the pre-World War II period.

The adverse balances of merchandise trade created by the excess of imports over exports were countered to some extent by direct aid from the U.S. and special procurement orders for U.S. forces based in Japan. However, the balance of international payments showed deficits in 1953, 1956 and 1957 and constituted a precarious situation.

Domestic Trade. — The importance of domestic trade is noteworthy. Internal trading within the Japanese archipelago is probably the largest and most active for any Asian country. In the late 1950s total sales in the wholesale trade amounted to more than 12,500,000 yen and in the retail trade. 500,000 yen annually.

2. Banking and Currency. — Financial institutions were adapted to the peculiar needs of Japan by the Meiji leaders in their efforts to accelerate economic development. The old banking and currency systems which operated under the feudal Tokugawa regime were abolished, and new methods were introduced, modeled on U.S. and European systems. Toward the end of the 19th century a large number of commercial and savings banks were founded by private entrepreneurs. The government established banks with special functions — the Bank of Japan (for the management of treasury funds and foreign exchange control see JAPAN, BANK OF), the Yokohama Specie bank, later the Bank of Tokyo (for foreign exchange), the Hypothec bank (for agricultural loans), the Industrial bank (for industrial loans), the Hokkaido Development bank and various colonial banks. These banks were important instruments of national economic policy from the time of their establishment. The government promoted and financed key industries such as railways, steel and shipbuilding largely through taxation and postal loans.

The Japanese financial system depends more on banking institutions than on a securities market for long-term funds.

From the Meiji era, a complete stock and bond market system in theory existed in Japan alongside the banking system. However, in practice most debentures were in the hands of banks. Loans for the purchase and sale of shares were made by banks to investment houses and to individuals. Stocks served as security for such loans. The demand for long-term loans, which in the west is normally met through the issue of securities, either shares or debentures, has in Japan been provided by the banks. Thus Japanese banks, though patterned after the English commercial banks whose functions were to receive deposits and to supply short-term operating funds, became, in fact, more like the mortgage banks (hypothec banks) of Germany.

Prior to World War II the Japanese short-term or call-money and discount markets were relatively underdeveloped by western standards and funds in these markets were inadequate. The short-term money market normally serves to keep funds circulating among banks and to maintain reserves. The inflation following World War II brought a decline in transactions by drafts. The concept of maintaining reserves was also gradually weakened among bankers who regarded them as a luxury which could not be afforded by a capital-hungry nation. As a result the banks came to depend on the Bank of Japan more than ever. In the 1950s a return to financial "normality" resulted in an increase in funds handled in the call-money and discount markets though they still fell short of prewar levels.

Japanese banking, despite outward similarities to western banking, developed features quite different from the financial systems it chose as models. The peculiar features of Japanese banking reflect the chronic shortage of capital which has plagued Japan. Following the restoration, the demands of the economy for rapid development could not wait for an accumulation of capital. Thus Japan's "hothouse" growth had to employ to the fullest the credit-creating power of the banking system. As a consequence the banking interests wielded considerable power in financial circles. Following World War II, changes were prescribed which aimed at democratizing economic institutions. These attempted to effect the withdrawal of banks from long-term financing. In the 1950s, however, banks were once again engaged not only in providing short-term credit, but also were reverting to their old practice of making long-term loans.

A great variety of financial and banking institutions has arisen in Japan to meet the complex needs of its economy. These include the Bank of Japan which is the central bank, the Central Co-operative Bank of Agriculture and Forestry and the Central Bank for Commercial and Industrial Co-operatives. Other important financial institutions are agricultural co-operative associations and prefectural credit federations, mutual loans and savings banks and insurance companies. In addition, there are special government organs such as the Trust Fund bureau, Post Office Life insurance, the Japan Development bank, the People's Finance corporation, the Housing Loan corporation and the Export-Import Bank of Japan. In the late 1950s there were nearly 100 banks with about 6,000 branches and approximately 14 foreign banks operating in Japan. There are also money markets: call-money market and call-money brokers; discount market and bill brokers; stock market with stock exchanges and stock companies.

With the establishment of the central Bank of Japan in 1882 a new currency-issue system was also inaugurated. Convertible notes were first issued in 1885. In addition to the specie reserve (gold) issue, an "elastic security reserve limitation system" was adopted whereby a security reserve issue was permitted against government bonds and other securities with 70,000,000 yen as the maximum limit. Subsequently the security-issue ceiling was raised and in 1930, following the example of other countries, the embargo on gold was lifted. At the end of 1931, however, gold was again placed under embargo and in 1941 the currency-issue system was completely altered and a "maximum issue limitation system" was adopted. The Bank of Japan notes were steadily increased during World War II, and after 1945 increased very rapidly. This was a cause as well as the result of the postwar inflation. However, after 1949 the increase in bank notes issued approximated the rate of increase in national income. In the 1950s Japan's currency-issue system became controlled. The limit of the issue of bank notes was determined by the minister of finance. Bank notes could be issued in excess of the set limit but in such a case, where the excess issue extended beyond 15 days, a tax was levied on the amount issued in excess. Against the amount of bank-note issue, an equivalent amount in securities was required. Securities permitted included commercial drafts, loans, state bonds and other credits, foreign exchange, gold, silver, etc. Thus, currency in circulation consisted of Bank of Japan notes, auxiliary coins and government notes; the latter expanded rapidly in World War II and were gradually reduced in the postwar period. In the early 1960s denominations of currency in circulation included auxiliary coins of 1, 5, 10 and 50 yen. Paper money in circulation consisted of 100-, 500- and 1,000-yen notes. In 1958 a 100-yen silver coin was introduced and for the first time 5,000-yen and 10,000-yen Bank of Japan notes were placed in circulation. The exchange rate after 1949 remained stable at 360 yen to U.S. $1 and 1,008 yen for the devalued pound sterling. Deposit currency consisting of banking deposits and postal transfer savings became more significant in the late 1950s in line with the development of credit economy and totaled about 50% of cash currency. (See also YEN.)

3. — National Finance. — Following the end of World War II Japan's national financial system was drastically overhauled. Under Japan's 1947 constitution the cabinet has the responsibility of preparing the national budget, which must be submitted to the

lower house of the diet; the legislature is the only body which can authorize the expenditure of funds by the national government. Taxes can be imposed or modified only as prescribed by laws enacted by the diet or with respect to local taxes by the local legislative bodies. The upper house considers the budget, but even if it does not agree with the decision of the lower house, the budget automatically becomes effective.

The constitution provides that the budget be prepared on a fiscal-year basis (April 1 to March 31) by the budget division of the ministry of finance. The centre of the government's budget system is the general account, which theoretically includes all revenue and expenditure directly applicable to the over-all fiscal operation of the government. The Japanese government also uses a special account system in its budgeting, which includes a large number of special accounts for the operation of government enterprises and other special aspects of government finance. Theoretically, each special account is self-balancing. In actual practice, however, there were substantial deficits in these accounts in the periods before and after World War II which were covered by direct government appropriations, borrowings and transfers of funds from one account to another.

The postwar fiscal policy of the Japanese government was characterized by large deficit financing. Unbalanced budgets and expansion of bank-note issue by the Bank of Japan reflected the principal underlying factors in the postwar inflation. In the early postwar years there were enormous claims on a depleted national income, among the more important being the large amount of war bonds and war indemnity claims and the need to assist private enterprise.

In fiscal 1949–50 the principle of a balanced budget was introduced. With expanding economic activity, efforts were made to increase revenues and to hold expenditures to minimum essentials. National taxes provided the bulk of government revenue (particularly in the 1950s). The largest returns come from income taxes, the corporation taxes and liquor taxes. Another very significant source of revenue is the profit from the government monopolies, tobacco, salt and camphor, with tobacco accounting for the largest proportion. In prewar years emphasis was placed on indirect taxes and there were indications in the 1960s of a reversion to increased indirect taxes and decreased direct taxes.

In the postwar years and especially in the early 1950s, local government finance was on a scale approximately equal to the levels of national finance. Increased local government expenditures resulted from changes aimed at instituting a democratic framework, particularly in the field of education. Furthermore, greater freedom permitted more local control over municipal finances. Deficit financing was practised to permit ambitious public-works programs which, in some instances, were unco-ordinated or competitive with central government expenditures for public works.

National Income and Wealth.—National income in 1957 amounted to approximately 8,350,000,000 yen or about 91,500 yen nominal national income per capita. By industry it was divided as follows: primary industry consisting of agriculture, forestry and fisheries, about 20%; secondary industry comprising mining, construction and manufacturing, 32%; and tertiary industry—wholesale and retail trade, financial enterprises and services, 48%. The main characteristics by distributive shares are: compensation of employees, about 50%; proprietors' income, 35%; and corporation profits, 11%. The national wealth survey, 1955, showed the total value of accumulated fixed assets obtained as a result of economic activities as 20,300,000,000 yen (225,000 yen per capita). Of the total value: 17% was owned by the government, 6% by local government and 77% by private corporations and enterprises.

C. Transport and Communications

For many years the serious development of highways was neglected in spite of Japan's rapid progress in other areas. The rugged terrain made road building difficult and expensive and earthquake destruction was also a handicap. Wheeled vehicles never played a major role in Japan's economy, and there was no strong demand for highway development, although a great deal of effort was devoted to the railroads and coastal shipping.

1. Roads.—Shortly after the restoration, Japan embarked upon a program of road construction and supervision. The first step was taken in 1875 when a conference of the governors of the prefectures was called to discuss the classification and maintenance of highways. It was decided that Japan's highways should fall into three classes: national, prefectural and local. Later, local roads a-ere divided into municipal roads on the one hand and town and village roads on the other.

National roads are built and maintained by the central government. The cost of building and maintaining the prefectural roads is divided between the central and the prefectural governments. The local roads are paid for by the districts they serve. Most local roads are at least 12 ft. wide; important municipal and all prefectural roads were required to be at least 18 ft. wide; and the minimum width of the national roads was placed at 24 ft., but some are considerably wider. Nevertheless, in the late 1950s Japanese roads could not in the main be regarded as first class by western standards. Only a small percentage were paved. During and immediately after World War II Japan's highway system underwent rapid and serious deterioration, partly from bomb damage and partly because of the increasing difficulty in securing adequate road-building equipment and material. In the late 1950s there were nominally about 600,000 mi. of road, but only 15,000 mi. were national roads, and of these about 3,000 mi. were paved. The road bureau of the ministry of construction is charged with carrying out a road-building program. Although still far from adequate, road construction was being pushed forward in the early 1960s. A number of modern, paved toll roads were completed. In 1958 the Kanmon tunnel connecting the highways between Shimonoseki and Moji in the southern part of Japan was completed. This double-decked tunnel paralleled the twin railroad tunnel which had been completed during World War II.

Vehicles.—The most common vehicles in prerestoration times were man-drawn carts, the norimon and the kago. The norimon was an elaborate type of litter, a miniature house slung from a massive pole and borne by carriers. The kago was a simpler contrivance, a kind of open palanquin; it was also borne by carriers. Both have long since disappeared. An important development took place in the 1880s with the invention of the jinrikisha, a two-wheeled vehicle usually pulled by a single runner. The use of this vehicle spread rapidly throughout Japan and also the other countries of the far east. In the 1930s, however, the jinrikisha lost much of its popularity, and by the beginning of World War II it was comparatively rare. It continued to be used only by a few old-fashioned Japanese and occasionally by doctors and geisha who sometimes had to go through narrow, winding back streets. A means of locomotion which became extremely popular in Japan, especially after 1918, was the bicycle, and Japanese firms proved adept at turning out large numbers at moderate prices. In many cases even those jinrikisha which remained were converted into vehicles drawn by a man mounted on a bicycle.

The important development of motor transportation in Japan took place shortly after the great earthquake of 1923. In 1924 there were about 40,000 motor vehicles in operation and that number increased steadily for the next few years. Until 1930 Japan was almost entirely dependent upon imports for its motor vehicles. In the mid-1930s domestic factories and assembly plants went into active operation. Ford and General Motors established assembly plants in Japan, and a number of small Japanese automotive manufacturing companies were set up. In 1938 motor-vehicle production exceeded imports for the first time.

World War II was disastrous for the Japanese motorcar industry. Absence of raw materials and war damage caused the production of new cars to dwindle almost to nothing. The motor-vehicle industry was rapidly revived in the post-World War II period, however, and in the late 1950s the production of both motorcycles and small-type three-wheelers was well in excess of 100,000 annually. Motor scooters were coming off the assembly lines at a rate of 100,000 a year, ordinary passenger cars were approaching 50,000, small trucks over 80,000 and buses 8,000.

In the late 1950s registered automobiles exceeded 2,000,000, rep-

resenting a considerable increase over the early 1950s. This is partly the result of an increase in light motor vehicles, such as motor bicycles, three-wheelers and scooters, which are registered as automobiles.

2. Railways. — There were no railways at the time of the restoration. The British minister, Sir Harry Smith Parkes, recommended the building of railways when the southern Japanese island of Kyushu suffered from famine in 1869, while there was a surplus of rice elsewhere. Neither the state treasury nor private capitalists were willing or able, at first, to finance railway construction. But an Englishman, Horatio Nelson Lay, offered to find the necessary funds and a loan of £1,000,000 was floated on the London market. Great Britain supplied some of the engineers and material for the first lines, which connected Tokyo with the neighbouring port of Yokohama, and Osaka with its adjacent port of Kobe. There had been opposition to the railway project in some circles, persons occupied in other forms of transportation fearing ruin, while extreme nationalists feared the loss of independence through the flotation of a foreign loan. However, the leading statesmen of the restoration, Itō Hirobumi and Ōkuma Shigenobu, carried through the scheme, and the presence of the emperor at the opening of the first line, between Tokyo and Yokohama, in 1872 silenced all opposition. The Osaka-Kobe line was completed in 1874 and extended to Kyoto in 1877. While British engineers surveyed the routes and supervised the work during the first few years, the Japanese showed themselves as apt pupils in railway construction as in other industries and trades which they learned from abroad, and they were soon able to dispense with foreign assistance.

The Tokyo-Yokohama and Kobe-Osaka lines were merely the nucleus of the Tōkaidō line, following the route of the historic highway linking up Tokyo and Yokohama with Kobe, the principal port and chief industrial city of western Japan, and with Osaka. The backbone of the Japanese railway system was a trunk line from Aomori at the northern end to Shimonoseki at the southern end of the main island, a distance of 1,153 mi. This line was later connected by an undersea railroad tunnel across the narrow strait of Shimonoseki with railway lines in Kyushu, of which the principal ones were Moji-Kagoshima (232½ mi.) and Moji-Nagasaki (163½ mi.). Despite some military objections, this main trunk line followed the old Tōkaidō route along the sea, although a secondary railway was built along the Nakasendō route in the interior. Additional lines were constructed in Hokkaido and east-west lines furnished connections with the main ports on the Sea of Japan such as Niigata and Tsuruga.

Private Railways and Nationalization. — Private capital, which was at first reluctant and hesitant, was coaxed into active participation in the construction of railways during the 1880s. An important step in the development of railways in Japan was the enactment of the Railway Construction law, 1892, which laid down a comprehensive policy of railway building for the future and recommended the consolidation of the existing lines into a single state-owned system. The difficulty in obtaining efficient co-ordination on the part of the 36 private companies during the war with Russia (1904–05) was an important factor in inducing the diet to pass a railway nationalization law, March 31, 1906.

The government railroads were originally under the ministry of communications, but after nationalization it was felt that some reorganization was necessary. In 1908 all government railroads were placed under a special railway board, which was responsible to the cabinet as a whole. A Railway Special Account law (1909) provided that the budget of the state railways should be kept separate from the general finances of the government. In 1920 there was another major reorganization, whereby the railway board was transformed into the ministry of railways. Operational control was decentralized, control being divided between one central and six regional offices. The central office consisted of eight bureaus, to which a ninth, the board of tourist industry, was added in 1930. The administrative structure was not greatly changed after 1920 but post-World War I conditions made necessary certain alterations between the government and the administrative structure. In 1943 the railways and all other forms of transportation were made subject to a newly created ministry of transportation and communications which was divided two years later into the ministry of transportation and the ministry of communications, with control over the railroads allotted to the former.

In 1948 the ministry of transportation was given over-all control over the national railroads and also assumed responsibility for the supervision of the private rail lines. It was given the power to approve new railroad construction and to close down existing lines. to control all ferry services and all motor transportation related to the railways. The Japan National railways, on the other hand, was a separate and semiautonomous corporation. Subject to over-all control by the ministry of transportation, it was authorized to operate the railways. The central bureau was established in Tokyo, and branch offices were set up in Nagoya, Osaka, Moji, Sendai and Sapporo.

The national railroad system and the remaining private railroads experienced a slow but steady growth. The Japanese railroads were, however, faced with certain problems not common to the rail systems of most other countries. The majority of Japanese industrial centres are on or near the coast, and coastwise shipping was favoured over railroads for much of the freight transportation. The railroads carried only about one-third of the tonnage of the country's domestic trade. For this reason the Japanese railroads came to rely upon passenger traffic.

Developments After *World* War *II*.—During World War II the Japanese railroad system experienced many difficulties. Bomb damage destroyed many locomotives, railway cars and workshops. However, so much of the coastal shipping was either sunk or used for other purposes that the railroads secured a much larger share than usual of freight transportation, Passenger traffic also increased. After the war the Japanese government, aided by the U.S., embarked on a program of rehabilitation and improvement.

The whole country is covered by an extensive railway network. The leading trunk lines are owned and operated by the Japan National Railways corporation. Private railways, which numbered over 200 in the early 1960s, also have an expanded network throughout the country. They are mostly auxiliary feeders to the trunk lines or short interurban lines. In the late 1950s the total length of the mainline railways was more than 17,000 mi., of which about 12,500 mi. were government owned and 4,500 mi. privately owned. Only about 18% of the Japan National railway was electrified as compared with 78% of the private railways. In addition, there were approximately 1,200 mi. of tramways. There were over 6,000 locomotives (including about 700 electric locomotives), 27,000 passenger cars (including 4,000 electric cars) and more than 100,000 freight cars. By the early 1960s a considerable amount of electrification and modernization had taken place.

.High rail speeds are limited in Japan because most of the tracks are of narrow gauge, though some private railway lines utilize standard-gauge rails. The Japanese adopted a gauge of 3 ft. 6 in. in contrast with the standard gauge of 4 ft. 8½ in. Railroad construction in Japan requires the use of many tunnels, curves and retaining walls. In such circumstances a narrow gauge seemed more economic and efficient, and the rolling stock was small and lightweight. Because of the number of curves on the track and the size of the locomotives, Japanese trains are forced to travel comparatively slowly.

3. Shipping. — A group of islands with deeply indented coasts, Japan is naturally a seafaring country and up to the 17th century Japanese mariners navigated the seas of eastern Asia with daring and skill. Japan was sufficiently advanced as a naval power to send a considerable force into Korea under Hideyoshi in the 16th century and Japanese corsairs harried the coasts of southern China. Japanese ships are reported to have traded with Siam, Luzon, Cochin China, Annam and other southeast Asian countries. This came to an end when the Tokugawa shogunate adopted a policy of strict isolation from the outside world.

After the Meiji Restoration. — Restrictions on maritime activity were scrapped when Japan began its program of all-out modernization. Even before the restoration the law against the construction of ocean-going craft had been repealed in 1853; and the government of the shogun built a pioneer sailing vessel on the European model. A shipbuilding yard was established at Yokosuka

and a naval college was instituted at Nagasaki. A shipping company which provided coastwise service was established in **1870.** The largest Japanese commercial shipping company, the Nippon Yiisen Kaisha (N.Y.K.), was incorporated in **1885**, the rising capitalist family of Mitsubishi investing much of the initial capital. The Mitsubishi company got its start when it took over **63** foreign steamers which the Japanese government had purchased to transport troops for a punitive expedition to Formosa in **1874.** The N.Y.K. steadily expanded its services, beginning with a line between Japan and Shanghai and then opening up connections with north China, Korea, Siberia and later with India and Australia. It inaugurated three services, Yokohama-London-Antwerp, Hong Kong-Japan-Seattle and Yokohama-Manila-Australia, in **1896.** Another large shipping company, the Ōsaka Shōsen Kaisha (O.S.K.), came into existence about the same time as the N.Y.K. and these two lines remained in the lead of the Japanese shipping companies.

War was invariably a stimulus to the development of Japanese shipping enterprise. The Chinese-Japanese War of 1894–95 had the same effect, on a larger scale, as the earlier expedition to Formosa. The Japanese government found itself obliged to maintain an army of **200,000** men in a foreign country for a year. As the available supply of shipping was inadequate there was extensive buying of new vessels and after the end of hostilities these vessels remained a part of the Japanese merchant marine. The Russo-Japanese War of 1904–05 was a still greater stimulus. After this war, Japan possessed more than 1,000,000 gross tons of merchant shipping and ranked sixth among the maritime powers of the world. Prior to the Chinese-Japanese War only about 10% of Japan's exports and imports were transported in Japanese ships, but this proportion increased to 40% after the Russo-Japanese War and to **48%** at the time of World War I. Legislation designed to encourage navigation was retained. This gave Japanese steamship companies mail subsidies for maintaining regular services to various parts of the world. Ships entitled to this subsidy were required to be of more than **3,000** tons, with a speed of at least **12** knots and not more than 15 years old.

World War I and After.—World War I was an even greater spur to Japan's development as a maritime power than the Chinese-Japanese and Russo-Japanese conflicts. There was a world-wide shortage of shipping and the Japanese merchant marine increased its gross tonnage by 1,000,000 tons. Many new shipping services were opened to all parts of the globe. The percentage of Japan's imports and exports carried in Japanese ships increased to almost 80%. As in other commercial and industrial activities, there was a tendency to dispense with foreigners when their services were no longer needed.

A characteristic of Japanese maritime industry, as of the Japanese economy in general, was the high degree of trustification. Such large commercial organizations as the Mitsui and Mitsubishi firms often produced goods in their own mines and factories, sold these goods through their own trading organizations abroad, financed the sales through their own banks and shipped the goods in their own ships.

The policy of the Japanese government had always been to assist, by subsidies and other means, the development of those industries which could contribute to increasing the country's war potential. However, up to 1937 the amount of financial help to merchant shipping was, in terms of absolute values, not remarkably high. Yet, it was sufficient to permit a steady increase in quantity and improvement in quality. In 1937 Japan possessed more than **2,500** steamships (100 gross tons or over) with a capacity of about **4,**500,000 gross tons. The policy of "scrap and build" was carried out so effectively that at this period there were few obsolete vessels left for scrapping.

Shipping After 1937.—The beginning of the so-called China incident in the middle of 1937 brought about several important changes in the development and organization of Japan's merchant shipping. The government foresaw an extended period of hostilities with a great need for expanded shipping facilities, and decided to create a system whereby it would have greater and more direct control, including an accelerated shipbuilding program. In 1937 legislation was passed which gave the ministry of communications (later transport and communications) control over all civilian merchant shipping.

Steps were taken to provide for interest credits with guarantees against loss and the granting of capital for the rapid construction of large and fast vessels. In 1939 several additional laws were passed, the main provisions being to enforce standardized ship construction, to permit the government to determine the nature and costs of building and repair work, to order shipbuilders to improve or replace their technical equipment and to grant subsidies or other forms of financial assistance for those purposes. Shipbuilding associations were organized and federated. As a result of these measures, when Japan launched its attack on Pearl Harbor in Dec. 1941 its merchant marine consisted of over 2,700 ships (100 gross tons or over) with a gross tonnage of nearly 6,500,000. In addition there were large numbers of smaller vessels of less than 100 gross tons, which together totaled about another 1,000,000 tons. At that time Japan stood third among the maritime countries of the world.

World War *II* and After.—To meet wartime transport problems, the Japanese government in March 1942 seized all merchant shipping and placed it under the direct control of a newly created shipping control bureau, which directed the movement of all ships. The armed forces took over about **4,000,000** tons of shipping in direct support of their operations, leaving only a little more than 2,000,000 tons for civil use, although the government economic planning board insisted that at least **3,000,000** gross tons of shipping would have to be retained constantly for civil needs. In an attempt to meet this shortage, a great many small ships, normally used only for coastal shipping, were diverted to overseas trade, a task for which they were ill suited. The shortage of shipping seriously handicapped Japan's war effort, since it was necessary to import a vast amount of raw materials in order to keep industries in production. Japan's system of convoying, antisubmarine warfare and antiaircraft defense proved grossly ineffective. As the result of Allied sea and air operations, Japan lost more than **2,300** ships with a total tonnage of almost 8,000,000. Japan's shipbuilding capacity was unable to keep up with this attrition, especially since many shipbuilding yards were destroyed by aerial bombardment. By Sept. 1945 Japan had only 1,400,000 gross tons of ships more than 100 tons in size. A large part of that tonnage, moreover, was unserviceable.

After capitulation all Japanese shipping was subject to the control of the occupation authorities, though control was exercised through the Japanese ministry of transportation. The ministry of transportation in turn continued to use the shipping control bureau to control the operation of all vessels of 100 gross tons and over. It was the policy of the government, however, to turn back to private hands the operation of all merchant vessels as soon as possible.

After the termination of hostilities, the government, aided by private industry, made strenuous efforts to repair existing vessels and to construct new ones. The shipbuilding rehabilitation was remarkable. From 1955 through 1957 Japan received orders for new ships aggregating 8,700,000 gross tons, accounting for about 20% of the total gross tonnage of new ships ordered from world shipbuilders during the period and putting Japan at the head of the list of major shipbuilding countries. The spectacular demand for Japanese ships on the basis of quality equipment, advanced techniques and reasonable cost attracted keen attention in international shipbuilding circles. In 1957 about 2,400,000 gross tons of new shipping were launched.

4. Air Transport.—During the Satsuma rebellion of **1877** two balloons were built. Kite balloons were used in the siege of Port Arthur during the Russo-Japanese War. An army officer made the first airplane flight in Japan in 1910. In the next year the first civil aviation flight took place. Thereafter civil aviation in Japan had a slow but steady growth. The first regular civil aviation service was established in **1922.** Regular scheduled flights between Tokyo and Osaka began in 1923 and air-mail service in 1925.

The Japan Air Transport company was formed in 1929 and

regular flights were made between Tokyo and Osaka on the main island of Honshu and Tokyo and Fukuoka on the island of Kyushu. Services were later extended to Seoul in Korea, Dairen in Manchuria and T'ai-pei on Formosa.

The Japanese government, in accord with general trends at the time, decided to exercise greater control over the growing aviation industry. Under government auspices the Japan Air Transport company and other smaller aviation companies merged to form Japan Airways company. In 1939 this company had about 120 planes and was operating about 12,000 mi. of air routes. At the beginning of World War II, civil aviation was placed under military control. Elaborate plans were made for the training of pilots and aviation schools were established.

After Japan's surrender its civil aviation came to an abrupt end. With the end of the occupation and the signing of the peace treaty, however, the way was cleared for a revival of Japanese civil aviation, which was renewed in Sept. 1951. Following the lifting of restrictions in 1952, air transportation in Japan developed very rapidly. Japan Air Lines was established in the fall of 1951 with a capital of 100,000,000 yen. It started regularly scheduled domestic flights Oct. 25, 1951. In Aug. 1952 the U.S.-Japan civil aviation agreement was signed, paving the way for Japan's airline to operate over the Pacific. The Japanese government adopted a policy of setting up a subsidized company which would fly domestic and international routes and accordingly introduced a bill into the diet, passed in Aug. 1952, which established the Japan Air Lines company (J.A.L.) in Oct. 1953 with a capital of 2,000,000,000 yen. The company opened its international route on Feb. 2, 1954, when the first flight set out for San Francisco. There are about 20 other companies, including Far Eastern Airlines and Japan Helicopter and Aeroplane Transports, engaged in scheduled and unscheduled flights.

Tokyo International airport is located at Haneda, Tokyo. Other airports are Itami in Osaka, Itazuke in Fukuoka, Chitose in Sapporo, Komaki in Nagoya, Iwakuni and Misawa.

5. Postal Service.—Japan's postal service was inaugurated in 1871 with the opening of a mail service between Tokyo, Osaka and other cities. A service for foreign mail was opened in March 1872, and British, U.S. and French post offices were set up; however, by 1877, when Japan concluded a convention with 25 countries participating in the International Mail Service treaty, these had ceased operation. There was a rapid increase in the number of post offices, of whichtheretvere 180 in 1871 and 5,527 in 1882. Thereafterthe rate of increase was slower, but additional post offices continued to be opened almost every year.

The Japanese post office proved itself reasonably efficient. In addition to the ordinary transmission of mail, it assumed duties such as receiving taxes on behalf of the various taxing authorities, distributing government pensions and annuities and providing places where government bonds could be bought and sold. The post office was also authorized to provide a number of banking services, including postal money orders, savings and postal life insurance. The postal savings system (inaugurated in 1875 and modeled on the British) proved immensely popular. In 1947 total deposits amounted to about 56,000,000,000 yen and by the late 1950s had surpassed 750,000,000,000 yen.

The post-office system was operated at the outset by the ministry of communications and during World War II by the ministry of transportation and communications. In 1949 a special ministry of postal services was established. Postal personnel numbered close to 260,000 in the late 1950s; the postal ministry had about 15,700 post offices under its jurisdiction and was handling annually about 5,200,000,000 pieces of domestic mail, 31,200,000 pieces of overseas mail shipped and 36,600,000 received.

6. Telecommunications.—Telegraph service in Japan was instituted for government messages in 1869. A public telegraph line was opened between Tokyo and Yokohama in the same year. Telegrams in European languages were dispatched in 1870 and in the same year Osaka and Kōbe began to exchange telegraph messages. Telegraph service between Tokyo and Nagasaki (with many intermediate points) dates from 1873. In 1879 Japan entered the International Telegraph association. Subsequently the development of the Japanese telegraph system was rapid. The telegraph system proved immensely popular with the Japanese. The number of telegrams sent generally exceeds, proportionately, that of any other country except the United States. After 1945 there was a thorough rehabilitation of the whole system, which had greatly deteriorated during the war period. In the late 1950s the number of domestic telegrams averaged 90,000,000 annually.

Japan was not so fortunate in the development of its telephone system though telephone communications in and between Tokyo and Yokohama were established in 1890 and long-distance operations between Tokyo and Osaka seven years later. For many years thereafter the number of telephone subscribers increased slowly, largely because of the difficulty in securing telephones. The possession of a telephone was considered an important property right which could be sold or upon which a mortgage could be raised. Consequently, there was strong pressure from subscribers against the granting of additional telephones to new applicants. During World War II the telephone system suffered heavy damage. About one-fourth of the wire system and nearly one-half of the existing telephones were destroyed. Rehabilitation resulted in expansion and improvement, and in the late 1950s the number of subscribers exceeded 2,500,000, more than double the prewar figure.

From their inception the telegraph and telephone systems were government monopolies. There was a close association with the postal system, for which reason many local post offices served, even in the 1960s, as telegraph and telephone offices. In 1949, when the post office was made a separate unit, the telegraph and telephone services were placed under a newly created ministry of telecommunications. After 1952 they were under the management of the Japan Telegraph and Telephone corporation. Both services were improved beyond their prewar levels and a program of rapid modernization was undertaken.

International Communications.—Japan's international communications started in 1871 with the laying of a submarine cable between Nagasaki and Shanghai. In later years important submarine cables connected Nagasaki with Vladivostok and Kamakura (near Tokyo) with Guam. Messages to Europe could be sent by way of Vladivostok and to the United States by way of Guam. Both cables were owned by foreign corporations.

Several wireless telegraph stations were set up in Japan in 1908. For a number of years radio was used only for domestic communications or for communications between ship and shore. In 1915, hoaever, regular radio communication was established between Otchishi station in Hokkaido and Petropavlovsk in Kamchatka. In subsequent years direct circuits were established with the principal cities of the world. In 1925 the Japan Wireless Telegraph company was established under government auspices to assure Japan's complete independence of foreign telegraph companies. The government transferred to the newly organized company its powerful station on Mt. Iwaki which it had erected for the purpose of establishing direct communication with Europe. The company was completely reorganized in 1938 when all international wireless communications were placed in the hands of the government-controlled International Telecommunications company. Large sums were spent to improve the operating station at Iwaki, but short-wave transmission made the old long-wave system employed there obsolete.

Two powerful new transmitting stations which could send messages by short-wave to all parts of the world were erected, one at Oyama near Tokyo and the other at Yosami near Nagoya. Three receiving stations were also established.

There has also been a considerable development of wireless or radiotelephony in Japan. The first experiments were made in 1911, but it was not until 1923 that the service was opened to the public with the inauguration of radiotelephone communications between shore stations at Kōbe and ships in the harbour. This service was gradually extended to the other principal ports. In 1932 the government formed the International Telephone company to foster and control the further development of radiotelephony. As a result. this service came to include the Japanese colonies and the major countries of the world. In 1938 the International Telephone company was absorbed into the International Telecommu-

nications company, which gave the Japanese government greater control over all international communications. In 1947 the company was liquidated, control of all wireless services being taken over by the government. After 1949 the International Communications division of the ministry of telecommunications assumed the responsibility for its operation. In 1953 this division became independent under the new name of International Telegraph and Telephone Company, Ltd. Japan's overseas telegraph and telephone system in the late 1950s consisted of 34 wireless telegraph circuits, 1 submarine cable, 30 wireless telephone circuits and 15 wireless photo circuits, enabling Japan to communicate with any country in the world.

Radio and Television Broadcasting. — The first radio station was opened in 1925. Later in the same year small stations were established in Osaka and Nagoya. These were experimental, and by the end of 1925 it was decided to place radio broadcasting on a more permanent and formalized basis. The three original stations were merged to form the Broadcasting Corporation of Japan, which was granted a monopoly of all broadcasting. Though the new corporation was sanctioned and protected by the government, it maintained a semiautonomous position until 1935, when all of its operations were brought under government control. Thereafter the programs served as instruments of government propaganda. Later events showed that this propaganda could also work in reverse. On Aug. 15, 1945, the emperor's order to his people to surrender was transmitted over the radio and proved a valuable aid in securing orderly submission to the occupation authorities.

The Broadcasting Corporation of Japan is not commercialized, and derives its revenues solely from licence fees. In the late 1950s the number of subscribers totaled more than 14,500,000 or approximately four registered radio sets for every five households. The Broadcasting Corporation of Japan maintains local stations as well as a number of major stations in the principal cities. Each local station originates part of its own programs, but a great deal of the total radio time is allotted to national network broadcasts. Overseas broadcasts are transmitted daily by Radio Japan. In 1950 the diet passed a law aimed at destroying the monopoly of the Broadcasting Corporation of Japan by permitting the establishment of private stations.

Regular television broadcasting began early in 1953 by a government-subsidized, noncommercial station. Following a rather slow growth in its early years, television in Japan in the early 1960s was a booming industry. Long-distance microwave circuits connecting the whole country permitted nation-wide TV circuits to be established from Hokkaido to Kyushu. The telecasting service area covered 80% of all Japanese households. It was estimated that there were at least 4,000,000 sets actually in use. Tokyo tower, which is higher than the Eiffel tower, is the television-transmitting centre of the capital. (W. H. CH.; W. M. McG.; R. B. H.)

BIBLIOGRAPHY.—*General works:* Basil Hall Chamberlain, *Things Japanese,* 6th ed. (1940); Herschel Webb, *An Introduction to Japan,* 2nd ed. (1957); H. Barton, *Japan's Modern Century* (1955), (ed.), *Japan* (1951), (comp.), *Selected List of Books and Articles on Japan in English, French and German* (1954); R. E. Ward, *Guide to Japanese Reference and Research Materials in the Field of Politzcal Science* (1950); Edwin O. Reischauer, *The United States and Japan* (1950); Bureau of Statistics, Office of the Prime Minister, *Japan Statistzcal Yearbook* (annually), *Statistical Handbook of Japan* (1958); Tourist Industry Bureau, Ministry of Transportation, *Japan: the Official Guide* (annually); D. Keene, *Living Japan* (1959).

Geography: Edward A. Ackerman, *Japan's Natural Resources* (1953); Robert B. Hall and Akira Watanabe, "Landforms of Japan," *Michigan Academy of Science, Arts and Letters,* xviii, pp. 157–207 (1932); T. Okada, *Climate of Japan* (1936); SCAP, "Japanese Mineral Resources," Natural Resources Section *Report 41* (1951), "Reconnaissance Soil Survey of Japan (Summary)," *Report 110-I* (1951), "River Control and Utilization in Japan," *Report 149* (1951), "Forestry in Japan," *Report 153* (1951); Glenn T. Trewartha, *Japan: a Physical, Cultural and Regional Geography* (1945).

The people and population: Ruth Benedict, *The Chrysanthemum and the Sword* (1946); John F. Embree, *Suye Mura, a Japanese Village* (1939); Douglas G. Haring, "Japan and the Japanese" in R. Linton (ed), *Most of the World,* pp. 814–875 (1949); A. L. Kroeber, *Anthropology* (1948); Weston LaBarre, "Some Observations on the Character Structure of the Orient: the Japanese," *Psychiatry,* vol. viii, no. 3 (1945); Edward Norbeck, *Takashima: a Japanese Fishing Comnzunity* (1954); Robert F. Spencer and Kanmo Imamura, "Notes on the Japanese Kinship System," *Journal of the American Oriental Society,* vol. lxx, pp. 165–173 (1950); S. Hattori, "Relationship of Japanese to the Ryukyu, Korean, and Altaic Languages," *Transactions of the Asiatic Society of Japan,* vol. 3, no. 1. pp. 101–133 (1948); R. P. Dore, *City Life in Japan: a Study of a Tokyo Ward* (1958); Richard Beardsley, John W. Hall and Robert E. Ward, *Village Japan* (1959); Masaharu Anesaki, *History of Japanese Religion* (1930); Harper H. Coates and Ryugaku Ishizuka, *Honen the Buddhist Saint* (1925); Sir Charles Eliot, *Japanese Buddhism* (1935); Daisetz Teitaro Suzuki, *Zen and Japanese Culture* (1959). *I.* B. Taeuber, *Population of Japan* (1958); Bureau of Statistics, Office of the Prime Minister, *1955 Census of Japan,* 3 vol.; Robert N. Bellah, *Tokugawa Religion* (1957); C. R. Boxer, *The Christian Century in Japan, 1549–1650* (1951); Otis Cary, *A History of Christianity in Japan,* 2 vol. (1909); D. C. Holtom, *The National Faith of Japan* (1938); H. Kishimoto *et al., Japanese Religion in the Meiji Era,* trans. by John F. Howes (1956); John Laures, *The Catholic Church in Japan* (1954); William K. Bunce (ed.), *Religions in Japan: Buddhism, Shinto, Christianity* (1955).

History: James Murdoch, *A History of Japan,* 3 vol. (1926); Edwin O. Reischauer, *Japan, Past and Present,* 2nd ed. (1952); Yosaburo Takekoshi, *The Economic Aspects of the History of the Civilization of Japan,* 3 vol. (1930); Ryūsaku Tsunoda, W. Theodore de Bary and Donald Keene (eds.), *Sources of the Japanese Tradition* (1958); G. J. Groot, *The Prehistory of Japan* (1951); R. Beardsley, "Japan Before History: a Survey of the Archaeological Record," *Far Eastern Quarterly,* 14, pp. 317–346 (1925); *Proceedings, Fourth Far Eastern Prehistory Congress,* part 1 (1956); J. E. Kidder, *Japan Before Buddhism* (1959); Robert K. and Jean Reischauer, *Early Japanese History,* 2 vol. (1937); George B. Sansom, *Japan:* a *Short Cultural History* rev. ed. (1943), *A History of Japan,* vol. 1, *To 1334* (1958), *The Western World and Japan* (1950); Kanichi Asakawa, *The Documents of Iriki* (1955); *F.* Jouon des Longrais, *L'Est et l'ouest, institutions du Japon et de l'occident comparées* (1958); Charles Boxer, *Jan Compagnie in Japan,* 2nd ed. (1950); Donald Keene, *The Japanese Discovery of Europe* (1952); S. Otsuki, *The Infiltration of European Civilization in Japan During the 18th Century,* trans. by C. C. Krieger (1940); John W. Hall, *Tanuma Okitsugu* (1955); Charles D. Sheldon, *The Rise of the Merchant Class in Tokugawa Japan* (1958); W. G. Beasley (ed. and trans.), *Selected Documents on Japanese Foreign Policy, 1853–1868* (1955); Thomas C. Smith, *Political Change and Industrial Developnzent in Japan: Government Enterprise, 1868–1880* (1955); Arthur Tiedemann, *Modern Japan: a Brief History* (1955); Robert A. Wilson, *Genesis of the Meiji Government in Japan, 1868–1871* (1957); T. Harris, *Complete Journal of Townsend Harris, First Anzerican Consul and Minister to Japan,* 2nd ed. (1959); Chitoshi Yanaga, *Japan Since Perry* (1949); Baron E. J. Lewe van Aduard, *Japan, From Surrender to Peace* (1953); Delmer M. Brown, *Nationalisnz in Japan* (1955); Robert J. C. Butow, *Japan's Decision to Surrender* (1954); Herbert Feis, *The Road to Pearl Harbor* (1950); *F.* C. Jones, *Japan's New Order in East Asia* (1954); John M. Maki, *Japanese Militarism* (1945); Yale Candee Maxon, *Control of Japanese Foreign Policy* (1957); Richard Storry, *The Double Patriots* (1957); SCAP, Government Section, *Political Reorientation of Japan, 1945–1948,* 2 vol.; *E* Herbert Norman, *Japan's Emergence as a Modern State* (1940); Marius B. Jansen, *The Japanese and Sun Yat-sen* (1954); Thomas C. Smith, *The Agrarian Origins of Modern Japan* (1959).

Administration and social conditions: Hugh Borton *et al, Japan Between East and West* (1957); Allan B. Cole, *Japanese Society and Politics: the Impact of Social Stratification and Mobility on Politics* (1956), *Political Tendencies of Japanese in Small Enterprises* (1959); Nobutaka Ike, *The Beginnings of Political Democracy in Japan* (1950), *Japanese Politics: an Introductory Survey* (1957); Harold S. Quigley, *Japanese Government and Politics: an Introductory Study* (1932); Harold S. Quigley and John Turner, *The New Japan: Government and Politics* (1956); Robert A. Scalapino, *Democracy and the Party Movement in Prewar Japan: the Failure of the First Attenzpt* (19?) ; Rodger Swearingen and Paul Langer, *Red Flag in Japan: Internattonal Communism in Action, 1919–1951* (1952); Chitoshi Yanaga, *Japanese People and Politics* (1956); George M. Beckmann, *The Making of the Meiji Constitution* (1957); R. E. Ward (ed.), *Five Studies in Japanese Politics* (1957); Kikuo Nakamura and Yutaka Matsumura, *Political Handbook of Japan, 1958* (1958); Robert K. Reischauer, *Japan, Government — Politics* (1939); Hugh Byas, *Government By Assassination* (1942); R. P. Dore, *Land Reform in Japan* (1959).

The economy: G. C. Allen, *Japan's Econonzic Recovery* (1958), *A Short Econonzic History of Modern Japan, 1867–1937* (1946); T. A. Bisson, *Zaibatsu Dissolution in Japan* (1954); Nihon Keizai Shimbun, *Industrial Review of Japan* (annually); Moritaro Yamada, *Land Utilization in Japan* (1951); Bank of Japan, *Economic Statistics of Japan* (annually), *Quarterly Review; The Oriental Economist* (monthly); *Journal of Finance and Commerce* (monthly); Jerome B. Cohen, *Japan's Postwar Econonzy* (1958), *Japan's Economy in War and Reconstruction* (1949); William W. Lockwood, *The Economic Development of Japan: Growth and Structural Change, 1868–1938* (1954); U.S. Department of Commerce, *Investment in Japan: Basic Information for United States Businessmen* (1956); S. Tsuru, *Essays on Japanese Econonzy* (1958); S. Shiomi, *Japan's Finance and Taxation, 1940–1956* (1957).

(M.B. J.; J. D. EE.; R. F. SR.; R.A.S.; J.M. KA.)

JAPAN, BANK OF (NIPPON GINKO). The Bank of Japan was established by the Law of the Bank of Japan of June 27, 1882, which was patterned upon that of the National Bank of Belgium with the exception of provisions regarding the issue of notes, for which the Reichsbank was taken as a model. The charter of the bank, originally granted until 1912, was extended for another 30 years from that date, and in 1942 the government promulgated a new Law of the Bank of Japan which superseded all preceding legislation and entailed a fundamental reorganization of the institution.

The law and bylaws of 1882 were amended many times. The authorized capital of the bank, initially fixed at 10,000,000 yen, was raised to 22,500,000 yen in 1895, 30,000,000 yen in 1898, and 60,000,000 yen in 1910; in 1941 its paid-up capital was 45,000,000 yen. Only Japanese nationals (who had to have the permission of the minister of finance) were entitled to acquire or transfer shares of the bank. The largest shareholder was the imperial household. Individual members of the imperial household and Japan's largest business concerns (Mitsui, Mitsubishi, Yasuda, Sumitomo and Nomura) were also among the important shareholders. Apparently the government did not hold any direct ownership interest in the bank.

At the time the bank was organized, the currency system of the country consisted of inconvertible paper money issued by the government and national banks. In 1884, the government promulgated the Convertible Bank Note law, which authorized the Bank of Japan to issue notes against a silver reserve. With the introduction of the gold standard in 1897, the bank was authorized to issue notes to an unlimited amount against a 100% metallic reserve consisting of four-fifths gold and one-fifth silver; to issue additional notes up to a limit fixed by law (originally set at 70,000,000 yen and gradually raised to 2,200,000,000 yen in 1938) against the security of government bonds and commercial paper; and to issue further notes against similar security subject to approval of the minister of finance and to the payment of a special tax (fixed in 1932 at not less than 3% per annum). In 1941, the bank was relieved of the obligation to maintain a basic metallic reserve and the minister of finance was empowered to fix the amount of tax-free notes which the bank could issue; the bank was required to hold as reserve gold and silver, commercial and treasury bills, and government bonds in the amount of its aggregate note issue. The notes of the Bank of Japan were legal tender throughout the empire. The bank's obligation to convert them into gold upon demand was suspended on Dec. 13, 1931.

The new Law of the Bank of Japan, promulgated on Feb. 4, 1942, became fully effective as of May 1, 1942. It modified basically the corporate structure of the bank, which it defined as a special institution "administered exclusively for the accomplishment of national aims." The law chartered the bank for an indeterminate period and raised the authorized capital from 60,000,000 yen to 100,000,000 yen. Shareholders were given "investment certificates" in exchange for their shares, to the amount actually paid in.

The new law made no mention of shareholders' meetings, but vested the minister of finance with full power to control the administration and management of the bank and to order the governor to carry on any activities essential for the attainment of national objectives "in accordance with the policy of the state and for a co-ordinated development of all economic forces of the Japanese nation." In addition to issuing legal-tender notes, without obligation to convert them into gold or foreign exchange, and to performing other central banking operations, the bank could, with the permission of the minister of finance, undertake practically all kinds of activities, including the financing of industry, the purchase and sale of bonds, debentures and stocks, and the transaction of foreign exchange business. The bank was also entrusted with authority to supervise all other financial institutions, and its governor was appointed president of the National Financial Control association organized in 1942.

Under the impact of World War II, the bank concentrated its activities along three major lines: (1) it placed government bonds in the market by distributing them to other financial institutions on the basis of their net accretion of deposits and funds during the course of the year; (2) it supplied credit to industry by rediscounting bills drawn upon the Industrial Bank of Japan by companies working under war contracts; and (3) it entered into monetary and credit agreements with central banking institutions in Japanese-dominated countries, the Yokohama Specie bank acting as its operating agent for this purpose. (See also YEN.)

(F. M. T.; X.)

JAPAN, SEA OF, a sea, 389,000 sq.mi. in area, between Japan and Sakhalin Island on the east and the Asian mainland. It is a true ocean basin with a mean depth of 4,400 ft. and a maximum of 12,276 ft., but with restricted connections to the world ocean. To the southwest it connects with the East China sea by the straits of Korea and Tsushima, together 120 mi. wide and 300 ft. deep, between Korea and the Japanese main islands of Honshu and Kyushu. Shimonoseki strait links it with Japan's Inland sea (Setonaiki). In the north the three connections to the Pacific and the Sea of Okhotsk, the Tsugaru, Sōya (La Pérouse) and Tatar straits, are much more narrow and shallow. The Tsushima current, a branch of the major Kuroshio current, enters from the southwest through Korea-Tsushima strait and carries water of high temperature and salinity northeastward along the west coast of Honshu and Hokkaido toward Sakhalin. Most of this flow recurves to form a southward current along the coasts of Siberia and Korea, after having been markedly cooled by cold air and diluted by river water.

The climatic influence on the Japanese islands is marked, especially in winter when cold air masses from the Asian mainland are warmed and pick up moisture during their passage over the Sea of Japan. This results in heavy snowfall, especially on the west coast of central Honshu. Winter temperatures on western Honshu and Hokkaido are also substantially higher than those at the same latitudes on the mainland.

The Sea of Japan is part of the world's most important fishing area. Cold-water species abound in the northern part where one of the largest herring runs in the world is found west of Hokkaido and catches of salmon, crab, cod and related fishes are also important. Warm-water species taken in the south include sardines (usually the leading catch in Japan), mackerel, tuna, shellfish and many others. Fishing is important all along the west coast of Japan. but particularly in Hokkaido, southwest Honshu and Kyushu. Fishing ports also dot the Japan sea coast of Korea and the U.S.S.R., particularly around Vladivostok, and the access of Japanese fishermen to these coastal waters is a residual problem of World War II.

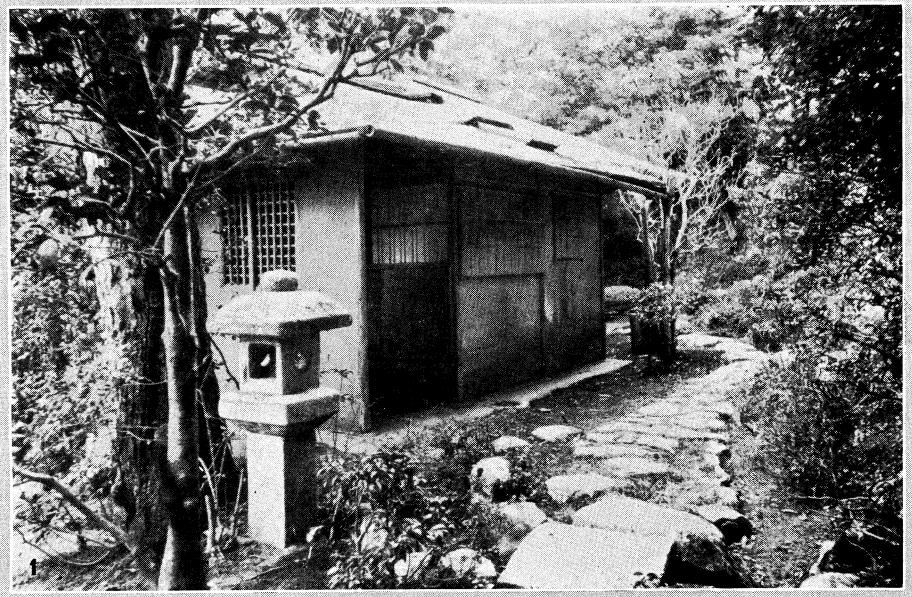
Commercially and strategically the Sea of Japan is important to Russia since Vladivostok is the only ice-free port on its east coast. It is likewise important to Japan as a separation from and an avenue of communication to the mainland. In this regard the Korea-Tsushima straits have long been of particular significance, both as a historic route between Japan and Korea and as the main entrance to the Sea of Japan. These straits were the scene of the destruction by typhoon of the Mongol invasion fleet of Kublai Khan in 1281 and the defeat of the Russian fleet by the Japanese in 1905, as well as of important military activity during World War II and the Korean war. (T. R. S.)

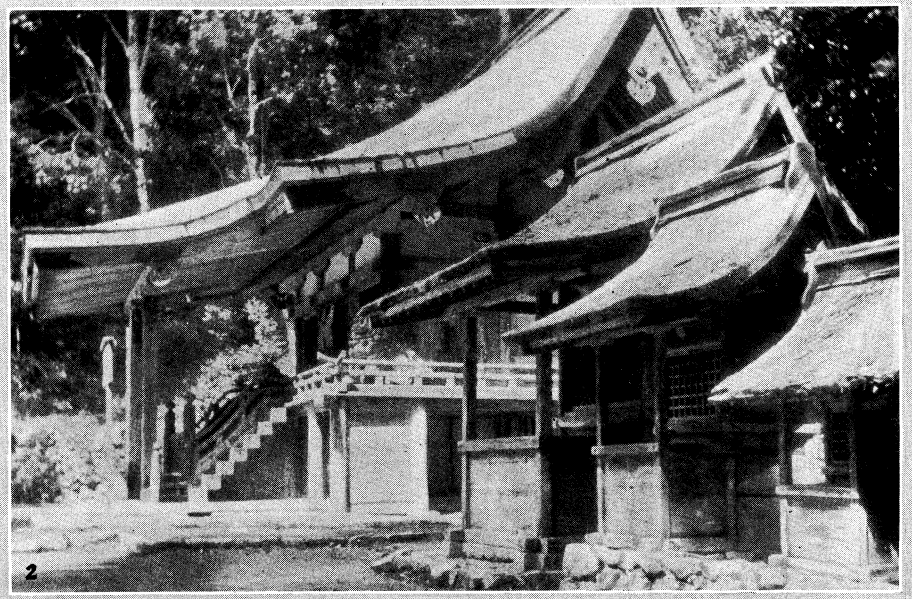
JAPAN CLOVER (LESPEDEZA STRIATA): see LESPEDEZA.

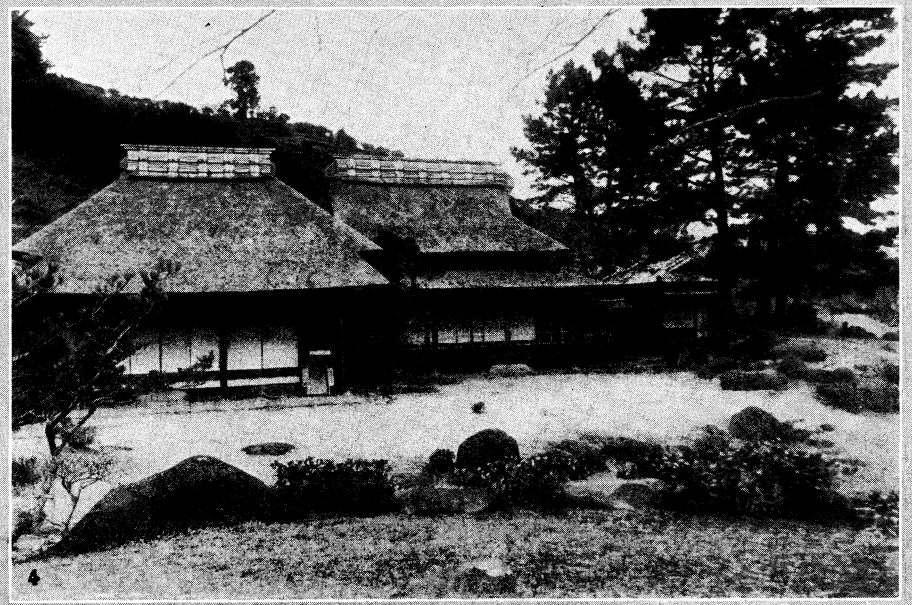
JAPANESE ARCHITECTURE. The physical features of the country and the national characteristics of cleanliness and simplicity have determined and guided the general trend of Japanese architecture; wood is the principal building material, for Japan is abundantly supplied with such splendid timber as ***hinoki*** (*Chamaecyparis obtusa*), which is still in excellent condition in buildings 12 or 13 centuries old.

A cornmission was created in 1897 for the preservation and care of such buildings, as well as sculpture and other works of art, and up to the beginning of 1928 more than 1,100 buildings, in spite of the recurrent conflagrations, had been placed under "special State protection."

Pre-Buddhistic Period.—The primitive form of Japanese architecture is known as primaeval palace construction. It consists in two posts set in the ground and supporting a ridgepole, to each end of which are lashed slantwise two rafters reaching to



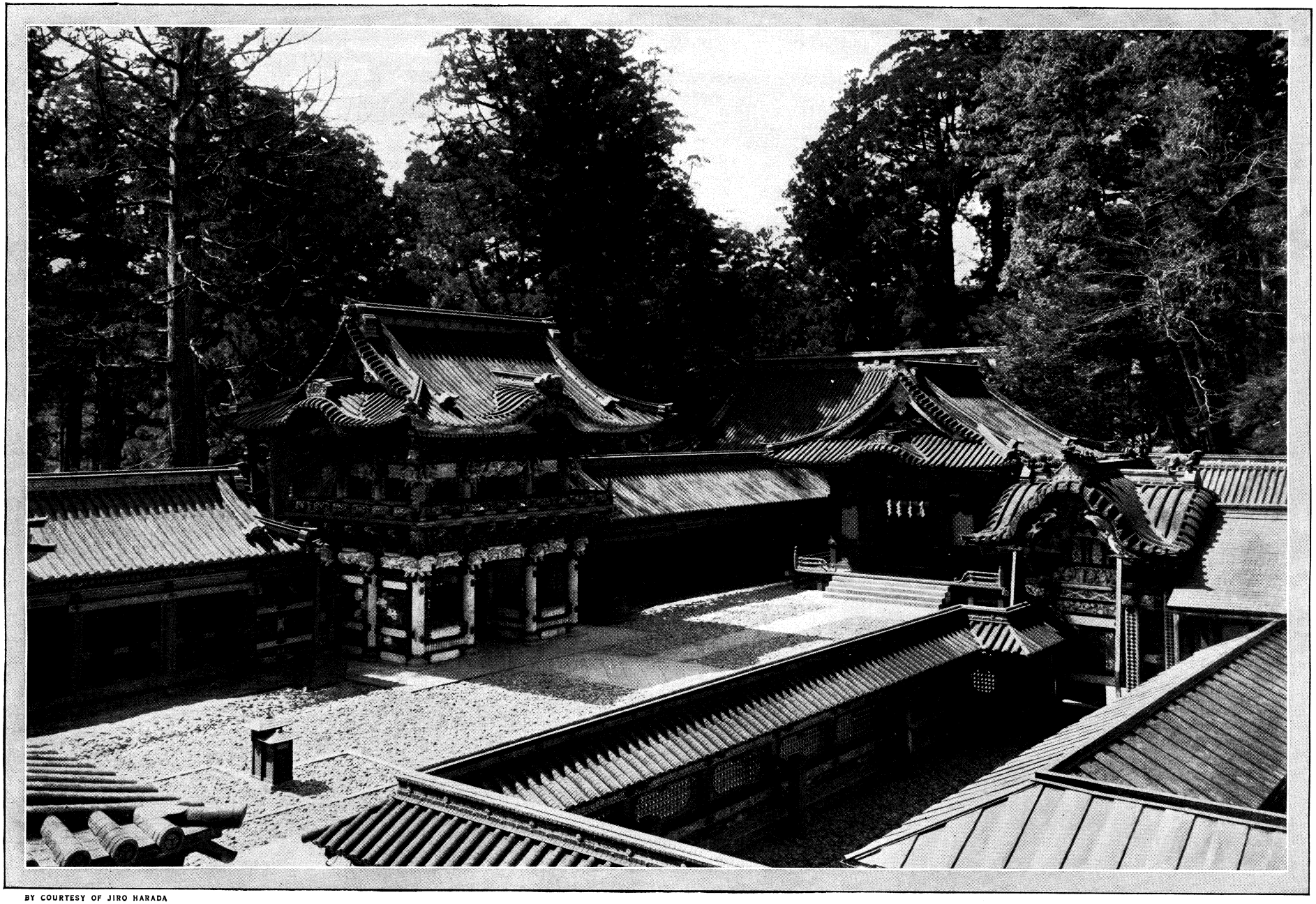




BY COURTESY OF JIRO HARADA

TEA PAVILION, A SHRINE AND OTHER JAPANESE BUILDINGS

1. Korin's *chaseki* (tea pavilion) in the garden of the Ninnaji, Kyoto
2. Shinto shrine
3. Nijo palace, Kyoto
4. Thatch-roofed cottages, Viscount Saga's villa at Atami



BY COURTESY OF JIRO HARADA

NIKKO SHRINE

Nikko shrine, showing Yomeimon, its principal gateway; built in the 17th century

BY COURTESY OF JIRO HARADA

VARIOUS FORMS OF JAPANESE ARCHITECTURE

1. Detail, five-storied pagoda of the Kofukuji, Nara. Karnakura period (1186–1335)
2. Pagoda of the Yakushiji; Tempyo period (708–781)
3. Castle at Hikone
4 and 5. Two views of the Kabukiza theatre in Tokyo; re-enforced concrete building; designed by Dr. Shin-iohiro Okada, executed by Obayashi-gumi
6. Shinto shrine at Nachi
7. Hōwōdō of Uji, built in the 11th century
8. Kondo of the Horyuji Monastery, built at the beginning of the 7th century; said to be the oldest wooden building in the world

the ground. To these rafters are tied horizontal beams to support a thatch which serves both as walls and roof; later a wooden floor was introduced, the whole structure raised, and the original shape of the roof retained while vertical walls were added. This simple form of architecture has been adhered to in some shrines sacred to Shinto. The oldest style is *Ō-yashiro,* the prototype of which is the shrine at Izumo; it developed into such forms as *8-tori* and *Sumiyoshi,* in none of which is there any evidence of the curves of a later date. These forms soon underwent slight variation, forming the style known as *Shinmei,* a perfect example of which is the Imperial Ise shrine, which is rebuilt every 20 years, exactly the same to the minutest detail, with plain white wood and a thatch of chamaecyparis bark. It is recorded that the emperor Nintoku (A.D. 313–399) did away with palace decorations for the sake of economy, and "lofty architecture" is spoken of in connection with his reign as well as with those of two succeeding emperors, thus showing that the palaces at that time were no longer built in the simplest form. Their architectural development, however, was retarded, owing to the custom of changing the seat of the imperial court at the death of each emperor, and real growth, therefore, only came with the establishment of the court, first at Nara (708) and later at Kyoto, where it remained nearly 11 centuries before it was finally removed to Tokyo in 1868.

Early Chinese Influence. — The official introduction of Buddhism to Japan from Korea in A.D. 552 completely changed the architecture as well as other branches of Japanese art. Temples on a grand scale with elaborate detail were built. Some of the buildings of the Horyuji monastery date from the beginning of the 7th century, and are considered to be the oldest wooden buildings in the world. With Buddhism, the influence of the six dynasties of China became evident, though those who built the Japanese temples were Koreans introduced at the same time. Soon afterward, however, T'ang influence became irresistible, and monasteries assumed a still greater grandeur in scale, as may be seen from what remains of Todaiji at Nara (completed about 750), a representative work of the Tempyo period (708–781). The exterior of the temple was coated with red oxide of lead and the interior painted in vivid colours, especially in the shade known as *ungen;* the palace at that time was also probably gorgeous with red pillars and green tiles. With the rise of two powerful sects of esoteric Buddhism (Shingon and Tendai) in the early Heian period (782–888) temple architecture again underwent a change, as the tenets of those sects required the monasteries to be built on mountain tops; Shinto architecture changed also and a curve was given to gable and roof, such forms being evolved as *Kasuga, Nagare* and *Hiye.*

First Nationalist Movement. — In the second half of the 9th century intercourse between Japan and China was interrupted. Left alone, Japan enjoyed a period of self-realization which gave the native taste a chance to discriminate and reassert itself in architecture, as well as in other branches of art. Grace and finish were imparted to architectural detail without sacrificing the strength and harmony of the whole. To the roof was given a gentle sweep of exquisite grace; to the interior a richer, but more subdued tone. However, the later Fujiwara period (1069–1185) revealed signs of weakness and a tendency to over-refinement and delicacy, and a philosophical endeavour to amalgamate Shintoism and Buddhism resulted in the modification of Shinto architecture. Aristocrats began building their mansions much after the fashion of the imperial residences; a style of architecture — Shindenzukuri — consisting of a series of oblong houses systematically arranged and joined by corridors, with a garden laid out on the southern side in which was a big pond, became the fashion.

Second Chinese Influence. — Another great wave of Chinese influence began to be felt in the Kamakura period (1186–1335), when the Zen sect of Buddhists, which was destined to grip the mind of the people and to influence the art of the country fundamentally, was introduced from China. At the same time a peculiarity of the Sung dynasty under the name of "Tenjiku," or Indian, was introduced. Side by side with these imported styles the native architecture continued, and only later was influenced by the Zen principles; the "Tenjiku" style, apparently not congenial to native taste, was allowed to die out. In the Zen style the interiors were either plain, or coloured with utmost simplicity, a low relief generally constituting the only form of decoration. The period being strongly militaristic it was but natural that a style should arise, known as *Buke-zukuri,* for military aristocrats. It was a natural native growth, but its fuller development was seen in the Nanbokucho (1336–93) and the Ashikaga (1394–1573) periods. Generally speaking, the Ashikaga period emphasized detail, ignoring structural significance, and revealing weakness in place of refinement, though it produced some great works.

Based upon the *Shinden* style of Fujiwara and the *Buke* style of Kamakura, already mentioned, and under the influence of Zen, there arose a form known as *Shoin-zukuri* ("a study style") in connection with domestic and palace architecture. It admitted more light into the house and provided the room with *tokonoma* (a recess for paintings and flowers to serve as decoration) and shelves for ornaments, etc.—two characteristic and pleasing features in the Japanese house. However, a greater triumph of native architecture was the creation of the *Chaseki,* a place for *cha-no-yu,* commonly known as the tea ceremonies, which, with Zen at its foundation, has most vitally influenced all branches of Japanese art, especially painting, architecture and garden designing. In the *chaseki* variation was insisted on lest monotony should weary the mind, and harmony and balance lest freedom of soul should be disturbed. While *cha-no-yu* was in vogue—in the latter part of the Ashikaga period culminating in the Momoyama period (1574–1602) — there developed the art of building fortified castles, strong and massive, and resistant to earthquakes. In the Momoyama period, though the forms were too well established to suffer any material change, architecture sustained a great innovation. For the first time in its long history, there were built lay buildings which far surpassed the temples in splendour; among noteworthy examples now remaining may be mentioned the Hiunkaku and the Stork chamber, both in Nishi Hongwanji, Kyoto, but originally at Momoyama, and the sanctuary of Ninnaji at Omuro which was part of an imperial palace.

Second Japanese Nationalist Movement. — Another nationalist period began with the Tokugawa regime (1603–1867), a period of peace and wealth. Many new buildings were erected and ruined temples restored; but it was in the construction of mausoleums and great edifices built over the bones of Tokugawa shoguns that the spirit of the age found its fullest expression. The best examples may be seen at Nikko. They are in a style known as *Gongen* or *Yatsumune,* suggesting a complicated system of roofs; the buildings were lacquered within and without, and profusely decorated with carvings. Many feudal lords of the period, following the example of the shogun, erected such extravagant buildings that it became necessary to impose restrictions. The magnitude of the scale on which the shogun kept his court may be conceived from the Nijo palace in Kyoto, still well preserved.

Dwelling Houses. — The evolution of the common dwelling houses of today was completed in the Tokugawa period. It was based on the *Chaseki* and *Shoin* styles, which were adopted by the people in general, and it brought with it a great development in landscape gardens which became indispensable as an integral part of the dwelling. The ordinary dwelling house is one or two storied, roofed either with gray tiles, or in the country, with thatch. The floor is covered with closely-fitted mats 2 inches thick, measuring 3 × 6 ft., the size of rooms being computed by the number of mats in them. The house is divided into rooms by sliding screens; light is admitted by a paper-covered lattice mounted as a sliding window, these screens are removable so as to throw the series of rooms into one. At night the house is closely shuttered by wooden panels running in grooves on the outside. It is now usual to have one reception room furnished in western style. The kitchen, long neglected, has been much improved by the introductiop of western conveniences and labour-saving devices. The whole interior, however, remains essentially simple and refined.

Post-Restoration. — With the restoration of power to the imperial throne in 1868, which was followed by the suppression of the feudal system, an attempt was made "to abolish every institu-

tion in Japan which had no counterpart in the civilized west." Naturally, the western style of architecture was welcomed with a zeal that led to the invitation of European and American architects to the country to demonstrate the art of building with bricks, stone, iron and concrete. Some attempts were made to harmonize the western and native styles of architecture, but with little success. A certain reaction set in just before the great earthquake and fire of 1923 destroyed much of Tokyo and its vicinity, exposing the weaknesses of both styles.

A tendency, however, is to be noted toward the adoption, on one hand, of western architecture for public buildings, and on the other toward maintenance of the pure native style for private dwelling houses since the old customs are still kept up in private life and the taste for simplicity remains essentially unchanged.

See Nō DRAMA; WOOD CARVING. (J. HAR.)

JAPANESE ART: see DANCE: The Orient: Japan; EMBROIDERY; ENAMEL: Far East; INTERIOR DECORATION: *The* Orient; IRONWORK: History: Asia; IVORY CARVING: Japan; JAPAKESE ARCHITECTURE; JAPANESE GARDENS; JAPANESE PAINTING AND PRINTS; JAPANESE SCULPTURE; JEWELLERY: *Oriental;* Nō DRAMA; POTTERY AND PORCELAIN: Near and Far East; TEXTILES: Oriental Textiles.

JAPANESE BEETLE, an economically important beetle (*Popillia japonica*) of the scarab family (Scarabaeidae) which was accidentally introduced into the United States from Japan, probably as larvae in the soil around imported plants. It was first discovered in the U.S. in 1916 near Riverton, N.J., and thereafter spread to a number of other states along the Atlantic seaboard and as far west as eastern Ohio. It still occurs in varying numbers from Maine southward to North Carolina, and in local colonies westward to the Mississippi river.

Adult Japanese beetles are known to feed upon about 200 species of plants, including practically all the economic crops. They seem to prefer, however, apple, quince, peach, cherry, plum, grape, blackberry, clover and corn. The beetle also attacks the foliage of many shade trees and ornamental shrubs and many weeds, especially knotweed or smartweed (Polygonum species). In many cases it completely defoliates trees and feeds upon the earlier-ripening varieties of fruit.

The larvae, living below the surface of the ground and feeding upon the roots of plants, damage lawns, pastures and golf courses. Also damaged are the roots of strawberries, cabbage and other plants that have been set in heavily infested fields. The eggs are deposited in the soil and hatch in about 14 days. The larva is one of the so-called white grubs, and passes its entire existence underground. The winter is passed in this stage, and during May the larva transforms to prepupa and then to pupa, the adult beetle emerging any time from the middle of June to the end of July, the exact time depending on the locality.

The adult beetle, about three-eighths of an inch in length and about the same in width, is bright metallic green in colour, with coppery-brown wing covers and two prominent white spots on top of the exposed tip of the abdomen. The beetles fly only in the daytime and often mass upon ripened fruits. Females will leave foliage temporarily to lay eggs in burrows in the ground. There is only one generation each year, most of the year being spent in the soil as egg, larva or pupa.

Federal and state agencies have made every possible effort to retard the further spread of this pest. DDT, methoxychlor, parathion and other poisonous spray materials, though they give good control of the adult beetles, differ in the duration of their protection against reinfestation. Lawns, golf courses and other turf lands may be protected up to five or more years by certain sprays and dusts. Baited traps help determine the extent and density of infestations but do not control the beetles.

Under the auspices of the U.S. government, intensive studies of the Japanese beetle have been made in its original home. Several of the beetle's natural enemies—species of parasitic wasps and flies—which have been found to destroy it there have been imported into the United States, where several of them have become established.

Of even greater promise as biological controls are disease-inducing microorganisms which are specific for the beetle. A bacterium, Bacillus popilliae, which causes milky disease in larvae has markedly reduced infestations in some areas. See also BEETLE; ENTOMOLOGY; INSECT.

Additional information may be obtained from the U.S. department of agriculture or from state agricultural experiment stations in affected areas.

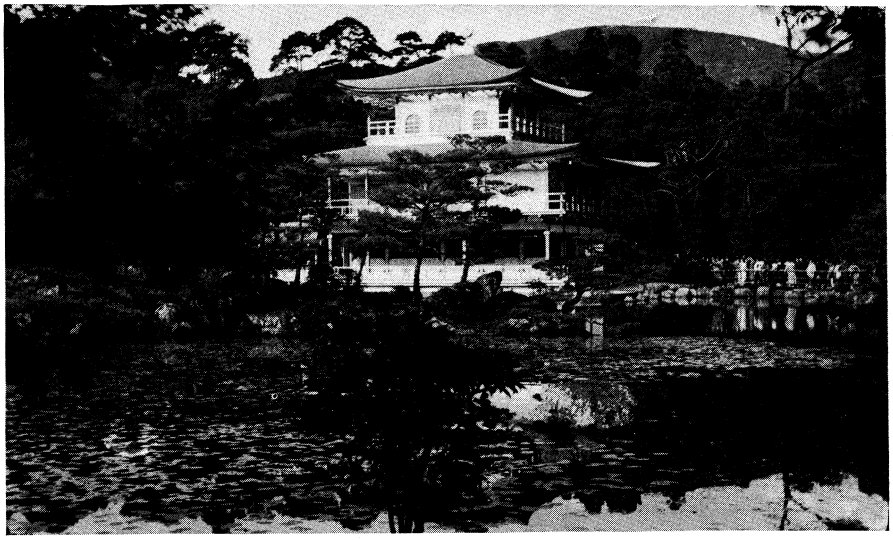
BIBLIOGRAPHY.—C. L. Metcalf and W. P. Flint, Destructive and Useful Insects, 3rd ed. rev. by R. L. Metcalf (1951); U.S. Department of Agriculture, "Insects," *1952* Yearbook of Agriculture (1952), Farmers' Bulletin *2004*. (L. O. H.; J. C. DY.)

JAPANESE GARDEN. The art of garden making was probably imported into Japan from China or Korea. Records show that the imperial palaces had gardens by the 5th century A.D., their chief characteristic being a pond with an islet connected to the shore by bridges—as is shown by later references to these precedents in Emperor Shōmu's (724–749) three gardens in Nara. During the Heian period (784–1185), when the symmetrical *shinden* style of architecture prevailed, the main garden was laid out on the southern side of the house. With the change of domestic architecture in the Kamakura period (1186–1335), however, came modifications of the garden. Learned Zen priests, who assiduously studied the art of garden making, gave Buddhistic names to different rocks in the design and linked religio-philosophic principles with landscape lore. Other cults and superstitions further complicated garden design. With the Muromachi period (1394–1573) came popularization of gardens, which were designed to be enjoyed not only as views to contemplate, but as microcosms to explore. The subjective mood became dominant and the gardens reflected individuality. People demanded *shibumi* in their gardens—an unassuming quality in which refinement underlies a commonplace appearance, perceptible only to a cultivated taste. Aesthetic priests, "tea men" and connoisseurs created new forms of gardens for cha-seki, the little pavilions or rooms built for the chanoyu (tea ceremony), and a special style developed which revolutionized Japanese garden art.

The succeeding vogue of designing in the three different degrees of elaboration—shin, gyo and so (elaborate, intermediate and abbreviated) was also adopted for gardens. Many splendid gardens were produced in the Momoyama (1574–1602) and Edo (1603–1868) periods. The centre of garden activity gradually shifted, however, from Kyoto to Edo (Tokyo), seat of the Tokugawa shogun. At one stage there was a utilitarian development; *e.g.,* the duck pond in the Hama detached palace in Tokyo and, in the Koraku-yen at Mito, the cultivation of reeds for arrow shafts and plums for military supplies. Feudal lords generally had fine gardens in their provincial homes as well. Quite a number of gardens survived the abolition of the feudal system after the restoration of 1868, yet many celebrated gardens perished through neglect or were sacrificed to modern progress. The establishment of public parks, which were not unknown even in feudal times, has been especially encouraged throughout Japan since 1873. Gardens in western style came in with other western modes but made little headway. The great earthquake and fire of 1923 demonstrated the utilization value of the Tokyo gardens; tens of thousands found safety in the parks and in large private gardens scattered throughout the city.

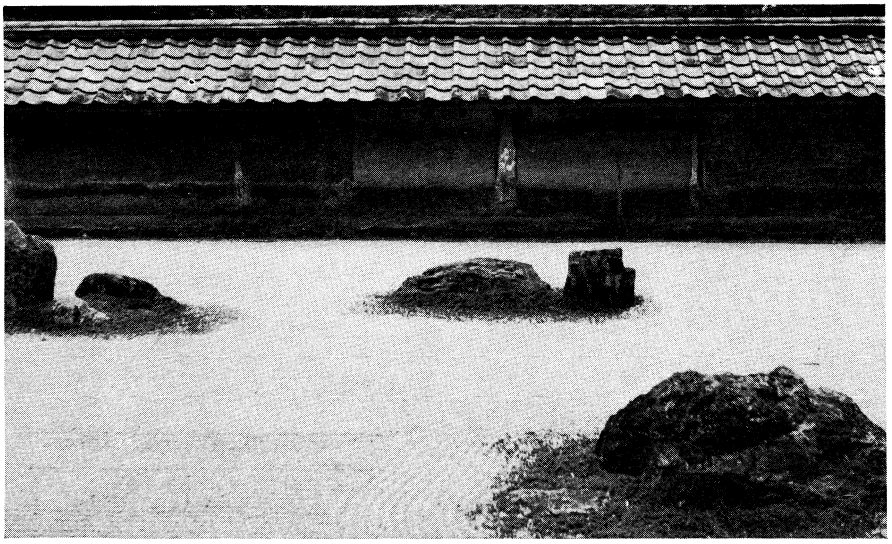
Types of Gardens.—Japanese gardens are generally classified according to the nature of the terrain, either tsuki-yama (artificial hills) or hira-niwa (level ground), each having particular features. *Tsuki-yama* consists of hills and ponds, hira-niwa consists of flat ground designed to represent a valley or moor; tsuki-yama may include a portion laid out as hira-niwa. Each type may, furthermore, be treated in any one of the three degrees of elaboration mentioned. Hill gardens as a rule include a stream and a pond of real water, but there is a special variation, the *kare-sansui* (dried-up landscape) style, in which rocks are composed to suggest a waterfall and its basin, while in a winding stream or a pond, gravel or sand is used to symbolize water or to suggest seasonally dried-up terrain. There are other styles: *sen-tei* (water garden), rin-sen (forest and water) and in level gardens, *bunjin-sukuri* (literary men's style), a simple and small style. The tea garden

JAPANESE GARDEN



Garden of Kinkakuji, the Golden pavilion, also called Rokuonji (Deer park), originally built for the shogun Yoshimitsu (1367–95) after his retirement. The garden comprises about 4½ ac., including a pond of 1¾ ac. with islands representing the tortoise and crane, symbols of long life. The pavilion, converted to a Buddhist temple after Yoshimitsu's death, was destroyed by fire in 1950. It was rebuilt according to the original plans in 1955

Tortoise island in one of the ponds of Sento Gosho, the imperial garden of Omiya Gosho, the palace of abdicated emperors. The garden was laid out by Kobori Enshyu in 1634. It contains two *chasaki* (teahouses) with a small garden attached to each. About 18 ac. in area including ponds of 2¼ ac.

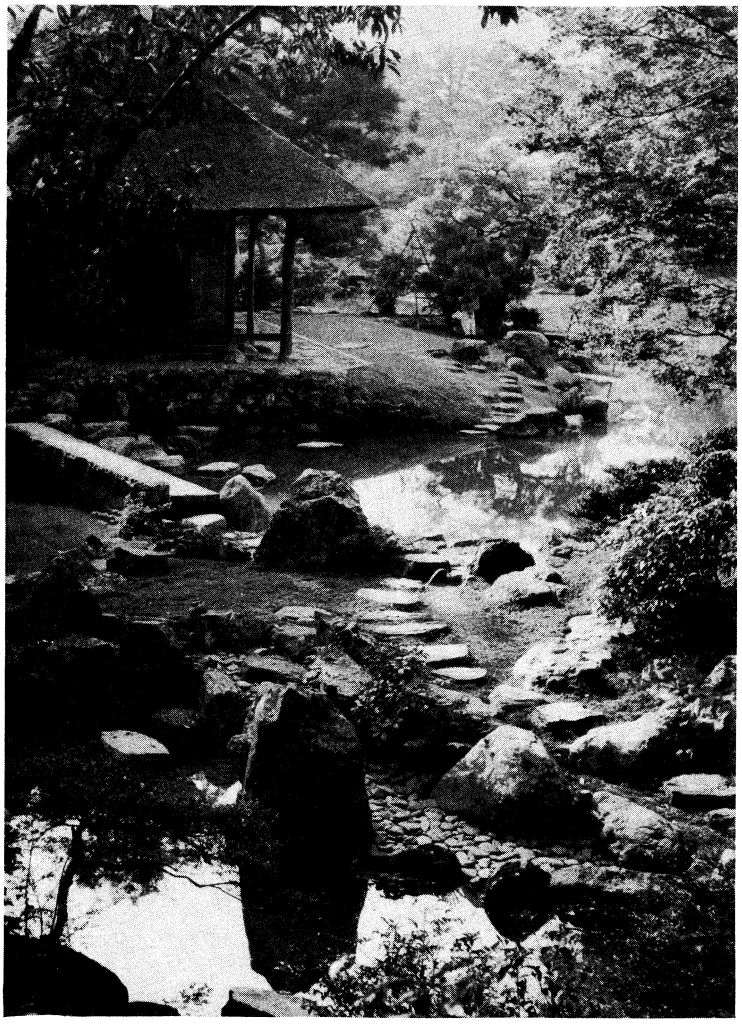


Ryoanji, a rectangular area of about 360 sq.yd. containing an arrangement of 15 rocks separated by raked white sand. Believed to have been endowed by the Tokugawa shoguns Iyeyasu and Iyemitsu, the garden is a symbolic composition of black and white, probably reflecting an influence from painting of the Sung and Yuan dynasties

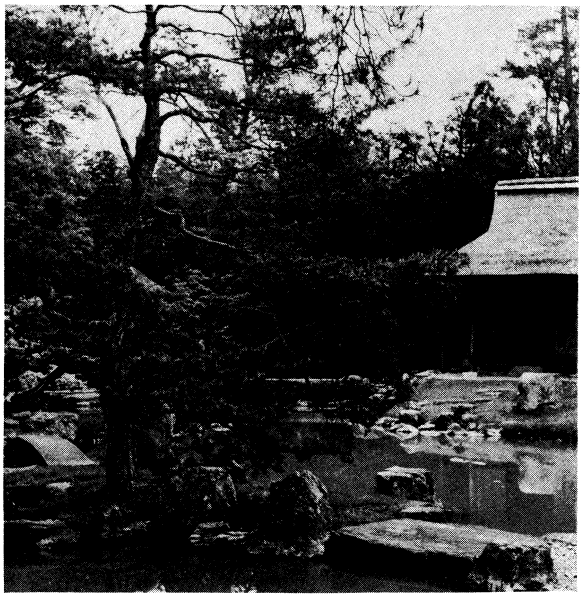
GARDENS OF KYŌTO

BY COURTESY OF JIRO HARADA

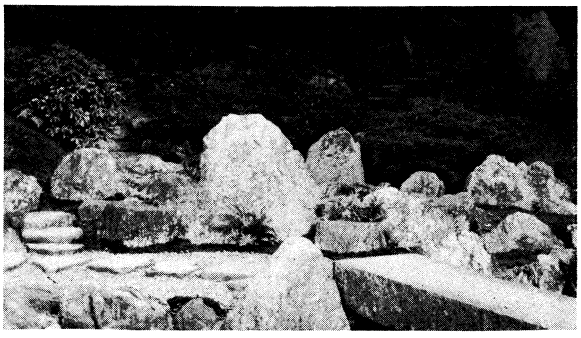
JAPANESE GARDEN



Path and planting leading to the Shokintei teahouse, Katsura. The design of the garden, considered Japan's most beautiful, is traditionally attributed to Kobori Enshyu **(1579-1647)**



Another view of the pool, stone bridges, rockwork and planting of the pine-zither grove near the Shokintei



Detail of the rock arrangement at the end of a monolithic stone bridge leading to the Shokintei

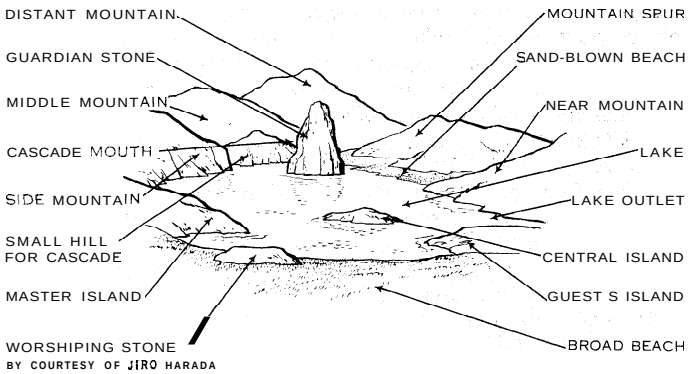
The parting of the stepping-stone pathways at the edge of a pool

GARDEN OF KATSURA IMPERIAL VILLA, KYŌTO

BY COURTESY OF JIRO HARADA

or *roji* (dewy ground or lane), is another distinct garden style evolved to meet the requirements of the tea ceremony. *Genkan-saki* (front of entrance) have always claimed special treatment—a simple curve in the path is used whenever possible, partly to conceal the door to the house and partly to give character to its front aspect.

Characteristic Features.— Japanese gardens are characterized by: the waterfall, of which there are ten or more different arrangements; the spring, and stream to which it gives rise; the lake; hills, built up from earth excavated from the basin for the lake; islands; bridges of many varieties; and the natural guardian stones



CHARACTERISTIC FEATURES OF A JAPANESE GARDEN

The selection and effective distribution of the stones are a prime consideration in garden design. After endless experiments and deep pondering, the best and most subtle compositions were handed down by means of drawings. A studied irregularity in the arrangement of steppingstones is a noteworthy feature of the *cha-noyu* garden, where beauty and use are combined. In modern Japanese gardens, flowers are few and evergreens popular. Simplicity, restraint and consistency are sought rather than gaiety, showiness or the obvious variations of the seasons. Evergreen foliage is preferred to the changing aspect of deciduous trees, although maples and a few others are used. As in the case of stones, trees must be distributed in the garden in harmony with their natural origin and habit of growth. Wells, decorative and useful alike. stone water basins in endless variety. stone lanterns and figures, pagodas, arbours and summer houses are the most characteristic garden furnishings, together with gateways and fences, particularly the widely varying *sode-gaki* (sleeve fences) attached to the side of a house to screen certain portions, harmonize the natural beauty of the garden with the architectural features of the house.

Ideals and Aims of Garden Design.— During its long history. the ideals of Japanese garden designing have been often modified by the prevailing thought of each period. At one time eminent Zen priests designed gardens in accordance with the principles of their philosophic teaching; at another time, painters became deeply interested and designed gardens as though they were landscapes painted on silk.

In the course of history. the objective standpoint in garden making gave way to the subjective impulse. Various philosophic principles and religious doctrines were applied to the making of gardens, not so much to interpret those principles and doctrines as to rationalize the aesthetics of garden design. Natural rocks distributed to illustrate familiar philosophic principles and even superstitions of all sorts still continue to some extent to influence the general design of the garden. The aim is to bring man close to nature and every conceivable means may be employed to realize it. Some master garden designers represented landscapes of China and Japan in miniature. They planned the garden and planted trees to give the illusion of the view extending over and beyond its immediate confines, but at the same time they designed it to be a secluded sylvan retreat, great ingenuity being displayed in both directions. In some instances, only a few stones in the narrow strip of ground suffice to suggest a great expanse of landscape, included as background.

Rikyu, in his garden at Sakai, obstructed the open view of the sea so that only when a guest stooped at the stone basin to wash his hands and rinse his mouth preparatory to entering the *cha-seki* did he catch an unexpected glimpse through the trees of shimmering sea, thus suddenly being made to realize the relation of the dipperful of water lifted from the basin to the vast expanse of sea, and of himself to the universe.

The Japanese have tried to emphasize in their gardens the charm of restraint; beauty is so concealed that it may be discovered individually, thus providing a thrill of joy to the soul like that which comes from doing a good deed in stealth. In its ideal at least, the Japanese garden, which always has been part of the home, is by no means merely an arrangement of beautiful spots; it aims at satisfying a human craving for the natural and, by supplying peace and repose, at offering a retreat in which man can find spiritual recreation and sustenance.

See also BON-SAI; JAPANESE ARCHITECTURE; MINIATURE LANDSCAPE.

BIBLIOGRAPHY.—J. Conder, *Landscape Gardening in Japan* **(1893)**; J Harada, *The Gardens of Japan* (1928), *Japanese Gardens* **(1956)** and *Lesson of Japanese Architecture* **(1956)**. (J. HAR.)

JAPANESE INDUSTRIAL BANK, THE: **see JAPAN, BANK OF.**

JAPANESE LANGUAGE. Japanese is spoken by more than 100,000,000 persons on the main islands of Japan, in the Ryukyus and—often bilingually or as a second language—in Korea and Formosa (Taiwan). A sizable number of speakers also live in Hawaii, California and Brazil. There are many varieties but Standard Japanese, the language of educated natives of Tokyo, is understood everywhere. The local dialects, especially those of the Ryukyus, are often mutually unintelligible. Proto-Japanese, the ancestor of the modem dialects, was probably spoken by the people of the Yayoi culture, who introduced rice cultivation to Japan around the 1st century A.D. Comparative study indicates that Japanese is probably related to Korean, which has a remarkably similar grammar; the two languages are possibly related also to the Altaic group of languages (Tungus-Manchu, Mongolian and Turkic families) and perhaps to Ainu and Gilyak.

History.— Both Japan and Korea were heavily influenced by Chinese culture. The peoples of the two countries were illiterate until they began learning to read and write Classical Chinese around the 4th century A.D. Though their own languages were completely different in structure, both the Japanese and the Koreans borrowed many Chinese words. The most basic vocabulary of modern Japanese is about 5% Chinese in origin; that of Korean is about 10%. But the majority of all the words in a Japanese or Korean dictionary come from China; the language turned to Chinese for technical and abstract terms, just as English turned to French, Latin and Greek. Since the 17th century, many European words have come into Japanese, for example *pan* "bread" from Portuguese *pão; buriki* "tin" from Dutch *blik; noiroze* "neurosis" from German *Neurose, bata* from English "butter." Borrowed words often changed their meanings: the word *arubaito* comes from German *Arbeit* "work" but in Japan it means "part-time job." Sometimes a word was borrowed in two different forms: *sutoraiku* usually means "strike (in baseball)" but *sutoreiki* means "strike (by workers)"; *garasu* means "glass (the substance)" but *gurasu* means "a glass (to drink from)." Multiple borrowing of the same word also occurred with the earlier loans from Chinese; a single Chinese written character often came to have several different "Chinese" readings. The actual sound of any one of these readings is usually different from the sound in any Chinese dialect today; both languages have been changing during the 1,500 years since Japanese borrowed the Chinese words.

Writing.— After the Japanese had learned Chinese, they tried to adapt the complicated Chinese characters (called *kanji)* to write their own tongue. In inscriptions of the 5th and 6th centuries they began using certain of the characters for their sound value alone, disregarding the Chinese meanings. This resulted in a cumbersome syllabary now known as *Man'yō-gana.* There are two modern syllabaries and each set contains about 50 symbols called *kana.* The ordinary roundish symbols known as *hiragana*

developed from the "grass-hand" (shorthand) forms of the characters and the squarish symbols called katakana, used as a kind of italics to write foreign words and unusual terms, were taken from abbreviations of the "square-hand" (printed) forms. On signs and in old-fashioned letters is sometimes found a virtually obsolete form of kana known as hentai-gana ("queer-shaped kana"); these symbols are a kind of fancy hiragana. It was quite a burden to learn from 3,000 to 5.000 characters, as well as two sets of kana and an antiquated spelling system; the spread of universal education in the 20th century led to demands for simplification. Modernization of the writing system was one of the many educational reforms that followed Japan's defeat in World War II. The ministry of education simplified the difficult shapes of many kanji and restricted the number for general use to less than 2,000. The use of kana was encouraged for many native Japanese words, technical terms and less common Chinese expressions; the kana spelling was standardized according to modern pronunciation. The elementary schools began teaching two kinds of romanization — the Hepburn type favoured by foreigners, which writes the vowels as if Italian and the consonants as if English; and the official Japanese type, which writes the consonants according to structural patterns in the language. The differences between the two types of romanization may be seen from a few place-names: Fuji — Huzi; Chisima — Tisima; *Tsu—Tu;* Jawa — Zyawa "Java"; Shanhai — Syanhai "Shanghai"; *Chōsen—Tyôsen* "Korea".

Pronunciation. — Standard Japanese has five vowels: a as in papa or ah, i as in marine or Toscanini, u as in Lulu, e as in peppy, *o* as in go; in addition there are ya as in yard, yu as in yule, yo as in *yo*yo. But the vowels are much shorter than their English counterparts and must be carefully distinguished from the long vowels *ā* (also written *â* or aa), ii (i or *î*), *ū* or uu), *ē* (*ê,* ee or ei), *ō* (*ô* or *oo*). The vowels *u* and *i* are often whispered or dropped after a voiceless consonant; sukiyaki is usually pronounced *s'kiyaki* and sukoshi "a little" often sounds like *s'kosh'*. There is also a syllabic nasal; the exact sound (longish m, n, ng or nasalized vowel) depends on the nature of the surrounding sounds. Unlike English, Japanese is spoken with even stress and rhythm, as if a metronome were ticking off each syllable. Standard Japanese has a light pitch accent which differentiates words and phrases much as English stress does. The following consonants are rather like English sounds; *p,* b, *m;* ch, j; k, g; w; s, *sh, h,* f. But f is made with both lips, as if lightly snuffing out a candle. And the sound g has split into two different sounds in Tokyo Japanese: a hard g (as in go) that is commonly used at the beginning of words and a nasal ng as in singer that is used in the middle of many (but not all) words. Japanese *t,* d and n are made against the teeth, unlike the English sounds. Japanese r sounds like a combination of *r, l* and d; it is a quick tap by the tip of the tongue against the ridge behind the teeth. The closest British sound is heard in berry, the closest American sound is heard in Betty. Double consonants are held twice as long and sound like less breathy versions of English hip-pocket, cat-tail, book-case (-kk-), rat-cheese, mis-say, mis-shoot, room-mate, pen-name.

Grammar. — Roughly speaking, there are three parts of speech: nouns (including some words that would be adjectives in English), verbs or inflected words (including most words that would be adjectives in English) and particles. A typical Japanese sentence is quite complete with only a verb form: Mimashita "[it] looked at [it]." If the Japanese wants to give more information about the situation, he puts nouns in front of the verb: *Inu* mimashita "[it] looked at [it] — the DOG was involved," *Inu* neko mimashita "[it] looked at [it] — the dog and the CAT were involved." Unlike English, the order of the words does not reveal the subject–object relationship; the earlier word simply has less emphasis. Particles are little words tacked on to make the grammatical relationship clear: *Inu‿ga neko‿o* mimashita "the dog as subject, the CAT *as* object — [it] looked at [it]" = "The dog looked at the CAT"; *Inu‿o neko‿ga* mimashita "The dog as object, the CAT as *subject*— [it] looked at [it]" = "The CAT looked at the dog." The particle *wa* de-emphasizes the word or words to which it is attached and highlights the following words; it is often used to set up a logical subject or object as the topic of a sentence or as an item in contrast in order to bring out the point of contrast. There are about 15 other particles with various functions and meanings, corresponding in part to Latin case endings or English word order, in part to prepositions. Most words are general in meaning: *inu* corresponds to six different English expressions — dog, dogs; a dog, some dogs; the dog, the dogs.

The syntax is relatively simple; modifying expressions precede the expressions modified and the order of words follows a subtle system of increasing emphasis, with the verb typically at the end. An important feature of Japanese is the use of speech styles and special status forms. In addition to polite and plain styles of speech, there are honorific expressions used about actions and things involving other persons, especially social superiors. Much of everyday speech is taken up with polite formulas of appreciation such as *dōmo* and *sumimasen* used to mean both "thank you" (arigatd) and "excuse me" (gonzen *nasai*). Other common formulas are greetings such as *ohayō* (*gozaimasu*) "good morning," *konnichi‿wa* "good afternoon," *komban‿wa* "good evening" and sayonara "goodbye." "No" is iie and "yes" is hai, *ē, sō* or nn, but the reference is often to the truth of the actual question asked and not to the logical situation behind it, so that the Japanese will respond to "Have we no bananas?" with "Yes, we have no bananas." Often Japanese simply repeat the verb: *arimasu* "we have," *arimasen* "we have not."

BIBLIOGRAPHY. — Joseph K. Yamagiwa, Modern Conversational Japanese (1942); Harold G. Henderson, Handbook of Japanese Grammar (1943); Bernard Bloch and Eleanor Harz Jorden, Spoken Japanese (1945); Samuel E. Martin, Essential Japanese (1954); Eleanor Harz Jorden, Beginning Japanese (1960). (S. E. MN.)

JAPANESE LAW. The interaction of two cultural and legal traditions, one indigenous Japanese, the other western, produced modern Japanese law. Before Japan's isolation from the west was ended in 1853 with Commodore Matthew Perry's visit, Japanese law developed independently of western influences. Conciliation was emphasized in response to social pressures exerted through an expanded family unit and a close-knit community. Few rules prescribed how disputes should be resolved. Remarkably little law in the modern sense existed; a static society, which officially discouraged commercial activity, apparently neither desired nor needed a developed legal order.

Western Influences. — Fundamental changes inevitably followed Japan's sudden involvement with the western world. The Meiji restoration of 1868 ended the Tokugawa shogunate and restored effective political power to the emperor. Japan sought to construct an economic, political and legal structure capable of commanding respect internationally, ending extraterritoriality and preserving national independence. The introduction of western law was one element in a wholesale importation of things western.

In legal matters, the Japanese took for models the systems of continental Europe, especially the German. The drafters of the Japanese civil code of 1898 surveyed many legal systems, including the French, Swiss and common laws, taking something from each. Their final product is, however, best characterized as following the first draft of the German civil code. In its subsequent development, the Japanese legal system remained true to these sources. The 1947 revisions of the code provisions dealing with "relatives and succession," which had reflected traditional Japanese attitudes, completed the transition of Japanese civil law to the continental European family of laws.

Legal Education. — Following European models, the law curriculum is part of the undergraduate university program and combines general and professional education. Instruction, by the lecture method, approaches the body of legal rules as essentially complete and largely contained in written codes. Little emphasis is placed on factual analysis. Even more than on the continent, the typical Japanese law graduate makes his career in a government or business bureaucracy. Since World War II, the Legal Training and Research institute has provided a unique kind of postuniversity training for those law graduates who seek careers as judges, procurators or lawyers and can pass the stringent and highly competitive examinations required for admission. Law teachers and law graduates doing legal work in governmental or business offices, however, are almost never graduates of the institute.

The Japanese lawyer, like his law, came with the new civilization; unlike his western brothers, he does not continue an ancient and honoured profession. In Tokugawa Japan, the closest counterpart to the western lawyer was the *kujishi,* an innkeeper who developed a counseling function. The United States occupation sought to free lawyers from governmental supervision and improve the bar's social status. The Japanese lawyer is not typically a counselor and general business adviser. Nor does he move in and out of government service.

Impact of U.S. Law.—On some points Japanese law is closer to that of the United States than to European models. This is largely a deposit of the post-World War II occupation and of subsequent contacts with U.S. legal thinking and education. The examination of witnesses in civil cases is now (at least theoretically) modeled after U.S. procedure. The absence of a special hierarchy of administrative courts is consistent with U.S. ideas. Many aspects of labour and corporation law are U.S. inspired. U.S. institutions and procedures have thus affected the character of Japanese law, legal thinking and legal education, though U.S. influence on aspects of social organization and political and economic thinking has been greater.

From the perspective of rules and institutions, the Japanese legal system is closer to the civil law of Europe than to the common law. In many ways, however, the Japanese legal order differs markedly from all western legal orders.

Role of Law in Japanese Society.—A striking aspect of Japan's transition at the turn of the 20th century from an isolated, preindustrial society into a modern, industrial state is that this was accomplished while preserving many of the traditional society's patterns and values. Practices and attitudes unacceptable to contemporary thinking have been abandoned; for example, the inferior position of women and the absolute domination by the family head over the smaller family units making up the "house" no longer have a legal basis. Yet, in accommodating itself to the imperatives of western culture, Japan avoided a sharp break with the past and preserved much of value in its own tradition, including a well-knit social structure.

The fact that Japanese law is not the product of organic evolution suggests a second point—the role of law in modern Japanese society differs markedly from its role in western societies. In Japan, law plays a far less pervasive role in the resolution of disputes and the creation and adjusting of rules regulating conduct. The paucity of Japanese decisions involving automobile accidents, manufacturer's liability for defective products and nuisance surprises a U.S. observer. He also notes the small size of the Japanese bar and the persistence of extralegal forms of dispute resolution. For many purposes a family transcending man, wife and dependent children still exists. The notion that a business is analogous to a family unit persists and colours all labour relations, especially in small and middle-sized firms. In the relatively homogeneous Japanese society, social status carries heavy obligations and community pressure is extremely powerful.

As Japan becomes westernized, law may come to play in Japan a role fully comparable to its role in the west; the sociological supports essential to the continued vitality of the Japanese conception of law are clearly being undercut by Japan's shift from a rural, agricultural economy to an urban, mechanized society. In all events, current Japanese lam in the books still gives a less accurate picture of how Japanese society actually adjusts disputes and harnesses human energy and capacity for mutually beneficial activity than western book law does for western society.

In large areas of Japanese life it is still difficult to predict whether a dispute will be settled under legal standards and it is often impossible to know whether a person will enforce legal rights. A related phenomenon is the use of legal forms, *e.g.,* the signing of a business contract, when the parties do not contemplate regulating their relationships under legal standards, but seek a continuing association allowing for adjustment in response to legally irrelevant considerations.

Facilities for conciliation promote adjustment in terms of nonlegal considerations. Local police stations provide conciliation rooms. Elders act as go-betweens.

Compared with the west, a strong consciousness of rights is lacking; this encourages compromise based on legally irrelevant considerations and the utilization of techniques for dispute resolution outside the formal law. This attitude toward rights underlies Japanese reluctance to embrace fully premises pervasive in western law, namely: the legal consequences of particular conduct should be predictable before the conduct has occurred or any dispute arisen; courts should give full effect to claims, a plaintiff receiving all or nothing at all; individual disputes should be resolved without considering the parties' social and economic backgrounds. These western assumptions reflect thinking about man and his society against a particular background of moral assumptions, cultural traditions, historic experience and economic potentials. The question remains open whether Japanese law will here approximate western law, which may itself be evolving on these points, as it has in more formal matters.

BIBLIOGRAPHY.—A useful bibliography is R. W. Rabinowitz, "Materials on Japanese Law in Western Languages," *Amer. J. Comp. Law,* **4.97** (1955). For older Japanese law, *see* J. H. Wigmore, *A Panorama of the World's Legal Systenzs,* 455–530 **(1936);** D. F. Henderson, "Some Aspects of Tokugawa Law," *Wash. Law Rev.,* 27:85 (1952); R. **W.** Rabinowitz, "The Historical Development of the Japanese Bar," *Harv. Law Rev.,* 70:61 **(1956).**

Modern developments: K. Takayanagi, "Reception and Influence of Occidental Legal Ideas in Japan," *Western Influences in Modern Japan,* ed. *by* I. O. Nitobe, 70 (1931); N. Hozumi, *The New Japanese Civil Code as Material for the Study of Comparative Jurisprudence* (1904); A T. von Mehren, "Some Reflections on Japanese Law," *Harv. Law Rev.,* 71:1486 (1958).

Post-World War II developments: T. L. Blakemore, "Post-War Developments in Japanese Law," *Wis. Law Rev.,* **632** (1947); A. C. Oppler, "The Reform of Japan's Legal and Judicial System Under Allied Occupation," *Wash. Law Rev.,* 24:290 (1949); **K.** Steiner, "Postwar Changes in the Japanese Civil Code," *Wash. Law Rev.,* 25:286 (1950); **K.** Takayanagi, "Contact of the Common Law with the Civil Law in Japan," *amer. J. Conzp. Law,* 4:60 (1955); J. Matsuda, '(The Japanese Legal Training and Research Institute," *Anzer. J. Comp. Law,* 7:366 (1958); **N.** L. Nathanson, "Constitutional Adjudication in Japan," *Amer. J. Conzp. Law,* 7:195 (1958); S. Wagatsuma, "Democratization of the Family Relation in Japan," *Wash. Law Rev.,* 25 **40j** (1950); T. Fueto, "The Discrepancy Between Marriage Law and Mores in Japan," *Amer. J. Comp. Law,* 5:256 (1956); R. B. Appleton, "Reforms. in Japanese Criminal Procedure Under Allied Occupation," *Wash. Law Rev.,* 24:401 (1949); S. B. Levine, "Management and Industrial Relations in Postwar Japan," *Far East. Quart.,* 15:57 (1955) and "The Labor Movement and Economic Development in Japan," *Proc. Industr. Rel. Res. Ass.,* 7:48 (1955).

(A. T. v. M.)

JAPANESE LITERATURE. In quantity and quality Japanese literature is one of the major oriental literatures, being less voluminous than the Chinese but comparable with the Arabic, Persian and Sanskrit literatures. It covers the period from the 5th century A.D. to the present.

As in European literatures, the novel, the drama and love poetry are of central importance; this contrasts markedly with the literature of China, where such works were considered inferior to those of a philosophical or historical nature. Japanese literature contains some of the world's longest novels and plays, but its genius reveals itself most conspicuously in shorter forms. Despite their beauty the longer works often betray the lack of a sense of overall structure and break down into episodes related only chronologically.

The difficulty experienced by writers in organizing their lyrical impressions and perceptions led to the perfecting of such literary genres, not so highly developed elsewhere, as the diary, the travel account and the book of random thoughts. Charm and a keen sensitivity to beauty are always apparent.

Early Period (to A.D. 794).—Early Japanese culture owed its impetus, if not its inspiration, to China. The Japanese were still comparatively primitive and without writing when, in the first four centuries A.D., knowledge of Chinese civilization gradually reached them through Korea. They rapidly assimilated this civilization and adopted Chinese characters as a writing system. Considerable literary development resulted during the next four centuries.

The earliest Japanese texts were written not in Japanese but in Chinese, partly because Chinese was regarded as more dignified and partly because the Chinese characters were unsuited for writ-

ing Japanese. (Japanese could at this stage be written accurately only by using the Chinese characters not for their meaning but phonetically. See JAPANESE LANGUAGE.) Nearly all the earlier documents have perished, and the first complete works extant are the *Kojiki* (712) and Nihongi (720), both officially commissioned "histories" of Japan (though heavily larded with myths and legends), and the Fudoki, local gazetteers dating from 713 and later. These works quote more than 200 folk songs in Japanese, several as old as the 5th century A.D.

The earliest prose works written in Japanese were the norito, Shinto prayers (probably 7th century), preserved in the *Engishiki* (927); and the *semmyō,* imperial edicts of the 8th century. preserved in the Shoku nihongi (795). Prose style was undeveloped, but the Japanese poetry in the *Manyōshū* (compiled some time after 759; Eng. trans., 1940), a remarkable anthology of over 4.joo poems by more than 450 poets, is most skillful. The poetic form used—the waka, deriving from the earlier folk songs—consists of an alternation of five-syllable and seven-syllable lines, without rhyme, stress, metrical pattern or other technical device. The *waka* had two main types: tanka (short poem), of five lines of 5. 7, 5, 7 and 7 syllables respectively, totaling 31, and *chōka* (long poem), an indefinite succession of pairs of j-syllable and 7-syllable lines, followed by a concluding additional 7-syllable line. The waka remained the standard poetic form for over 1.000 years, and is distinctively Japanese, avoiding (at least until the 20th century) words of Chinese origin. Among *Manyōshū* poets, the most famous are Kakinomoto no Hitomaro (c. 655–*c.* 710); Yamabe no Akahito (died c. 736); Ōtomo no Yakamochi (*c.* 718–785), one of the anthology's chief compilers; Ōtomo no Tabito (665–731); and Yamanoe no Okura (659–*c.* 733). The *Manyōshū* is the symbol of the great cultural advance of the Nara period (710–784). Its poems are direct and filled with genuine emotion, whether they treat the death of a wife or child, the glory of the imperial family or the pleasures of drink. Both in their moving simplicity and in their diversity of themes they reflect something of the spirit of the early period and contrast strikingly with the more polished but narrower verse of later times.

About 750 the imperial court (the centre of literary activity) turned from composition in Japanese to composition in Chinese; the *Kaifūsō* (751) is an anthology of Chinese poetry by Japanese poets.

Classical Period (794–1192).—The Heian, or Fujiwara, period (794–1192), when the Japanese capital was at Kyoto, was a brilliant period of culture and especially of literature. It began unpromisingly, composition in Chinese still being in vogue, but from about 850 composition in Japanese flourished increasingly, mainly as a result of the invention of the kana phonetic syllabary, which enormously facilitated the writing of Japanese.

The development of composition in Japanese was pioneered by a revival of waka poetry. The *Kokinshū* (905; Eng. trans., 1922), compiled by the poets Ki no Tsurayuki (d. 946), Ōshikōchi no Mitsune (c. 859–*c.* 921), Mibu no Tadamine (c. 867–*c.* 96j) and Ki no Tomonori (d. 906), was commissioned by the emperor as an anthology of this revival. Poetry writing was an indispensable accomplishment of the aristocracy. Skill in the art was a good means of gaining preferment at court; it was also the requisite of a lover, whose messages to his mistress would be exquisitely penned, dexterously folded and attached to a spray of the blossoms of the season. In this period the tanka almost ousted the *chōka,* because short, elegantly turned poems a-ere more suited to the lover's billet-doux or to competitions for poems on a given theme—a frequent court pastime—than the longer forms. The poetic style, too, changed; simplicity and directness yielded to refinement and complexity, reflecting an advanced sensitivity which valued the aesthetic perception of subtle shades of meaning and appreciated intricate word play, puns and allusions. Certain themes. such as the falling of the cherry blossoms or the reddening of the autumn leaves, became stereotyped, but in the hands of such a master as the priest Saigyō (1118–90) even such hackneyed imagery acquired a movingly symbolic content.

Prose.—Parallel to the 9th-century development of poetry, prose composition in Japanese made steady progress. The earliest surviving prose story is the *Taketori* monogatari ("Tale of the Bamboo Cutter." mid-9th century), a fairy tale about a princess who comes from the moon to dwell on earth in the home of a humble bamboo cutter. Many of the other early works contain similar elements of fantasy or fable, but in poem tales such as the *Ise* monogatari ("Tales of Ise," about 950) are found more realistic stories. The poem tale was a succession of tanka connected by short prose passages, often of considerable narrative interest. which ostensibly give the circumstances of the poems. Diaries and travel accounts also began to flourish. The earliest extant is the Tosa nikki (935) by Ki no Tsurayuki, whose prose style has poetic beauty; in it, he assumed the character of a woman—significantly, for in this period fiction writing was largely the achievement of women. As one result, Japanese literature is probably the only one in which the greatest works are by women. These works include the *Kagerō* nikki (974–977), the journal of a noblewoman; the diaries of Izumi Shikibu and Murasaki Shikibu; and the delightful *Makura* no *sōshi* ("Pillow-Book of Sei Shōnagon," about 101j), a work of the utmost sophistication and charm. The greatest literary product of the period, and indeed of the entire literature. is the *Genji* monogatari ("Tale of Genji," about 1010) by Murasaki Shikibu. It is the first important novel written anywhere in the world. It retains its popularity in Japan and is well known in the English-speaking world, thanks to Arthur Waley's superb translation (6 vol., 1925–1933; 1 vol.. 1935).

The success of the Genji monogatari was so overpowering that it tended to influence excessively or even to stifle the production of later novels by the court society, which before long was forced by the bitter warfare that marked the close of the period to turn its attention away from elegant and polished romances.

Middle Ages (1192–1603).—The court at Kyoto continued during most of the "middle ages" to be a centre of cultural activity, but military power shifted from one group of war lords to another; at times the country was divided into many virtually independent states. Fifteen more poetic anthologies were commissioned. Most of the poets placidly followed the stereotypes established in happier times. but in the best of the collections, the *Shinkokinshū* (1205), the tone is darkened, and the prevailing note is one of death and separation. The *Shinkokinshū* poets sought to fill their verses nith as much symbolic content as they could. This resulted in a display of craftsmanship which has sometimes been denounced as artificiality; nevertheless, their tastes, and particularly those of the compiler Fujiwara no Teika, or Sadaie (1162–1241), have continued to dominate Japanese poetic sensibility.

In the 15th century linked verse (renga) became the preferred medium of the leading poets, including the priest Sōgi (1421–1502). Generally three or more poets took part in composing a linked-verse sequence, supplying alternate verses, one in three lines of j, 7 and j syllables, the next in two lines of 7 and 7 syllables each. In other words, the classical tanka mas divided into two "links," and these could be strung out to form a "chain" of indefinite length. Elaborate codes were devised to govern the fitting of the links. As in most other works of Japanese literature, much more attention was given to the relations of the successive elements than to the over-all structure. The first three lines of a linked-verse sequence were to become an independent poem under the name of hokku or *haiku.*

Verse in Chinese had during this period an importance roughly equivalent to that of Latin poetry during the middle ages in Europe, sometimes reaching the realm of genuine poetry but more often being a mere display of technical proficiency. More significant poetry may be found in the *Nō* dramas, particularly those by Kan'nami Kiyotsugu (1333–84) and his son Seami Motokiyo (1363–1443). (See NŌ DRAMA.) These two men by their genius metamorphosed what had been primitive song and dance playlets into one of the noble arts of the world. Their plays were strongly tinged with Buddhist sentiment and were almost uniformly tragic in tone. Comic interludes called *kyōgen* were performed between the *Nō* dramas for relief. Though of popular origins, the *Nō* quickly became associated with the court of the shogun, and the art acquired hieratical trappings which made further developments within the medium difficult.

Prose. previously written in almost pure Japanese, became intermixed with Chinese words. Military stories. mainly having to do with the wars at the end of the Heian period. were prominent. Of these the *Heike monogatari* ("Tale of the Heike," 13th century; Eng. trans.. 1918, 1921) is the most celebrated. It is a work of exceptional, if uneven, beauty, and has been a rich quarry for Iater novelists and dramatists. The *Heike monogatari* opens with a Buddhist declaration of the impermanence of all things, and this statement, so often in the mouths of even the Heian courtiers. had peculiar significance in an age of war and destruction. The same insistence on impermanence is found in the *Hōjōki* (1212) by Kamo no Chōmei (1153–1216), a hermit's description of how he came to abandon the world. It is found also in the random essays, *Tsurezuregusa* ("Essays in Idleness." *c.* 1330–35), by Yoshida Kenkō (1283–1350), though here it is mixed with a sometimes contradictory appreciation of the lovely things of this world.

Unhappiness over the spectacle of a world torn by disorder led writers of every type of literature to attempt to suggest eternal truths in their works by means of a kind of symbolism known as *yūgen*. We find *yūgen* in the *Nō* particularly. but almost equally in the poetry of Teika or in the "Essays in Idleness." Parallel developments occurred in the tea ceremony, the landscape garden and monochrome painting, all arts which suggest or symbolize rather than state.

Rise of Popular Literature (1603–1868).—The Tokugawa period (1603–1868) was one of internal peace and prosperity after the reunification of Japan. Edo (the modern Tokyo) became the cultural capital, and from 1638 to 1853 Japan was closed, by government decree, to normal contact with the outside world.

There was a rapid resurgence of literature, the output of which is remarkable for its extent and variety. It was characterized by liveliness, virility, humour and sensation. The genres were largely changed, for two reasons: first, the writers were no longer court nobles or Buddhist priests, but men of the military class (now free from civil wars) and members of the new, economically powerful commercial class whose tastes were different; second, cheap printing and wider education brought books to a different public.

The tanka, for many centuries an almost fossilized form, underwent startling changes, first as a result of the rediscovery of the simple strength of the *Manyōshū*, which had been overshadowed by later anthologies, and later with the decision to make the tanka a vehicle for expressing life as it actually was led in early 19th-century Japan. Kamo no Mabuchi (1697–1769) represented the *Manyōshū* scholars and poets; the priest Ryōkan (1757–1831), Okuma Kotomichi (1798–1868) and Tachibana Akemi (1812–68) were among those who proved that the tanka was not confined in range to descriptions of blossoms or the autumn moon, but could equally well express joy over fish for dinner or wrath at political events. Some writers who felt that they could not give full vent to their emotions within the tanka turned as in the past to poetry in Chinese. Rai Sanyō (1780–1832) probably wrote Chinese more skillfully than any Japanese writer had ever done.

The chief development in poetry. however, was the emergence of the *haiku* as an important genre. The greatest of the *haiku* masters was Matsuo Bash6 (1644–94). Despite their brief compass. his *haiku* can often suggest a whole world, and they range in tone from the lighthearted to the profoundly sorrowful. Some of Bashō's best-known works are travel accounts interspersed with his verses; of these *Oku* no *Hosomichi* ("The Narrow Road of Oku." 1694) has become one of the most popular and revered works of the literature. Later *haiku* poets added new colouring: Tosa Buson (1716–84) the warmth of romantic love, and Kobayashi Issa (1763–1828) the accents of the common people.

Popular forms of drama more suited than the sombre *Nō* to the rising townsman class developed in the late 16th century: the *jōruri* or puppet theatre, which used chanters to intone the puppets' dialogue. and the *kabuki (see* also THEATRE: *The East).* The *jōruri* theatre prospered because of the brilliance of the playwrights Chikamatsu Monzaemon (1653–1725), Japan's greatest dramatist; Takeda Izumo (1691–1756), the principal author of the immortal *Chūshingura* ("The Treasury of Loyal Retainers," 1748; Eng. trans., 1910); and Chikamatsu Hanji (1725–83). The *jōruri* plays fell into two main categories: those based, however loosely, on historical facts or legends, and those dealing with contemporary life The domestic plays are rated much higher critically because they avoid the bombast and fantastic displays of heroism which mark the historical dramas. but the latter remain superb acting vehicles in the *kabuki* theatre, for which they have been adapted.

Fiction abounded in many forms The first important novelist after the Heian period, Ihara Saikaku (1642–93), enchanted his readers with racy accounts of the amorous and financial affairs of the merchant class and of the demimonde. Saikaku's combination of a glittering style and a warm sympathy for the characters he portrayed lifted his tales from the borders of pornography to genuine art. Ueda Akinari (1734–1809) dealt more frequently with supernatural and grotesque events, as in his *Ugetsu* monogatari (1768). Mention must also be made of the novels of Takizawa Bakin (1767–1848), most of them of immense length and crushingly moralistic in manner.

More than half of Tokugawa literature comprises learned. historical and philosophical works of all kinds, often of high value. This learning uas encouraged by the Tokugawa shoguns, who sought help in administrative theory from the Chinese Confucian philosophy, which embraced political theory. interpreted by the *kangakusha* (scholars of Chinese learning), who taught and wrote so extensively that Confucianism. including its virtues of loyalty and piety, became an important influence. In reaction there arose another school of writers. *wagakusha* or *kokugakusha,* who upheld all branches of native Japanese civilization and learning. Men of this school did much to revive Shinto beliefs and to prepare for the imperial restoration of 1868.

Modern Period. — The modern period resulted from the inrush of western influence after the reopening of Japan to foreign intercourse in 1853, and may be dated from the imperial restoration (1868) in Tokyo in place of the Tokugawa shogunate. Almost every branch of life, including literature. was rapidly and profoundly affected by imitation of European and United States ways. Some writers wholeheartedly accepted western models; others adhered to Tokugawa styles while making fun of foreign methods; the majority, however, attempted to compromise. Constant changes — political, social and psychological — produced an attendant variety of literature, multiplied in turn by the influence of successive European literary movements.

In poetry there was extraordinary activity. Into the traditional forms of the tanka and *haiku* new ideas and language were poured, not always with entire success; many poets would blush to mention cherry blossoms but revel in such exotic European flowers as the lilac or acacia, and the sighing of the wind was often replaced by the clang of a passing tram. Yosano Akiko (1878–1942), Ishikawa Takuboku (1885–1912) and Saitō Mokichi (1882–1953) were among those most successful with the new tanka. lending the form respectively notes of romantic love. social consciousness and modern psychology. Free verse was popular, though often in fact it reduced itself to patterns of five and seven syllables. Shimazaki Tōson (1872–1943) was the first important poet of this style. His "Song of the Autumn Wind" (1896) is a skillful echo of Shelley; ten years later Japanese poets were writing Symbolist verse. In the *haiku,* Masaoka Shiki (1867–1902) was recognized even in his own day as an immortal poet, and numerous other *haiku* poets ensured that western influence would not destroy this uniquely Japanese form. A body of verse translated so beautifully from foreign tongues as to be considered part of Japanese literature has also been of great importance.

Translations dominated the modern Japanese theatre. The public, honever, still preferred the *kabuki* to the modern theatre, and the favourite playwrights were those of the 18th century or men such as Kawatake Mokuami (1816–93) whose works reveal little foreign influence. Perhaps by way of reaction the intellectuals, the chief supporters of the modern theatre, tended to prefer plays derived from European works if not actual translations.

Fiction poured out in thousands of volumes by hundreds of writers, many of whom consciously imitated some western model. In the Meiji period (1868–1912) fiction owed much to Tsubouchi

Shōyō (1859–1935), who in Shdsetsu *shinzui* (1885) stressed the need for realistic and rational novel writing; and to Futabatei Shimei (1864–1909), who pioneered the use of everyday speech instead of the difficult literary language. Mori Ōgai (1862–1922) was especially revered by later writers as the creator of the most highly esteemed modern literary style. By general consent, however, the chief novelist was Natsume Sōseki (1867–1916), a reflective writer less concerned with depicting extraordinary events than with day-to-day happenings in the lives of average Japanese.

An amazing burst of creative activity occurred in the decade following the conclusion of the Russo-Japanese War in 1905. Probably never before in the history of Japanese literature were so many important writers working at once. Some of the novelists who first emerged into prominence at this time were Nagai Kafū (1879–1959), Tanizaki Junichirō (1886–) and Akutagawa Ryūnosuke (1892–1927). Their works, which revealed a powerful attraction to the Japanese past, tempered by a modern, essentially western sensibility, dominated Japanese literature through the 1920s and 1930s. Nagai Kafū most frequently found his subjects among the entertainers of the gay quarters of Tokyo, and chronicled with exquisite artistry the passing of the old city. In some of Tanizaki's novels, particularly Tade *Kuu Mushi* (1929; Eng. trans., Some Prefer Nettles, 1955), the conflict between traditional and western-inspired ways was the central theme. Problems of another kind—those of social injustice-led the "proletariat literature" school to produce books intended to promote revolutionary changes. Robayashi Takiji (1903–33) was considered the outstanding figure in this movement. Other writers, convinced that the essential function of literature was artistic rather than propagandistic, formed such opposing schools as the "neosensualists," whose members included Yokomitsu Riichi (1898–1947) and Kawabata Yasunari (1899–). These were two of the finest novelists of the generation after Tanizaki.

Japanese critics have divided the fiction of the period up to 1941 into many schools, each consisting of a leading writer and a cluster of disciples. Probably the most influential author was Shiga Naoya (1883–). His characteristic literary form was a closely autobiographical story, related by him with stylistic beauty and a sensitive intelligence, but lacking in invention or coherent structure. This "I novel" (*shishōsetsu*) came to occupy a place of almost dominant importance.

The wars of the 1930s and 1940s stifled most literary production, but tl ıncl signaled a new period oı activity, b th by the older generation and by such new men as Dazai Osamu (1909–48) and Mishima Yukio (1925–).

BIBLIOGRAPHY.—W. G. Aston, *A History of Japanese Literature* (1899); W. T. de Bary, *Five Women Who Loved Love* (1956); *O.* Dazai, *The Setting Sun* (1956); *Y.* Kawabata, *Snow Country* (1957); *D.* Keene, *Japanese Literature: An Introduction for Western Readers* (1953); D. Keene (ed.), *Anthology of Japanese Literature* (1955) and *Modern Japanese Literature* (1956); *Y.* Mishima, *Five Modern Nō Plays* (1957); Y. Okazaki, *Japanese Literature in the Meiji Era* (1956); N. Peri, *Le Nō* (1944); E. O. Reischauer and J. K. Yamagiwa, *Translations From Early Japanese Literature* (1951); *E.* Seidensticker, *Kagero Nikki* (1955); *J.* Tanizaki, *The Makioka Sisters* (1957); A. Waley (trans.), *Japanese Poetry* (1919); *Pillow-Book* of *Sei Shōnagon,* trans. by A. Waley (1929); Murasaki Shikibu, *Tale of Genji,* trans, by *A.* Waley (1935). (E. B. CL.; DD. K.)

JAPANESE MUSIC. The total picture of Japanese music, Iike that of Japanese culture as a whole, suggests a fusion of different cultural elements; and to such fusion may perhaps be ascribed the vigour of the Japanese musical tradition. Documentary evidence from the 8th century A.D. shows that deliberate importation of foreign music, in this instance from Korea, had already begun in the 5th century. Not only the surviving music of the imperial court, however, but the entire range of Japanese folk song as well suggests a fundamental heterogeneity of musical culture, such as is unlikely to derive from conscious borrowing but may well spring from a fusion of cultures in the remote past.

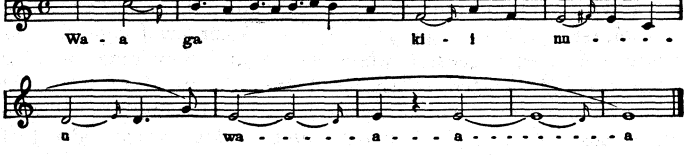
The Character of Japanese Music.—Japanese melodies can be referred to two types of scale structure, both basically with five notes to the octave; both occasionally filling in minor- or major-third gaps, and so becoming six- or seven-note scales. One type, conveniently described as Sino-Japanese, is to be found over the whole of the far east and particularly in Mongolia. China and Indochina, as well as Japan; this may be represented by the series: . . . C D E G A C' . . . , and each note may serve as starting point for a different five-note mode: C D E G A C', D E G A C' D', etc. In Japan, the mode C D E G A C' (1) is relatively uncommon; the more favoured mode may be represented by G A C' D' E' G' (2). Of the six mode keys used in the ancient music of the imperial court, for example, three are of the first kind (1)--+yo modes in different keys; three, of the second kind (2)—*ritsu* modes in different keys.

The second type of scale structure occurs not only in Japan, but conspicuously in Indonesia and the coastal areas of the Indian archipelago, with traces elsewhere on the Asiatic mainland. It may be represented by the series: . . . B C E F A B' . . . . Again, each note may serve as starting point for a different five-note mode; but in Japan only three of the possible modes are exploited, those on A, B and E. These are sometimes described as "national" modes, but that they have any more claim to this description than have the Sino-Japanese modes is by no means certain.

Melodies based on either of these note series tend, like Chinese and Mongolian melodies, to make use of the interval of a fourth as a constructional unit; chains of thirds, so common in western European folk song, are infrequent. It is rare to find purely syllabic—one-note-to-one-syllable—tunes in Japanese folk song; for the most part, songs tend to be partly syllabic and partly melismatic, with several notes sung to one syllable of the text. The simple, square-cut, symmetrical dance structures. so common in uestern folk and popular music, are less common in Japan. where folk song displays a great variety of asymmetrical and often quite complex structures. On the whole, binary or quaternary ($\frac{2}{4}$ or $\frac{4}{4}$) rhythms predominate; and though irregularities occur, there is no extended use of ternary or irregular rhythms.

Some of these characteristics are displayed by the following rice-planting song ("Taué Uta") from Kanto province (Nippon Minyo Taikan [Kanto-Hen] edited by Nippon Hoso Kyokai [Japan Broadcasting Corporation-NHK]).

As an example of the "national" type of mode, the following is a single phrase from the famous saibara (literally "horse-grooming music") "Koromogae" (see E. Harich-Schneider, "Koromogae, one of the Saibara of Japanese Court Music" in *Monumenta Nipponica,* viii, $\frac{1}{2}$, pp. 398–406, Tokyo, 1952). The mode is that on E: E F A B C E', with D as filler.



The genre saibara may well derive from songs of provincial pack-horse dravers; but since the 10th century it has formed part of the imperial court music, gagaku (from the Chinese. "elegant music"), and its accompaniment has gradually come to include the board zither or koto (13 strings), bass lute or biwa (4 strings), the free-reed mouth organ or sho (17 pipes), the oboe or *hichiriki* and the transverse flute, fue or oteki, of the ceremonial orchestra, imported into Japan from China in late T'ang and Sung times (8th-10th century).

This incorporation of folk material, transformed by foreign instruments and instrumentation, has probably occurred repeatedly in the growth of the repertoire of the palace musicians. Of the

works surviving from this period and ultimately deriving from music of the T'ang court in China, one of the most famous is *Etenraku,* "Music Coming Through From Heaven." Though basically in *ryo* or *ritsu* modes, the melodies of *gagaku* acquire in performance a strongly "national" flavour through traditional embellishment *(see* E. Harich-Schneider, "The Present Position of Japanese Court Music," *The Muszcal Quarterly,* vol xxxic, New York, 1953). Closely related to *saibara,* but retaining a more primitive accompaniment of flute and percussion only, are the shrine dances, *kagura.*

Through the translations of Noel Peri and Arthur Waley, the texts of the Nō drama — the creation of the 1 jth-century player and writer Se'ami Motokiyo — have been made accessible in the west; but the texts are wedded to a largely unknown music more archaic in resource than the text itself, and as poignant in effect. The style of declamation is related to Buddhist cantillation.

The instrument most commonly associated aith Japan in the west, the *samisen,* a long-necked, three-stringed. flat-bellied lute, did not appear in Japan until the middle of the 16th century, coming from the Ryukyu Islands. It has since become the chief accompanying instrument in popular use. for this purpose displacing the *biwa.* In addition to its widespread popular usage, it provides (together with assorted percussion) the accompaniment in *joruri,* associated since the 16th century with the tragic narrative of the puppet plays; and also for *gzdayu,* a more lyrical genre. The modern repertoire of *naga-uta* (solo "long" songs) began to develop in the early 18th century; the *ha-sate* ("odd" songs. all short) are a development of the early 19th century. (See *Album of Japanese Music,* Tokyo; recordings published by the Kokusai Bunka Shiukokai, Tokyo.) (L. E. R. P.)

History. — The traditional origin of Japanese music is generally traced back to Izanagi and Izanami, the creator and creatress of the country in Japanese mythology. whom the 8th-century *Kojiki* records as having sung together in chorus. Dancing is likewise linked with the performance of the celestial deities before the cave of the sun goddess, when songs were sung and Amano Kanatomi-no-mikoto played on a zither made from six stretched bows. Historically, too, vocal music came first and when instruments were introduced, they were generally the accompaniments of the dance as well as song.

The musical history of Japan may be divided into four periods.

Primztive Period. — The first is the primitive period ending with the death of the emperor Inkyo (453) when native music existed in which the stress was laid on the beauty of the human voice, though later more value was attached to its literary side. There were *royei* (chanted poems), *kume-uta* (war songs), *imayo* (the singing of genre sonnets) and such instrumental music as *kagura* (sacred dance), *saibara* and *uta-gaki* in which men and women joined in the revels on the outskirts of their villages. Records speak of the emperor Inkyo playing on a *wagon* (Japanese native *koto)* and the empress dancing at the imperial banquet given in 419 on the completion of their new palace. Hand drums and pipes made of bamboo appear to have been in existence at that time.

Period of Foreign Music (453–1186).—The second period is marked by the importation of foreign music, beginning with 453 and lasting about 700 years. Its main events may be summarized as follows, each numeral covering about a century: (1) The king of Shiragi (Silla), Korea, sent 80 musicians to attend the funeral of the emperor Inkyo in 453, thus marking the first importation of foreign music into Japan. (2) The king of Kudara, Korea. in the middle of the 7th century dispatched a number of musicians to remain at the Japanese court; about the same time music came also from Koma, Korea. At this time *kure-gaku (gagaku),* which played an important part in Buddhist ceremonial, was also introduced. (3) Indian, as well as Chinese, music had already found its way to Japan through Korea. But the influence of T'ang music, coming direct from China, became irresistible and played an important part in the grand inauguration ceremony of the Great Buddha of Todaiji, Nara, in 752. The music of European Turkey and of Arabia also found its way to Japan before the establishment (in 702) of the imperial bureau of music (Uta-ryo) which consisted of more than 500 singers, musicians, etc. (4) The *biwa* (bass lute) and the *koto* (zither) were brought from China. There was a revival of T'ang and Korean music, and this foreign music so dominated the Cta-ryo that O-uta-dokoro was created for the development of native music to be used on certain ceremonial occasions. (5) The contact between foreign and native music gave rise to new instruments. (6) There was a further development of *gagaku* for the court use. (7) There arose the class of *shirabyoshi* (white measure markers) whose semipoetical chants were accompanied by drum and flute. It was during this time that a separation of popular from aristocratic music took place.

Period of National Music (1186–1896).—The third period covers about 700 years, beginning with the reign of the emperor Go Toba (1186), and is characterized by the birth of genuine national music. The principal features of the period, each covering about a century, are: (1) the vogue of *hei-gaku,* the recital to *biwa* accompaniment of epics of the Taira clan, and of *yei-nen* (life-lengthening dance) by the monks; (2) the rise of *den-gaku* (originally an agricultural mime) which found favour with the military class; (3) the rise of *saru-gaku* (monkey mime) patronized by the court; (4) a new movement in native music and the birth of popular or people's music; (5) the rise of a truly popular music with the cultivation in the Hoei era (1704–11) of the *samisen;* (6) the development of the *samisen* music of the common people and of *uta-mono* (songs) and *katari-mono,* such as the tragic recitation of *joruri;* (7) a commingling of various kinds of music.

Period of European Music (1896 *and After). — The* fourth period begins with the end of the Chino-Japanese war in 1895, and is characterized by the importation and spread of European music in Japan. It was in 1896 that western phonographs were introduced into Japan. European music gained great favour, especially with young people, and it so dominated the Tokyo Academy of Music, the highest institution of its kind in Japan, that in 1911 a special commission was set up in the academy with the purpose of preserving the traditional music of Japan. Pianos and western violins became household instruments. But the *koto, samisen* and *shakuhachi* (bamboo pipe) were still retained, and the tragic recitative of the *joruri* or *gidayu,* with or without the accompaniment of puppet or other plays, together with other forms of recitative and native styles of singing such as *naga-uta, uta-zawa* and *ko-uta* continued to hold their own in varying degrees.

Recent attempts of Japanese composers to produce a synthesis of western and national style are of great interest. Among modern Japanese composers for western instruments, the names of Kojiro Kobune, Bunya Koh, Shukichi Mitsukuri and Yoritsune Matsudaira may be mentioned. (J. HAR.)

BIBLIOGRAPHY.—Mueller, "Einige Notizen über die japanische Musik," *Mitteilungen der deutschen Gesellschaft fur Natur- und Volkerkunde Ostasiens in Tokio,* pp. 13–20, 41–48, 19–35 (Tokyo, 1874–76); Sir Francis T. Piggott, *The Music and Musical Instruments of Japan* (Yokohama and London, 1893 and 1909); N. Peri. "Essai sur les gammes japonaises," *Bibliothèque musicale du musée Guimet,* i (Paris, 1934); Y. Saionji, *Nihon Minyō Taikan, Kantō-hen* (Tokyo, 1953); H. Tanabe, *Nihon Ongaku Kōwa* (Tokyo, 1926); E. Harich-Schneider, "Koromogae, One of the Saibara of Japanese Court Music," *Monumenta Nipponica,* viii, ½, pp. 398–406 (Tokyo, 1952), "The Present Condition of Japanese Court Music," *The Musical Quarterly,* xxxix, pp. 49–74 (New York, 1953). (L. E. R. P.)

JAPANESE PAINTING AND PRINTS. Although it originated in China, Japanese painting has not been merely imitative. The impact of Chinese civilization on Japan was even greater than that of Italy and Greece on western Europe, but periods of Chinese influence, which were often transmitted by way of Korea, alternated with periods in which the Japanese genius, insular and unified, asserted its special gifts and qualities. Since the Meiji restoration in 1868 Japanese painting has undergone a metamorphosis as a result of the impact of western civilization.

General Characteristics. — Japanese painting before the Meiji restoration was based on the typical Japanese attitude of perceiving the self, not in opposition to the outer world, but as part of it. The world was apprehended intuitively from within. This attitude created art of unique beauty — an art with no conflict between image and perception, an art of complete empathy and, at the same time, of abstraction. Japanese painting ignores the cast shadows of nature. It attempts no sculptural effects. It attempts very little relief and only a suggestion of modeling. It attempts to represent not a three-dimensional physical space, but an internally apprehended space. It aims not at the complete represen-

tation of a scene, but a selection of the significant elements, using blank space as a factor in the design. It employs a subjective system of perspective instead of one with a fixed viewpoint. Bird's-eye views are even more prevalent than in Chinese painting. Japanese artists study nature with ardent attention; their aim is to train the memory so that they will be able to record a mental image with the utmost vividness and truth. They concentrate on life, movement and character, but always with an eye to decorative effect. Their technique follows that of the Chinese. The medium is Chinese ink called *sumi,* which yields tones ranging from deep lustrous black to silvery gray, and opaque water colours, which are usually mixed with diluted bone glue. Paintings are either in *sumi* alone or coloured, often very slightly. The material is silk or absorbent paper, generally sized with alum or a substance made from beans. The strokes of the brush are valued as a direct communication of personality, as they are in handwriting, which is also done with the brush instead of a pen and is valuable training for the painter. Japanese painters learned from China an art of line drawing which can express strong emotion or reveal the intrinsic beauty, as well as the elemental forces, of nature. They developed delicate lines capable of communicating the painter's most subtle sentiments. Mural painting was practised in early times, but never to the extent that it was in China. More popular was painting on screens, usually six-fold but sometimes two-fold, and sliding doors. Another popular form of painting was the *makimono,* the horizontal scroll which was sometimes of immense length. Since the 13th century, however, the most common form of painting has been the *kakemono,* the hanging painting. The *kakemono,* mounted on fine brocade or other textile fabrics, is kept rolled up and, when shown, is hung in a sort of alcove called the tokonoma, reserved for this purpose.

The subjects of Japanese painting are often similar to those of Chinese art, but, in periods when Chinese influence was not paramount, the life of action has been a far more prominent and fruitful theme. In many paintings of native style there is an emotional feeling which tends to be sentimental. High spirits and a frank gaiety are also distinctive qualities that find expression in Japanese art. The national instinct for fastidious order is reflected in art. This tendency, in conjunction with the extraordinary sensitivity of the Japanese, resulted in paintings which represent the beauty of nature in extremely refined, simple forms. This tendency, however, has sometimes become a weakness, causing some Japanese painters, especially when striving for decorative effects, to miss the inner reality of the subject. Another bane of Japanese painters has been the sacrifice of inner significance for clever brush manipulation. Nevertheless it must be emphasized that the Japanese have shown an instinctive taste that amounts to genius; and perhaps in no other country has fine taste been so widely diffused. The colour prints of the 18th century, which were produced by men of the artisan class solely for a public of the same class, have been appreciated as miracles of refinement and exquisite design in the western world. China has nothing comparable.

Although in general Japanese art may be less profound than Chinese art, there are among the early religious paintings some sublime masterpieces. In the portrayal of swift and vehement action Japanese draftsmen of medieval times are unsurpassed. Nor have the Chinese ever produced anything like the superb array of screen paintings by great masters of the 16th and 17th centuries which are among the greatest glories of Japanese painting. Japanese painting represents a continuous tradition of 1,300 years, perpetually renewing itself. But since nearly all its great masterpieces have remained in Japan, the range of its achievement has not been appreciated by the rest of the world.

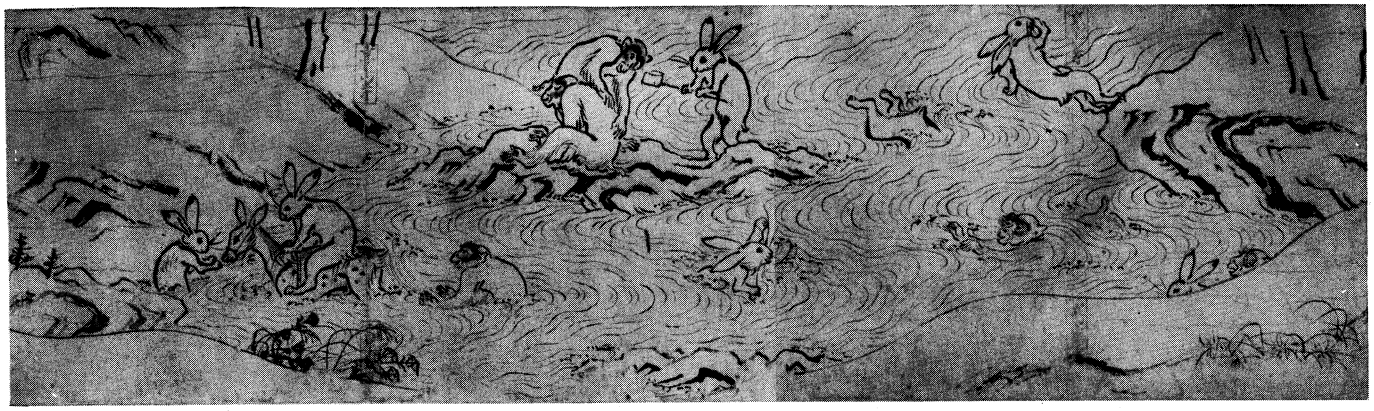
PAINTING

Early Buddhist Art (6th–8th centuries).—Paintings of the protohistoric period are so primitive as hardly to merit mention. The real tradition of Japanese painting began with the introduction of Buddhism, which, in its successful progress from India, reached Japan by way of Korea in the 6th century. Of its earliest phase the one existing relic is the Tamamushi shrine, a miniature temple, on a high pedestal, with doors and panels painted with Buddhist figures and scenes in colours on lacquered ground in the Chinese Buddhist style of the Six Dynasties period. The shrine was probably made in Japan about the mid-7th century.

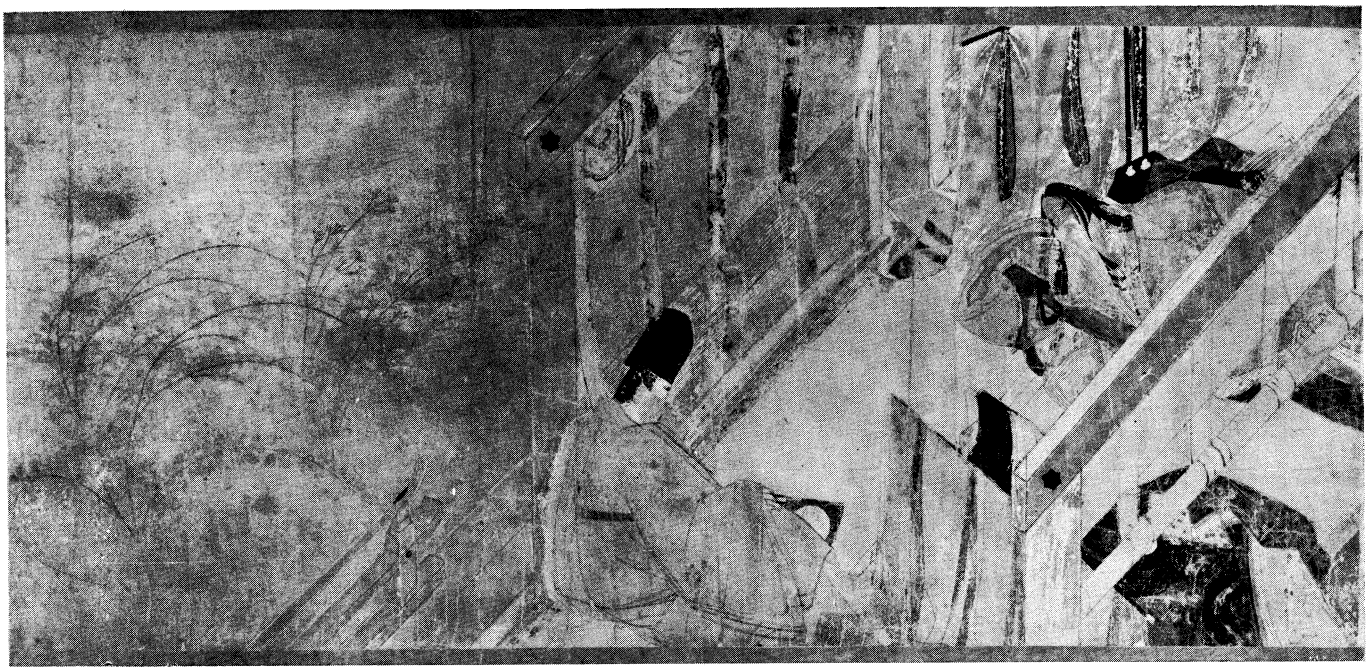
The earliest independent painting is the portrait of "Crown Prince Shōtoku and His Two Sons." Prince Shōtoku (573–621) was a great and enlightened prince, who as regent under the Empress Suiko (reigned 592–628) energetically propagated Buddhism and fostered the arts. Painted after his death, probably about 700, the portrait reflects Chinese early T'ang painting, especially the style now associated with Yen Li-pen. Another style of T'ang painting, said to have been originated by Wei-ch'ih I-sêng, is reflected in the paintings decorating the piece called "Lady Tachibana's Shrine." Painted in the same style, but in much grander scale and with more spiritual loftiness, are the frescoes in the Golden hall of the Hōryūji monastery near Nara, which are believed to have been painted about A.D. 700 or a little later. Unfortunately, this grandest monument of early Japanese painting was gravely damaged by fire and water in 1949. In the Nara period (710–794), during which, except for the last ten years, Japan's capital was located at Nara, the matured style of Chinese middle T'ang painting was closely followed, as may be seen in the "Beauties Under the Trees" in the Shōsōin and the exquisite "Kichijō-ten" (Srī-Mahā-devī) owned by the Yakushiji monastery at Nara. In 756 the consort of the emperor Shōmu dedicated the belongings of her dead husband to Buddha. These treasures have been preserved in the Shōsōin at Nara; they vividly show the outward signs of the Chinese civilization of the period. It would be difficult to say to what extent these exquisite objects were a product of Japanese workmanship. But it is certain that the Japanese adopted the arts and graces, the costume and ceremony, and the literary and aesthetic pastimes of Chinese life with a responsive appreciation. Fine taste and sensitive docility are characteristic of the Japanese.

Early Heian Period (794–897).—In 794 the capital was moved to Kyoto, then called Heian, and from that date to 1185 extends the Heian period, the latter three centuries of which are often called the Fujiwara period (897–1185) after the great clan of Fujiwara. Buddhist painting gained even greater importance in the Heian period as a result of the introduction of esoteric Buddhism; its direct follower Kūkai (774–835) established the Shingon sect in Japan, and the priest Saichci (767–822) started a Japanese version of the Tendai sect. These two sects flourished all through the Heian period and deeply influenced its art. Both emphasized mystic rituals in which religious pictures played especially important parts. From the early Heian period a small number of paintings have survived. All were used for esoteric Buddhist rites and are filled with mystic solemnity. They are painted after the Chinese late T'ang style, but some reveal certain Japanese characteristics. Five pictures of the "Portraits of Seven Patriarchs of Shingon Sect" in the Kyōō-Gokokuji monastery, Kycito, are Chinese T'ang paintings but the two others were painted in Japan. The lines of these two are less severe and strong but more abstract and graceful than the Chinese originals. The Twelve Devas, a series of twelve paintings owned by the Saidaiji monastery, show the tenderness and grace which are characteristic of the next, Fujiwara, period. In secular painting, which consisted mainly of decorated screens and panels, the Chinese style also seems to have been closely followed. As contemporary records indicate, only in subject matter did Japanese taste begin to show itself; Japanese, as well as Chinese, themes including intimate Japanese landscapes were painted. This tendency brought a gradual nationalization of style, which was fully developed in the ensuing period. Among the 9th-century painters whose works and deeds are recorded, Kudara-no-Kawanari (782–853) and Kose Kanaoka (active in the late 9th century) are the most famous. (In this article the family name precedes the first name or nom de plume, according to Japanese custom.)

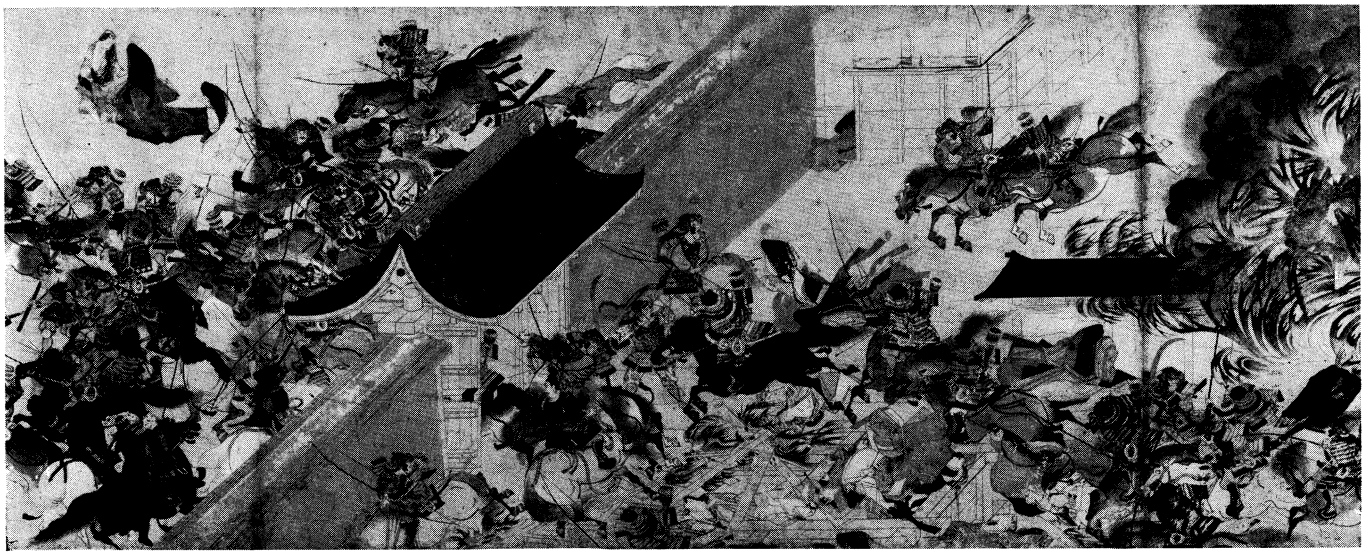
Late Heian Period (897–1185).—The Late Heian or Fujiwara period was the period when the characteristic style of Japanese art was created. From the end of the 9th century to the 12th century, official relations with China were suspended, although there was



A section of one of the four scrolls of "Animal Caricatures" traditionally attributed to Priest Kakuyū (1053–1140); Fujiwara period, 12th century. Owned by the Kozan-ji monastery, Kyōto, Japan



"Prince Genji consoling sick Murasaki-no-ue," a section of the picture scrolls of the *Genji* monogatari attributed to Fujiwara Takayoshi; Fujiwara period; first half of the 12th century. In the Goto museum, Tokyo; formerly owned by Y. Masuda, Tokyo, Japan



"The Burning of the Sanjo Palace." from the picture scrolls of the Heiji insurrection; Kamakura period, 13th century. In the Museum of Fine Arts, Boston, Mass.

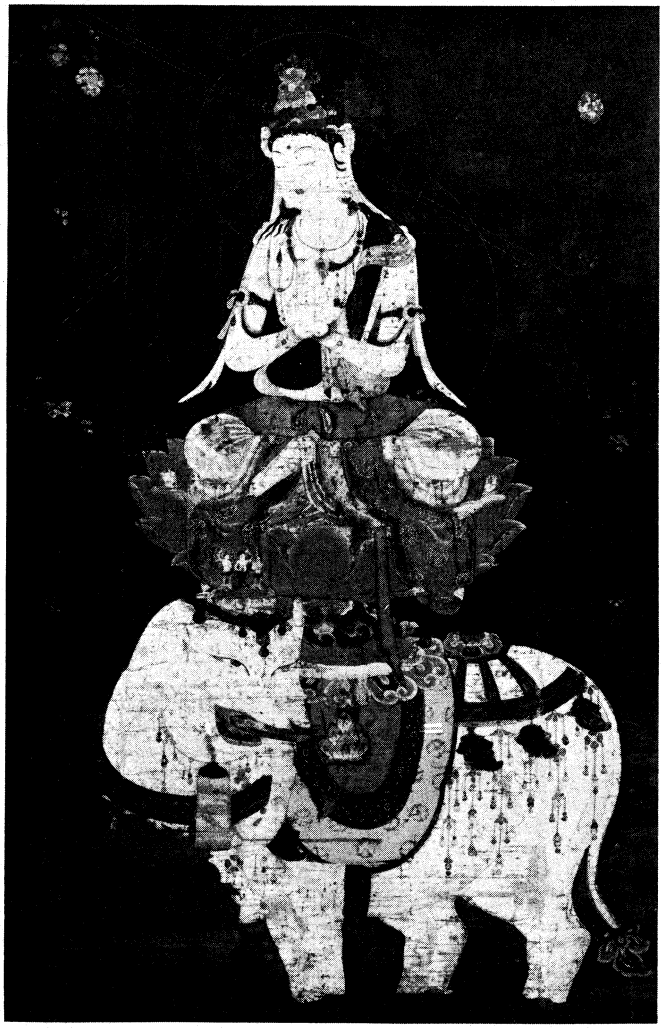
JAPANESE PAINTING OF THE 12TH AND 13TH CENTURIES

BY COURTESY OF (CENTRE) Y. MASUDA, TOKYO; (BOTTOM) MUSEUM OF FINE ARTS, BOSTON; PHOTOGRAPHS, (TOP) BENRIDO CO., (CENTRE) M. SAKAMOTO, TOKYO

JAPANESE PAINTING AND PRINTS

Picture of the *Raigo*, "Coming to Welcome," representing Amitābha descending to welcome the blessed soul; Fujiwara period, 11th or 12th century. Owned by the Hachiman-ko, Mt. Kōya, Japan

"Summer Landscape," painting in *sumi* wash by Sesshū (1420–1506); Muromachi period. In the National museum, Tokyo, Japan



"Image of Fugen" (Samantabhadra); Fujiwara period, 12th century. In the National museum, Tokyo, Japan

JAPANESE PAINTING OF THE FUJIWARA AND MUROMACHI PERIODS

BY COURTESY OF (BOTTOM) THE NATIONAL MUSEUM, TOKYO; PHOTOGRAPHS, BENRIDO CO., KYŌTO, JAPAN

One of a pair of six-fold screens from Matsushima by Sōtatsu; early Edo period, first half of the 17th century. Freer Gallery of Art, Washington, D.C.

Two of the series of sliding panels in the Chishaku-in temple, Kyōto. Momoyama period, late 16th or early 17th century. Possibly the work of Hasegawa Tbhaku (1539–1610)

PAINTINGS OF THE MOMOYAMA AND EDO PERIODS

BY COURTESY OF (TOP) SMITHSONIAN INSTITUTION, FREER GALLERY OF ART, WASHINGTON, D.C.; (BOTTOM) PHOTOGRAPHED ESPECIALLY FOR "ENCYCLOPEDIA BRITANNICA" BY BENRIDO COMPANY. LTD., KYŌTO, JAPAN

"Red and White Plums," a pair of two-fold screens by Ogata Kōrin (1658–1716). Atami Museum of Art, Japan

"The Broken Shoestring," by Suzuki Harunobu (1725–70), the first painter to employ full colours in wood-block printing

"Beauty in the Mirror," by Kitagawa Utamaro (1753–1806) one of Japan's greatest masters of figure design

PAINTING AND PRINTS OF THE EDO PERIOD

BY COURTESY OF (BOTTOM LEFT, BOTTOM RIGHT) THE TRUSTEES OF THE BRITISH MUSEUM; (TOP) PHOTOGRAPHED ESPECIALLY FOR "ENCYCLOPÆDIA BRITANNICA" BY BENRIDO COMPANY, LTD., KYŌTO, JAPAN

some private trading and communication with the continent. Shut up within herself Japan began to assimilate the marvelous inheritance she had received from the continent, and at the same time developed her art according to her own genius. The emperor's power gradually devolved to a regency and allied nobles, mostly of the Fujiwara clan, and an aristocratic culture flourished. The courtiers' hedonism coupled with a typically Japanese sensitivity and love of nature fostered an extremely refined aesthetic culture which made this period the golden age of Japanese art and literature.

Reflecting their culture, Buddhist paintings of this period have not only religious loftiness but also sensuous beauty. The monumental "Death of Sakyamuni" in the Kongōbuji monastery on Mt. Kōya, and the magnificent "Resurrection of Sakyamuni," owned by the Chōhōji monastery near Kyoto, are of sublime beauty. In the graceful "Image of Fugen" (Samantabhadra) in the National museum, Tokyo, is reflected the refined, effeminate culture of the late Fujiwara period. Esoteric Buddhism exercised its authority among the courtiers, who relied on its mystic rites to secure ends in this and other worlds. It brought forth many masterpieces nhich, though painted according to strict iconographical rules, have at once sensuous beauty and mystic solemnity, as in the "Twelve Devas," painted in 1127, in the Kyōō-Gokokuji, Kyoto, or overwhelming mystic power as in the "Green Fudo" (Acalanatha) in the Seiren-in temple, Kyoto.

The romantic aestheticism of the time found characteristic expression in the pictures of *Raigō*, "Coming to Welcome," which represent beatific visions of Amitiibha descending to welcome the blessed soul. These pictures were born from the doctrine of Jōdo (Holy Land or Paradise), which taught the worship of Amitiibha, who was believed to welcome in his Western Paradise the souls of faithful dead. This worship was advocated by the priest Eshin (d. 1017) of the Tendai sect, who found many followers. The sumptuous picture of the *Raigō* owned by the Hachiman-ko on Mt. Kōya is traditionally associated with Eshin, one of the great religious painters of Japan, but it seems to date from a little later time. The beautiful evening landscape painted in bird's-eye view below the descending Amitiibha of this picture is a typical Japanese scene, and betrays characteristic Japanese sentiment and taste for colourful nature and decorative beauty. The same can be said about the landscapes in the pictures representing various aspects of the *Raigō* painted in 1053 on the walls and doors of the Hōō-dō or Phoenix hall in the Byōdōin monastery, Uji.

Yamato-e.—National feeling was further developed in secular painting and produced pictures which represent Japanese themes with Japanese taste and sentiment and in a style which became consequently different from the Chinese. This kind of painting was called *Yamato-e* meaning Japanese picture. It was fashionable in the Fujiwara period to decorate screens and panels with *Yamato-e.* Even more popular were *E-makimono, i.e.,* picture scrolls. There are two styles of *Yamato-e* from this period. One is predominantly linear, using vigorous lines capable of expressing strong emotion and movement. Colour plays a subordinate role. It is more or less realistic and can be described as masculine in comparison with the other style which is feminine. This second style is decorative and abstract, aiming chiefly at expressing sentiment rather than reality. It uses at once line and colour, the two elements being complemental to each other. Its lines are delicate and graceful, communicating subtle sentiment. Its colours are pretty and symbolic. The early stage of this style can be traced in the series of five 2-fold screens with the illustrated biography of Prince Shōtoku by Hata Chitei, painted originally as a mural in 1069.

Three masterpieces of the first, linear style date, in all probability, from the latter half of the 12th century. One is the "Legends of Mt. Shigi" painted in three long scrolls. They vividly depict miracles performed by a virtuous priest in five long continuous paintings, the one in the first scroll being almost 30 ft. long. The composition develops continuously from right to left, and tells a story. The internally apprehended space of Japanese painting, with which even the time element can be merged, is demonstrated here to much advantage.

Another masterpiece of continuous composition is the "Story of Tomo-no-Dainagon" in three scrolls attributed to Tokiwa Mitsunaga. Painted in the same linear style but of a different nature are the four scrolls of "Animal Caricatures." They seem to have been painted by more than one painter, although tradition ascribes them to Kakuyū (1053–1140), the famous priest-painter popularly known by the title Toba Sōjō. These scrolls catch the lively movements of animals in witty and animated drawings in *sumi.*

In contrast, the beautiful picture scrolls illustrating the *Genji monogatari,* the novel by the Lady Murasaki, show the fully developed second style of *Yamato-e* at its most splendid and original. The cult of beauty and the courtiers' conception of life as a continuous ceremony are reflected in the symbolistic stylization of exquisite design, in which the play of curving forms against straight lines and angles is enriched by the contrast of delicate but glowing colours. It is chiefly an art of representing the sentiment and atmosphere of life indoors, which is shown in bird's-eye view by omitting roof and ceiling. The profuse beauties of nature are symbolized by trees and flowers painted sometimes in delicate isolation but always in harmony with the atmosphere of the scene. Traditionally ascribed to Fujiwara Takayoshi, the Genji scrolls do seem to date from his time, the first half of the 12th century. About the middle of the 12th century the long rivalry of the great samurai clans of Taira and Minamoto came to a head, and Japan was engaged in civil war, during which, however, art continued to flourish.

Kamakura Period (1185–1336).—In the end the Minamoto triumphed, and Yoritomo took the title of shogun, military governor. He established his government at Kamakura. It was a period dominated by warriors who took a realistic attitude toward life. This attitude and their virile spirit are reflected in the art of this period. The swift and summary power of stroke, and the animated intensity of the linear style of *Yamato-e* were now applied to the scenes of action and excitement in scroll paintings narrating military romances, the stories of virtuous priests, the legends concerning Buddhist temples and Shinto shrines, etc. Many of these scrolls display the astonishing ability of the artists to group figures in long rhythms of excited action. Three picture scrolls of scenes from the Heiji insurrection, one of which is in the Boston museum, comprise the apex of this style in dramatic design, energy of movement and vehemence of action. Besides the battle scenes and the interiors with their glimpses of court life and amorous intrigue, episodes and incidents taken from the ordinary life of the people are depicted, with intimacy, truth. humour and pathos. The virile spirit of the period was not favourable for the second, decorative style of *Yamato-e,* but it did produce several masterpieces still extant. It also influenced the linear style which became. as a result, more colourful than before. These two styles are successfully merged in the nine scrolls of the "History of Kitano Tenjin Shrine" dating from the early 13th century.

As a result of the renewed relations with the continent, Chinese art under the Sung dynasty began to influence Japanese painting. The Chinese influence, coupled with the realistic spirit of the time, gave Buddhist paintings of this period a certain naturalistic quality and much movement, as may be seen in the "Monju (Manjusri) Travelling Over the Sea" owned by the Kodai-in temple and the "Running Fudo" in the Inouye collection. The doctrine of Jōdo, now developed into several new sects, became popular among ordinary people. Many beautiful pictures of the *Raigō,* including paintings of a new version showing Amitābha rising in glory behind the mountain, date from this period. The realistic attitude toward life led also to the development of portrait painting. Two great masterpieces of the beginning of this period are the portrait of Yoritomo and that of Shigemori of Taira, both in the Jingoji monastery and both attributed to Takanobu (1142–1205).

Muromachi Period (1336–1573).—The Ashikaga line of shoguns was established in 1336 and lasted until 1573. Kyoto once again became the actual capital. the headquarters being at Muromachi. The *Yamato-e* tradition of making illustrated scrolls was weakened by changes in taste and in mode of life, such as the introduction of the tokonoma. *The Yomato-e* school, henceforth

called the Tosa school because it was led by a family bearing this name, degenerated into a mannerism, though Tosa Mitsunobu did some excellent works in the late 15th and early 16th centuries. During the 14th century a complete change came over the spirit of Japanese painting. During the latter half of the Kamakura period the doctrines of the Zen sect of Buddhism had taken a deep hold on the samurai, the warrior class, as well as on the monks. Zen despised ceremony, the worship of images and dogmas; it relied on wordless communication, on contemplation of the absolute in oneself. Zen had been the dominant inspiration of the art of the latter part of the Sung period in China; and it was to Chinese painting of that period that the Japanese now turned. The Japanese accepted as the archetypes of this new movement the great masters Hsia Kuei and Ma Yiian and a master of ink sketch, Mu Ch'i. The sumi paintings inspired by Zen doctrine during the Sung and Yiian periods were eagerly collected, a fact which naturally influenced Japanese painting and helped inaugurate a new era in art.

This movement had a few precursors in the 14th century, notably the priest Mokuan, an early exponent of the new technique, and then Kaō and Ryōzen, both Zen priests. In the latter half of the century there appeared the great priest-painter Minchō (1352–1431), who painted Buddhist subjects, and possibly landscapes, with powerful brush strokes in the new Chinese style. By the beginning of the 15th century the rising generation was drawn more and more to the Chinese style, producing swift sketches in *sumi* wash, charged with concentrated energy. A spray of blossom, a bird poised on a reed, a glimpse of mountains among the mists, a sage absorbed in thought — the theme, whatever it was, was not so much the thing represented as what the theme evoked in the spectator's mind: fact, transmuted to symbol and idea. To find the spiritual reality in oneself was the Zen aim; an insight into the universe, embodied by the painter's brush in a hinted scene, could be more potent than all the teaching of the sages. The central figure of the new school was Shtibun (fl. early 1jth century), a priest of the Shōkokuji monastery in Kyoto, who was appointed a court painter to the shogun. He was preceded by Josetsu (fl. early 15th century) and followed by Bunsei (fl. mid-15th century), Sōtan (1413–81) and Geiami (1431–8j).

A still greater artist, Sesshti (1420–1506), created a more personal art, which is distinguished for its force and intensity of conception and vehemence of brush stroke, though he painted in several different styles. He had numerous disciples and followers, among whom Sesson (1504–89?) was the greatest. Another school was originated by Kanō Masanobu (1434–1530), the first of the long line of Kanō artists, which lasted into modern times. The family, of military stock, was soon patronized by the shoguns. The Kanō tradition would not have become so powerful had it not been for the genius of Masanobu's son Motonobu (1476–1559), who was one of the greatest masters of Japanese painting. Being not a priest but a professional painter he freed the Chinese style of painting from the predominant influence of Zen Buddhism, and made aesthetic satisfaction its only object. As a result his own Japanese taste asserted itself in his work. He learned not only from Chinese Sung and Ming paintings but also from traditional Yamato-e, and established a new nationalized Chinese style, which came to be known as the Kanō style. The Kanō masters dominated painting for several generations.

Momoyama Period (1573–1615).—Motonobu's grandson, Eitoku (1543–90) gave a new character to the Kanō style. At the end of the civil war which ended with the downfall of the Ashikaga shogunate, there was a revulsion in taste from the reticent severity of the Muromachi period toward material splendour. Great war lords like Nobunaga and Hideyoshi, who finally unified Japan, built huge castles with vast apartments. These were sumptuously decorated with gorgeous sliding panels and folding screens painted by Eitoku, Sanraku (1559–163j) and their pupils. Among the screen and panel paintings of this period are some of the finest creations of Japanese art. They combine energy and breadth with monumental design and are often painted with splendid colours on a ground of gold leaf. The lines drawn in vigorous brushwork have the imaginative feeling which expresses high artistic sensitiveness and finely developed taste. This style followed the Chinese example in its synthetic power, emotional concentration and massive grandeur, while taking over some of the Yamato-e conventions, especially its decorative use of colour.

Besides the Kanō masters, some other excellent painters also produced monumental masterpieces. Hasegawa Tōhaku (1539–1610) was the most prominent among them. He created his own style of sumi painting under the strong influence of Mu Ch'i. Some scholars think he also did such sumptuous paintings in colour as the celebrated series of sliding doors in the Chishaku-in temple, Kyoto. Even in the pure Yamato-e tradition there evolved a monumental style, out of which was to grow the decorative style of Sōtatsu and Kōrin.

Edo Period (1615–1867).—The civil wars ended at last with the establishment of the Tokugawa shogunate government in Edo (the present Tokyo). The hereditary position of court painters to the shogun was held by the Kanō family. Tanyū (1602–74), grandson of Eitoku, returned to the simple taste of the early Kanō masters, and became the model which the Kanō school was to follow. Ink painting, usually with light tints added, was the favourite medium. The Kanō school remained influential as the official school of painting throughout the period, but their art degenerated into mannerism by the late 17th century.

The Tosa school maintained itself, but in general its painters depended on its past, repeating a consecrated formula, except Mitsuoki (1617–91) who broke new ground by adopting the keen realism of Chinese Sung academicians. In strength of colour the Tosa school was outmoded by a new decorative style which was created in the early part of the 17th century by Sōtatsu, an extraordinary genius whose biography is obscure. Apparently under the strong influence of Kōetsu (1558–1637), who was a distinguished aesthete, a man of many talents and most of all an incomparable calligrapher, Sōtatsu developed his decorative style on the ground of Yanzato-e tradition, taking over also the technique of Chinese sumi-wash painting, which he also applied to painting in colour. His painting is a highly decorative transformation of nature apprehended by the artist's characteristic Japanese sensibility. Sometimes Sōtatsu collaborated with Kōetsu, the latter writing poems on paper decorated by the former with floral and animal designs treated in flat washes of gold and silver. Ogata Kōrin (1658–1716) carried the decorative style to yet further audacities. His bold abstraction of nature in a colourful decorative pattern is unique. His brother Kenzan (1663–1743) was a fine painter in the same style, but even more distinguished as a potter. The style was to be revived later by the exquisite but rather cold Sakai Hōitsu (1761–1828).

Ukiyo-e.—Another school was that of Ukiyo-e, the picture of the transient world of daily life. In the Momoyama and early Edo periods there had been painters of the traditional schools, notably the Kanō school, who ventured on subject matter drawn from contemporary everyday life. They produced splendid genre paintings representing such themes as people at their occupations, gaiety in the amusement quarters or at the festivals, and picnics in the countryside. In the first half of the 17th century pretty girls also became a favourite theme. These pictures reflect the artists' new interest in everyday life, but were painted mostly for rich patrons, not for the people. It was in the second half of the 17th century that Ukiyo-e arose in Edo as popular art to meet the new artistic demand of the lower classes. The leading painter was Hishikama Moronobu (1618?–94?), a genius who established the basic style of Ukiyo-e both in painting and prints. Working as an illustrator for storybooks, he exploited the woodcut as an inexpensive means for mirroring the contemporary life of the people; and the woodcut became the medium of a truly popular art which was yet of singular refinement. It is in wood-block prints (see below) that most of the Ukiyo-e masters did their best work. But they were also painters, and a few of the best Ukiyo-e artists, like Chōshun, designed no prints. Ukiyo-e was almost exclusively the art of the populace of Edo. Meanwhile, during the 18th century, other movements were stirring in Kyōto and elsewhere.

First, there was the rise of a new Chinese movement called Bunjin-ga or literary men's painting, which was fostered by in-

tellectuals. Its models were the light, freely handled landscapes in sumi of the so-called Southern school of painting advanced by Chinese literati in the Ming and Ch'ing periods. Ike-no-Taiga (1723–76) and Yosa Buson (1716–83) established Bunjin-ga in Japan. Each developed a highly individual style, but both used the light, soft brushwork of the Southern school to great advantage in expressing poetic sentiment. They were followed by another great genius, Uragami Gyokudō (1745–1820). Another Chinese movement was stirred by beautifully coloured. rather naturalistic. flower painting introduced by a Chinese painter, Shên Nan-p'in, who came to Nagasaki in 1731. Although he did not have any distinguished followers, his influence was great; it reinforced the naturalistic tendency of the time, of which Maruyama Ōkyo (1733–95) mas the protagonist. Under the influence of Shên's naturalistic painting and Dutch copperplate prints Ōkyo painted with an unerring brush more directly from nature than earlier Japanese, though he never deserted the main conventions of his country's art. He soon found many followers both in Kyoto and Edo, including several painters of some importance. The poetic Bunjin-ga and the fastidious naturalism of Okyo's Maruyama school were successfully merged by Matsumura Goshun (1752–1811) in his refined, graceful painting, full of life and poetry. His Shijō school proved popular through the rest of the Edo period.

European painting introduced by Jesuit missionaries in the late 16th century had surprisingly little influence. Although adopted at the time by a small group, the technique of European painting disappeared almost completely after the prohibition of Christianity. The realism of European painting, reintroduced by the Dutch, began to inffuence Japanese painting, though only slightly. in the 18th century, as in the case of Ōkyo. European perspective was attempted by some Ukiyo-e masters. Watanabe Kazan (1793–1841), a pupil of fashionable eclectic painter. Tani Bunch6 (1763–1840), took advantage of European realism to give his paintings, particularly portraits, lifelike effect. Some painters tried oil, some others copperplate prints, but their work was nothing more than experiment.

Modern Development (1868–). — With the Meiji restoration (1868) Japan entered into the international world. It hurriedly imported western civilization in every field, resulting in the co-existence of two different cultures, traditional Japanese and modern western. With this dual civilization as its background. modern Japanese painting is extremely diverse in its appearance. It is customarily classified, after the medium used. into two categories. Japanese style and western style. As a result of the introduction of European culture, especially its natural science and 19th-century realism, the Japanese learned the European way of seeing things. They learned of various rules of objective realism such as linear and aerial perspective, and shading. This knowledge lured Japanese artists; a conflict between image and perception arose in the mind of Japanese painters. To overcome this conflict many differentapproaches have been tried. The first attempt was realism. The western-minded took up realistic oil painting, and later imported Impressionism. The traditionally-minded advanced the realistic element of traditional Japanese painting, especially the Maruyama and Shijō schools; Takeuchi Seihō (1864–1942) and Kawai Gyokudō (1873–1957) are the representative artists of this trend. Meanwhile. Okakura Kakuzō (1862–1913), a gifted art critic nho inspired young Japanese-style painters with his romantic idealism, called for a modern revival of traditional, subjective painting. The early exponents of this movement were Yokoyama Taikan (1868–1958) and Hishida Shunso (1874–1911). The artists of the next generation. such as Kobayashi Kokei (1883–1957) and Hayami Gyoshū (1894–1935), worked further to find a new way of representing the intrinsic beauty of nature as a higher synthesis of modern realism and characteristic Japanese subjectivism. The younger generation followed them. Among the western-style painters, too, a reaction against realism set in after World War I. In their case the influence of European modern art movements was particularly strong. Some painters, however, succeeded in using European technique in a Japanese way. After World War II life became too complex, mental tensions and agonies too acute, to be dealt with in a traditional art form, Japanese or western. The subjectivistic movement in the western art world, which expanded the field of representation to the full range of human mental activities, significantly influenced young artists in their effort to find adequate visual forms for expressing their complicated inward life. Even Japanese-style painters have taken advantage of this recent development. It still does not seem likely, however, that Japan's ancient inheritance in art will ever be wholly superseded.

WOOD-BLOCK PRINTS

The art of the copperplate print which was introduced in the 16th century by the Jesuits and was reintroduced in the 18th century by the Dutch, did not prove congenial. The woodcut is the national mode of engraving and has been carried to a pitch of marvelous perfection. The art of the woodcut was introduced into Japan from China in the wake of Buddhism. It was used for printing both texts and pictures. Actually, the earliest surviving specimens of printed texts in the world are Japanese, dating from the 8th century, and are in the form of Buddhist charms. For a long period the woodcut was confined to the production of popular images of piety. The earliest extant woodcuts of genre subjects date from the late 12th century. They are designs on fan-shaped papers on which sacred texts were written. In 1391 and again in 1414 some remarkable woodcuts were made to illustrate a block-printed history of the Yūzū Nembutsu sect, but there was no real development of the art until the 17th century.

In 1608 an illustrated edition of the Ise monogatari, a classic story, appeared with woodcuts. Other illustrated editions of classic and popular stories followed. But it was Hishikawa Moronobu who transformed the art and made possible all the brilliant work of the Ukiyo-e artists of the 18th century. A desire for the pleasure of art had sprung up among the loner classes, now that they at last enjoyed the peace of a settled government. Paintings were too expensive. Moronobu saw the enormous possibilities of the woodcut and adapted his style to the limitations and possibilities of the medium. There was soon a demand for colour. Moronobu and his pupils produced broadsheets as well as books, and these were often coloured by hand, tan, or red lead, being the dominant colour (hence the name tan-e for these prints).

The theatre was a passion of the Edo populace. An actor named Torii Kiyomoto. who designed posters for the Osaka theatre, came to Edo in 1687 and though his own work has not survived, he founded a famous dynasty of artists. His son Kiyonobu (1664–1729) was the first to design portraits of actors. which were to remain one of the staple themes of print artists. Kiyonobu's son Kiyomasu I (1694–1716?) rivaled his father. Competing in popularity with portraits of actors were portraits of fashionable beauties, especially courtesans. The Kaigetsudō group of artists during the early years of the 18th century produced some stately prints of women. But in this field Okumura Masanobu (1686–1764) was much more inventive and productive.

In the early 1740s Ckiyo-e came to be printed in two or three colours. Colour printing, invented in China in the 16th century, was introduced into Japan as early as 1634: the frontispiece of the 1634 edition of the Jingo-ki was printed in colours. But the technique was not applied to popular prints until about 1740. The cherry wood used was carved on the plank, as in Europe until the days of Thomas Bewick. A separate block was cut for each colour. Accurate register was obtained by the simple means of a guide mark in the form of a right angle at the lower right corner of each block and a straight line parallel to the lower edge near the left corner. The tao- or three-colour prints were called beni-e. (The same name was used for hand-coloured prints more elaborate than tan-e.) Masanobu, Kiyonobu II, Kiyomasu II and Ishikawa Toyonobu (1711–85) worked in this medium. The number of colours was soon increased to five. In 176j the first elaborate polychrome prints, called nzshiki-e, were published by Suzuki Harunobu (1725–70), an enchanting colourist, who until his death was to reign over Ukiyo-e. He created a fashion for pictures of lyrical scenes with figures of exquisite grace. Harunobu's closest follower was Koryusai. Katsukawa Shunshō (1726–92) revived the prestige of

the theatrical prints, neglected by Harunobu, by representing the actors in a less stylized manner than the early Torii masters. From about 1780 to 1790 Ukiyo-e was again dominated by a single master, Torii Kiyonaga (1752–1815), in whose designs the almost childlike grace of Harunobu's types was supplanted by tall and stately figures. There is an unrivaled poise and dignity in his groups. Utamaro (1753?–1806) was an even greater master of figure design. In the discovery of beautiful relations between figures, in a sort of intensity of design, and in revealing the sensuous beauty of women, he is incomparable. During the 1790s Eishi and Toyokuni competed with Utamaro for popular favour. Sharaku published in 1794–95 a series of actor prints surpassing in power all his predecessors in this line. After Utamaro's death in 1806, Ukiyo-e as an art for representing beauties and actors declined, but the school was regenerated by Hokusai (1760–1849) who found new inspiration in landscape. His "Thirty-six Views of Mt. Fuji" and other sets contain some of the finest landscape designs ever made. A little later Hiroshige (1797–1858) in countless sets of prints depicted every aspect of his own country in every weather, with extraordinary intimacy and freshness. His contemporaries, Kuniyoshi and Kunisada, were the last Ukiyo-e masters of figure design. The school which had mirrored the popular life of Edo for two centuries virtually came to an end with Hiroshige's death.

The revival of the art of woodcut began in the late 1920s as part of the modern art movement. The precursor was Yamamoto Kanae (1882–1946). Onchi Kōshirō (1891–1955) and Hiratsuka Un-ichi (1895–) were early exponents who, though working in entirely different styles, did most for the renaissance of this national art, which thrived after World War II.

BIBLIOGRAPHY.—H. Minamoto, *An Illustrated History of Japanese Art*, Eng. trans. by H. G. Henderson (1935); L. Warner, *The Enduring Art of Japan* (1952); R. T. Paine and A. Soper, *The Art and Architecture of Japan* (1955); *Pageant of Japanese Art*, vol. i and ii (painting by I. Kondo) (1957); M. Kawakita, *Modern Japanese Painting* (1957); Y. Yashiro, *Two Thousand Years of Japanese Art* (1958); S. Tajima, *Masterpieces Selected From the Ukiyoye School* (1906–09); Vignier and Inada, *Estampes Japonaises* (1910–14); L. Binyon and J. J. O. Sexton, *Japanese Colour Prints* (1923); O. Statler, *Modern Japanese Prints* (1956). (L. Bi.; C. F. Y.)

JAPANESE SCULPTURE. The sculpture of Japan presents an unbroken tradition of three-dimensional image making from prehistoric to modern times. Art historians use the term to cover figures of clay, wood, bronze, lacquer and other materials as well as stone.

EARLY HISTORY (Before A.D. 552)

The earliest examples of Japanese sculpture are clay figures of the Jomon period, perhaps akin to fertility goddesses found elsewhere in the world. From prehistoric into early historic times, or roughly from the third into the seventh century, Japan produced a unique type of sculpture in the form of hollow reddish clay figures called *haniwa*, which were partially imbedded in an erect position about important grave mounds. The distinctive tubular character of the early purely geometric examples is maintained even as they develop into recognizable subjects. The subjects include armed warriors, female musicians and harnessed horses, in broadest abstraction combined with the accurate rendering of such appurtenances as helmets, knives, belts, necklaces, saddles and bridles. Dogs, pigs, monkeys and birds capture the peculiar essence of each creature without losing their characteristic hollow plastic form. Models of boats and houses are also found. Attempts to associate the haniwa with the contemporaneous tomb figures of China (ming ch'i) serve rather to emphasize differences. Since they are products of the indigenous Shinto tradition, parallels are better sought on Japanese soil, as, for example, in folk-toy survivals.

A striking feature of the *haniwa* not found in the Chinese ming ch'i is the hollow eye, or other aperture, interpreted as the point of entrance for an indwelling spirit.

ASUKA PERIOD (A.D. 552–645)

Introduction of Buddhism.—When foreign gods in anthropomorphic guise were introduced with Buddhism in 552 (or a few decades earlier), the concept of a man-made image designed to hold a spirit was clearly one with which the Japanese were already familiar. The earliest Buddhist images to come, Chinese or Korean, were given a mixed reception and some were destroyed because of their understood threat as real gods, rather than as mere idols. The new religion was not to gain a foothold without bitter strife which the pro-Buddhist Soga clan eventually won—aided, according to legend, by the Guardian Kings of the Four Quarters of the Cosmos (Shi-tenno).

Thereafter, these four deities were especially venerated and often were subjects for the image makers.

Suiko Style.—The subjects of the early Buddhist sculptors sprang from the hierarchy of the gods of Mahayana or Northern Buddhism, and came full-fledged with that religion from the mainland. An important factor in the acceptance of these foreign deities was undoubtedly the abstract simplicity of the primitive Wei style then flourishing in China. The naive. sincere and joyful qualities which that style gave to Chinese Buddhist sculpture must have aided the Japanese in their ready acceptance of the religion. Certainly those very qualities reappeared in the early Buddhist sculpture of the Suiko style (593–628), a number of which have been preserved in the kondo—main hall of worship—at the Horyu-ji, a temple built in A.D. 607 The central image, a bronze Shaka, the Buddha known to history as Sakyamuni. portrayed as a superhuman sage in meditation, forms a triad with a pair of Bodhisattvas. beings in the hierarchy second only to Buddhas. Although knonn to have been made under the direction of Tori Busshi, a man of Korean descent, the three recall many of the figures hewn in the cliffs of Yunkang, China, a scant four decades earlier. These and other treasured images are guarded by the only surviving Suiko set of Guardian Kings—still lower in the hierarchy—four solid woods with gilt bronze crowns, each supported by crouching demonic monsters. They are identified as Jikoku-ten and Komoku-ten, protectors of east and west, and Zocho-ten and Tamon-ten. protectors of south and north, being the *lokapalas* of Indian lore. Overhead hang three original baldachins, on which are many youthful Apsarases, one of the minor categories of celestials, seated or kneeling on lotus flowers, clad in skirts and flying scarves, playing musical instruments and praising Buddha. These delightful wooden miniatures and the rows of accompanying phoenixes still bear traces of original paint. The arrangement of the whole (suggested here by a partial selection of objects now kept on the main dais), is important as preserving more or less intact examples of the earliest sculptures in their proper relationship to each other.

Also kept in the kondo is the slender six-foot Kwannon (or Kokuzo) a gift, according to tradition, from the Korean kingdom of Kudara (Paekche). Much original colour and a gilt bronze crown remain.

An equally famous wooden Kwannon, also possibly Korean, is enshrined in the nearby Yume-dono (Dream hall). where it was kept in secret, wrapped up in yards of cloth, for centuries. A huge and elaborate openwork crown appropriately graces this, one of the most appealing images of this Merciful Bodhisattva.

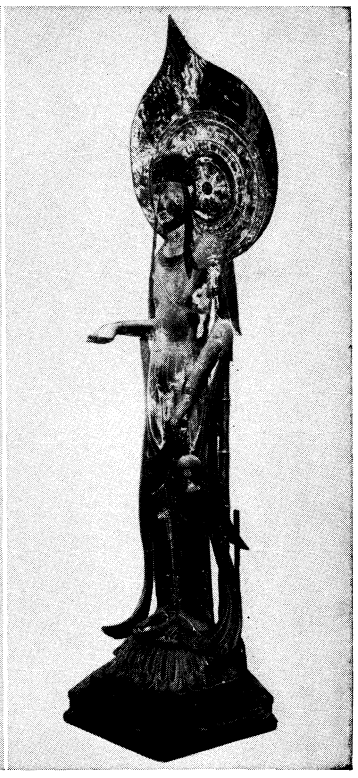
Half a dozen lesser wooden Suiko figures, "the six Kwannon," also belonging to this temple were apparently fashioned in wood after bronze prototypes—with gilded surfaces completing the illusion of the dearer material. A further group of nearly 50 small bronzes from the Horyu-ji, a gift to the Imperial Household in the 19th century and now in the Tokyo National museum, includes many Suiko Buddhas, Bodhisattvas and a unique image of Maya, mother of the Buddha, at the moment of his miraculous birth. The holy child is shown emerging from her right sleeve. Two flying Apsarases from a set of attendants to this figure are also preserved.

Among the few Suiko sculptures outside the Horyu-ji is a large and dignified wooden Bodhisattva at Horin-ji.

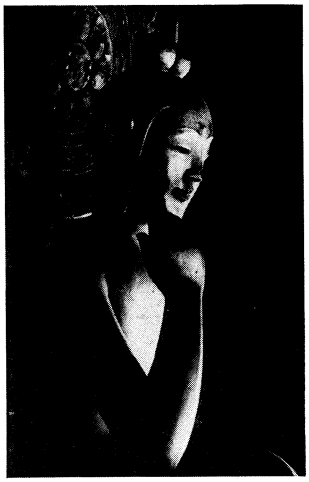
All Suiko images bear the unmistakable signs of primitive art reflecting the known early Chinese styles, or the Korean equivalents and embodying occasional Japanese variations difficult to detect. Large heads, gentle smiles, almond-shaped eyes, wedge-shaped necks, crossed scarves, cloth folds that resemble running

Above: Two haniwa, clay figures found associated with grave mounds dating before A.D. 552

Above, left: Wood Kwannon, Horyu-ji temple. Asuka period. Centre: Tamon-ten, one of the four Guardian Kings; wood, with gilt bronze crown. Horyu-ji temple. Asuka period. Right: "Kudara" Kwannon of wood, six ft. high. Horyu-ji temple. Asuka period

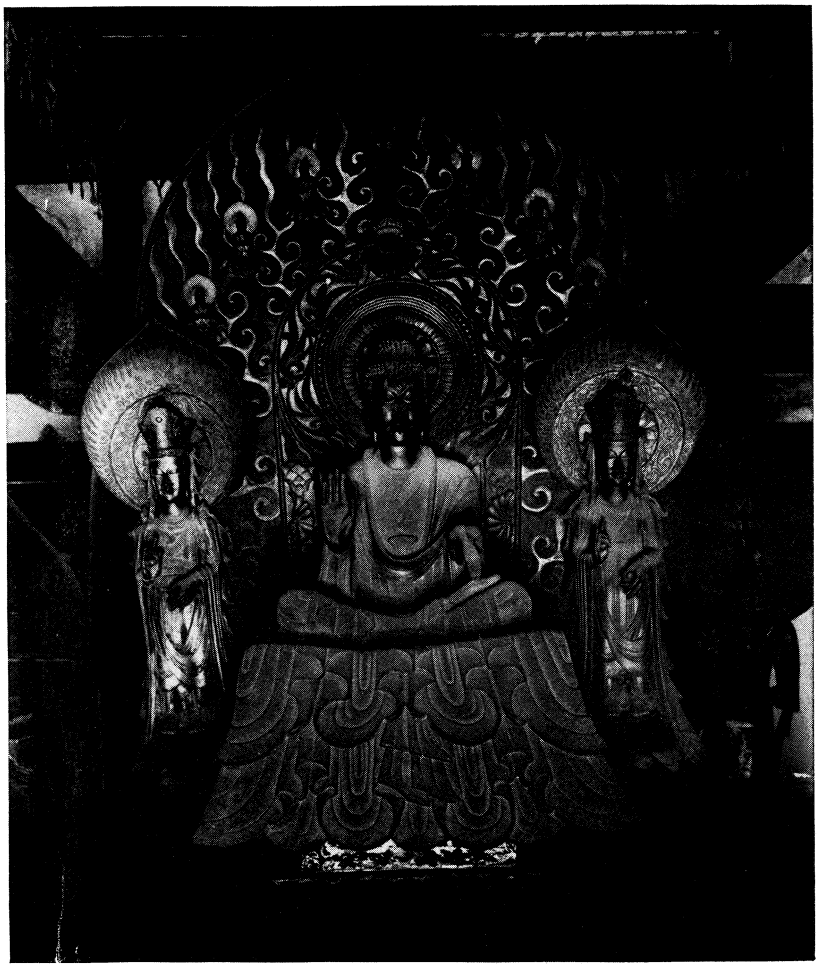


SCULPTURE OF THE JOMON (BEFORE A.D. 552) AND ASUKA (A.D. 552–645) PERIODS



Detail of the head of the so-called Nyoirin Kwannon, Miroku. Chugu-ji nunnery, Nara, Wood. Asuka period

Shaka trinity, Horyu-ji temple. Entirely in bronze, the group is comprised of the Buddha Sakyamuni and a pair of Bodhisattvas. Asuka period



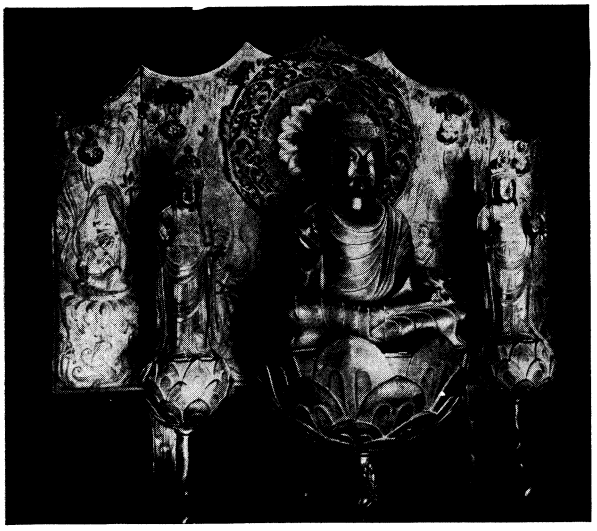
GRAPHS (PAIR AT TOP LEFT AND BOTTOM LEFT) ASUKA-EN, JAPAN

JAPANESE SCULPTURE

Buddha head, Kofuku-ji temple, Nara. Bronze; three feet high

Six-foot bronze Sho-kwannon, Yakushi-ji

HAKUHO PERIOD (A.D. 645–710)



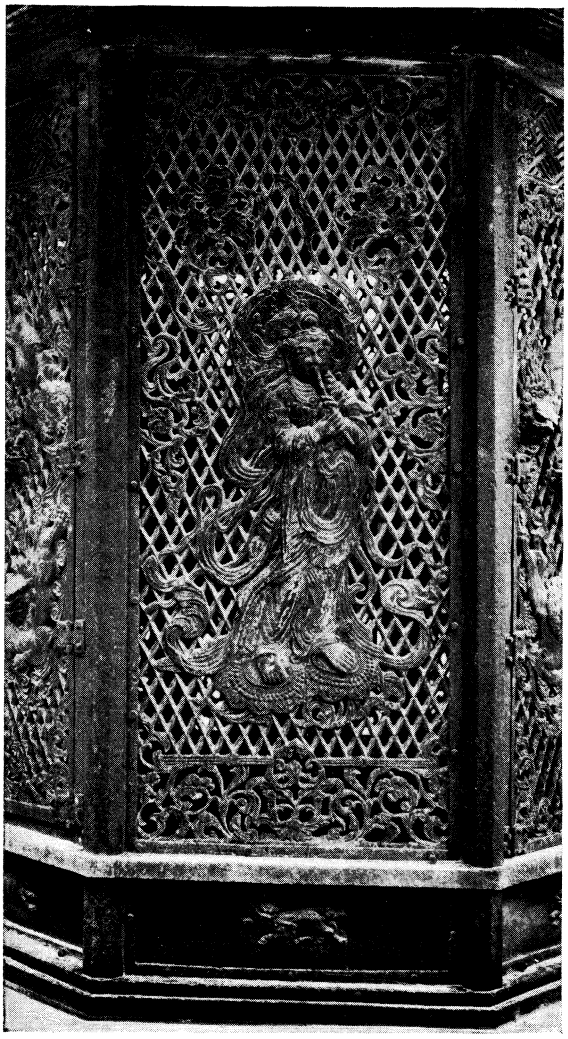
Details of Lady Tachibana's shrine, Horyu-ji. Above left, the Amida trinity: Buddha, Kwannon and Seishi. Below left, detail of the screen behind the trinity. Below right, detail of the "lake" from which rise the lotuses on which the trinity sit. The shrine is of gilt bronze; less than two feet high

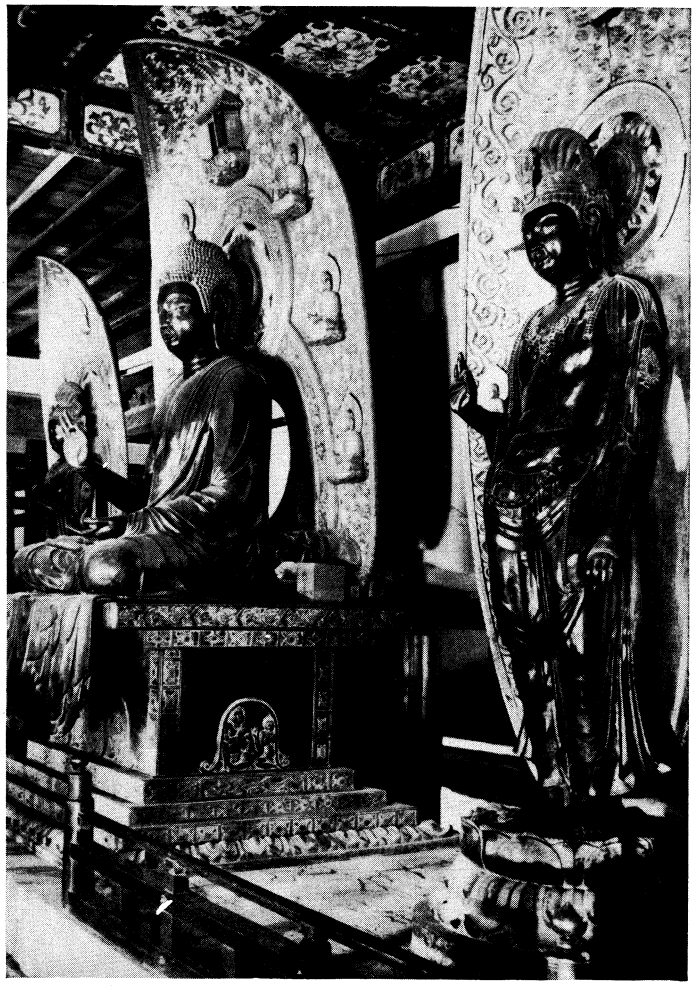
PHOTOGRAPHS, ASUKA-EN, JAPAN

Detail of the figure of Gakko, 11 ft. high, from the triad at Yakushi-ji

NARA (TEMPYO) PERIOD (A.D. 710–784)

Panel depicting one of the heavenly musicians from a bronze lantern at Todai-ji





The bronze triad at Yakushi-ji: Buddha flanked by Nikko and Gakko

Incised bronze image of Buddha on one of the lotus leaves from the Buddha Roshana (Vairocana), Todai-ji, Nara

PHOTOGRAPHS, (TOP LEFT, TOP RIGHT. BOTTOM RIGHT) ASUKA-EN, JAPAN

JAPANESE SCULPTURE

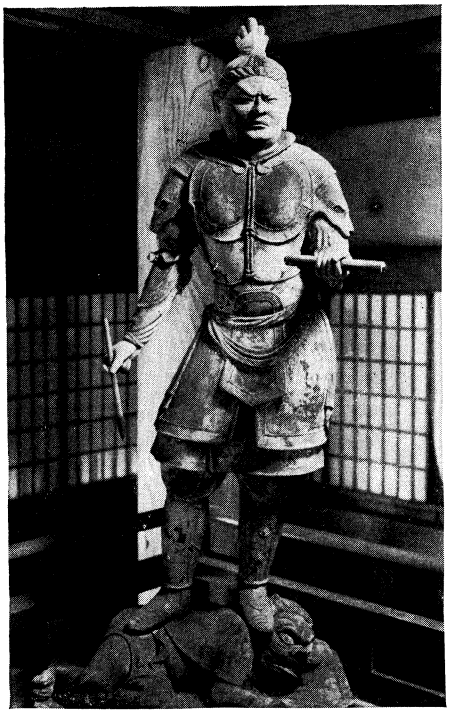
Eight-armed Fuku-kenjaku Kwannon at the Sangatsu-do, Todai-ji, Nara. Dry lacquer

The attendant figures of Taishaku-ten and Bon-ten in front of the Fuku-kenjaku Kwannon, Sangatsu-do. Dry lacquer

Head of one of the four Heavenly Kings, Sangatsu-do, Todai-ji. Dry lacquer

NARA PERIOD

Below left: Shukkongo-jin, the Thunderbolt Bearer (Vajrapani), Sangatsu-do, Todai-ji; unbaked clay. *Below centre:* Komoku-ten, one of the four Heavenly Guardians in the Kaidan-in, Todai-ji; clay



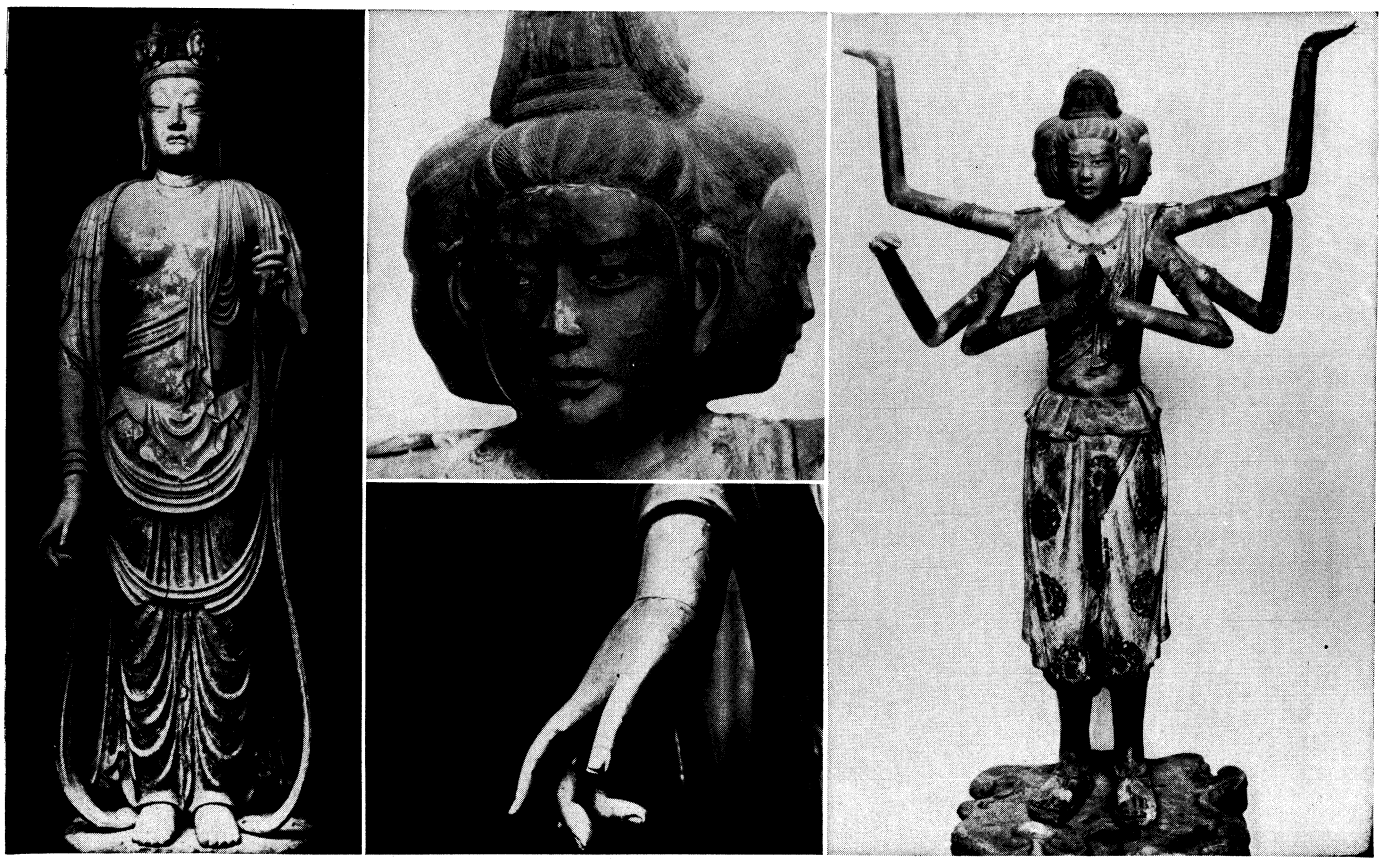
Jikoku-ten, another of the Heavenly Guardians of the Kaidan-in

PHOTOGRAPHS (ALL EXCEPT BOTTOM CENTRE) ASUKA-EN, JAPAN

THOUSAND-ARMED (SENJU) KWANNON, TOSHODAI-JI MONASTERY

Dry lacquer, 17½ ft. high. Nara period

JAPANESE SCULPTURE



Left: Juichi-men (Eleven-faced) **Kwannon, Shorin-ji,** Nara. Dry lacquer, **6½ ft.** high. Centre, above: Detail of the head of Ashura. Centre, below: Detail of the hand of **Juichi-men.** ***Right:*** Ashura, a three-faced, six-armed dry lacquer sculpture from the Kofuku-ji, Nara

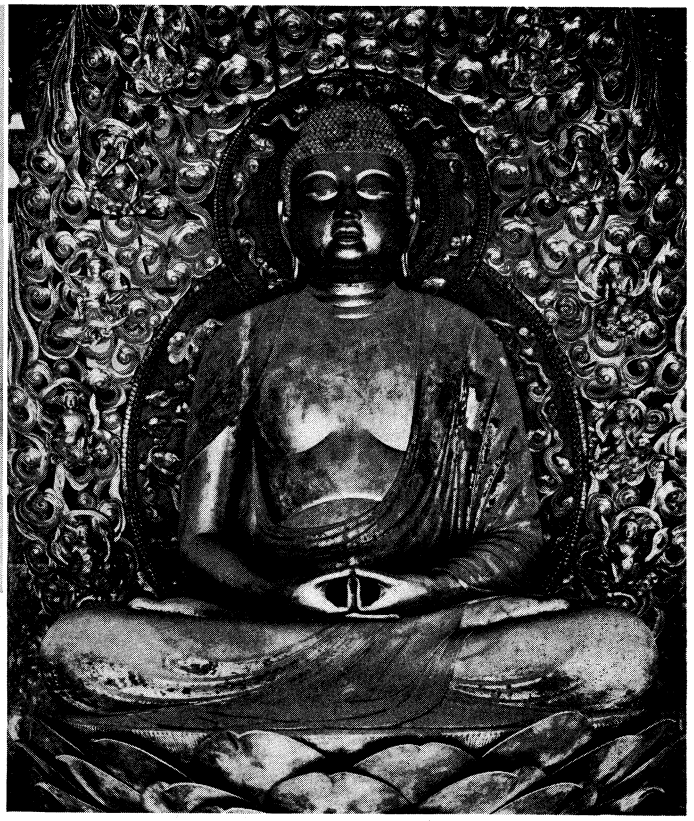
The priest Ganjin, a life-size lacquer. **Toshodai-ji** monastery

NARA PERIOD

Roshana Buddha and attendant figures, **Toshodai-ji.** Dry lacquer, **11** ft. high

PHOTOGRAPHS, ASUKA-EN. JAPAN

Left: Eleven-faced Kwannon, Hokke-ji, Kyoto. Unpainted sandalwood. Early Heian. *Right:* Buddha, larger than life size, Gango-ji, Nara. Wood. Early Heian



Amida of the Howo-do (Phoenix hall), Byodo-in, Uji. Nine ft., wood overlaid with gold leaf. Late Heian

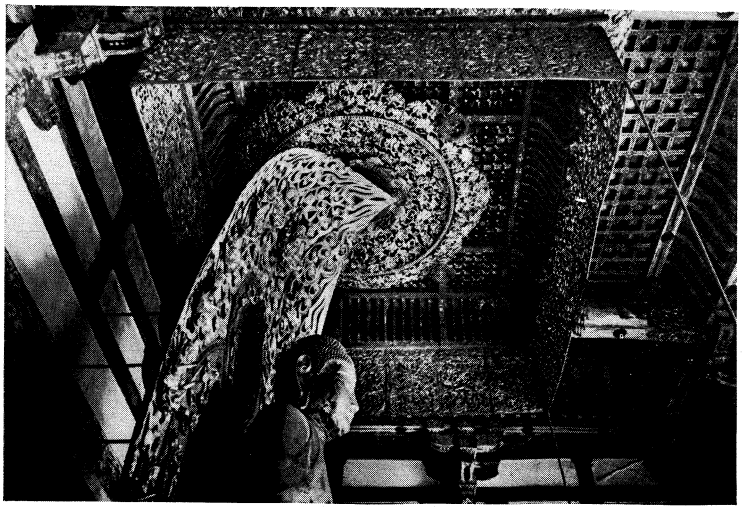
EARLY HEIAN (JOGAN) (A.D. 784–897) AND LATE HEIAN (FUJIWARA), (A.D. 898–1185)

Kichijo-ten (Goddess of Good Luck) at Joruru-ji temple, near Nara. Painted wood. Late Heian

Ichiji Kinrin, Chuson-ji, Iwate prefecture. Wood. Late Heian

Meikira, one of the 12 generals, Kofuku-ji, Nara. Wood in low relief. Late Heian

Canopy and ceiling of the Howo-do, Byodo-in. Wood. Late Heian

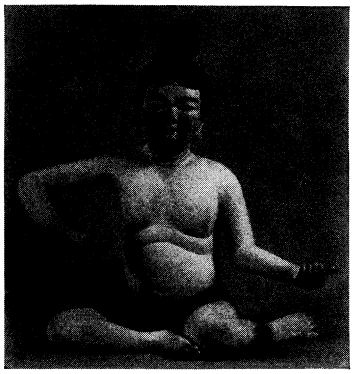


JAPANESE SCULPTURE

Demon lantern-bearer, Kofuku-ji, Nara. Wood

Left: The old mendicant Basu, Sanjusan-gen-do, Kyoto; wood. ***Right:*** The patriarch Muchaku, Kofuku-ji; wood, 6 ft. high

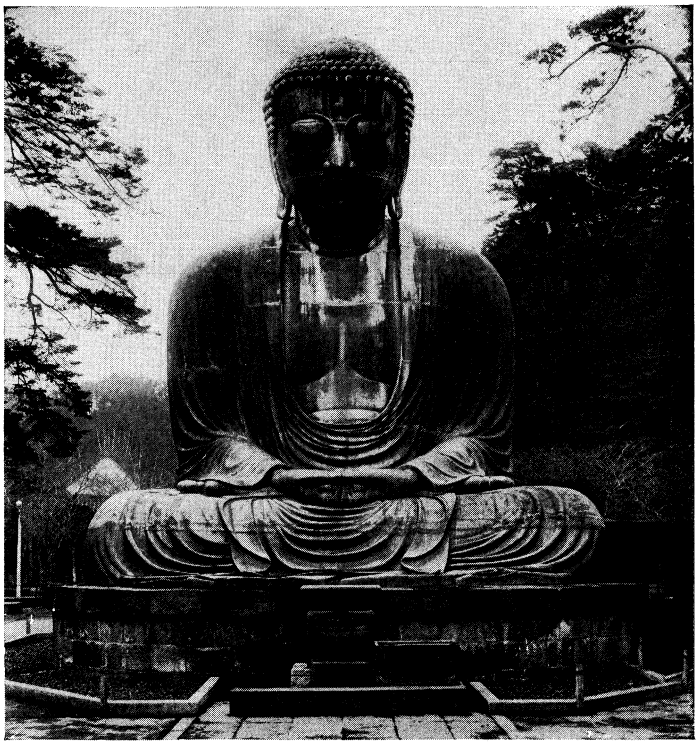
Portrait of Uesugi Shigefusa, Kamakura city. Wood



The goddess Ben-ten, Kamakura city. Wood

KAMAKURA PERIOD (A.D. 1185–1392)

Dainichi at Enjo-ji, Nara. Wood



The great bronze Amida of Kamakura. Cast in 1252, it is 49 ft. high including dais

script "r's," and serrate scarf ends are typical features in a school of sculpture that anticipates much of the appearance and spirituality of the Romanesque in the west.

The style flourished with the Buddhist church as a result of three important factors: (1) the initial leadership of continental monks and nuns, (2) the patronage of Prince Shotoku (572–621) and the Empress Suiko (593–628). and (3) the faith of the multitude who were never required to renounce their own loved Shinto gods.

HAKUHO PERIOD (A.D. 645–710)

Confucianism, coming in with the Taikwa Reforms of A.D. 645, had no deterring effect on Buddhism. The Suiko style in sculpture continued into Hakuho with no sudden changes, so that borderline examples are irregularly attributed to either period. Three notable wooden Bodhisattvas identified by scholars as Miroku Bosatsu (Sanscrit, Maitreya), the Buddha of the Future, are often classified under Hakuho. They sit on lotus pedestals in the Pose of Royal Ease, *lalita asana,* with one leg resting horizontally, the other pendant, one hand against cheek, smiling and thoughtful. The earliest is the highly polished image, distinctive for its double top-knot and subtle charm, at Chugu-ji nunnery near Horyu-ji. It is worshipped there today as Kwannon. The other two are kept at Koryu-ji, Kyoto. One is noted for the freshness of its condition, a calculated twist to one wrist, and an attribution, apparently anachronistic, to the hand of Shotoku. The last has some of its carved draperies eked out with lacquered leather, a unique feature for the period.

Sophistication crept into Hakuho style almost imperceptibly as the child-like simplicity inherited from Suiko eventually felt the impact of early T'ang developments in China. Faces are slightly rounder; arms are longer and "pipelike" without hint of muscle; bodies tend toward human proportion; parallel drapery lines give in to the converging; stiff drapery folds take on fluidity. Hands are smaller, hieratic gestures more carefully observed. The formal Suiko vision is tempered by a few new craftsman's devices, but retains its essentially wondrous nature.

Several examples in bronze remain—*e.g.,* the so-called "Fragrant Yakushi," Buddha of Healing at the Shinyakushi-ji, standing erect, his austere form enhanced by a monk's robe with folds modeled like rippling waves. An equally fine example for the Bodhisattva type is the Horyu-ji's Kwannon called "Yumetagae" or "Dream Conjuror" for its understood power to transform bad dreams into good. The royal bearing of the type is expertly emphasized with crown, jewelry, scarves and closely draped skirt or *dhoti.*

The greatest treasure from the period, however, is the Lady Tachibana's shrine at Horyu-ji.

In this, Amida Buddha with intricate openwork halo, and attendants Kwannon and Seishi, rise on three lotuses that spiral upward from a wind-blown lake. A background screen portrays in delicate relief five lotus-borne heavenly beings with scarves swirling up toward tiny Buddhas. The shrine, less than two feet high, is of gilt bronze. The six-foot bronze Sho-kwannon at Yakushi-ji that curiously combines primitive serrate drapery with subtly looped scarves and other conflicting features, is the largest of the period—if it is not a later archaistic piece. That a much larger bronze once existed is shown by the three-foot Buddha head found in 1937 at Kofuku-ji. Scholars date this head between A.D. 678 and 685.

NARA (TEMPYO) PERIOD (A.D. 710–784)

Buddhism, actively encouraged by the great Emperor Shomu (724–749) and other royal patrons, attained unbelievable power and prosperity. The founding of new temples increased the demand for sacred images and the image makers, centred about Nara, the new capital, flourished as never before. This is Japan's golden age of sculpture. The craft guilds and Buddhist workshops included bronze casters, gilders, clay modelers, lacquerers, wood carvers and others, equal to the craftsmen of contemporary T'ang China. They produced one of the world's finest bronze groups in the triad at Yakushi-ji, a noble seated Yakushi Buddha, nine feet high, flanked by eleven-foot figures of Nikko and Gakko. Standards of the Tempyo style, they are done in the full round almost fleshly style of T'ang with calligraphic line wedded to plastically conceived flowing drapery. The nobility of their canonical proportions assures for them a godly stature and saves them from the stigma of "idealized anatomy." Faces are full and eyebrows highly arched. Except for the Buddha, whose tonsure is suggested in the traditional snail-like curls, headdresses are realistic, as are ears. Necklaces and bracelets grace broadly modeled chests and supple wrists. Hands and rounded fingers display knowledge of precise gestures that were focal points to worshippers.

Mightiest of bronze deities cast in Japan was the original 53-ft. seated Buddha Roshana (Vairocana), dedicated at Todai-ji, Nara, in A.D. 752. Identified with the solar power, a Buddha above all Buddhas, presiding over a cosmos formed of countless worlds, the image must have commanded the highest skill. Fires destroyed it, but its perfection may be inferred from the few original lotus petals that remain beneath the present image, restored in later centuries and known now as "Daibutsu." A bronze lantern of same date and at same temple, with elaborately clad heavenly musicians and hurtling lions in relief on lattice panels, is held equal to the best casting of the Italian Renaissance. The swishing draperies and shaggy manes embody elaborateness and sophistication of three-dimensional style such as Japan had never known before.

Other important bronzes of this period are the Kaniman-ji Shaka, 8 ft. 8 in. high, known for the sculptural beauty of its gestures and drapery folds, and the Todai-ji's 1 ft. 8 in. Infant Buddha, shown as recorded in the scriptures, pointing to Heaven and Earth at the moment of birth.

Paradoxically for so prosperous an era, common clay was also a medium for sculpture. Over 60 small clay saints and divinities made in A.D. 711 remain in four niches in the Horyu-ji pagoda. The Bodhisattvas closely resemble T'ang clays far away at Tunhuang, China. About 30 larger examples—some over life-size—are also found in and about Nara. The majority of these appear to be from a single workshop; 20 are closely related iconographically. There are two sets of the Four Heavenly Guardians, at Todai-ji's initiation hall (Kaidan-in), and at Horyu-ji's refectory (Jiki-do); there are 11 of the god Yakushi's 12 protecting generals (Juni-jinsho) at Shinyakushi-ji; and finally there is the fiercest of them all, Shukkongo-jin—Vajrapani or Thunderbolt Bearer kept in secret in the Todai-ji's Sangatsu-do. Of the four others in this 8th-century hall, the best known are Bon-ten and Taishaku-ten (the Indian gods Brahma and Indra), benign figures in long robes and royal hairdress, standing with hands clasped in reverence. All these clays were once fully coloured with bright pigments of which there are still traces. The necessary stiffness of the figures of the unbaked clay guardians is more than made up for by the masterful, rugged handling of the faces—so that the general appearance is one of action. The last-mentioned pair are subtly modeled in face and garb, being lifelike yet strongly aloof from the world.

Lacquer sculpture was the great specialty of the period. About 50 extant examples are of the hollow variety in which lacquer-soaked cloth was modeled over wooden armatures, lattice supports or removable clay cores.

Remarkable for gigantic size are the nine hollow lacquers of the Sangatsu-do: Bon-ten and Taishaku-ten, the Four Heavenly Kings, the Ni-o (guardian pair named Misshaku and Kongo), and the central eight-armed Fuku-kenjaku Kwannon. They range from 10 to more than 14 ft. high. The Kwannon retains its original many-rayed nimbus, halo and open-work crown graced by a nine-inch Amida Buddha—the only Nara period sculpture done in silver.

Two sets of figures: the Eight Deva types, *hachi-bushu,* and six of an original Ten Disciples of Buddha—an amazing total of 14 slender hollow lacquer figures—near life-size, have survived unseparated since they were made for the Kofuku-ji 12 centuries ago. The stiffly erect bodies, clad in armour or priests' robes embellished in colour, are given life by keenly observed facial features. This is true even of the cock-faced general or the three-

faced, six-armed Ashura.

Of particular importance to the study of lacquer sculpture is the great monastery, Toshodai-ji founded in 759 by the Chinese priest Ganjin. Chinese craftsmen who came with him worked with Japanese on construction of the temple and its images. Here may be seen lacquer figures of all techniques, among which is an intensely moving portrait in hollow lacquer, life-size, of the old and blind Ganjin seated in contemplation.

The main image of the kondo is a colossal seated Roshana Buddha, hollow lacquer with inside lattice support. This is more than 11 ft. high not counting its dais, nor its nimbus with a thousand tiny Buddhas in relief. In the same hall stands the 17½-ft. Senju (Thousand-armed) Kwannon, 953 of its original arms still in place. Tradition attributes this to a spirit who took up temporary residence in the sculptor's body. It was made by modeling in lacquer-soaked materials over a wood core, and is the largest example in that technique.

Under the same roof is also the largest sculpture in the related technique of carved wood surfaced with lacquer—a 12-ft. standing Yakushi.

Other famous sculptures of the wood-core variety are the 6½-ft. figure of Juichi-men (Eleven-faced) Kwannon at Shorin-ji—the tangible vision of a Buddhist saviour at once gentle and magnificent—and the life-size and strikingly lifelike figure of Buddha's friend, the sage Yuima (Vimalakirti) at Hokke-ji nunnery.

Wood sculpture, polychromed over thinly applied kaolin and glue, seems not to have been common until the latter part of the period. An interesting and perhaps an early group of five preserved at Daian-ji shows Kwannon in different aspects. Exquisite renderings of scarves and jewelry on these would seem to bear out temple records of contacts with the T'ang capital. Toshodai-ji owns the largest group, a dozen or more, all apparently of the later decades of the 8th century. In these is seen the gradual transition toward the massive forms of Jogan. Buddhist sculpture, which in Tempyo came close to realism, was saved from that danger by new spiritual trends that demanded greater formalism and abstraction.

EARLY HEIAN (JOGAN) PERIOD (A.D. 784–897)

The shifting of the capital from Nara to Kyoto in the decade 784–794 marks a change in style, for which there were three main reasons: (1) reduction of the influence of the court, (2) iconographic needs of the monasteries of the esoteric Shingon and Tendai sects, (3) a preference for wood. Buddhist deities took on varied and complicated shapes to represent highly evolved spiritual concepts in tangible form, for the contemplation of mystics. Thus there was neither decadence nor archaism and Japanese sculpture in the realm of wood carving reached its finest flower.

Heads are heavy-set on shoulders; chests and abdomens are rounded; draperies cascade from mighty torsos; navels are cut deep. The Jogan style is one of massiveness and power.

The sculptors, blocking out massive forms from solid tree trunks were masters with wood, following the grain in long, swift knife strokes or chiseling boldly across it. New force was given to the familiar Buddha face, figure and robe, as seen in the over life-size erect examples at Jingo-ji, Gango-ji and Muro-ji. At the last temple alone, the original setting, with 9th-century architecture and painting, is preserved. Muro-ji is also known for a fine seated Shaka, whose robe shows the typical "rolling wave" convention, sharp ridges alternating with curved.

The Hokke-ji's small eleven-faced Kwannon of unpainted, fragrant sandalwood is a tribute to the Jogan sculptor's ability to combine solidity with the impression of lightness. Few images made for worship are more appealing. By contrast, the six-armed Nyoirin Kwannon of Kwanshin-ji, superhuman and maternal—for all the beauty of original colour on lotus throne, nimbus and figure—is difficult of approach. Here the image maker has made a symbol of Divine Power and Divine Love for revelation only to the specially learned initiate, and it is therefore ordinarily kept in concealment.

Human likeness is never found in Jogan sculpture except as a point of departure. Witness the Five Kokuzo ("Sky-wombs") at Jingo-ji. All assume the yoga posture with face in contemplation. Arms and hands of all are set in calculated gesture holding thunderbolts and other symbols. By rare chance several male and female Shinto images have survived. Simple but nonetheless splendid abstractions, they affect formal seated postures and costumes of the ancient Chinese Han tradition and have no connection with Buddhist iconography. A total of six survive at Yakushi-ji; Ozu Jinja, Shiga; and Matsuno-o Jinja, Kyoto.

LATE HELAN (FUJIWARA) PERIOD (A.D. 898–1185)

The court once again exerted its influence over Buddhism as the powerful Fujiwara aristocracy lavished its wealth to the glory of Buddha. Amida's paradise, the blissful goal of the Pure Land sect, was frequently portrayed—with the combined efforts of all manner of craftsmen. At Uji is the Howo-do (Phoenix hall) of Byodo-in, dating from 1053, with Jocho's 9-ft. image of Amida, wood heavily overlaid with gold leaf. Its great carved openwork nimbus and overhead canopy are original. Mounted high on the surrounding walls are 52 separate wood reliefs so subtly carved as to look full round—Bodhisattvas dancing and playing music each on individual clouds—originally brightly coloured. A large pair of bronze phoenixes surmount the roof.

Next in fame is the smaller Konjiki-do (well-named "Hall of Golden Splendour") of Chuson-ji in northern Honshu built in 1124. In an interior decorated all over with painted lacquer and mother-of-pearl inlay and gilt bronze hangings are three altars containing each an Amida triad attended by six images of Jizo and the Four Heavenly Guardians.

The Fujiwara style, generally speaking, retained some devices of Jogan such as eddying drapery swirls, while it reverted to the comparative slenderness of Tempyo, and added sweetness and softness of its own. Subtle refinements are found in postures, facial expressions and colour. Along with an intensive demand for Buddhist images there developed an essentially new technique of assembly from parts. Head, chest and abdomen. sides, knees and lap, arms, and hands were sometimes made separately. The technique with the two advantages of economy in lumber and speed of production was to remain standard for large sculptures in Japan.

Scattered widely over Japan are many Fujiwara sculptures, invariably of exquisite workmanship. Interesting for iconography and for structure is the Chuson-ji's two-foot ten-inch Ichiji Kinrin, an almost feminine rendering of Dainichi as Revealer of Truth. It is half-round, having no back, and is hollowed out; it is one of the earliest examples with eyes of crystals. Another unusual piece is the figure of Fugen on an elephant, kept in the Okura museum in Tokyo. At Joruri-ji near Nara, typifying the charm and refinement of the age, is the little figure of Kichijo-ten (Goddess of Good Luck) in the guise of a young court lady in bright flowing garments, seeming to float on an elaborately painted lotus flower. Only a shade more human is the portrait of the young Prince Shotoku treasured at Horyu-ji.

On the level of caricature, with muscular legs and wrinkled faces, twisting, squinting and grimacing, are the Kofuku-ji's 12 generals in the same low relief as the Howo-do Bodhisattvas. There appears to be no limit to the range of the Fujiwara sculptor.

KAMAKURA PERIOD (A.D. 118.51392)

The concentration of power in military hands under Minamoto Yoritomo at the outset of this period, and the moving of the administrative functions from Kyoto to Kamakura, were symbols of sharp cultural changes. It is not surprising that there were coinciding changes in Buddhist sculpture. Some of the spirituality of Fujiwara and some of its aristocratic flavour were lost. Yet under stimulus of the new age, the arts of the image makers saw even greater activity than before.

Although there was no immediate break with Fujiwara style, as many borderline sculptures show, there were important new trends. Humanism affected religious thinking so that while the Jodo sect was still popular, the vision of Amida's paradise was brought closer to earth. The tendency was for divine figures to be more humanly rendered and for human figures to be more realistic.

Along with the inevitable drift toward materialism, however, there was a powerful resurgence of the 8th-century spirit, the Shogun in fact becoming the moving force behind a veritable Tempyo renaissance.

Temples at Nara were repaired or rebuilt; sacred images were commissioned in quantity and on massive scale. Yoritomo, for instance, ordered a set of six images 32 ft. high: the Four Guardian Kings, Kwannon and Kokuzo for the Nara Daibutsu-den which had burned. After two and a half years of planning, production of scale models, assembly of parts, and application of colours. these were completed in A.D. 1196. The project had required the efforts of 4 master sculptors headed by Unkei, 80 assistants, and 160 carpenters and woodcutters. Though these images were lost in a 15th-century fire, the 26-ft. pair of guardians. Ni-o, at the South Gate still stand. Unkei and Kwaikei with 16 artisans had completed the mighty pair in only ten weeks. These powerful figures hark back to Tempyo and T'ang prototypes, but the joinery, the bulging muscles. the threatening faces, all speak of a living Kamakura tradition in which the skills of many were employed as in the medieval guilds of Europe. A smaller project, the Kofuku-ji's octagonal Hokuen-do, complete with nine images, was the work of Unkei and several of his sons. Tankei, Koun, Koben, and Kosho. Famous, here, for their extraordinary realism are the 6-ft. pair of patriarchs Seishin and Muchaku. attendant on Maitreya. They typify Kamakura carving at its cleverest—presenting in painted wood the illusion of modeling, if not indeed of actual drapery and flesh. But Unkei's work was abstract when iconography required, as in his spirit-infused Dainichi at Enjo-ji, Nara.

The extent to which the craft guild system of Kamakura could be carried may be seen at the Sanjusan-gen-do, Kyoto, with its 1000 gilt wood images of Kwannon, each eleven-headed and many-armed. While still in his teens, Lnkei worked on one of these images with his father. Kokei—even as his own son Tankei did after him. From father to son as from master to pupil the traditions were handed down. The same hall owns other images. including the vivid individual figure of the half naked old mendicant Basu with staff and scroll and bony chest And in Rokuhara Mitsu-ji is Kosho's wandering monk Kuya with staff and gong, calling the name of Amida Buddha. So realistic is this that six tiny images of the deity project on a wire from his mouth.

Kosho's brother Koben could be terribly realistic even with demons, as seen in his squat, muscular lantern-bearers, horned and three-eyed. done for Kofuku-ji, Nara.

The sculptures of Kamakura city were likewise superb. as is evidenced there in three well-known examples of very different types. The first is a seated lay portrait of Lesugi Shigefusa with lifelike face set off by formal starched coat. full-blown "trousers" and tall hat. The second is a tender goddess. Ben-ten, unclad and in the easy posture of one playing a musical instrument. Her proper beauty is seen nhen. as intended, she wears silk garments and holds a *biwa.*

Finally there is the great, calm. world-famous colossal bronze Amida, rising, with stone dais. 49 ft.; cast in 12 52, and seated for all but two and a half centuries in the open air.

The period was one of prolific output and varied repertory. It was also a period that mixed the formal conservatism of traditional craftsmanship with innovations of the moment.

AFTER KAMAKURA

While some hold that the realism of Kamakura sculpture spelled its death knell, it is to be noted that the 14th century uas one of almost constant warfare. Social equilibrium was disturbed and craftsmen were pressed into service By the 1 jth century the new Zen Buddhist impact from China, already felt in Kamakura times, had taken strong hold. Aniconic, though not iconoclastic, it hardly provided the stimulus for sculpture. Formal Buddhist images have continued to be made right up to the present without varying too greatly from or quite measuring up to the works of the last great period.

Searching far and wide, however. it is still possible to find evidences of a strong undercurrent of indigenous folk image making. Kozan-ji, in the hills behind Kyoto, owns a splendid pair of deer, perhaps from Ashikaga period (1392–1568); Seto and Bizen by the 16th century produced ceramic lions; all through Tokugawa (1615–1867) there were casual carvings in wood or chiseled stone figures of monkeys and foxes, or roadside deities, or the Seven Lucky Gods. These were the products of the genius of Shinto—that had indeed contributed to Japan's carvers all through the ages.

See also JAPANESE PAINTING AND PRINTS; JAPANESE ARCHITECTURE; JAPANESE GARDENS; SCULPTURE: Oriental; CHINESE SCULPTURE; INDIAN ART.

BIBLIOGRAPHY.—Bijutsu Shuppan-sha, *Album of Japanese Sculpture,* vol. i–vi, (1952), *Exhibition of Japanese Painting and Sculpture* (Catalogue) (1953); Jiro Harada, *A Glimpse* of *Japanese Ideals* (1937); Takeshi Kobayashi, *Study on the Life and Works of Unkei* (1954); Hoshu Minamoto, *An Illustrated History of Japanese Art,* trans. *by H* G. Henderson (1935); *Pageant of Japanese Art,* vol. iii, *Sculpture,* ed by staff members of the Tokyo National museum (1952); R. T. Paine and A. Soper, *The Art and Architecture of Japan* (1955); G. B. Sansom, *Japan, a Short Cultural History,* rev. ed (1943); Peter Swann, *An Introduction to the Arts of Japan* (1958); Noritake Tsuda, *Handbook of Japanese Art* (1935); Langdon Warner, *The Craft of the Japanese Sculptor* (1936), *The Enduring Art of Japan* (1952), *Japanese Sculpture of the Suiko Period* (1923) and *Japanese Sculpture of the Tempyo Period,* ed. and arranged by James Marshall Plumer (1959); Yukio Yashiro, *Two Thousand Years of Japanese Art* (1958).

(J. M. P.)

JAPANNING, a process for decorating and protecting the surfaces of metal articles with finishes that are hardened by heating in ovens. The term originated in the 18th century when it included all sorts of glossy decorations on wood, leather, tin and papier-mâché, which emulated the celebrated lacquer work of the Japanese (see LACQUER; ENAMEL). Black japan, a mixture of molten asphalt. natural-resin varnishes, drying oils and turpentine has a clear, brownish undertone. The japans have largely been displaced by modern baking enamels: tough, durable coatings composed of pigments ground in synthetic-resin varnishes. They are made in a variety of finishes—gloss, mat and textural—and are used on typeariters, bicycles, military items, etc. After spraying or dipping. the articles are heated in ovens at a temperature between 250° and 350° F. Besides this batch system, coated articles may also be passed through heated tunnels in a continuous production system.

Certain air-drying enamels also in use, are less resistant to wear; brush-applied varieties of this type are also available in cans for household use. Liquid enamels are so called because of their resemblance to true porcelain or vitreous enamel; the name distinguishes them from ordinary oil paints. Japanning has also been displaced by the cellulose lacquer-enamels (see VARNISH), far less durable than the synthetic-varnish enamels but widely used because of their extreme rapidity of drying, lower cost and other considerations. The term japan survives more actively in an altogether different product, japan colours. These are quick-drying lustreless paints miscible with turpentine and universally sold in tubes and cans for sign painting and decorative work.

(RH. M.)

JAPHETH, one of the three sons of Noah, was, according to the tradition of the "Priestly" stratum of the Old Testament, the third "son"; but the older tradition of Gen. ix, 20–27 represents him as the second son. The oracle of blessing, Gen. ix, 27 ("God enlarge Japheth, and let him dwell in the tents of Shem; and let Canaan be his slave"), displays hostility against Canaan (*q.v.*), and looks favourably upon Japheth, but is not easy to interpret clearly. "Dwell in the tents of" is usually understood to mean "have friendly intercourse with," the passage thus indicating friendly relations between the descendants of Japheth and the Semites. (W. L. W.; X.)

JAQUES-DALCROZE, EMILE (1865–1950), Swiss composer and teacher of musical eurhythmics (*q.v.*), was born at Vienna July 6, 1865, of French-Swiss parents. He went to Geneva in 1875 where he attended the college and the university, and followed the courses at the Conservatoire. He then studied (1887) at the Conservatoires of Vienna and Paris and completed his musical education under Délibes. In 1886 he accepted the post of chef d'orchestre at Algiers. Returning to Vienna he studied composition under R. Fuchs and A. Bruckner, After the death of Hugo de

Senger, he directed the sol-fa and harmony courses at the Conservatoire of Geneva (1891). His numerous works include many charming songs, such as Chansons populaires, Chansons de route, etc. His other musical compositions are very numerous, and include symphonies and choral works on a large scale, such as La *Veillée* (1893) and Le Festival *vaudois* (1903). Other compositions were Le *Violon* maudit (1893), Sancho Panza (1897), Le Bonhomme jadis (1905), Echo et Narcisse (1912), Les Premiers souvenirs (1918), La *Fête* de la Jeunesse (1923), Les Belles Vacances (1932) and Genkve chante (1937). His great work, however, lay in the development of the eurhythmic instinct, particularly in children, and its application to physical training and the modern dance. After 1915 he was the director at Geneva of the Institut Jaques-Dalcroze, originally founded at Hellerau in Bavaria. His writings include: *Rhythmic* Movement (1920); Rhythm, Music and Education, Eng. tr. (1921); Eurhythmics, Art and Education, Eng. tr. (1930). He died in Geneva, Switz., July 2, 1950.

JARARACA (Trimeresurus jararaca), a poisonous crotaline snake of tropical South America, related to the fer-de-lance (*q.v.*). See PIT VIPER.

JARGON (JARGOON), a name applied to those zircons which are fine enough to be cut as gem stones, but are not of the red colour which characterizes the hyacinth (*q.v.*). The name is related to Arab *zargun* (zircon). Some of the finest jargons are green, others brown and yellow, while some are colourless. The colourless jargon may be obtained by heating certain coloured stones. See ZIRCON.

Jargon also refers to the language variations used by a particular group (see SLANG), or to a hybrid language. See PIDGIN.

JARIR IBN 'ATIYA AL-KHATFI (d. 728) was one of a famous trio of rival Arab poets. He is renowned for the exchange with these rivals, al-Farazdaq and al-Akhtal (*qq.v.*), of a series of satirical poems (naka 'id, ed. by A. A. Bevan, 3 vol., 1905–09 and published, 1922, with notes by A. Salhani, respectively). He lived mainly in Iraq and won favour at the court of the caliph Omar II. His collected works, comprising panegyric and laments in addition to satire, were published in Cairo (1896).

JARMO. The low mound known as Jarmo—in full, Qalat Jarmo—is a prehistoric archaeological site in the Kurdish hills of northeastern Iraq, about 35 mi. east of the modern city of Kirkuk. The importance of the site rests on the archaeological traces it reveals of a very early aspect of the first village-farming communities. The approximate dozen layers of architectural building and renovation also yield traces of domesticated wheats, barley and the dog and goat, suggesting the achievement of a settled agricultural way of life. Other artifacts in the Jarmo catalogue, such as flint sickle blades, milling stones and—in the uppermost levels of the site only—pottery, hint at the technological adjustments made to the new food-producing way of life. The estimated age of the site, by radioactive-carbon dating, is about 6750 B.C.

See also ARCHAEOLOGY: Prehistory: The Old *World* of the Recent Period.

See R. J. Braidwood ***et al.,*** Prehistoric ***Investigations in Iraqi Kurdistan*** (1960). ***(R. J.*** B.)

JARNACH, PHILIPP (1892–), German composer who was a follower of Busoni, was born, July 26, 1892, at Noisy, near Paris. He was the son of the Spanish sculptor, Esteban Jarnach. He studied the piano under Edouard Risler and harmony under Albert Lavignac in Paris. In 1915, at Zürich, he met Busoni whose operas, Arlecchino and Turandot, he arranged for piano, and under whose influence he wrote his String Quintet, Opus 10. In 1927 he was appointed professor of composition at the Cologne conservatory. He was naturalized in 1931, and in 1949 became director of the Hamburg conservatory. Among his chamber works, which show an affinity with Hindemith, are two sonatas for unaccompanied violin. His orchestral works include Musik mit Mozart and Morgenklangspiel. He completed Busoni's opera Doktor Faustus after the composer's death.

JÄRNEFELT, EDVARD ARMAS (1869–1958), Finnish-born composer and conductor who introduced Wagner's operas to Finland and who is known for his works for small orchestra. Born at Viipuri, Aug. 14, 1869, he studied at Helsinki, Berlin and Paris with, among others, Busoni and Massenet. He conducted at Viipuri (1898–1903), and in 1904 gave first performances of Wagner's operas at Helsinki. He was appointed conductor of the Stockholm opera in 1905, naturalized Swedish in 1910 and in 1932 returned to Finland as director of the Helsinki opera. Jarnefelt was known as a conductor of Beethoven and Wagner, and also of the works of his brother-in-law, Sibelius. He wrote choral works, symphonic poems, about 50 songs, incidental music and piano pieces, but became known chiefly by his Berceuse and Praeludium. He was married to the Finnish Wagnerian soprano, Maikki Pakarinen, and later to the soprano, Liva Edstrom. He died, June 23, 1958, at Stockholm.

JAROSITE, a mineral species similar to alunite (*q.v.*) consisting of hydrous potassium and aluminum sulfate, and often occurring as incrustations of minute indistinct crystals with a yellowish-brown colour and brilliant lustre.

The best specimens, consisting of crystalline crusts on limonite, are from the Jaroso ravine in the Sierra Almagrera, in the province of Almeria, Spain, from which locality the mineral receives its name. It appears to be a common product of decomposition of sulfides in mineral veins, and one variety from Nevada and New Mexico, plumbojarosite, contains lead.

JARRAH WOOD, the product of a large tree (Eucalyptus marginata) found in southwestern Australia, where it is said to cover an area of 14,000 sq.mi. The trees grow straight in the stem to a great size, and yield squared timber up to 40 ft. long and 24 in, in diameter. The wood is hard, heavy and close-grained, with a mahogany-red colour, and sometimes sufficient "figure" to render it suitable for cabinetmakers' use. The timber possesses several useful characteristics; and great expectations were at first formed as to its value for shipbuilding and general constructive purposes; these expectations have not, however, been realized. Its greatest merit for marine purposes is due to the fact that it resists, better than any other timber, the attacks of the Teredo navalis and other marine borers, and on land it is equally exempt, in tropical countries, from the ravages of white ants. When felled with the sap at its lowest point and well seasoned, the wood stands exposure to the air, earth or sea remarkably well, on which account it is used for railway sleepers (ties), telegraph poles and piles in the British colonies and India. The wood, however, frequently shows longitudinal blisters, or lacunae, filled with resin, such as may be observed in spruce fir timber; and it is deficient in fibre, breaking with a short fracture under moderate pressure.

JARRATT, DEVEREUX (1733–1801), American Anglican clergyman, was born on Jan. 17, 1733, in Kent county, Va. He received little schooling but developed a fondness for reading, and in this way prepared himself for tutoring. One of the families with whom he found employment as tutor were devout Presbyterians, and as a result Jarratt's mind was turned toward religion. He soon felt a call to enter the Presbyterian ministry, but finally decided to seek ordination in the Anglican communion. In Oct. 1762 he sailed for England where he was ordained a deacon by the bishop of London and priest by the bishop of Chester. He was detained for three months by smallpox, and after his recovery he heard John Wesley and George Whitefield preach. Returning to Virginia in 1763, Jarratt was installed in a parish in Dinwiddie county, and there he remained, a faithful spiritual shepherd, until his death on Jan. 29, 1801.

Jarratt extended his ministry over many counties in Virginia and North Carolina, and when the first Methodist preachers appeared, he was one of the few Anglican clergymen who gave them full cooperation, entertaining them in his home and administering the sacraments to their new converts. (See METHODISM.) The fullest account of the Methodist revival is Jarratt's, which he sent to John Wesley and which Francis Asbury (*q.v.*) placed in his Journal. When the American Methodists separated from the Anglicans in 1784 and formed the Methodist Episcopal Church, Jarratt was alienated. As a slave owner, he was further estranged by the stringent rules adopted by the Methodists condemning slavery.

See W. W Sweet, Men of Zeal (1935). (W. W. S.)

JARROW, a port and municipal borough (1875) in the Jarrow parliamentary division of Durham, Eng., on the right bank of the

Tyne, 63 mi. below Newcastle. Pop. (1951) 28,635. Area 2.7 sq.mi. The parish church of St. Paul was dedicated in 685, and close by are the scattered ruins of the monastery begun by St. Benedict Biscop in 681 and consecrated by Ceolfrid in 685. Within the walls of this monastery the Venerable Bede spent his life. The town's industries include ship repairing, iron and steel processing and fabrication, and various light industries. A great quantity of coal is shipped. It owed its development largely to Sir Charles Mark Palmer, whose shipyards and steelworks provided employment for the majority of the townsmen until the collapse of the company after World War I. A return to prosperity began in 1939; new industries were introduced, followed by the creation of a trading estate in 1946. There is a large oil installation with wharf facilities available at all tides. A tunnel under the Tyne was begun in 1947 and first opened in 1951. Near St. Paul's church is the Jarrow Slake, a large timber pool.

JARVIS ISLAND, a sand and coral atoll in the central Pacific ocean, about 2 mi. long by 1 mi. wide. Jarvis was first reported by the British ship "Eliza Francis" under the command of Captain Brown in 1821, and has been variously called Bunker, Volunteer, Jervis and Brook. The American Guano company claimed it in 1857 and worked it until 1879. Great Britain annexed the island in 1889, but did not exploit it. The U.S. established a small colony there in 1935 without British opposition and on May 13, 1936, Pres. Franklin D. Roosevelt placed it under the jurisdiction of the secretary of the interior. Later it was placed under jurisdiction of the Department of the Navy. The colonists were evacuated in Feb. 1942, and the settlement was not re-established after World War II. (J. H. K.)

JASHAR, BOOK OF, a Hebrew composition mentioned as though well known in Josh. x, 13, and II Sam. i, 18. From these two passages it seems to have been a book of songs relating to important events, but no early collection of the kind is now extant, nor is anything known of it. Various speculations have been put forward as to the name: (1) that it means the book of the upright, *i.e.* Israel or distinguished Israelites, the root being the same as in Jeshurun; (2) that Jashar is a transposition of *shîr* (song); (3) that it should be pointed Yashir (sing), and was so called after its first word. None of these is very convincing, though support may be found for them all in the versions. The Septuagint favours (1) by its rendering ἐπὶ βιβλίου τοῦ εὐθοῦς in Samuel (it omits the words in Joshua); the Vulgate has *in libro justorum* in both places; the Syriac in Samuel has *Ashīr,* which suggests a Hebrew reading *ha-shir* (the song): and in Joshua it translates "book of praises." The Targum on both passages has "book of the law," an explanation which is followed by the chief Jewish commentators, making the incidents the fulfillment of passages in the Pentateuch. Since it contained the lament of David (II Sam. i, 18) it cannot have been completed till after his time. If Wellhausen's restoration of I Kings viii, 12, be accepted (from Septuagint, I Kings viii, 53, ἐν βιβλίῳ τῆς ωδῆς) where the reference is to the building of the Temple. the book must have been growing in the time of Solomon. In later times when it became customary to compose midrashic works under well-known names, a book of Jashar naturally made its appearance. This has nothing to do with the older book. (L. E. E.–B.)

JASHPUR, formerly a princely state of the Chhattisgarh agency; merged as a *tehsil* on Jan. 1, 1948, with Raigarh district of Madhya Pradesh, India. The country is divided almost equally into high- and lowlands. The Uparghat plateau on the east rises 2,200 ft. above sea level, and the highest hill in these uplands is Ranijula (3,527 ft.). The only river of importance is the Ib, the sands from which from time immemorial have been washed for gold. The high Khuria plateau is much resorted to by graziers from Mirzapur, in Uttar Pradesh. The *tehsil* area is 1.764 sq.mi.; pop. (1951) 255,328. Jashpur iron, which is smelted by the Kols, is highly prized. Sal forests abound, and elephants, bison and other big game are to be found. Jungle products include, besides timber, lac, silk cocoons and beeswax which are exported.

JASMIN, JACQUES (1798–1864), Provençal poet, was born at Agen, his family name being Boé. In 1825 he published *Charivari* and ten years later his first volume of *Papillotos* ("Curl Papers"), containing poems in French, and in the familiar Agen *patois* of the working classes. Jasmin was the most famous forerunner in Provençal literature (*q.v.*) of Mistral and the *Félibrige.* His poetic gift, and his flexible voice and action, fitted him admirably for this double role of troubadour and jongleur. In 1835 he recited his "Blind Girl of Castel-Cuillé" at Bordeaux, in 1836 at Toulouse; and he met with an enthusiastic reception in both cities. Most of his public recitations were given for benevolent purposes, the proceeds being contributed by him to the restoration of the church of Vergt and other good works. Four successive volumes of *Papillotos* were published during his lifetime, mostly pictures of humble life—in many cases real episodes—carefully elaborated by the poet. In 1852 Jasmin's works were crowned by the Académie Française, and a pension was awarded him. His title of "Maistre ès Jeux" is a distinction only conferred by the academy of Toulouse on illustrious writers. Pius IX sent him the insignia of a knight of St. Gregory the Great, and he was made chevalier of the Legion of Honour. He spent the latter years of his life on a small estate which he had bought near Agen and named "Papillotos," and which he describes in *Ma Bigno* ("My Vine"). He died on Oct. 4, 1864.

JASMINE or JESSAMINE, botanically *Jasminum,* a genus of shrubs or climbers of the family Oleaceae, comprising about 100 species, of which 40 or more occur in North America and in Great Britain. The plants of the genus are mostly natives of the warmer regions of the old world; there is one South American species. The leaves are pinnate or ternate, or sometimes apparently simple, consisting of one leaflet. The common white jasmine, *Jasminum officinale,* one of the best known and most highly esteemed of hardy cultivated ligneous climbers, is a native of northern India and Persia. In the centre and south of Europe it is thoroughly acclimatized. Although it grows to the height of 12 and sometimes 20 ft., its stem is feeble and requires support. The fragrant white flowers bloom from June to October.

J. HORACE MCFARLAND CO.

SPANISH JASMINE (J. OFFICINALE VAR. GRANDIFLORUM)

The zambak or Arabian jasmine, *J. sambac,* is an evergreen white-flowered climber, 6 ft. high. The Spanish or Catalonian jasmine, *J. officinale* var. *grandiflorum,* a native of the northwest Himalayas cultivated in both the old and new world, is very like *J. officinale* but differs in the leaflet size; the branches are shorter and stouter, the flowers larger and reddish underneath. By grafting it on two-year-old plants of *J. officinale,* an erect bush about 3 ft. high is obtained, requiring no supports.

The aroma is extracted by the process known as *enfleurage, i.e.,* absorption by a fatty body, such as purified lard or olive oil. Square glass trays framed with wood about 3 in. deep are spread over with grease about half an inch thick, in which ridges are made to facilitate absorption, and sprinkled with freshly gathered flowers, which are renewed every morning during the whole time the plant remains in blossom. Three pounds of fresh flowers will perfume 1 lb. of grease—this is extracted by maceration in 1 pt. of rectified spirit to form the extract.

The distinguishing characters of J. *odoratissimum,* a native of the Canary Islands and Madeira, consist principally in the alternate, ternate and pinnate leaves. the 3-flowered terminal peduncles and the j-cleft yellow corolla with obtuse segments. The flowers have the advantage of retaining when dry their natural perfume. which is suggestive of a mixture of jasmine, jonquil and orange blossom. In China *J. paniculatum* is cultivated as an erect shrub. known as *sieu-hing-hwa;* it is valued for its flowers, which are used with those of *J. sambac,* for scenting jasmine tea. *J. angustifolium* is a beautiful evergreen climber. 10 to 12 ft. high. found in the Coromandel forests, and introduced into cultivation. All

of the above can be grown outdoors only in mild climates.

A hardy species commonly cultivated in gardens is the low or Italian yellow-flowered jasmine, J. *humile,* an East Indian species introduced and now found wild in the south of Europe, an erect shrub, 3 or 4 ft. high, with angular branches. alternate and mostly ternate leaves, blossoming from June to September. The common yellow jasmine, J. *fruticans,* a native of southern Europe and the Mediterranean region, is a less hardy evergreen shrub. 10 to 12 ft. high. with weak, slender stems requiring support. and bearing yellow. odourless flowers from spring to autumn. J. *nudiflorum,* the winter jasmine. of China, which bears its bright yellow flowers in winter or early spring before the leaves appear, is hardy in the Cnited States from New York southward.

JASON, in Greek legend, son of Aeson. king of Iolcus in Thessaly. After his return from Colchis in Asia Minor (see ARGONAUTS), he lived at Corinth with his wife Medea (*q.v.*) for many years. At last he put away Medea in order to marry Glauce (or Creüsa), daughter of the Corinthian king, Creon. To avenge herself. Medea presented the new bride with a robe and headdress. by whose magic properties the wearer was burned to death, and slew her children by Jason with her own hand. His death was said to have been by suicide through grief. caused by Medea's vengeance; or he was crushed by the fall of the poop of the ship "Argo," under which he had laid himself down to sleep.

JASPER, an impure variety of chalcedonic to cryptocrystalline quartz (*q.v.*), in composition essentially SiO_2 (silica), long used in jewelry. The colour varies from red, yellow, brown, dark green. to grayish blue. Some varieties are banded in layers of different colours. others are striped or irregularly spotted. Most jasper is opaque in the hand specimen. and much that is used as a semiprecious stone is red or brown, owing to included hematite. Most of it is cut cabochon. The hardness is essentially that of quartz (7). The ancient term jaspis included not only the present-day jasper but also probably chrysoprase and other types of chalcedony. Medicinal values were long attributed to jasper. including a belief that its wearing strengthened the stomach.

Jasper is common and widely distributed, occurring chiefly as veinlets. concretions and replacements in a variety of sedimentary and metamorphic rocks and also less commonly as nodules in volcanic rocks. It may be deposited either by meteoric (atmospheric) or ground waters or by hydrothermal solutions.

Fine material has long been known from the Libyan desert and the Nile valley. The variety riband jasper is colour banded, as for example the red-green striped Siberian material. Beautiful examples of jasperized fossil wood are found in Arizona. Jasper also is common as detrital pebbles. Swiss or German lapis is an artificially coloured jasper made to imitate lapis lazuli. See also CHERT AND FLINT; GEM: *Gems* in Art: History.

See E. H. Kraus and C. B. Slawson, *Gems and Gem Materials,* 5th *ed.* (1947); K. Schlossmacher, *Edelsteine und Perlen (1954).*

(E. W. HH.)

JASSY (RUMANIAN IAŞI), a town of Rumania, in the region of the same name, situated on the left bank of the Bahlui river, an affluent of the Jijia, about 10 mi. W. of the Pruth. Pop. (1956) 112,977. Jassy communicates by rail with Galatz, Kishinev and Czernowitz. The surrounding country is one of uplands and woods, among which rise the monasteries of Cetatuia. Frumoasa and Galata with its mineral springs, the water-cure establishment of Rapide and the great seminary of Socola. Jassy is the seat of the metropolitan of Moldavia and Suceava, and of a Roman Catholic archbishop. The two oldest churches date from the reign of Stephen the Great (1457–1504); perhaps the finest, however. are the 17th-century metropolitans. St. Spiridion and Trei Erarchi, the last a curious example of Byzantine art, erected in 1640 by Vasile Lupu (the Wolf) and adorned with countless gilded carvings on its outer walls and twin towers. The St. Spiridion foundation (founded by Prince Gregory Ghika in 1727 and available for the sick of all countries and creeds) maintains hospitals and churches in several towns of Moldavia. besides the baths at Slanic in Walachia. There are six hospitals. the chief Rumanian university. a military academy and schools of art, music and commerce; three museums. a fine hall and a theatre; the state library, where the chief records of Rumanian history are preserved; an appeal court, a chamber of commerce and several banks. The city is the headquarters of the 4th army corps. It has an active trade in petroleum, salt, metals, timber, cereals, fruit, vine, spirits. preserved meat, textiles, clothing. leather, cardboard and cigarette paper, and a considerable industry. Jassy is mentioned as early as the 14th century, and probably derives its name from the Cuman "Jazyges" or bowmen. It was often visited by the Moldavian court. In 1565, Prince Alexander Lapusneanu moved the capital of Moldavia from Suceava to Jassy. It was already famous as a centre of culture. Between 1561 and 1563 a school and a Lutheran church were founded by the Greek adventurer, Jacob Basilicus (see RUMANIA: History: Moldavia). In 1643 the first printed book published in Moldavia was issued from a press established by Vasile Lupu. He also founded a school, the first in which the mother tongue took the place of Greek. Jassy was burned by the Tatars in 1513, by the Turks in 1538 and by the Russians in 1686. By the peace of Jassy the second Russo-Turkish War was brought to a close in 1792. A Greek insurrection under Ypsilanti in 1821 led to the storming of the city by the Turks in 1822. In 1844 there was a severe conflagration. In 1861 the government of Rumania was removed to Bucharest, but during World War I was again temporarily transferred to Jassy.

JAT, the great agricultural caste of northwest India. At the 1931 census of India, the total number of Jats was 8,377,819. They were found in Baluchistan, Sind, Punjab, western United Provinces (Uttar Pradesh) and Rajputana (Rajasthan) and comprised people belonging to Moslem. Sikh and Hindu religions. The 1941 census report gave only the figures of Baluchistan and Sind and the 1951 census had no data about castes. The 1947 partition of India must have affected the Jats greatly and there must have been a large exodus on both sides of the border. But no figures are available about these movements. Historically. the Jats seem to have been pushed from the extreme northwest, apparently their original habitat, into southeast Punjab, Delhi. western U.P. and the whole of Rajasthan which they now occupy. They may be identified with the Getae of Herodotus; they are also called Jalt or Jagdal in Baluchistan. No Jat kingdoms are known to have existed before the 17th century

In their present habitat the Jats hold the best lands. In the country around Delhi the usual form of address to a Jat is *chowdhary sahib,* chowdhary being the title of a village revenue official. The Jats do not have an elaborate system of hypergamous clans like the Rajputs and Marathas, though like all people who have come into contact uith the Rajputs, there seems to have been an attempt at establishing a hierarchical system. Certain families claiming Kshatriya rank do not allow the remarriage of a widow and do not give their daughters to families which have this custom. The Jats are patrilineal and patrilocal and are divided into exogamous clans called gotra. The rule of marriage used to be that a person could not marry another belonging to the gotra of his father, mother's father, mother's mother's father or father's mother's father. This is called the four-gotra rule. In modern times this rule, which effectively prevented marriage among kin related even in the third degree, has been relaxed. Another rule of marriage is that two families, even when they fulfil all other conditions, shall not be joined by marriage if they live in the same village or if their villages have a common boundary. This is called *sim-simna* bhaichar (behaving like brothers because the boundaries meet). Because of these two restrictions, Jats have a very widely dispersed kin. Both these rules are also followed by other groups living in the Gangetic plain. In appearance Jats are of middle height to tall, very hairy, with big noses and sometimes with very prominent cheekbones, which gives them a very rugged appearance. They belong to one of the militant groups of the Hindus of the northwest and are uorshippers of Rama, but especially of Hanuman, the monkey god and symbol of physical prowess and loyalty. See also CASTE (INDIAN). (I. KE.)

JATAKA, the technical name in Buddhist literature for a story of one or other of the previous births of the Buddha. The word is also used for the name of a collection of 547 of such stories included in the Buddhist Pali canon. The form of most of

these tales is a very common Indian one known as akhyana. It may be a beast fable, a story of common life or a folk tale told in prose, with the climax or essential part of the dialogue in verse. It is this verse or verses which, as being the utterance of the Bodhisattva or future Buddha, constitutes the canonical portion of the Jataka. The Jataka itself (the story of the past) is always preceded by a story of the present, an incident in the life of the historical Buddha, which is the occasion for his telling the story of the past, and followed by the identification, in which the chief characters are declared to be previous births of persons who appear in the story of the present. There is also a verbal commentary explaining the archaic language of the verses.

A few of the tales are almost identical with some of the beast fables of Aesop, and a larger number with the tales of the *Panchatantra*. It is especially among these where evidence of adaptation from non-Buddhist sources appears, the Bodhisattva in some of them being merely a spectator, but necessarily introduced in order to turn the story into a jataka. The last ten are long romances and the last of all, the Vessantara-jatuka, is a favourite subject of dramatic representation in Burma. The ethical teaching is mostly that of the virtues of secular life, and moral retribution is emphasized by the doctrines of karma and rebirth (see KARMA).

The introduction to the Jataka book (Nidana-katha), which was compiled in Ceylon but mainly from Indian sources, contains a biography of the Buddha from the period when he first determined to attain Buddhahood down to the beginning of his preaching. There is no evidence for the view formerly held that it was this introduction which reached Persia and formed the direct source of the story of Barlaam and Joasaph. The Buddhistic features in this story more probably came from a Sanskrit source, and recent discoveries show that they passed through a Manichaean channel (see BARLAAM AND JOSAPHAT).

Jataka is mentioned in the canon as being one of the nine divisions of the word of the Buddha, but this is no evidence for the age of the Jataka book. The prose of this is a retranslation into Pali from the Singhalese, probably in the 5th century A.D. A few of the tales, with the same verses but with very archaic prose, are found in the Vinaya, and these appear to be survivals of jatakas as they existed before their translation into Singhalese. The earliest evidence for a collection of such tales is in the carvings illustrating a number of jatakas on the stupa of Bharhut, which are assigned to the 3rd or and century B.C., but additions to the collection probably went on much later. The Pali canon also contains the Cariya-pitaka, a collection of 36 jatakas told shortly and baldly in verse. There is no such great collection of jatakas in Sanskrit works, but many of the Pali jatakas as well as others are found in the Mahavastu and in Tibetan and Chinese translations from Sanskrit. The Jatakamala is a collection of 34 jatakas in Sanskrit verse by Aryasura, a writer of the 4th century A.D. The Avadanas are a similar type of tale, and many of them actually are jatakas

BIBLIOGRAPHY.—V, Fausboll, *The Jataka,* Pali text (1877–97); Eng. trans. ed. by E B Cowell (1895–1913); A. Cunningham, *The Stupa of Bharhut* (1879); *Cariyā-pitaka,* ed. by *R* Morris for the Pali Text Society (1882); H. Kern, *Jātaka-mālā,* Sanskrit text (Cambridge, Mass, 1891; Eng. trans. by J. S. Speyer, 1895); bibliography in M. Winternitz, *Geschichte der Zndischen Litt.,* vol. 2 (1920); Rhys Davids, *Buddhist India,* chap. xi on the Jātaka Rook (1903), *Buddhist Birth Stortes,* new ed. (1926); Barua and Sinha, *Bharhut Inscriptions* (1926).
(E. J. T.)

JATH, a town and subdivision (*taluk*) of South Satara district, Bombay state, India. The town (pop. 1951, 7,005) is 92 mi. southeast of Satara.

JATH TALUK (area 874 sq.mi.; pop., 1951, 108,270) corresponds with the former princely state of Jath, which was in the Deccan and Kolhapur agency and was absorbed into Bombay on March 8. 1948. The chief, whose title was deshmukh, was a Maratha of the Daphle family. The small state of Daphlapur was added to Jath in 1917.

JÁTIVA (formerly written XATIVA) or SAN FELIPE DE JÁTIVA, a town of eastern Spain, in Valencia province, on the right bank of the Albaida river, a tributary of the Júcar, and at the junction of the Valencia-Murcia and Valencia-Albacete railways. Pop. (1950) 18,230 (mun.). Játiva was the Roman Saetabis, later Valeria Augusta, of Carthaginian or Iberian origin. Pliny (23–79) and Martial (c. 40–102) mention the excellence of its linen cloth. Under the Visigoths (c. 483–711) it became an episcopal see; but early in the 8th century it was captured by the Moors, under whom it attained great prosperity and received its present name. It was reconquered by James I of Aragon (1213–76). During the 15th and 16th centuries, Jativa was the home of many members of the house of Borgia or Borja, who migrated there from Borja in Saragossa. Játiva is built on the margin of a fertile plain, and on the southern slopes of the Monte Bernisa, a hill with two peaks, each surmounted by a castle.

JAUCOURT, ARNAIL FRANÇOIS, MARQUIS DE (1757–1852), French politician, was born on Nov. 14, 1757, at Tournan-en-Brie. By 1789 he had risen to the rank of colonel in Condé's dragoon regiment. A man of liberal ideas. he represented Seine-et-Marne in the legislative assembly, but his views were too moderate for his colleagues, and in 1792 he mas arrested on suspicion of being a reactionary. Madame de Stael procured his release just before the September massacres. He accompanied Talleyrand to England, returned, then went to Switzerland till 18 Brumaire. Thanks to Talleyrand, he was for some time president of the tribunate. In 1803 he entered the senate. In 1804 he was attached to the household of Joseph Bonaparte. His Bonapartist views cooled, and at the Restoration he became minister of state and a peer of France, serving as foreign minister while Talleyrand was in Vienna. At the second Restoration he was for a brief period minister of marine. He devoted himself to the Protestant interest in France. A member of the upper house till the establishment of the Second Republic, he lived to rally to the government of Louis Napoleon, dying at Presles on Feb. 5, 1852.

JAUER, now JAWOR, formerly a town in the Prussian province of Silesia, Ger., 13 mi. S. of Liegnitz, on the Wiithende Neisse after 1945 in Warclaw province, Poland. Pop. (1957 est.) 12,300. The town was first mentioned in 1242 and was formerly the capital of a principality embracing about 1.200 sq.mi. From 1392 to 1741 it belonged to the kings of Bohemia, being taken from Maria Theresa by Frederick the Great. Jauer was formerly the prosperous seat of the Silesian linen trade, but three burnings in the Thirty Years' War permanently injured it. St. Martin's church dates from 1267–90, and the Evangelical church from 1655. Jauer manufactures leather, carpets, cigars, carriages and agricultural machinery.

JAUHARI (ABU NASR ISMAIL IBN HAMMAD UL-JAUHARI) (d. 1002 or 1010), Arabian lexicographer, was born at Farab on the borders of Turkistan. He studied in Farab and Bagdad, and settled first in Damghan, then at Nishapur, where he died. His great work is the *Kitāb us-Ṣaḥāḥ fil-Lugha,* an Arabic dictionary, in which the words are arranged alphabetically according to the last letter of the root. He only partially finished the last recension, but the work was completed by his pupil, Abu Ishaq Ibrahim ibn Salih ul-Warraq.

Of the edition begun by E. Scheidius with a Latin translation, one part only appeared at Harderwijk (1776). The whole has been published at Tebriz (1854) and at Cairo (1865), and many abridgments and Persian translations have appeared; *cf.* C. Brockelmann, *Geschichte der arabischen Literatur* (Weimar, 1898), i.

JAUNDICE or ICTERUS is a medical term used by physicians and laymen to describe a yellowish pigmentation of the skin. This is usually first noted in the whites of the eyeballs; the urine has a marked amber coloration and in some forms there may be an absence of bile pigments in the stools. It is the result of an excess of bilirubin, one of the bile pigments, which varies in its character chemically depending on whether it enters the blood stream before or after being subjected to action by the liver cells. Tests of the blood bilirubin are helpful in differentiating various types of jaundice.

The main causes of jaundice are obstruction of the bile passages, injury to the liver cells from toxins or infections and excessive destruction of the red blood cells or erythrocytes from a variety of disorders. The three main varieties are the obstructive, the toxic or infectious, and the haemolytic. Treatment depends

upon the cause and may be medical or surgical. It is important to have a correct diagnosis before instituting treatment.

(F. L. A.)

JAUNPUR, a city and district in the Benares division of Uttar Pradesh, India. The city is on the left bank of the Gumti river, 34 mi. N.W. of Benares by rail. Pop. (1951) 52,351. Jaunpur is an ancient city, the former capital of a Mohammedan kingdom which once extended from Budaun and Etawah to Bihar. It abounds in splendid architectural monuments, most of which belong to the period when the rulers of Jaunpur were independent of Delhi. The fort of Firuz Shah is in great part completely ruined, but there remain a fine gateway of the 16th century, a mosque dating from 1376, and the *hammams* or baths of Ibrahim Shah. Among other buildings may be mentioned the Atala Musjid (1408) and the ruined Jinjiri Musjid, mosques built by Ibrahim, the first of which has a great cloistered court and a magnificent façade; the Dariba mosque constructed by two of Ibrahim's governors; the Lal Darwaza erected by the queen of Mahmud; the Jamma Musjid (1438–1478) or great mosque of Husain, with court and cloisters, standing on a raised terrace, and in part restored in modern times; and finally the splendid bridge over the Gumti, erected by Munim Khan, Mogul governor in 1569–1573. The city has now lost its importance, the only industries surviving being the manufacture of perfumes and papier-mâché articles.

The DISTRICT OF JAUNPUR has an area of 1,555 sq.mi. It forms part of the wide Gangetic plain, and its surface is accordingly composed of a thick alluvial deposit. The whole country is closely tilled, and is divided into two unequal parts by the sinuous channel of the Gumti, a tributary of the Ganges, which flows past the city of Jaunpur. The Gumti is liable to sudden inundations during the rainy season, owing to the high banks it has piled up at its entrance into the Ganges, which act as dams to prevent the prompt outflow of its flooded waters. The greatest recorded flood took place in Sept. 1871, when 4,000 houses in the city were swept away, besides 9,000 more in villages along its banks. Pop. (1951) 1,517,173. Sugar refining is the principal industry.

In prehistoric times Jaunpur seems to have formed a portion of the Ajodhya principality, and when it first made an appearance in authentic history it was subject to the rulers of Benares. With the rest of their dominions it fell under the yoke of the Mohammedan invaders in 1194. In 1394 Malik Sarwar, a provincial governor, threw off his allegiance to Delhi and established himself at Jaunpur where he assumed the title of Sultan-us-Shark, or "eastern emperor." For nearly a century the Sharki dynasty ruled at Jaunpur, and proved formidable rivals to the sovereigns of Delhi, until in 1479 Bahlol Lodi recovered his imperial sway. In 1775 the district became British by the treaty of Fyzabad.

JAUREGUI, JUAN DE (1583–1641), Spanish poet, whose *Rimas* (1618), a collection of graceful lyrics, is preceded by a controversial preface which attracted much attention on account of its outspoken declaration against *culteranismo*. His poem *Orfeo* (1624), however, is visibly influenced by Luis de Góngora y Argote while a translation of the *Pharsalia* (begun before 1614 but not published until 1684) reveals Jauregui as a complete convert to the new school.

JAURES, AUGUSTE MARIE JOSEPH JEAN (1859–1914), French socialist leader, was born at Castres (Tarn) on Sept. 3, 1859. His ancestors on his father's side included two admirals, of whom one was ambassador to Spain and to Russia and minister of marine. Jaurks was educated at the *collège* of Castres, at the Collkge Sainte Barbe, the Lycee Louis le Grand and the École Normale Supérieure in Paris. His career at the normal school was the most brilliant possible, and his fellow students, among them being Henri Bergson, predicted for him a great political future.

After having passed the "concours d'agrégation" Jaurès was elected, in 1881, master of philosophy at the Lycée d'Albi. In 1883 he became lecturer in the University of Toulouse. But he had already set his mind upon a parliamentary career, although his mother did her best to dissuade him. At the legislative elections of Oct. 4, 1885, he was elected deputy for Tarn. He was 26 years old. During the first two years of his term he took little part in debates. His poetic and burning eloquence embarrassed parliamentarians accustomed to the so-called "britannique" eloquence of Clemenceau, Waldeck-Rousseau. Ribot, Pelletan, Freycinet and others. His maiden speech was delivered Oct. 21, 1886, on a question relating to primary education. On every question with which he dealt in the chamber he adopted a courageous attitude which showed him incapable of sacrificing his principles to parliamentary compromise or to motives of self-interest. Without allying himself to any party, he devoted himself passionately to the public good and to the general welfare; but at the close of the session the meagre results of his efforts discouraged him so much that he decided to abandon politics and asked to be reinstated in his post of professor at the University of Toulouse. Persuaded by his friends, however, he stood for Castres, and failed. In November Jaurks resumed the professor's chair. His lectures were now thronged with students, workmen, middle-class folk, other professors, men of science, men of learning. During this period he wrote his theses for the doctorate. His French thesis was entitled *De la realité du monde sensible.* In his Latin thesis he traced the origins of German socialism *De primis socialismi germanici lineamentis apud Lutherum, Kant, Fichte et Hegel.*

In the articles which he wrote at this time for the local organ *La Dépêche* his ideas on politics and economics were seen to turn more and more toward socialism, to which, at the close of 1890, he at last publicly announced his adhesion. After the strike at Carmaux, in the course of which he defended the claims of the miners, Jaures was elected deputy, in 1893, at a local election, and his term of office was renewed at the general elections of 1894. Defeated again in 1898, he was re-elected in 1902; and his electorate remained faithful to him from that time on. In the chamber he took a large part in the debates on the Panama and Boulangist crises, in discussions of agrarian and colonial questions, on fiscal policy and protectionist measures, on syndicalism and the separation of church and state, on military laws and electoral reform. In the Dreyfus affair his energetic intervention captured the Socialist party, which hesitated at first to take part in a conflict which seemed not to concern the proletariat. His campaign in favour of Dreyfus, a "living witness to military lies, to political cowardice, to the crimes of authority" did not cease until Dreyfus was definitely rehabilitated.

Led by the logical development of his metaphysical and religious ideas to social conceptions which obliged him to accept the socialist teaching, Jaurès adhered closely to the rapidly growing Socialist party. The socialism of Jaurks differed essentially from the Marxian doctrine. "Our socialism," wrote Jaurks, "is French in origin. French in inspiration, and French in character." His ultimate aim was harmony founded on justice. Social harmony implies the disappearance of an injustice which provokes conflicts, hatreds and their horrible consequences, an injustice originating in capitalist ownership. Jaurlts was a socialist because "the domination of one class is an outrage against humanity." Into this doctrine he breathed his own glowing and generous ideas and, at the same time. drew from it the strength with which he animated it. "No serious social programme can be realised without a definite social doctrine," he wrote, and for him the whole socialist ideal must inspire organic reformatory action and thus establish a socialism, democratic, republican and lay. Jaurks strove to bring about unification of the various socialist groups. At the congress of 1901 a section of groups rallied to him under the name of the *parti socialiste français,* while the others formed the *parti socialiste de France!* After the Amsterdam congress in 1905 the two groups coalesced and Jaurès became, in fact, their moral and intellectual chief. Thereafter his political activity was bound up with that of the unified Socialist party, whose parliamentary activity he directed with great skill. He drafted most of the resolutions at Socialist congresses and defended them in an admirably conciliatory spirit. His philosophy of history, unlike that of Marx, did not hold that the development of society is explained by historical materialism; he postulated for it an intelligent directing force and an ideal wisdom. To uphold his convictions, Jaurlts, after the Amsterdam congress in 1905, struggled alone against the

entire international for a share of power and for the preservation of the democratic-socialist bloc. He violently attacked and denounced as impotent the German Social Democracy which dominated the congress and was supported by the old French Socialist organizations. On April 17, 1904, Jean Jaurks, with Aristide Briand, founded *l'Humanité,* which became the daily organ of the Socialist party His daily leading article in it was written for the most part from his seat in the chamber.

Jaurès early foresaw that the unstable equilibrium of the triple alliance and the triple entente was bound to end in a catastrophe, and he wished to avert it by the simultaneous international action of the proletariat. A passionate lover of France, he sought to spare his country the horrors of devastation by war. While he maintained that a democracy should not have an aggressive policy, he did not deny the duty of every nation to defend itself. To prevent misunderstanding between socialism and patriotism he wrote: "A nation which could not count, in days of crisis or when its life is in danger, upon the national devotion of the working class, would be a wretched thing indeed." He supported the policy of arbitration and all measures to secure international peace, but at the same time, in the name of the workers of France, he insisted "that the nation organise all its military forces, irrespective of class or caste, for the sole purpose of national defence." Against Germany, militarist and absolutist, stood France, a nation in arms, practising "a policy of supreme national defence which would lead not only to peace but to the assurance of peace." Jaurès expounded and developed his ideas on the organization of "a nation in arms" in his great book, *L'Armée* nouvelle.

The policy of world-wide solidarity which Jaurès proclaimed was of no avail against the blind forces which precipitated the war, but Jaurès continued to strive for peace. On July 28, 1914, before the outbreak of war, he and some of his most eminent Socialist colleagues went to Brussels to confer, in the name of the French Socialist party, with representatives of international labour on the best means of averting the threat of war, which he still thought could be avoided. But he was nonetheless full of anguish over the fate of France, compelled to defend itself against aggression. On the eve of mobilization, in Paris, on July 31, 1914, Jaurès succumbed to the bullets of an assassin—a half-wit, impelled to this crime by the calumnies of Jaurès's adversaries. His obsequies were celebrated Aug. 4 in the midst of an immense popular gathering, and his body was interred at Albi. In 1925 his mortal remains were brought back to Paris and deposited in the Pantheon. (E. HE.; X.)

JAVA. Fourth in area but the most important of the islands of the Indonesian archipelago constituting the Republic of Indonesia, Java is separated from Sumatra on the west by the Sunda strait, 14–50 mi. wide, and from Bali on the east, by the Bali strait, 1½ mi. wide on the north. It is 606 mi. long and 127 mi. wide at greatest dimensions, and its area including the island of Madura (*q.v.*) is 51,032 sq.mi. In 1951 there were 52,756,000 inhabitants. Java lies between 5° 52′ and 8° 47′ S. and 105° 13′ and 114° 37′ E.

Mountains.—A longitudinal mountain chain from west to east, surmounted by volcanoes, is flanked in the north by lowlands and in the south by limestone ridges. In the east the portion west of Pasuruan (with volcanic highlands and peaks up to 10,968 ft.) is wider, while a peninsula with the volcanic Tengger, Ijang and Ijen highlands tapers out eastward. Java's highest volcano, the Semeru (12,060 ft.), is there. Middle Java, between Semarang and Cheribon, has a chain formation of mountains (Slamet 11,-286 ft.); there the watershed is central, rather than near the south coast as it is in the east. Between the central mountains and the limestone ridge at the south is the Kedu valley, the most densely populated part of the island. West Java has the Preanger mountains in the southeast (Chikuraj 9,255 ft.) near the coast, with extensive upland basins, of which that of Bandung is the most important; westward the heights are less but in northwest Bantam another group rises to 5,730 ft. The strip along the north coast of the island varies in width from 1 to 40 mi. Java is highly volcanic, yet serious eruptions are few; 35 of the 112 volcanic centres are active. The Tangkuban Prau, Papandayan, Merapi, Kelut, Lamongan, Semeru and Kawah Ijen are under constant observation. The Bromo (7,800 ft.), always steaming, rises from a huge crater bed of sand in the Tengger highlands. Papandayan is capped by sulphur deposits, and the volcanic centres show solfatara (steam jets), boiling wells and mud cauldrons, with the ground coloured bright red, yellow and green. In some places, poisonous gases may be seen rising. The Ijen plateau is one of the largest of extinct craters, covering 82 sq.mi.

Rivers.—Most rivers in Java run northward, down the longer slope, but a few go to the south coast; the largest, the Solo and the Brantas in East Java, are turned east by northern limestone ridges before they reach the coast. The Solo river is 336 mi. long. The southern streams are rapid and rough. In the west the Tarum and Manuk are the most important. In the wet season most of the rivers are navigable for small boats. However, they are mainly used to supply water for irrigation.

Plains.—In the east the northern Japara plain is formed of volcanic deposits; the Juwana, Rembang and Surabaya plains are marine sand and clay. Most interior plains are volcanic; those of the south coast are marsh and sandhills. In Middle and in West Java the northern plain is alluvial, with marsh and coral remains about the lowest levels. The rivers flowing into the shallow northern sea have built up a changing flat belt of sand and mud. The northeast coast is often wooded and of varied contour; westward past Cheribon the coastline is low and rich in mangrove and nipa palm. There has been reclamation for villages. The currents of the deep ocean on the south sweep away river mud but heap up shifting sand ridges which, during the southeast monsoons may block river mouths. The limestone ranges thrust out headlands with cliffs rising 1,600 ft. from the sea.

Geology.—In Java the Cretaceous occurs in one small inlier, strongly upfolded near the centre of the island; the Eocene appears as coal seams, sandstones and limestones, and the later Tertiary strata yield marls. breccias, and limestones and cover 38% of the island. The Miocene strata are very thick; fresh water Pliocene strata in the east, or the Pleistocene immediately above it yielded the famous "ape-man" or "dawn man" fossil called Pithecanthropus, and there is much marine Pleistocene material, some of it 350 ft. above sea level. The oldest rocks are serpentine and mica schists, in part perhaps cretaceous. Faults separate the central volcanic highlands from the northern lowlands and from the broken country to the south, so that the island is formed of strips. The central volcanic mountains rest on highly folded Tertiary rocks with indications of underlying Cretaceous sandstones and Palaeozoic schists; they are interrupted by an extension of sediments southward across the island from Semarang. Vulcanicity developed in the mid-Tertiary and attained its maximum in Pleistocene times; volcanic rocks, especially andesites and basalts, cover 28% of the island.

Climate.—In spite of its subequatorial location. Java rarely has extreme heat. The temperature averages 78° to 80° F.; mountains, sea breezes and thunder showers in the wet monsoon relieve the heat. The highest temperature is found in the plains along the north coast, but in the mountains it is much cooler. At about 2,000 ft. are temperate conditions, and a temperature of 27° has been recorded on the heights. The mean daily range at Djakarta (formerly Batavia) is 11.8°; in the mountains, 38°. Absolute maxima and minima are 96.4° and 66° at Djakarta, 99° and 62.4" at Assembagus (south coast) and 71.9° and 47.5° at Tosari (5,692 ft.). The coastal districts are coolest at 6 A.M. and warmest at 1 P.M. High humidity is general (75%–90%), which especially in the transition period between the dry and wet monsoon makes the climate debilitating.

Java has a northwest monsoon from December to March, bringing much rain and clouds especially in the north, while from April to October it has a southeast monsoon bringing some rain to the south coast but making August the sunniest month at Djakarta. Strong cyclones and typhoons are unknown, but afternoon thunderstorms are common in the mountains and at night during the wet northwest monsoon. Djakarta has an average of 122 thunderstorms a year. The northwest monsoon extends to about 12,000 ft.

Rainfall varies. January is usually the most rainy month.

Djakarta averages 70.7 in., Cheribon 90.38, Banyuwangi 53.72, Bogor (formerly Buitenzorg) 165.94, Bandung (2,395 ft.) 77.2, Chilachap (south coast) 152.25, Kalisat (3,609 ft.) 62.4 and Assembagus, the driest station, 35.39 in. Regions of maximum rainfall are west Bantam, around Mt. Cherimaj in Cheribon, north central Java south of Pekalonpan, around Mt. Muria in central Java, and in the highlands of eastern Java. Periods of drought last from 12 to 53 days in the west, and 14 to 116 in the east, and once a drought at Situbondo lasted 227 days.

Fauna. — The Javan one-horned rhinoceros is closely allied to a form in southeastern Asia but is dying out. The tiger occurs in Java and also the banteng or wild ox (Bos sondaicus), akin to the gaur, the great wild ox of India. There are two species of wild pig, both very destructive to crops, a leopard, a wildcat, deer. notably the little muntjac (Cervulus muntjac) and the graceful musk deer (Tragulus javanicus), several species of ape, Galeopithecus (a flying lemuroid), many bats which produce guano deposits: squirrels, flying squirrels, porcupines, rats, mice, shrews. ichneumons, civet cats, hares, badgers and the scaly anteater (*Manis* javanica). The dugong, a large aquatic mammal, visits the coasts of Java.

The green peacock (*Pavo muticus*) is found in Java. A rare and beautiful jungle fowl (*Gallus* varius) is found there and also *Gallus gallus,* the red jungle fowl. The bird population includes 400 species; snipe and other water fowl abound and weaverbirds and ricebirds prey upon the crops. Only two parrots occur. The swift (*Collocalia*) which produces the edible bird's nest is found along the coast. Two trogons, two blue-ground thrushes, a pink-headed dove, a black and crimson oriole and three broad-tailed ground pigeons belong to Java. Large crocodiles (C. *porosus*) are common, and lizards swarm; the monitors Varanus salvator (minyawak) and V. *bivitatus* (beawak) are large enough to attack poultry, Snakes, numbering more than 100 species, include the great python (Python reticulatus) reverenced because it destroys field mice, the cobra and an adder.

Seas, rivers and ponds swarm with gorgeously coloured fish which form a large element in the food supply. Crabs, lobsters and crayfish are common. More than 500 species of butterflies occur there, and moths, beetles, mosquitoes, ants, termites and hornets are common. Scorpions and centipedes are troublesome, and spiders abound; one spider snares small birds.

Vegetation. — More than 5,000 species of plants are known and the botanic gardens of Bogor are world-famed. The vegetation is south Asian, with Australian affinities in the southeast and east. Dense rain forest abounds in Java on the damp slopes of the mountains. The rasamala (Altingia excelsa), a tall timber tree, common in the west, is absent from the east, where mountain Casuarina flourishes. Thick bamboo woods occur in the west; the teak or "djati" forests are scattered along the northern plain but are mainly on the limestone hills of Rembang, Semarang, Madiun and Kediri. The most important fruit trees are banana, mango (*Mangifera* indica), nangca (Artocarpus integra) and durian (Durio zibethinus).

There are four plant zones. The lowlands are entirely cultivated. Soil composition and degree of fertility vary considerably, depending on whether the sediments are of recent volcanic origin or limestone.

From sea level to 1,750 ft. is found the coastal zone, the most extensive of the four; some trees, such as Barringtonia *speciosa* and *Terminalia catappa,* grow only near the sea. Epiphytic plants are uncommon, and fleshy-leaved plants abound on salty soil. A short distance inland, palms and bamboo begin. Where limestone is found in the hills, acacias, sterculias, rattans, pepper vines and jasmine are common. Acacia forms fine woods between 400 and 1,300 ft., and teak thrives between 100 and 2,000 ft., forming one-fourth of the government forests. In this zone rice, maize, sugar cane, tapioca, coconut palms, rubber, tobacco and some cotton are grown. Higher up, in the second zone, are the rain forests with brilliantly flowering epiphytes, notably orchids, as well as ferns and fungi, growing on the tree trunks. Magnolia and anonaceous trees are general, while rasamala grows 130 ft. high in Middle Java; Casuarina and also bamboo are found almost everywhere there. The temperature of the second zone is 64" to 74° F. It has a much narrower range of species, and its cultivated plants include tea, cinchona and coffee. As the altitude increases, strawberries. violets and herbaceous composites occur. In the third zone (temperature, 54° to 64°) are lakes with rich grassy shores. Azaleas and rhododendrons abound, as well as oaks, chestnuts, maples and laurels; Trema orientalis is found on Mt. Merapi and Mt. Kelut. Many trees are covered with mosses and lichens. Crowfoots, horsetails, meadow rue, whortleberries (*Vaccinium*), raspberries and blackberries are found. Many European vegetables are grown in this zone. On about 20 peaks, forming the fourth zone, conditions are alpine or subalpine, and frosts occur. Ironwood, myrtle, elder, rhododendron. barberry, guelderrose, honeysuckle. heather and the so-called Javanese edelweiss (*Anaphalis javanica*) are common. The royal cowslip (*Primula* imperialis) is said to grow only on the summit of Pangerango, where wood sorrel, sow thistle, chickweed. lily of the valley, foxglove, lobelia, yew and annual grasses also grow.

The main value of the forests is in their hydrological function. Teak is the chief tree economically exploited, principally by the state, which owns the teak forests. About 5% was exported. There are a forestry school and an experimental station in Bogor. The service of forestry controls and protects all national forests in order to prevent the soil on the slopes of the mountains from eroding and to maintain a supply of water for irrigation purposes in the dry monsoon. (J. O. M. B.; X.)

ARCHAEOLOGY

The building of stone temples began at the end of the 7th century, with its centre in middle Java. An earlier West Java period which probably used only light material has left no traces. The classical, or Middle Javanese, style which closely follows Indian traditions flourished in the 8th and 9th centuries, and while ap- the 13th and 14th centuries. Art declined in the 15th century and about 928. The centre of culture was then transferred to East Java. Of the first centuries of the East Javanese period there are only sporadic remains; the great mass of monuments dates from the 13th and 14th centuries. Art declined in the 15th century and in the beginning of the 16th century was destroyed by Islam.

Middle Javanese art yields small temples. in groups and singly, square with vestibule in front, projections for niches on the three other sides, a roof in stories with corner towers, while the decoration is very restrained and combines harmoniously with the architecture; the panels of the faces are often smooth, the only ornamentation introduced being in borders around the entrance and niches, consisting of the head of a monster (*kāla* motive, derived from a lion's head) at the top and a makara at each side (*kāla*-makara ornament). The sculpture is simple and severe. On the Dieng plateau, near Wonosobo, a place of pilgrimage was dedicated to Siva; of the original 200 buildings, 8 small temples still survive.

About A.D 750 this art became greatly enriched and refined, with closer political relations with the kingdom of the Sailendras in Sumatra who ruled over Java as well; larger edifices, better technique, bolder designs and more extensive, systematically planned groups of temples are then found; the panels of the façades are filled with ornamentation or reliefs. In Sumatra only a few buildings have survived (*e.g.,* the stupa of Muara Takus, on the Upper Kampar). In Java are numerous monuments, almost all dedicated to Mahāyāna Buddhism.

The most important monument is the stupa of Borobudur with its foretemple Mendut. The latter contains a very large but delicately finished image of the Buddha between two Bodhisattvas. Borobudur itself is a terraced mound, dressed with stone, surrounded by four square galleries, crowned with niches and covered by three circular terraces, with transparent bell stupas. In these bells and in the niches are found images of the Dhyāni-Buddhas. Along the galleries Sanskrit texts are illustrated. At the top arises the main stupa, where an unfinished Buddha image has been discovered, thought to be Adi-Buddha. The foot of the monument was covered from sight, even as early as the Middle Javanese period, by a pile of stones.

These edifices were erected in the Sailendra era, A.D. 750–860. Their successors, the princes of Mataram, built even richer monuments especially in Prambanan, where, besides the Buddhistic Chandi Plaosan, consisting of two Vihāras with Bodhisattvas, terraces and side temples, the Chandi Lara Djonggrang (*c.* 900), was constructed as the national temple (dedicated to Siva), and the royal mausoleum. Within four rows of minor temples, on the middle terrace, lie eight large buildings. The central and most important one is for Siva and contains the images of the god and his pantheon and a series of Rāmāyana reliefs. On the sides are shrines of Brahma and Vishnu; opposite to Siva stands a temple for his riding bull Nandin.

As to the relation between Middle and East Javanese art, East Javanese art is regarded by some as the direct descendant of the Middle Javanese style; they assume that only the disappearance of the connecting links prevents us from following its footsteps. Others hold that East Javanese art had an individual and indigenous character and was contemporary with Middle Javanese art. The distinction between the two is clear. The harmonious connection between ornament and architecture is lost; the part is often made conspicuous at the cost of the whole; the systematic groups are replaced by apparently capricious combinations in different styles; the evenly flowing relief conceptions become episodic and the figures represented assume the appearance of the *wayang* puppets (Javanese shadow show). In the frame work ornamentation the *makaras* disappear and the monster heads stand alone; in the roof formation the towers are squeezed inward, so that pyramidal forms with horizontal layers are formed. The same texts find a place in the shrines of both sects, and at last Siva-Buddha temples are built.

A few very ancient remains are pure Middle Javanese such as Chandi Badut; others, from the transition period, show a combination of Middle and East Javan characteristics, as at Chandi Sanggariti, built round a medicinal spring and at Chandi Gunung-Gangsir near Bangil, an example of ancient brick building. East Java uses brick, combined with stone, while Middle Java prefers stone. The mausoleum-bathing place (bathing place where burial has also taken place) Djalatunda on the Penanggungan, dating from 577, is distinctly East Javanese; the reliefs which surround the middle terrace form a contrast to Middle Javanese especially in their lively composition. A later bathing place, Belahan, yielded a fine image of the king Airlangga (1042) represented as Vishnu on Garuda.

The continuous series of East Javan works of art beginning halfway through the 13th century with Chandi Kidal, near Malang, shows that in spite of the great delicacy of execution the feeling of proportion in the ornamentation was weakening. Medallions have become an important motive in decoration, but are replaced later by an inserted plate. At Chandi Djago. somewhat later. are high receding terraces. on top of which the temple stands. The reliefs. rendering ancient Javanese texts, are entirely in *wayang* style. The divine figures of the Bodhisattva Amoghapāśa and his followers are more in accordance with the older style. Both edifices are royal mausolea. The unfinished tower temple of Singasari, with the side chapels built out from it, contained Sivaitic deities. In this neighbourhood was found an image of the Buddhist Prajnāpāramitā, one of the best products of East Javanese art. An image of Harihara, with the features of King Krtariijasa (1294–1309), the founder of Majapahit, from the ruined shrine of Simping is the work of a nearly related school.

At its height, in the 14th century, the Majapahit empire dominated the whole archipelago. and its prosperity is reflected in its monuments. To this period belong Chandi Djabung near Kraksaan, the only example of a circular tower with a circular crown, and probably Chandi Sawentar near Blitar, striking from the severity of its lines. Of Chandi Surawana and Tigawangi only the basements remain, with rich reliefs, in which the available space is filled with reproductions of nature. At Djedong a few gateways remain, as on the ground of the ancient capital Majapahit itself, where also a bathing place and ruins of temples are found.

The chief shrine of East Java was Palah, now Chandi Panataran. This Siva temple rose on the summit of three terraces, in the reliefs of which the episodes represented were cut up into small pieces, thus sacrificing the clearness of the story to the exigencies of decoration, and the artists gave human forms to the surrounding natural objects (clouds, mountains, trees, etc.). The group contains further a small temple, around which serpents coil, several terraces, bathing places and many other remains quite unsystematically arranged.

A great Buddhistic group, Chandi Sanggrahan, is almost entirely destroyed; Chandi Ngetos is of much clumsier form and the grottos of Selamangleng are the only examples of relief decorations found within caves hollowed out of the living rock.

In the 15th century, art in the plain was declining, as at Chandi Gambar and Tuban; whereas in the mountains there flourished sanctuaries both of a Hindu and a more Indonesian appearance; to the first belong Indrakila, Penanggungan and Penampikan, to the latter Argapura. In the extreme west of East Java, on the Lawu, Chandi Sukuh and Tjeta show how the Hindu Javanese and Indonesian culture, in the course of this century, combined to form a peculiar but not unpleasing mixture. The centre of worship there was not a temple but a pyramidal terrace.

At the beginning of the 16th century Majapahit fell, and Islam became dominant, but the Hindu-Javan forms of building had become so national that the new religion used them in the minaret of Kudus and the mosque of Sendang-duwur; this style proved to have no permanent hold on life. Hinduism survived for some time in the eastern corner of the island and there raised the temples of Matjanputih. It finally succumbed and took refuge on the island of Bali, where it exists to the present day.

BIBLIOGRAPHY.—W. P. Groeneveldt, *Catalogus der Archeologische Verzameling te Batavia* (1887); J. W. Yzerman, *Beschrijving der oudheden nabij de grens der residenties Soerakarta en Djogdjakarta* (1891); *R.* D. M. Verbeek, *Oudheden van Java,* rev. ed. (1915–22); E. A. von Saher, *De versierende kunsten in Nederlandsch Oost-Indië* (1900); *J.* L. A. Brandes, *Tjandi Djago* (1904); J. L. A. Brandes, *Tjandi Singasari and De Wolkentooneelen van Panataran* (1909); *T.* van Erp, "Hindu Monumental Art in Central Java," *Twentieth Century Impressions of Netherlands India* (1909); *H.* H. Juynboll, *Catalogus van 's Rijks Ethnographisch Museum te Leiden,* V, *Javaansche oudheden* (1909); J. F. Scheltema, *Monumental Java,* 2nd ed. (1926); K. With, *Java, Brahmanische, Buddhistische und eigenlebige Architektur und Plastik* (1920); N. J. Krom, *Inleiding tot de Hindoe-Javaansche Kunst* (1923); W. F. Stutterheim, *Rāma-Legenden und Rāma-Reliefs in Indonesien* (192;) ; Publicaties van den Oudheidkundigen Dienst in Ned. Indië I (1925) ; N. J. Krom, "L'art javanais dans les musées de Hollande et de Java," *Ars Asiatica,* viii (1926) ; M. P. Verneuil, *Les temples de la période classique indo-javanaise* (1927) ; N. J. Krom, *Archaeologiral Description of Barabudur* (1927; plates, 1920) ; H. Parmentier, "Origine commune des architectures hindoues dans l'Inde et en Extrême-Orient," *Etudes Asiatiques,* II (1925) ; *see* also articles by Vogel and Goloubew in Indian Society, *The Influences of Indian Art* (1925); *A.* K. Coomaraswamy, *History of Indian and Indonesian Art,* part vi (1927) ; J. W. Stapel, *Geschiedenis van Nederlandsch Indië,* vol. i (1939). (N. J. K.)

HISTORY

The first definite reference to Java in European literature is probably that of Marco Polo in the 13th century. Early Arab chroniclers included parts of Sumatra and Java under the general definition of Jawi. The history of the island before the appearance of the Portuguese (*c.* 1511) divides itself into two parts. the long period of Hindu influence and the first part of the succeeding Mohammedan regime. It is said that Hindus visited Java during the first century A.D. They came first as traders; later there were priests among them. They intermarried with the Javanese and in this way spread their culture and religion. It is unlikely that any part of Java was ever actually ruled by Hindus. The earlier Hindu-Javanese cultural and political centre of importance was Mataram in Middle Java. Around 928 A.D., however, this centre moved to East Java, where several kingdoms came successively into existence, the last and best known of which was Majapahit (1293–1520). A considerable civilization was built up by the Hindus, and João de Barros says that the Portuguese found in Java "the most civilized people of these parts"; while all the other peoples of the archipelago were addicted to piracy, there is no account of Javanese piratical expeditions. After the overthrow of Majapahit Java again split up into many kingdoms or prov-

inces. In the meantime Mohammedanism had been introduced in Java by traders from Gujarat (India), Malacca and Sumatra, and gradually the Javanese became Moslems. After the fall of Majapahit, supremacy went back to Middle Java, where in succession the kingdoms of Demak, Pajang and Mataram came into power, the latter founded in 1586 by the governor of the province of Mataram. The first Dutch traders arrived in 1596; in 1602 the Dutch East India company was formed; and in 1610, when the first Dutch governor general was appointed, they were given permission to build a settlement in the neighbourhood of Jajakerta. In 1619, after several unsuccessful attempts to dislodge the Dutch, the town of Jajakerta was taken by the governor general, Jan Pieterszoon Coen, who founded Batavia (Djakarta) there. During the next century and a quarter they were repeatedly in conflict with native princes, each challenge ending in an extension of Dutch power. Possession of the Preanger was obtained in 1705 by treaty with Mataram; in 1745 Dutch authority was recognized over the whole of the northeast coast, and ten years later Mataram was divided into the states of Surakarta and Djokjakarta (Jokjakarta) whose princes acknowledged the sovereignty of the Netherlands. The kingdom of Bantam was subjugated in 1808. During the later Napoleonic period France laid claim to Dutch possessions in the east, and the hoisting of the French flag at Batavia brought in the British, who defeated the French at Weltevreden. Stamford Raffles was appointed lieutenant governor, subject to the control of Lord Minto, governor general of India. Raffles revolutionized the whole system of administration, abolished the tribute and introduced a reform of the land and legal systems. He was in charge of Java from 1811 to 1816, when it was returned to the Dutch, who had to face a five-year rebellion started in 1825 by Dipa Negara, and suffered heavily in men and money. In 1830 when the Netherlands was engaged with the revolt of Belgium at home, it had no resources with which to relieve the financial difficulties of the colony. Baron von den Bosch offered to provide the necessary funds. He was governor general and colonial minister from 1830 to 1839—black years in Java's history. He resumed the old policy of forced cultures which sought to prevent the indigenous culture from assimilating the developments of modern Europe. In the meanwhile Dutch opinion at home was roused, and in 1854 laws were passed intended to put the whole political and economic administration on a humane and progressive basis, while new reforms, under the influence of liberal economic doctrines which paved the way for private enterprise in Java, were introduced in 1870. Sloet van de Beele as governor general in 1866 abolished passports for natives travelling in Java, reduced the *corvée* and abandoned the farming out of fisheries. Primary education and a liberal penal code were introduced in 1872.

Java thereafter was governed along lines that frequently commanded the admiration of students of political science. In 1903 the Javanese were admitted to a part in local affairs, and a first step in representative government and decentralization was followed by others, till in 1918 a *volksraad* or people's council was created. The effect of education, the example of Japan, the Chinese revolution, the Indian Swaraj movement and the national and racial unrest throughout the world, especially after World War I, had their reactions and repercussions on the Javanese. The demand for home rule grew among the moderates, and the right to independence was insisted on by extremists. In 1925 the people's council became a full co-legislative body, and a few years later the Indonesians were given the majority in the *volksraad*. Democratic administrative reforms in the local sphere were introduced between 1926 and 1930, resulting in the creation of provincial councils and regency councils, followed in 1931 by the so-called emancipation of the Javanese internal administration.

After the outbreak of World War II in 1939, the Netherlands intensified efforts to give the Netherlands Indies military and naval protection against a possible Japanese attack. Even after the conquest of the mother country in 1940, the Dutch administrators continued, with the help of the United States, to strengthen the defenses of the islands. The program was inadequate, however, and the fall of the outer islands and Singapore to Japan early in 1942 coupled with the naval defeat in the Java sea on Feb. 27–28 sealed the fate of Java. On the night of Feb. 28 Japanese troops made their initial landings on the island; within a few days they were reinforced by an estimated five divisions.

Batavia fell March 5, and Bandung two days later. The great naval base at Surabaya (Surabaja) was conquered March 10, after most of its installations had been destroyed. Thereafter virtually all resistance to the invaders ceased, though guerrilla campaigns were fought in the mountains.

From 1942 until 1945 Japan exploited the resources and impressed the population into forced labour and military service. The occupation, however, resulted in a revitalization of the nationalist movement. By agreement among nationalist leaders one group led by Sukarno accepted posts in the occupation government while the remainder headed by Sutan Sjahrir led the resistance movement. During the occupation these leaders convened a national assembly which drew up a democratic constitution.

On Aug. 17, 1945, two days after the surrender of Japan, an independent Republic of Indonesia was proclaimed, ending 350 years of colonial rule. On the following day Sukarno was elected president, and a provisional constitution was adopted. When British forces arrived in Java on Sept. 29 to accept the Japanese surrender, the republican government was functioning. The landing of Dutch forces against the opposition of forces of the republic signaled the outbreak of hostilities. Negotiations which commenced in March 1946 led to the Linggadjati agreement of Nov. 15, 1946, in which the Netherlands recognized the Republic of Indonesia as the de facto government of Java, Sumatra and Madura. The agreement provided for the establishment of a United States of Indonesia comprising the republic, Borneo and eastern Indonesia and for the formation of a Netherlands-Indonesian union.

Subsequent efforts to implement the Linggadjati agreement, however, met with strong opposition both in the Netherlands and in Java. On July 21, 1947, the Dutch commenced a "police action" which reduced the territory held by the republic to central Java. Following a cease-fire affected by action of the United Nations Security council, both parties, meeting with a UN Good Offices committee aboard the U.S.S. "Renville," agreed on Jan. 17, 1948, upon a truce and a basis for further negotiations. On Dec. 19, 1948, Dutch forces, in a second "police action," captured the capital at Djokjakarta and placed the republic under martial law. Upon protest of the UN Good Qffices committee the government was reinstated on July 3, 1949.

Finally, on Nov. 2, 1949, agreement was reached in a conference at The Hague upon a charter for the transfer of sovereignty and the statute of a Netherlands-Indonesian union. Meanwhile, in Java a consultative assembly, on Oct. 29, 1949, had adopted a provisional constitution for the federal state. The transfer of sovereignty from the Netherlands to the United States of Indonesia was proclaimed Dec. 27, 1949. In structure the federation comprised 16 member states each having its own executive head, cabinet and legislative branch.

The federation was short lived. Following votes of the member states to merge with the Republic of Indonesia the present unitary state, a constitutional democracy, was proclaimed on Aug. 17, 1950, with Sukarno as president. Thus Java, which had been the beacon of independence and prime mover of the nationalist movement, became the seat of government of the Republic of Indonesia. On Aug. 10, 1954, an agreement was concluded dissolving the Netherlands-Indonesian union.

SOCIAL AND ECONOMIC CONDITIONS

Population and Social Conditions.— Supporting two-thirds of the population of the Indonesian archipelago on 7% of the total land area and having a population density of 1,033.8 persons per square mile, Java is one of the world's most densely populated areas. The density is greatest in the southern and central parts of the island where regions are found with an average of 2,260 persons per square mile. The vast majority, 96%, of the inhabitants live in rural communities and engage in growing their own food on small farms averaging a few acres in size.

The principal city, Djakarta, located at the mouth of the Tjili-

wung river on the northwest coast of Java is the national capital of Indonesia. In 1956 its population of about 1,927,788 was about four times as great as before World War II. Djakarta (Jakarta) is the largest city and the governmental, commercial and cultural centre of Indonesia. The lower town in which the commercial houses are located still retains its picturesque canals, Chinese quarter and quaint dwellings in contrast with the broad streets and modem office buildings. The government offices, foreign embassies and residential sections are in the upper town. After World War II the city proper expanded to encompass former suburbs, while new residential areas developed in the outlying Tjideng and Kebajoran areas. The meteorological bureau and the teaching, medical, philosophy and law faculties of the University of Indonesia are located there.

Western Java is relatively sparsely populated. The majority of the population are Sundanese who originated in the Preanger highlands and form 20% of Java's inhabitants. They differ in customs and language from the Javanese who inhabit central and eastern Java. Extensive jungles exist in this area, and the soil is not as fertile as in most other parts of Java. Bandung, situated on a high plateau in the northwest, is the capital of West Java. Sometimes known as the Paris of Java it is a holiday resort city. The population of Bandung was approximately 870,346 in 1956. Of historical interest is the ruined town of Bantam near the north coast, once an important trade cenrre, with vestiges of old palaces and European settlements. Among the Mohammedan antiquities is the Kasepuhan "Kraton" (palace) at Cheribon. In West Java also is the radio station of Malabar for international communications.

The capital of the province of Central Java is Semarang (Ambarawa), an important harbour and centre of commerce on the north-central coast. Pop. (1956 est.) 389,970. Railroads connect Semarang with Djakarta, Surabaya and Djokjakarta (Jogjakarta).

The plains of Djokjakarta and Surakarta lie in the south of Java. Both towns are centres of Javanese cultural life. There the characteristic Javanese dances are preserved and developed. The Javanese shadow play, based on stories from the beautiful and rich Hindu-inspired Javanese literature, is popular throughout the island as is the Javanese orchestra (gamalan). Djokjakarta is also famous for its silver handicraft work and its batik industry.

In this section are the remnants of the old Hindu-Javanese culture which once prevailed in Java. Eight miles north of Djokjakarta is the great stupa of the Borobudur, a relic of Buddhism. Close by is the temple of Mendut in which is a huge and imposing statue of Buddha. The temples of Prambanam to the east of Djokjakarta are relics of the Brahmanic faith and one of the marvels of ancient religious art. A smaller and older temple group is found at the Dieng plateau.

The most important city of eastern Java and the second largest city and port of Indonesia is Surabaya; population (1956 est.) 980,905. Located on the northeast coast opposite Madura on the Kali Mas river, it is an important naval base, trade and industrial centre. The drydocks and navy yard there were destroyed by the Dutch during the Japanese invasion of March 1942. A naval aerodrome is at Morokrembangan. Surabaya has a modern harbour at Tanjong Perak with drydocks for ships up to 15,500 tons.

Surabaya is the capital of East Java. Railroads connect it with Djokjakarta and Djakarta. Another line runs to Malang, situated on a large plateau to the south surrounded by volcanoes. This city is the centre of estate agriculture in the region. At Malang is an experimental station for coffee growing. Another point connected with Surabaya is Banyuwangi, with ferry service to the island of Bali. Along this line are the town of Pasuruan with an experimental station for the sugar industry and the town of Probolinggo, an export harbour primarily for sugar. South of Surabaya near Modjokerto (Mojokerto) and also in the vicinity of Malang are several temples which date from the Hindu period. The little village of Majapahit is the old capital of the once famous empire of that name.

Although the majority of the people in eastern Java are Javanese, there is an important influx of Madurese from the island of Madura, especially in the northeastern part of this province. The Madurese people are famous as cattle breeders and fishermen.

The people of Java are of Malay stock although they show Mongolian affinities in dark skin, lack of body hair and poverty of beard. They are small in stature, generally broad-headed and have straight hair, while many of them have the typical Mongolian eye. The three groups nhich inhabit Java differ in character as well as in language. The Javanese have a great love for order and harmony; the Sundanese have a more lively temperament; and the Madurese have a rather hot temper but they are thrifty and energetic. Their religion is Mohammedanism, but a strong influence of Buddhism and Brahmanism can still be discerned, and folk beliefs still have a great influence among the masses.

The main food staple of Java is rice, which is used with vegetables and fish. Meat is eaten only occasionally, as is milk.

blen as well as women wear long skirts (sarongs); with these the women wear blouses and the men wear jackets, while the men always wear either a black cap or a kind of turban.

Agriculture.—The agricultural pattern developed in Java under the Netherlands did not change basically after Indonesia became independent in Dec. 1949. The following characteristics distinguish Indonesian smallholder from European estate agriculture in Java: (1) smallholder agriculture is directed primarily to the production of food crops for domestic consumption while estate agriculture produces for export; (2) smallholders' plots of ground average 2–7 ac., while the western entrepreneur holds areas on long-term lease averaging 1,500 ac.; (3) western enterprises represent large capital investments contrasted with a small investment of the Indonesian smallholder; and (4) estate agriculture engages in the final processing of the product—sugar, tea, quinine, etc.—while the Indonesian smallholder usually sells the grown product immediately, leaving the final processing to others.

Smallholder Agriculture.—Java's primary crop is rice. The average yield of rice (8.2 cwt. per acre) is second only in southeast Asia to that oi Malaya. In 1950, 47% of the area devoted to smallholder agriculture produced rice. Although irrigated rice is grown throughout the island, the greatest production is in West Java. For centuries the Javanese people have irrigated their fields. Before the Japanese invasion of 1942 the construction of an elaborate system of canals, dams, aqueducts, syphons and reservoirs at a cost of 200,000,000 guilders improved more than 3,000,000 ac. of sawahs. As a result of improved irrigation and the constant care of the agricultural service, rice imports decreased from 13,000 tons in 1930 until Java became a rice-exporting area in 1939, the exports being primarily sent to other islands of the archipelago. Following World War II rice production dropped making imports necessary. By the 1950s, however, production had approached the level of domestic consumption.

Maize is second in importance for domestic consumption; production of shelled maize in 1930 was 1,956,000 tons and in 1950, 1,600,000 tons. Next is cassava (tapioca), with a production of 5,216,000 tons in 1930, 8,290,000 tons in 1940 and 7,000,000 tons in 1950. Cassava has occupied about one-tenth of Java's cultivated area. Its export supplied approximately three-quarters of the world's prewar needs for industrial starch, gums and sizes.

The soybean has played a more and more important role in the economy of Java, with production increasing from 102,000 tons in 1920 to 283,000 tons in 1940; in 1950 it was 245,000 tons.

The Indonesian farmer also produces practically the entire output of kapok, peanuts, sesame, potatoes, vegetables, such fruits as bananas, mangoes, duran and other citrus fruits, and a large proportion of essential oils. Tea gardens are found in the neighbourhood of the tea estates, primarily in West Java, and coffee is grown by Indonesian farmers in Malang and Besuki and tobacco in Bodjonegoro, Kediri, Besuki and Banjumas. In Bantam, in West Java, the coconut is grown in abundance.

Sugar.—Sugar was a well-known product of Java when the Dutch first came to the Indies in 1596. At that time, Chinese primarily grew the sugar cane and were the owners of the sugar mills. Gradually, however, with the support of the government, the basis was laid in the 19th century for scientific processing of sugar by western enterprise.

Sugar cane is usually produced on irrigated land. The economic crisis of the 1930s dealt a great blow to the sugar industry. Under the international sugar agreement concluded in 1937, Java secured 6% of the world's sugar market in 1939 (1,576,159 tons exported) as compared with 11% in 1929. During World War II and the years immediately following, sugar production suffered as a result of war devastation and political instability. Far below prewar production, Java produced 618,191 tons of sugar in 1953, of which 150,000 tons were exported.

Rubber.—In Java rubber is grown almost exclusively on western plantations. Unlike the other islands of the Indies where an important native agriculture of rubber exists, Java has only a few Indonesian rubber gardens. Since almost all of the lowlands in Java are in use for agricultural purposes by the Indonesian population, the rubber estates are generally located between 300 and 1,500 ft. above sea level on long-term leases.

Following World War II, rubber producers felt the effects of the competition of synthetic rubber on world markets. Notwithstanding the decline in world rubber prices, estate rubber production increased from 10,000,000 kg. in 1950 to 23,780,266 kg. in 1953. Reflecting the downward trend of world market prices, smallholder production dropped from 10,000,000 kg. in 1952 to 7,785,564 kg. in 1953.

Tea.—Most favourable for tea cultivation are regions at an altitude from 2,000 to 6,000 ft. above sea level where rainfall is plentiful and uniformly divided over the year. In 1829 the cultivation of tea was stimulated in the mountains south of Bogor, and the mountain region of West Java became the centre of tea growing. Later tea estates were established also in East and Middle Java. Chinese tea varieties were generally replaced by Assam tea, since this species had a greater popularity on the European market.

Tobacco.—There are two centres of tobacco culture in Java: in Djokjakarta and Surakarta and in Besuki in East Java. In Djokjakarta and Surakarta an excellent quality of leaf tobacco is produced by intensified cultivation and drainage. In Besuki the growing is done by smallholders. The estates supply the seedlings and complete the curing and processing.

Coffee.—Coffee was extensively cultivated in Java as early as the time of the East Indies company. During the 19th century it was grown under government order by the Indonesians. After 1870 an important private industry developed, but serious leaf disease and a drop in the market prices caused a crisis in the trade, resulting in the introduction of new varieties.

Coffee cultivation is centred in eastern Java and in the mountains south of Semarang in central Java. Estate production of coffee in 1953 was 18,525 tons.

Cinchona.—Ordinarily, 91% of the world's quinine is produced in Java. In 1854 the first cinchona plants and seeds were imported from South America. Planting was confined at that time to the government cinchona estate, and not until 1872 did private enterprise enter into cultivation, when new species of cinchona were made available from seeds of another variety, the Cinchona *ledgeriana.*

The chief centre of cinchona growing is western Java (Pengalengan plateau). The cinchona bark is obtained by cutting down the trees and by pounding the trunks until the bark loosens. Production in 1950 was 9,114 tons of bark. In 1950, 2,456 tons of bark and 63 tons of quinine were exported.

Industries.—Although some native industries had always existed on Java, such as weaving and batik, it was during and after World War I that modern industrial development started. After the economic depression of the 1930s, industrialization received additional stimulus when it had become clear that Java, like the Indies as a whole, had a one-sided agricultural development which made it very vulnerable and extremely dependent on world conditions and the world market. Moreover, there was in Java the ever-pressing problem of overpopulation for which a complete solution was difficult to find. Although the agricultural productive capacity of the people had been brought to a higher plane by means of improving and extending irrigation facilities and by agricultural information services, these measures alone were not sufficient. Other measures were emigration of Javanese farmers to the outer provinces and further industrialization of Java.

Java's industry falls into three groups: cottage industry which is entirely in the hands of the Indonesian farmers (producing simple agricultural tools, hats, knives and rattan weaving); the small-scale industry, generally not working with machine power (such as weaving); and the large industries on a completely capitalistic basis. The smaller industries are often organized into so-called centrales, a kind of co-operative which established factories for the final processing of the products. From 1935 to 1942 about 500 new large and medium industries were established, such as a Goodyear Tire and Rubber plant at Bogor, the General Motors assembly plant at Tandjungpriok (Tanjong Priok), the breweries in Djakarta and Surabaya, the Bata shoe manufactory near Djakarta, also paper mills, soap factories, textile mills, etc. Between 1950 and 1954 factories had been completed or were under construction for rubber processing; cotton spinning; bicycle and radio assembly; plywood manufacture; coconut oil processing; chemical manufacture; ceramics, porcelain, slate and tile manufacture; and other enterprises designed primarily to produce more goods for home consumption.

Mining.—The mining industry is of relatively small importance in Java. Only petroleum extraction was developed on a large scale. The most important centre is Tjepu, on the border of East and Middle Java; oil is also drilled near Surabaya at Wonokromo. Manganese ore is found and exploited near Djokjakarta (Kulon Progo). Sulphur is obtained from Mt. Kawah Putih near Bandung, and Mt. Welirang near Malang. Gold and silver are found in Bantam (West Java). Iodine springs occur south of Surabaya (Modjokerto). Salt is produced, as a government monopoly, on the island of Madura.

Administration.—Following the relinquishment of sovereignty by the Netherlands on Dec. 27. 1949, the Republic of the United States of Indonesia existed for eight months as a loose federation of 16 member states. The successor Republic of Indonesia, established Aug. 17, 1950, is a unitary constitutional democracy. Administratively the republic is divided into 20 provinces. Each province is administered by a governor appointed by the minister of home affairs of the central government upon the recommendation of the provincial house of representatives. Since independence each village in Java has had a representative council of not exceeding 30 members. The village administrative head, or *lurah,* responsible to the representative council, administers the village with separate staffs for administration, education, health, religious affairs, people's welfare and security.

(J. W. CR.; J. C. L.; J. O. M. B.)

JAVANESE LANGUAGE is spoken as a native language by more people (over 40,000,000) than any other Malayo-Polynesian language. The vast majority of its speakers are on Java, occupying all except the western third and a section of the northern coast opposite Madura. Others are in the large cities of western Indonesia and the plantations and oil fields of Sumatra.

Central Javanese, the dialect of Solo (Surakarta) and Djokjakarta, has the highest prestige. Other dialects are Western Javanese, with its centre in Tegal, and Eastern Javanese, with its centre in Surabaja. Javanese has a number of well-defined status styles. Most elaborate is the difference between the ngoko (informal) and the krama (deferential) styles. When neither of these is suitable, the madya ("middle") style is used. Other styles are the krama *inggil* (highly deferential) and the basa kedaton ("palace language"). The Javanese alphabet is a modification of a Pallava (south Indian) alphabet.

Javanese literature is extensive and varied. In the Old Javanese period (c. 750 to c. 1400) Indic influence was paramount; the oldest inscriptions, the translations of the Mahabharata and Ramayana, and other poetry and prose date from this time. The coming of Islam in the Middle Javanese period (1400–1550) introduced changes of content rather than of form. In the New Javanese period (1550 to present) there has been a slow transition toward modern western literature. Javanese literature has strongly influenced the Balinese, Sundanese, Madurese and Malay literatures. The amount of publication in Javanese is small because of the

concentratio? on developing an Indonesian literature. (I. DN.)

JAVARI (Spanish YAVARÍ), a river which rises about 7° S. on the border between Brazil and Peru and flows northeast for about 656 mi. to join the Amazon (*q.v.*) near the Brazilian outpost of Benjamin Constant. It separates the Loreto department in Peru from the state of Amazonas in Brazil.

The river flows through unbroken tropical rain forest in which there are only a few very miniature riverbank clearings and is navigable for launches almost to its source. The old Brazilian spelling was *Javary.* (P. E. J.)

JAVELIN THROWING, the art of throwing a spear as a sport, was first introduced in the ancient Olympic games competitions as one of the events of the pentathlon in 708 B.C. (For the use of the javelin in war *see* WEAPONS, PRIMITIVE.)

The modern javelin used in Olympic and national competitions throughout the world is a spear of wood or metal with a sharp metal point. It must be constructed in such a way that the space between the foremost point and the centre of grsvity is not longer than 3 ft. $7\frac{1}{3}$ in. (110 cm.) or shorter than 2 ft. $11\frac{2}{5}$ in. (go cm.). It must have about the centre of gravity a grip formed by a binding 6.3 in. (16 cm.) broad, of whipcord, without thongs or notches in the shaft, and must have no other holding than the above-mentioned binding, the circumference at either edge not exceeding the circumference of the shaft by more than .984 in. (25 mm.).

The length must not be less than 8 ft. $6\frac{3}{8}$ in. (260 cm.) complete as thrown. The weight must not be less than 1.76 lb. (800 g.) complete as thrown.

Until the second half of the 20th century javelins from Finland and Sweden were used almost exclusively in international competition. But radical developments were made by a California manufacturer. Richard Held, and at the 1956 Olympics almost all the competitors used spears based on the new principles, chief of which is a larger surface area producing gliderlike qualities.

In the first half of the 20th century Scandinavian athletes dominated the event. Sweden was the first nation to hold a championship in 1896, and at the initial international competition at the unofficial 1906 Olympics in Athens, Greece, Eric Lemming of Sweden won with a throw of 175 ft. 6 in. Lemming went on to win official Olympic crowns in 1908 and 1912 and he was followed by Jonni Myrra of Finland in 1920 and 1924. (For Olympic records of the event *see* OLYMPIC GAMES.)

Until the 1950s two Finnish stars, Matti Jarvinen and Yrjo Nikkanen, dwarfed all other throwers; Nikkanen in 1938 set a record of 258 ft. $2\frac{3}{8}$ in., which was broken in 1953 by Richard Held's brother Franklin (Bud) Held, who did 263 ft. 10 in. Other modern stars have been Cy Young (1952 Olympic champion) and William Miller of the United States, Janusz Sidlo of Poland and Egil Danielsen of Norway, who set a world's record at the 1956 Olympics. Just before those games Danielsen did 304 ft. $1\frac{1}{2}$ in. using an illegal, discuslike spin.

Method of Throwing. — The javelin is held overhead with the front tip down at an angle of 45° from the horizontal, the fingers grasping the javelin loosely but firmly. For most throwers, a run of 60 to 70 ft. to the final check mark (which lies about 30 ft. from the throuing line) is sufficient. The run must be very relaxed; there must be perfect co-ordination between the rhythm of the legs and the back-and-forth motion of the javelin. The body should lean very slightly forward during the run, primarily from the hips. As the final check mark is reached, the thrower should begin to straighten up preparatory to releasing the javelin with an explosive effort, the result of which will be determined by whether the preliminary phases were smoothly balanced and whether the javelin was moving fonvard at the instant the main explosive force was applied. The final delivery of the javelin is made with a snap of the wrist at an angle ranging from 45° to 50°.

BIBLIOGRAPHY.—Amateur Athletic Union of the United States, *Track and Field Guide* (annual); F. A. M. Webster, *Athletics* (1932); Martti Jukola, *Athletics in Finland* (1932); Richard V Ganslen and Matti Jarvinen, "Finnish Javelin Throwing," *Scholastic Coach* (Feb. 1950).
(H AR. RN.; E. J. G.)

JAW, in anatomy, the term for the upper maxillary bone and the mandible or lower maxillary bone of the skull; it is sometimes loosely applied to all the lower front parts of the skull. The upper maxillary bone holds the upper teeth and contains the large maxillary sinus. The lower teeth are attached to the mandible, which moves on the skull, articulating with it in the fossae of the temporal bones. *See* SKULL. (F. *L.* A.)

JAY, JOHN (1745–1829), U.S. statesman, diplomat and jurist, an active participant in the formation of the United States and first chief justice of the supreme court, was born in New York city on Dec. 12, 1745, the sixth son of Peter and Mary Van Cortlandt Jay. His father, a prosperous and prominent merchant of French Protestant descent, reared him in the rigorous doctrines of his Calvinist faith and sent him to King's college (now Columbia university). John graduated in May 1764 and three years later, after studying and working as a clerk in a law office, obtained the degree of master of arts. In Oct. 1768 he received his license to practise law in the province of New York and in the next six years built a lucrative practice. Through his marriage to Sarah Van Brugh Livingston in April 1774 he joined another of New York's first families.

An opponent of radicalism, Jay deplored the violence in the quarrel betneen Great Britain and her American colonies, hoping, until the eve of independence, for a reconciliation with the mother country. Xonetheless, he supported the colonial cause. As a member of the first continental congress of 1774 he drafted *The Address to the People of Great Britain,* stating the rights of the colonists. That document gained him a wide reputation. At the second congress of 1775 he wrote a letter to the "Oppressed Inhabitants of Canada" and was probably the author of addresses to the peoples of Jamaica and Ireland.

While still a delegate to the continental congress Jay was elected to the New York provincial congress and in May 1776 attended its meetings. Thus he did not sign the Declaration of Independence in Philadelphia. But he drafted the resolutions by which New York, in July 1776, approved it. In March of the following year he also drafted New York's first state constitution, and in May was elected the state's first chief justice. He returned to the continental congress on Dec. 7, 1778, and three days later won election as its president.

After Spain entered the War of the American Revolution as France's ally, in June 1779, congress sought to persuade her to join the Franco-American alliance of 1778, advance a loan of $5 million and allow Americans free navigation of the Mississippi river. In exchange the United States offered to guarantee the Floridas to Spain. To gain those objectives congress appointed Jay minister plenipotentiary to Spain in Sept. 1779. There he met with frustration and evasion; Spain, fearing that open aid to the American rebels would set a dangerous precedent for the dissatisfied in her own colonies, refused to receive him officially and thus recognize American independence. Desperately eager for the Spanish treaty, congress in Feb. 1781 ordered Jay to give up U.S. claims to navigation of the Mississippi. Although opposed to the concession, Jay made the offer. Still his mission failed. All that Jay obtained from the Spaniards mas a small loan of about $150,000.

After congress had appointed him one of the commissioners to make peace with Great Britain, Jay left Madrid for Paris in May 1782. There, according to his instructions, he was to do nothing without the "knowledge and concurrence" of the United States French allies. Distrusting the French. Jay, on his own initiative and contrary to his instructions, opened separate undercover negotiations with the British. As a result, Jay and his fellow commissioners Benjamin Franklin, John Adams and Henry Laurens on Nov. 30, 1782, signed preliminary articles of peace in which Britain granted surprisingly liberal terms. Without significant change they became the final peace settlement in the Treaty of Paris of Sept. 3, 1783.

When Jay returned to New York in July 1784 he learned that congress had elected him secretary for foreign affairs. Since he was uncertain of the power of the office and in October was also elected a delegate to congress, he delayed acceptance until December. Jay made the most of his limited powers and raised the office to a position of prominence and prestige. But he also ran into difficulties with congress. In 1786 he negotiated a treaty with

Don Diego de Gardoqui of Spain committing the United States to forbear use of the Mississippi for 25 years in return for commercial concessions. Southerners blocked it, believing that Jay had sacrificed the navigational interests of the southwest for benefits to traders in the northeast. The sectional suspicions aroused by the Jay-Gardoqui treaty were largely responsible for the later constitutional provision requiring a two-thirds vote of the senate for approval of treaties.

Jay's difficulties convinced him that the nation needed a more strongly centralized government than the Confederation provided. Although he failed to be elected to the Constitutional Convention of 1787, he plunged into the fight for ratification of the federal constitution it framed. Using the pseudonym "Publius" he collaborated with Alexander Hamilton and James Madison on *The Federalist,* the classical defense of the constitution, writing five of the essays. In addition, he wrote a widely read constitutional tract, published anonymously, called an *Address to the People of New York.* At the New York convention for ratification of the federal constitution at Poughkeepsie in July 1788, he moved its adoption by his state.

When George Washington in 1789 became president under the new federal government, he appointed Jay the first chief justice of the United States. Jay's most notable case was *Chisholm* v. *Georgia,* dealing with the issue of whether or not a citizen of one state could bring an original suit in the supreme court against another state for breach of contract. By deciding against Georgia, Jay and the court dealt a blow to state sovereignty. The decision led to the adoption of the 11th amendment to the constitution, denying the federal courts authority in suits by citizens against a state.

In 1792 Jay lost a bitterly contested election for the governorship of New York to George Clinton. But the most controversial episode in his career came when he negotiated a commercial agreement with Great Britain, signed on Nov. 19, 1794, and known as Jay's treaty. Although it failed to redress accumulated grievances, it helped avert a war with the British. It also became a bitter issue between Jay's own Federalist party and the opposition Republican party, led by Thomas Jefferson and James Madison. Mobs burned Jay in effigy and opponents denounced him as a "damned arch-traitor." At one time before the negotiation Jay had been considered a leading candidate to succeed Washington but the unpopular treaty ruined whatever chances he had for the presidency. New York Federalists, however, elected him governor, a post he assumed on July 1, 1795, three days after resigning as chief justice, and held until 1801 when he retired from public life. His remaining 27 years, spent on his farm at Bedford, N.Y., where he died on May 17, 1829, were calm and uneventful.

A vain and haughty aristocrat and a conservative Federalist in politics, Jay distrusted popular democracy. Yet he was also a humanitarian, a strong nationalist and patriot who believed in republican principles, one of the learned and accomplished statesmen of his day and an outstanding founding father of the nation.

BIBLIOGRAPHY.—F. Monaghan, *John Jay* (1935), is the standard and best biography. *See* also H. P. Johnston, ed., *The Correspondence and Public Papers of John Jay,* 4 vol. (1890–93); W. Jay, *The Life of John Jay: With Selections from his Correspondence and Miscellaneous Papers,* 2 vol. (1833); G. Pellew, *John Jay* (1890); S. F. Bemis, "John Jay," *The American Secretaries of State and Their Diplomacy,* ed. by S. F. Bemis, 10 vol., vol. i, pp. 193–285 (1927–29). (A. DE C.)

JAY (*Garrulus glandarius),* a member of the crow family and the type of the subfamily Garrulinae. It inhabits the whole of Europe south of 64° N. and is fairly common in the wooded districts of Great Britain, where, however, it is remorselessly persecuted by gamekeepers and is consequently very shy. The body is cinnamon coloured; the tail coverts, white; and the wings contain patches of vivid blue and black striped feathers, used by fishermen for artificial flies. The voice is a harsh scream. The jay, despite its shyness, is a lively bird with an insatiable curiosity. The nest is placed in a tree or bush and in it are laid four to seven eggs of a greenish-white colour closely freckled with light olive. The flight is weak, and on the ground the bird hops. During the breeding season it is almost wholly silent. Its food includes fruits, insects, carrion and, during the spring and summer, eggs and young birds. In eastern Russia its range overlaps that of the allied G. *brandti,* which is distributed across Siberia to Japan. In the south of Europe, Caucasia and Asia Minor occurs G. *krynicki.* Other species occur in Asia and Africa.

EUROPEAN JAY

In America the commonest forms are the extremely tame Canada jay *(Perisoreus canadensis),* often called the "whisky jack," which has a very sombre coloration and no crest and occurs throughout Canada and the mountains from Washington to northern California; and the beautiful blue jay *(Cyanocitta cristata)* of eastern North America from southern Canada to the Gulf states and west to the Rockies, which has a distinct crest. Both have habits somewhat similar to the European species. The latter has a considerable talent for mimicry. The conspicuously crested Steller's jay *(Cyanocitta stelleri),* blackish or slate head and blue body, lives in western mountains from Alaska to Mexico. The duller, grayer-breasted blue crestless jays (*Aphelocoma coerulescens)* are represented by a race in Florida and eight races in the mountains of the western U.S.; another species (*A. sordida)* has two races along the Mexican border from the Chisos mountains to southern Arizona. The green jay *(Xanthoura yncas)* reaches the lower Rio Grande valley of Texas. (G. F. Ss.)

JAY TREATY, the name applied, in U.S. history, to a treaty signed on Nov. 19, 1794, by John Jay and Lord Grenville on behalf of the United States and Great Britain, respectively. The U.S. grievances which led to the negotiations consisted principally in Great Britain's refusal to withdraw its troops from the forts on the northwestern frontier, as required by the peace treaty of 1783; its refusal to make compensation for slaves carried away by the British army at the close of the American Revolution; its restrictions on U.S. commerce; its refusal to enter into any commercial treaty with the United States; and the antineutral policy according to which British naval vessels were authorized to search U.S. merchantmen and impress U.S. seamen.

After negotiations which lasted for several months Jay obtained a treaty which, although departing widely from his instructions, he believed would adjust some of the differences between the two nations. It provided that the northwest posts should be evacuated by June 1, 1796, that commissioners should be appointed to settle the northeast and northwest boundaries and that the claims of British merchants as well as the U.S. claims for compensation for illegal seizures should be referred to commissioners. The remaining articles of the documents constituted a treaty of commerce. By them the United States was granted privileges of trade in the British East Indies; some provisions were made for reciprocal freedom of trade between the United States and the British dominions in Europe; and some articles were specified under the head of "contraband of war," but only limited concessions were granted in the West Indian trade. The latter clause, which was limited to two years from the close of the existing war (between France and Great Britain and its allies), provided that U.S. vessels not exceeding 70 tons burden might trade with the West Indies, but should bring in only US. products and take away to U.S. ports only West Indian products; moreover, the United States was to export in U.S. vessels no molasses, sugar, coffee, cocoa or cotton to any port of the world.

Other clauses provided for the free navigation of the Mississippi, that no enemy of England should fit out privateers in U.S. waters and that Americans should not accept commissions from the French minister. The treaty was silent on such important subjects as compensation for stolen slaves, neutral rights and the impressment of U.S. sailors.

The treaty was laid before a special session of the senate on June 8, 1795, and, with the exception of the article relating to West Indies trade, was ratified on June 24 by a bare two-thirds majority. Its subsequent publication raised a storm of protest both in the U.S. and France. The opposition filled newspapers with articles denouncing it and Jay was burned in effigy. Once in operation the treaty grew in favour.

JAZZ is a term which, during World War I, became generally and ambiguously applied to American popular dance music in common time. Borrowed from music, the word jazz was widely used

with reference to American social mores during the decade following World War I—the so-called jazz age—a period notable for, among other things, a financial boom, prohibition, bootleggers' gang wars, mixed drinking in speak-easies, knee-length skirts and parvenu display. The urban manners of the time are suggested in such novels as F. Scott Fitzgerald's *The* Great Gatsby and John Dos Passos' trilogy *U.S.A.*

Several informed studies of the varieties of music called jazz have been published (*see* the bibliography at the end of this article). Through the years of slavery American Negroes came in contact with various forms of American music in Anglo-Celtic traditions, such as folk songs, church hymns, reels, jigs and other dance music, popular songs and military marches. Negroes in the Louisiana region were also familiar with sundry French-derived musical forms, and that region was also subject to West Indian and Latin-American musical influences. The result was the development of a distinctive Afro-American musical idiom. Its forms included spirituals, work songs, blues and dance music. The spirituals were religious songs sometimes developed on the basis of church hymns but also often original. The work songs, frequently sung by Negro labourers or convict gangs, were chants whose strong rhythms were inspired by working gestures. The blues, usually sung solo. were short expressions. often rudely philosophical or sexual in subject matter, and generally in a melancholy vein. A particular 12-bar basic chord sequence seems to have been very common. Many short blues verses might be strung together to make a narrative song. The dance music embraced a variety of forms, among them the 12-bar blues, usually in common time. It was dance music of a Negroid type which was first called jazz

With the "discovery" of Afro-American music in the latter half of the 19th century, many spirituals were adapted for concert performance on the basis of notations made from Negro singing. But important characteristics of that singing could not have been caught in notation; the adapters Europeanized their scores, presumably with the idea of producing music which would be thoroughly agreeable to conventional concert ears. Spirituals, as usually heard in concerts, are no more than genteel, mellowed suggestions of the folk music. This applies also to the current spiritual singing of many Negro groups with conservatory training. It is probable that, originally, all the Afro-American musical forms strongly revealed the same idiomatic characteristics, that the expression of the spirituals was very similar to that of the dance music. The characteristics of the Afro-American idiom may be briefly described as follows:

Improvisation. — This folk music, like all others, was improvised; few of the singers or players had any knowledge of notation. Certain improvisations passed from voice to voice and became traditional. But the impulse to improvise at each performance was so widespread that it must be regarded as characteristic of the idiom. In their hymn singing the southern Negroes frequently invented new melodic phrases, embellishments, harmonies or new words, and often in a conipetitive spirit. Similarly, around 1900, Negro brass bands in New Orleans used military marches as a basis for improvisation. When two or more bands happened to meet on the street there would be "cutting" contests—competitions in improvisation between the outstanding players of each band. The development of extended musical forms requires, of course, training in notation, which the Negro folk musicians did not have; their music consisted in general of variations, traditional or improvised at the time, on short themes or chord progressions. They made sustained music by prolonging the series of variations.

Melody and Harmony. — The Negroes responded to European harmonic principles in their own way. Their voices or instruments tended to slur or strike the tonic third and seventh (and, less often. other tones), when these occupied an important place in the melody, somewhere between flat and natural (such practice is, of course, impossible with fixed-tone instruments like the piano, but perfectly possible with the trumpet, trombone, clarinet, etc.). Suggestions as to why this was so have been made; there is provocative literature on tlie relation of jazz to African musical forms. This practice is one aspect of Negro folk music which would have escaped notation. Attempts to suggest its effect in written music have usually been made by flatting the third and seventh Such notes are customarily called blue notes They have been used in many popular songs and other compositions intended to have a Negroid flavour—which, under the circumstances, could scarcely be anything more than that. The Negro folk music was fluidly infused with blue, with tones sounded variously between flat and natural and with harmonies involving those tones as chord components, so much so that the music may be regarded, modally speaking, as having been developed around its own blues scale—the diatonic with mobile third and seventh. Moreover, the Negroes had a decided talent for close chromatic harmony of the sort often described as barber shop. The mixture of blue melody and harmony with close chromaticism gave their music a very distinctive texture, its majors only relatively major.

Rhythm.—The rhythmic aspect of the Negro folk music was strikingly unusual and often confusing to ears habituated to western rhythms. In western musical classics syncopation is a familiar feature, but it is usually intermittent and it is likely to be regular, expected in pattern, occurring at the same beats in each bar. Also, the syncopation is usually confined either to the melody or the harmony. But in the Negro folk music syncopation was a fluid. pervading principle; it might be said that the Negroes' whole conception of rhythm was syncopated. In playing dance music in unaccented 4/4 time, the very regularity of the beat facilitates the improvising of rhythms around it, as does the fact that the bear is unaccented. It seems probable that well before the turn of the century Negro dance musicians played music rhythmically similar to recent Negroid jazz in which there is a continuous polyrhythmic interplay of different syncopations by both percussive and melodic instruments, syncopation not only in percussive accents but also in fluid changes of pitch, tone or volume or combinations among the three. Although, in such music, certain rhythmic tendencies are recurrent, such as the polyrhythmic superimposition of three-over-four, it should be emphasized that these are tendencies and are treated by talented jazz players with all manner of variation and elaboration, often extremely subtle. Such rhythmic intricacies, proceeding out of the players' instincts and often highly propulsive. can be only rudely suggested in notation.

Here another frequent characteristic of Negroid jazz may be mentioned: two or more players often improvise melodies simultaneously on the basis of a known chord progression, each player being guided by his own feeling and the sound of his fellows. The result is what might be called an informal jazz counterpoint, whose interweaving melodies, in different syncopated rhythms, are often as exciting to its devotees as they are confusing to unaccustomed ears.

Tone Colour.—The Negro folk musicians sang, of course, not according to conservatory traditions but as they felt; thus pure tone often moved into deliberate roughness, stridency or shouting. Also, they sang with their instruments as they did with their voices. This does not mean that they imitated the human voice, although various popular instrumentalists have done so for novelty effect. The Negroes, unaffected by the legitimate instrumental traditions calling for precise attack and pure, even tone played their brasses, reeds and other initruments with personal, expressive inflections, natural slurs and slight glissandi, varying qualities of tone from the pure to the harsh. varying degrees of vibrato, such as may be heard in the natural singing voice. It may be said that they vocalized their instruments. Such personal instrumental expression is also, of course, beyond notation.

Beginning in the 1890s, Afro-American piano syncopation by such midwestern masters as Scott Joplin and James Scott was called ragtime. and this term was soon applied to any popular music marked by raggy rhythms. Dance niusic revealing most of the characteristics of the Negro idiom had its first vogue in 1914 when white bands from New Orleans were imported as novelty attractions by Chicago café proprietors. The name jazz was applied to the music. derisively, in the latter city, uhere the word had an obscene meaning and proved of inestimable publicity value. The music was immediately and variously counterfeited by many band

leaders who were not at home in the idiom but wished to cash in on its success and developed such parodies as they were able. Instead of blue texture there were blue notes. Instead of vocalized instrumentalism there were vocal imitations—cornet baby cries and laughing trombones. Instead of subtle polyrhythms there was any kind of syncopated clatter the musicians could furnish, abetted by drummers with sets of kitchen utensils. The name jazz was appropriated by all the din makers.

Various aspects of jazz were vaguely reflected in the music of many finished and fashionable dance orchestra leaders, the most famous of whom was Paul Whiteman. In the early 1930s Negroid jazz began to grow in popularity, the chief reason being the programs of certain bands on national radio networks. In order to distinguish the music from the generality of $\frac{4}{4}$ dance music also known as jazz, devotees of the former began calling it swing—a word which Negro musicians had long used as a verb with obviously rhythmic connotations. But no sooner did this word show signs of having commercial drawing power than it was appropriated by as wide a variety of dance musicians and applied as ambiguously by the public as the word jazz had been years before. Around 1940 a group of Negro musicians in Harlem, New York city, began an elaboration of the jazz language which came to be known as bebop (syllables suggested by certain abrupt rhythmic accents in the music). The genera1 characteristics of this jazz were an enriched harmonic vocabulary, sometimes reaching into polytonality and atonality; a prolific use of flatted fifths, passing notes and passing chords; complicated melodic patterns, often of markedly irregular phrase lengths; and highly eccentric rhythms, frequently drawing on Caribbean sources. Bebop ran into many clichés, but its most creative players were extraordinary musicians. They animated a new generation of jazz players, who, in the 1950s, showed a great deal of subtle brilliance in improvisation and a steady development in the art of distinctive composition for jazz band. Significantly, many of these men were students of formal musical theory.

Dozens of Negroid jazz improvisers have been, widely admired for their inventiveness and virtuosity. Many of them played under such famous Negro pianist-band leaders as Fletcher Henderson, Duke Ellington and Count Basie. Outstanding players prior to the bebop development included Louis Armstrong, trumpet; Bix Beiderbecke, cornet; Miff Mole, Jack Teagarden, trombone; Johnny Dodds, Pee Wee Russell, clarinet; Sidney Bechet, soprano saxophone; Coleman Hawkins, Lester Young, tenor saxophone; Jelly-Roll Morton, Earl Hines, Teddy Wilson, piano; Sidney Catlett, Joe Jones, drums. Bebop and post-bebop jazz masters included Charles Parker, alto saxophone; Dizzy Gillespie, trumpet; J. J. Johnson, trombone; Lennie Tristano, piano; Max Roach, drums.

BIBLIOGRAPHY.—W. Hobson, *American Jazz Music* (New York, London, 1939); F. Ramsey, Jr., and C. E Smith (eds.), *Jazzmen* (New York, 1939); L. Feather, *Inside Be-bop* (New York, 1949); A. Lomax, *Mister Jelly Roll* (New York, 1950; London, 1952); Rudi Blesh and Harriet Janis, *They All Played Ragtime* (New York, 1950); Winthrop Sargeant, *Jazz: Hot and Hybrid*, new ed. (New York, 1946); Andre Hodeir, *Hommes et Problèmes du Jazz* (1954); magazines. *Down Beat; Rerord Changer; Metronbme.* (W. HN.)

JEAN D'ARRAS, a 15th-century *trouvdre,* was the collaborator with Antoine du Val and Fouquart de Cambrai in a collection of stories entitled *Évangiles des quenouilles,* told by ladies at their spinning, which relate the current theories on a great variety of subjects. The work throws much light on mediaeval manners.

There were many editions of this book in the 15th and 16th centuries, one of which was printed by Wynkyn de Worde in English as *The Gospelles of Dystaves. A* modern edition (Collection Jannet) has a preface by Anatole France.

Another *trouvdre,* JEAN D'ARRAS who flourished in the second half of the 14th century, wrote, at the request of John. duke of Berry, a long prose romance entitled *l'Histoire de Mélusine.* It relates with many digressions the antecedents and life of the fairy Mélusine (*q.v.*).

JEAN DE MEUN or DE MEUNG (*c.* 1240–*c.* 1305), whose original name was Jean Clopinel or Chopinel, was born at Meun-sur-Loire. Tradition asserts that he studied at the University of Paris. At any rate he was, like his contemporary, Rutebeuf, a defender of Guillaume de St. Amour and a bitter critic of the mendicant orders. Most of his life seems to have been spent in Paris, where he possessed, in the Rue St. Jacques, a house described in 1305 as that of the late Jean de Meung. Jean de Meun says that in his youth he composed songs that were sung in every public place and school in France. In the enumeration of his own works he places first his continuation of the *Roman* de la *rose* of Guillaume de Lorris. The date of this second part is generally fixed between 1268 and 1285 by a reference in the poem to the death of Manfred and Conradin, executed (1268) by order of Charles of Anjou (d. 1285), who is described as the present king of Sicily. Jean de Meun doubtless edited the work of his predecessor, Guillaume de Lorris, before using it as the starting point of his own vast poem, running to 19,000 lines.

The continuation of Jean de Meun is a satire on the monastic orders, on celibacy, on the nobility, the papal see, the excessive pretensions of royalty and especially on women and marriage. Guillaume had been the servant of love and the exponent of the laws of "courtoisie"; Jean de Meun added an "art of love," exposing with brutality the vices of women, their arts of deception and the means by which men may outwit them.

Spirit and Style.—Jean de Meun embodied the mocking, sceptical spirit of the *fabliaux.* He did not share in current superstitions, he had no respect for established institutions and he scorned the conventions of feudalism and romance. His poem shows in the highest degree, in spite of the looseness of its plan, the faculties of keen observation, lucid reasoning and exposition; it entitles him to be considered one of the greatest of French mediaeval poets. He handled the French language with an ease and precision unknown to his predecessors, and the length of his poem was no bar to its popularity in the 13th and 14th centuries. Part of its vogue no doubt resulted from the fact that the author, who had mastered practically all the scientific and literary knowledge of his contemporaries in France, had found room in his poem for a great amount of useful information and for numerous citations from classical authors.

Jean de Meun translated in 1284 the treatise, De *re militari,* of Vegetius into French as *Le livre de Vegèce de l'art de chevalerie* (ed. Ulysse Robert, *Soc. des anciens teztes fr., 1897).* He also produced a spirited version, the first in French, of the letters of Abélard and Héloïse. A 14th-century manuscript of this translation in the Bibliothèque Nationale has annotations by Petrarch. His translation of the *De consolatione phzlosophiae* of Boetius is preceded by a letter to Philip IV in which he enumerates his earlier works, two of which are lost—*De spirituelle amitié* from the *De spirituali amicitia* of Aelred of Rievaulx (d. 1166) and the *Livre des merveilles d'Hirlande* from the *Topographia Hibernica,* or *De Mirabzlibus Hiberniae* of Giraldus Cambrensis (Giraud de Barry). His last poems are doubtless his *Testament* and *Codicille* The *Testament* is written in quatrains in monorime and contains advice to the different classes of the community

See also Paulin Paris in *Hist. lit de la France,* xxviii; E Langlois in *Hist de la langue et de la lit. française,* ed by L. Petit de Julleville, ii (1896); the introduction to Langlois's 1914 ed. of the *Roman de la rose* (*q.v.*).

JEANNIN, PIERRE (1540–1622), French statesman, was born at Autun. A pupil of Jacques Cujas at Bourges. he was an advocate at Dijon in 1569 and became councillor and then president of the *parlement* of Burgundy. He opposed in vain the massacre of St. Bartholomew in his province. As a Catholic, he supported the duke of Mayenne, Charles of Lorraine, against Henry of Navarre (Henry IV of France) and even went to Spain as the League's envoy. He worked, however, for the reconciliation of Mayenne and Henry and transferred his loyalty to Henry after the victory of Fontaine-Française (1595), subsequently becoming one of his most influential advisers A member of the *conseil des affaires,* he took a leading part in the politics of the new reign, for example in negotiating the treaty of Lyons with Savoy (1601) and as ambassador to the United Provinces (1607–09).

JEANS, SIR JAMES HOPWOOD (1877–1946), English mathematician and physicist, best known for his popular books on science, particularly astronomy. Born in London on Sept. 11, 1877, he mas educated at Cambridge, where he was second wrangler in 1898 and Smith's prizeman in 1900. He held the posts of university lecturer in applied mathematics at Cambridge (1904) and professor of applied mathematics at Princeton university.

Jeans applied mathematics to many branches of physics and astronomy with marked success. In the kinetic theory of gases he gave proofs for the law of equipartition of energy and for Maxwell's law of distribution of the velocity of molecules. Jeans developed a formula for the distribution of energy emitted by a black body; he used classical methods and arrived at a formula similar to that of Lord Rayleigh which only holds for long wave lengths. He also wrote on other aspects of radiation such as the interaction between radiation and free electrons. In astronomy Jeans applied mathematics to such good effect that a number of original theories on cosmogony resulted. As an example, his work on the stability of pear-shaped figures may be taken; he considered such bodies rotating in an incompressible fluid, later he considered the fluid to be compressible. The same mathematical analysis was then applied to problems of splitting caused by tides produced by the approach of a second body, and this in its turn was applied to the break-up of stars. Jeans also showed that Laplace's theory of the origin of the solar system was incorrect. He studied the effect of gravitational attraction on the motion of stars. He wrote papers on the formation of binary stars; the nature of spiral nebulae; his theory of giant and dwarf stars; the source of stellar energy; and the evolution and radiation of gaseous stars. Knighted in 1928, he was awarded the Order of Merit in 1939. He died on Sept. 17, 1946.

Jeans was the author of *Dynamical Theory of Gases* (1904; 4th ed., 1925), *Mathematical Theory of Electricity and Magnetism* (1908; 5th ed., 1933), *Problems of Cosmogony and Stellar Dynamics* (1919), *Radiation and the Quantum Theory* (1914; 1924), *Atomicity and Quanta* (1926), *Astronomy and Cosmogony* (1928), *The Universe Around Us* (1929), *The Stars in Their Courses* (1931), *New Background of Science* (1933), *Through Space and Time* (1934) and *An Introduction to the Kinetic Theory of Gases* (1940).

See E. A. Milne, *Sir James Jeans* (1952)

JEBB, SIR RICHARD CLAVERHOUSE (1841–1905), British classical scholar. was, above all. an outstanding interpreter of the plays of Sophocles. Born at Dundee on Aug. 27, 1841, and educated at Charterhouse and at Trinity college. Cambridge, he was fellow and lecturer of his college until 1875 when he became professor of Greek at Glasgow university. In 1889 he returned to Cambridge on his appointment as regius professor of Greek there. He was M.P. for Cambridge university during 1891–1905. He was knighted in 1900 and he received the Order of Merit in 1905.

He died at Cambridge on Dec. 9, 1905.

A scholar of wide range, Jebb combined that intuitive sense of Greek style which made him an excellent composer of Greek verse with the learning and critical outlook of the 19th century. His chief works are: an edition of the *Characters of Theophrastus* (1870; re-edited by J. E. Sandys. 1909); *The Attic Orators From Antiphon to Isaeos* (1876; 2nd ed., 1893); *Selections From the Attzc Orators* (1880; 2nd ed., 1888); *Bentley* (1882), in the "English Men of Letters series"; *Homer* (1887; 6th ed.. 1898); *The Growth and Influence of Classical Greek Poetry* (1893); an edition of the poems of Bacchylides (1905); and, most important, the valuable edition of the plays of Sophocles, from the *Oedipus Tyrannus* (1883) to the *Ajax* (1896).

Jebb's *Essays and Addresses* and *Life and Letters* were published by his widow in 1907. *See* also J. E. Sandys, *History of Classical Scholarship,* vol. iii *(1908).* (M. L. CE.)

JEBEIL: *see* BYBLOS.

JEDBURGH, royal and small burgh and county town, Roxburgh, Scotland. Pop. (1951) 4,083. It stands on the Jed Water, a tributary of the Teviot, 474 mi. S.E. of Edinburgh by road. There have been many variants of the name, and locally the word is frequently pronounced Jeddart. The original site of the town was at Old Jeddart, about 4 mi. S. The chief industry is the manufacture of rayon. Corn milling, tanning and glove making are carried on and fruit (especially pears) and garden produce flourish.

The principal feature is the ruined abbey, the stateliest of the renowned group of Border abbeys—Jedburgh, Melrose. Dryburgh and Kelso. In 1118 David I, when earl of Cumbria, founded a priory at Jedburgh for Augustinian monks from the abbey of St. Quentin at Beauvais in France. In 1147, after he had become king, he erected it into an abbey dedicated to the Virgin. Repeatedly damaged in Border warfare it was burned in 1523 and ruined in 1544–45 during the English invasion led by the earl of Hertford. The establishment was suppressed in 1559, the revenues being temporarily annexed to the crown. After changing owners more than once, the lands were purchased in 1637 by the 3rd earl of Lothian. Latterly five of the bays at the west end had been utilized as the parish church, but the 9th marquess of Lothian built a church and presented it to the heritors in exchange for the ruined abbey. In 1913 it was taken over for the nation by the Ancient Monuments commission and is now cared for by the ministry of works.

The abbey was built of Old Red Sandstone and is a beautiful example of the Norman and Transition styles. The west front contains a great Norman porch and a fine wheel window. The tower, at the intersection of the nave and transepts, is of unusually massive proportions. With the exception of the north piers and a small portion of the wall above, which are Norman, the tower dates from the end of the 15th century. The whole of the south transept has perished. The north transept, with early Decorated windows, has been covered in and walled off and is the burial ground of the Kers of Ferniehirst, ancestors of the marquess of Lothian. The earliest tombstone is dated 1524. All that is left of the choir, which contains some very early Norman work, is two bays, corresponding to the design of the nave. It is supposed that the aisle. with decorated window and groined roof, south of the chancel, formed the grammar school (removed from the abbey in 1751) in which Samuel Rutherford (1600–61), principal of St. Mary's college, St. Andrews, and James Thomson, author of *The Seasons,* were educated. The richly carved doorway from the south aisle into what was formerly the cloister is a modern copy of one which had decayed. Foundations of various of the abbey buildings have been uncovered in the gardens sloping down to the river.

The castle stood on high ground above the river at the south end of the burgh, or "town-head." Erected by David I, it was one of the strongholds ceded to England in 1174, under the treaty of Falaise, for the ransom of William the Lion. It was, however, so often captured by the English that it became a menace rather than a protection, and the townsfolk demolished it in 1409. It was occasionally used as a royal residence. The site was occupied in 1823 by the county prison, now known as the castle, which gradually fell into disuse and was acquired by the corporation in 1890.

A house in Queen street, in which Mary, queen of Scots, resided in 1566, was bought by the corporation and is now arranged as a museum with many relics relating to the queen. It was from and to this house that she made her sensational 40-mi. ride to visit Bothwell at Hermitage castle. A house in Castlegate was occupied by Prince Charles Edward in 1745.

The grammar school (built in 1883 to replace the successor of the school in the abbey) was founded by William Turnbull, bishop of Glasgow (d. 1454). The old market cross still exists. Jedburgh was made a royal burgh in the reign of David I and received a charter from Robert I and another in 1566.

"Jeddart justice," according to which a man was hanged first and tried afterward, seems to have been a hasty generalization from a solitary fact—the summary execution in James VI's reign of a gang of rogues at the instance of Sir George Home—but nevertheless passed into a proverb.

JEEP, the popular name for the U.S. army's ¼-ton truck widely used in World War II, and, when capitalized a registered trademark of Willys Motors, Inc. No really satisfactory explanation of the origin of the term has ever been given; some have related it to a comic-strip character created by E. C. Segar and others to a slurring of the letters GP (general purpose).

The jeep was developed originally as a fast military reconnaissance car to replace the motorcycle. It was the smallest of the U.S. army's trucks in World War 11—only about 11 ft. long and

4 ft. high—but it had remarkable power, stamina and maneuverability. It could haul troops, ammunition or light cargo, tow airplanes or small artillery pieces and, with special fittings, serve as an ambulance, fire-fighting vehicle. mobile machine-gun mount or radio patrol car. "Good Lord," wrote war corresponderit Ernie Pyle, "I don't think we could continue the war without the jeep. it does everything." (Scripps-Howard Newspapers.) The jeep could cross bridges too weak to support other motorized equipment and could easily be transported by airplane. The secret of its ground mobility lay in its light weight (bet een 2,200–2,500 ib., depending upon the model), its four-wheel drive and powerful four-cylinder gasoline engine. Its top highway speed was 60 m.p.h.

Development of the jeep began in the 1930s as part of a broad program for motorization of the U.S. army. The first successful pilot model was built by the American Bantam Car company in 1940. A model submitted by the Willys-Overland company was officially adopted by the U.S. army in Aug. 1941. Production of jeeps during World War II by Willys-Overland and the Ford Motor company totaled 634,569.

In 1941 work went forward on development of an amphibian jeep for use in landing operations. A successful amphibian jeep resulted but was not widely used because of its small size. It could not compete with the larger 2½-ton amphibian truck known as the DUKW that soon gained world-wide fame, nearly rivalling that of the jeep itself

See also TRANSPORT, MILITARY. (H. C. T.)

JEFFERIES, RICHARD (1848–1887), writer on the English countryside and novelist, was born on Nov 6, 1848, at Coate near Swindon. At the age of 15 he made an unsuccessful attempt to reach Russia and then America. Returning home, he obtained a post on the local paper. His early novels were failures, but in 1872 he published a remarkably original letter in the *Times*, on "The Wiltshire Labourer," which was the turning point in his career. In 1873 he found his true field of work, the life of the country. and began to write for *Fraser's Magazine* on "Farming and Farmers ' Jefferies died at Goring, Sussex, on Aug. 14, 1887. His best-known books are. *The Gamekeeper at Home* (1878); *Wild Life in a Southern County* (1879); *Wood Magic* (1881); *Life of the Fields* (1884), containing the best paper he ever wrote, "The Pageant of Summer"; *Amaryllis at the Fair* (1884); and the autobiographical works *Bevis* (1882) and *The Story of My Heart* (1883).

BIBLIOGRAPHY.—Sir Walter Besant, *Eulogy of Richard Jefferies* (1888); H. S. Salt. *Richard Jefleries: a Study* (1894); *Concerning R. Jefferies, by* various authors (1944). More recent collections are *Beauty is Immortal* (1948) and *Field and Farm; Essays Now First Collected* (1957).

JEFFERS, (JOHN) ROBINSON (1887–1962), one of the most controversial U.S. poets of the 20th century, was born Jan. 10, 1887, at Pittsburgh. Pa.. In over a dozen volumes he explored the disillusionment characteristic of literature after World War I. His first two were of slight interest, but his third book: *Tamar and Other Poems* (1924), which brought him immediate fame, revealed the unique style and eccentric ideas developed in such later volumes as *Cawdor* (1928), *Thurso's Landing* (1932), *Be Angry at the Sun* (1941). The shorter lyrics as well as his sprawling narrative poems celebrate the splendour of the coastal scenery near Carmel, Calif., where Jeffers and his wife Una moved in 1916. The narratives preach Jeffers' cosmic religion, based on a complex interplay of certain ideas: civilizations inevitably decline, becoming "self-conscious" or "introverted." a condition which Jeffers symbolizes in his narratives by incest. Indeed, all things except his pantheistically conceived God are transient, and human life is viewed as a frantic, often contemptible struggle within a "net" of passions. Jeffers therefore argues that man should become an "inhumanist"; that is, he should turn his attention from man and train it instead upon God. This basic philosophical scheme, along with his violence. his long verse line and unabashed rhetoric, have been attacked by some critics. Although the attacks somewhat eroded Jeffers' reputation, they did not endanger his place in American literature as a poet of power arid originality, as well as a brilliant adapter of Euripides' *Medea* (produced in 1946). He died Jan. 20, 1962, at Carmel, Calif.

BIBLIOGRAPHY.—S. S. Alberts, *A Bibliography of the Works of Robinson Jeffers* (1933); Lawrence Clark Powell, *Robinson Jeffers, the Man and His Work* (1940); Radcliffe Squires, *The Loyalties of Robinson Jeffers* (1956). (*J. R.* Ss.)

JEFFERS, WILLIAM MARTIN (1876–1953), U.S. railroader, who played an important part in the development of the Union Pacific railroad, was born in North Platte, Neb., Jan. 2, 1876. His father. William J. Jeffers, was an Irish immigrant whose first employment in the United States was on construction of the Union Pacific railroad. The son's first job was in June 1890 as office boy for the Union Pacific at North Platte, the only railroad he ever worked for. He progressed as clerk, station helper and telegraph operator to become a train dispatcher in 1898; division superintendent in 1909; general superintendent in 1915; general manager in 1916; vice-president in 1917; and president in 1937. From Sept. 1942 to Sept. 1943 he served as U.S. rubber director in Washington, D.C. He retired as Union Pacific president in 1946 and became \ice-chairman of the board of directors. He died March 6, 1953, in Pasadena, Calif. (R. Bu.)

JEFFERSON, JOSEPH (1829–190j), U.S. actor, one of the best-loved in U.S. theatrical history. was born in Philadelphia, Pa., on Feb. 20, 1829. The third actor of this name in a family of actors and managers, Jefferson completely eclipsed his forebears. He made his stage debut at the age of three, as the boy in Kotzebue's *Pizarro,* and after years of struggle as a traveling actor and manager achieved his first important success as Asa Trenchard in Tom Taylor's *Our American Cousin* (1858). This play was the turning point in his career, as it was in that of E. A. Sothern. who created the role of Lord Dundreary. Other parts played by Jefferson in those years mere Dr. Pangloss in *The Heir at Laze,* (1857), Newman Noggs in *Nicholas Nickleby* (1859) and Salem Scudder in Dion Boucicault's *The Octoroon* (1859). His Bob Acres in *The Rivals,* although very successful, was more Jefferson's creation than Sheridan's.

In 1859 Jefferson made a stage adaptation oi Washington Irving's *Kip Van Winkle,* which was only moderately successful. While in England in 186j he commissioned Boucicault to write another version and this, along with minor improvements incorporated over the years, was the final one. As Rip, Jefferson delighted London audiences for 170 consecutive nights. After 1865 he created no new roles, as his public never tired of the delightful and sensitive characterization of Rip. Through the last third of the 19th century Jefferson remained at a peak of popularity. The friend of many leading figures in politics, art and literature, he brought dignity to the stage. Jefferson was awarded the lifetime honour of the presidency of the Players' club, succeeding Edwin Booth and preceding John Drew. His first wife mas the actress Margaret Clements Lockyer, and his second was Sarah Warren, niece of the actor William Warren. He died on April 23, 1905.

Jefferson's *Autobiography* (1889) is written with admirable spirit and humour, and its judgments with regard to the art of the actor and the playwright entitle it to a place beside Colley Cibber's *Apology.*

BIBLIOGRAPHY.—William Winter, *The Jeffersons* (1881), *Life and Art of Joseph Jefferson* (1894); Mrs. E. Jefferson, *Recollections of Joseph Jefferson* (1909). (S. W. H.)

JEFFERSON, THOMAS (1743–1826), third president of the United States of America, the most conspicuous of American apostles of democracy, and one of the great liberals of modern times, was born on April 13, 1743, at Shadwell, Albemarle county, Virginia. His father, Peter Jefferson (1707–1757), was a civil engineer who became a justice of the peace, colonel of the county militia and a burgess. served the Crown in intercolonial boundary surveys, and married into one of the most prominent colonial families, the Randolphs. Albemarle county was then in the frontier wilderness of the Blue Ridge, and was very different. socially, from the lowland counties where a few broad-acred families dominated an open-handed, somewhar luxurious and assertive aristocracy. Unlike his Randolph connections, Peter Jefferson was a

Whig and a thorough democrat; from him, and from the frontier, his son came naturally by democracy.

Education and Personal Traits.—He left the college of William and Mary at Williamsburg, in his 20th year, with a good knowledge of Latin, Greek and French, to which he soon added Spanish, Italian and Anglo-Saxon; and a familiarity with the higher mathematics (throughout life he made practical use of the calculus) and natural sciences only possessed, at his age, by men who have a rare natural taste and ability for those studies. He remained an ardent student throughout life, able to give and take in association with the many scholars, American and foreign, whom he numbered among his friends and correspondents. With a liberal Scotsman, Dr. William Small, then of the faculty of William and Mary and later a friend of Erasmus Darwin, and George Wythe (1726–1806), a very accomplished scholar and leader of the Virginia bar, he was an habitual member, while still in college, of a *partie carrée* at the table of Francis Fauquier (c. 1720–68), the accomplished lieutenant-governor of Virginia. Jefferson was an expert violinist, a good singer and dancer, proficient in outdoor sports, and an excellent horseman. Thoroughbred horses always remained to him a necessary luxury. When it is added that Fauquier was a passionate gambler, and that the gentry who gathered every winter at Williamsburg, the seat of provincial Government, were ruinously addicted to the same weakness, and that Jefferson had a taste for racing, it does credit to his early strength of character that of his social environment he took only the good. He never used tobacco, never played cards, never gambled and was never party to a personal quarrel.

A Virginia Lawyer.—Soon after leaving college he entered Wythe's law office, and in 1767, after five years of close study, was admitted to the bar. His average income during seven years of practice, about £300, was large for that time. To his collecting zeal Virginia owes the preservation of a large part of her early statutes, and of such of her colonial reports as still survive. He left practice with a poor opinion of lawyers—"whose trade it is to question everything, yield nothing, and talk by the hour." Moreover, industry and scholarship, not advocacy, for which he had neither the requisite voice nor temperament, were the secret of his success, which was such as to show that the profession had no rewards that were not fairly within his reach. Doubtless he saw and wished to reform the law's abuses. He turned, therefore, the more willingly to politics when his activity in the colonial cause compelled him to abandon practice in 1774.

Marriage and Home Life.—The death of his father had left him an estate of 1,900 ac., the income from which gave him the position of an independent country gentleman; and he added to his farms after the ambitious Virginia fashion until, when he married in his 30th year, there were 5,000 ac., all paid for; and almost as much more (though subject to heavy debts) came to him in 1773 on the death of his father-in-law. On Jan. 1, 1772, he married Martha Wayles Skelton (1749–82), a childless widow of 23, very handsome and accomplished. Their married life was exceedingly happy, and he never remarried after her early death. Of six children born from their union two daughters alone survived infancy. Jefferson's affectionate, generous and devoted relations with his children and grandchildren are among the fine features of his character.

Early Public Services.—He began his public service as a justice of the peace. Later he was chosen a member of the Virginia house of burgesses in 1769, and of every succeeding assembly and convention of the colony until he entered the Continental Congress in 1775. He was prominent in all, and a foremost member of several, great deliberative bodies, yet he can fairly be said never to have made a speech. He hated the "morbid rage of debate," believing men were never convinced by argument, but only by reflection, through reading or unprovocative conversation; and this behef guided him through life. He was, however, as John Adams said of him in the Continental Congress, though a silent member, so "prompt, frank, explicit and decisive upon committees and in conversation (not even Samuel Adams was more so)" that he was soon acknowledged as one of the strongest members. **A** forceful, facile pen added greatly to his influence. Elected in 1774 to the first Virginia convention, called to consider the state of the colony and advance inter-colonial union, but prevented by illness from attending, he sent to the convention elaborate resolutions, which he proposed as instructions to the Virginia delegates to the Continental Congress that was to meet at Philadelphia in September. In the direct language of reproach and advice, these resolutions attacked the supremacy of Parliament and the errors of the king (with no disingenuous loading of the Crown's policy upon its agents), maintaining that "the relation between Great Britain and these colonies was exactly the same as that of England and Scotland after the accession of James and until the Union; and that our emigration to this country gave England no more rights over us than the emigration of the Danes and Saxons gave to the present authorities of their mother country over England." This was cutting at the common root of allegiance, emigration and colonization; but such radicalism was too thorough-going for the immediate end. The resolutions were published, however, as a pamphlet, entitled *A Summary View* of *the Rights* of *America*, which was of immense influence. In England, after receiving such modifications—attributed to Burke—as adapted it to the purposes of the opposition, this pamphlet ran through many editions, and procured for its author, as he said, "the honour of having his name inserted in a long list of proscriptions enrolled in a bill of attainder commenced in one of the two houses of parliament, but suppressed in embryo by the hasty course of events." It placed Jefferson among the foremost leaders of revolution, and procured for him the honour of drafting, later, the Declaration of Independence, whose historical portions were, in large part, only a revised transcript of the *Summary View*. In June 1775 he took his seat in the Continental Congress, taking with him fresh credentials of radicalism in the shape of Virginia's answer, which he had drafted, to Lord North's conciliatory propositions. He soon drafted the reply of Congress to the same propositions. Reappointed to the next Congress, he signalized his service by the authorship of the Declaration of Independence (*q.v.*). Again reappointed, ne surrendered his seat, and after refusing a proffered election to serve as a commissioner with Benjamin Franklin and Silas Deane in France, he re-entered in Oct. 1776 the Virginia legislature, where he considered his services most needed.

Revision of the Laws of Virginia.—The local work to which Jefferson attributed such importance was the formulation of Virginia's constitution and a revision of her laws. Various of his proposals for the former (limiting the acquisition of public lands, regulating suffrage and legislative apportionment) were too radical for adoption at that time, and some were never adopted. Of the proposed statutory reforms he says: "I considered four . . . as forming a system by which every trace would be eradicated of ancient or future aristocracy, and a foundation laid for a government truly republican"—the repeal of the laws of entail; the abolition of primogeniture and the unequal division of inheritances (Jefferson was himself an eldest son); the guarantee of freedom of conscience and relief of the people from supporting, by taxation, an established church; and a system of general education. The first object was embodied in law in 1776, the second in 1785, the third—the first law of its kind in Christendom, although not the earliest practice of such liberty in America—in 1786. The last tuo were parts of a body of codified laws prepared (1776–79) by a commission, but very largely by Jefferson. Not so fortunate were his ambitious schemes of education. District, grammar and classical schools, a free State library and a State college, were all included in his plan. He was the first American statesman to make education by the State a fundamental article of democratic faith. His bill for elementary education he regarded as the most important part of the code, but Virginia had no strong middle class and the planters would not assume the burden of educating the poor. In 1779 he founded at William and Mary the first professorship of law in America.

At this time Jefferson championed the natural right of expatriation and gradual emancipation of all slaves. His earliest legislative effort, in 1769, had been marked by an effort to secure to masters freedom to manumit their slaves without removing

them from the State. It was unsuccessful, and the more radical measure he now favoured was more impossible of attainment; but a bill he introduced to prohibit the importation of slaves was passed in 1778. Finally he endeavoured, though unsuccessfully, to secure the introduction of juries into the courts of chancery, and—a generation and more before the fruition of the labours of Romilly and his co-workers in England—aided in securing a humanitarian revision of the penal code, which, though lost by one vote in 1785, was sustained by public sentiment and adopted in 1796. Capital punishment was confined to treason and murder; the former was not to be attended by corruption of blood, drawing or quartering; all other felonies were made punishable by confinement and hard labour, save a few to which was applied, against Jefferson's desire, the principle of retaliation. Jefferson is of course not entitled to sole credit for all these services: Wythe, George Mason and James Madison, in particular, were his devoted lieutenants, and—after his departure for France—principals in the struggle; moreover, an approving public opinion must receive large credit. But Jefferson was throughout the chief inspirer and most ardent worker.

Governor of Virginia.—In 1779, at almost the gloomiest stage of the war in the Southern States, he succeeded Patrick Henry as the governor of Virginia. In his second term (1780–81) the State was overrun by British expeditions, and Jefferson was blamed for the ineffectual resistance. Though he cannot be said to have been eminently fitted for the task that devolved upon him in such a crisis, most of the criticism of his administration was undoubtedly grossly unjust. He declined the renomination for the governorship, but was unanimously returned to the State legislature; and on the day previously set for legislative inquiry he received, by unanimous vote of the house, a declaration of thanks and confidence. He wished, however, to retire permanently from public life, a wish strengthened by the illness and death of his wife. At this time he composed his *Notes on Virginia*, a semi-statistical work full of humanitarian liberalism.

Services in Congress.—Congress twice olfered him an appointment as one of the plenipotentiaries to negotiate peace with England, and he accepted the second offer, but the business was so far advanced before he could sail that his appointment was recalled. The following winter (1783), again in Congress, he headed the committee appointed to consider the treaty of peace. In the succeeding session his service was marked by a report from which resulted the present U.S. monetary system (its decimal basis being due, however, to Gouverneur Morris); and by the honour of reporting the first definitely formulated plan for the government of the Western Territories, that embodied in the ordinance of 1784. For the cession by Virginia to the United States of the vast territory north-west of the Ohio, consummated in that year, Jefferson had long laboured. Its importance to national unity was immense. His ordinance was notable for a provision that slavery should not exist after 1800, defeated in 1784 but adopted in 1787 for the Northwest Territory—a step which is very often said to have saved the Union in the Civil War; the Southwest Territory (out of which were later formed Mississippi, Alabama, etc.) being given over to slavery. To this anti-slavery clause of 1784 (though preceded by unofficial proposals to the same end) belongs rightly some special honour as setting a precedent for Federal control of slavery in the Territories, which later proved of such enormous consequence. His anti-slavery opinions grew in strength with years. Not only justice but patriotism pleaded with him the cause of the negroes, for he realized the dire political dangers of slavery, and foresaw the certainty that the slaves must some day, in some way, be freed; and could any feasible plan of emancipation and re-migration have been suggested he would have regarded its cost as a mere bagatelle. It is true that of his slaves (at one time he owned above 150) he manumitted but a few at his death; and had he fully realized his insolvency doubtless he would have deprived his creditors of none. It is also true that he opposed the Missouri Compromise of 1820—whether rightly or wrongly may be disputed—but at any rate for reasons (reflecting old political struggles) that are unsatisfying.

Minister to France.—From 1784 to 1789 he was in France, first under an appointment to assist Benjamin Franklin and John Adams in negotiating treaties of commerce with European States, and then as Franklin's successor (1785–89) as minister to France. In these years he travelled widely in western Europe. Though the commercial principles of the United States were far too liberal for acceptance, as such, by powers holding colonies in America, Jefferson won some specific concessions to American trade. He was exceedingly popular as a minister.

Religious and Political Theories.—The criticism is even to-day current with the uninformed that Jefferson took his manners (Patrick Henry semi-humorously charged, because he favoured French cooking, that he had "abjured his native victuals"), his morals, "irreligion" and political philosophy from his French residence; and it cannot be wholly ignored. It may therefore be said that there is nothing except scandal to contradict the conclusion, which abundant evidence supports, that Jefferson's morals, mind and tongue were pure. He was not an atheist, but a sincere deist. His attitude toward religion was deeply reverent, but he regarded it as so purely a matter of individual conscience that he was reluctant to discuss it even with his family or friends. "I am a Christian," he wrote in 1823, "in the only sense in which he (Jesus) wished any one to be; sincerely attached to his doctrines in preference to all others; ascribing to himself every human excellence and believing he never claimed any other." Religion was only "evidenced, as concerns the world, by each one's daily life." He compiled from the New Testament a volume of Jesus' teachings which still survives. and has been published as "Jefferson's bible." He was necessarily an enemy of any State church, since he demanded absolute freedom of private judgment, and regarded creeds as "the bane and ruin of the Christian church." To-day he would be a Unitarian, or a member of an ethical culture society.

His political theories had a deep and broad basis in English Whiggism; and though he may well have found at least confirmation of his own ideas in French writers—and notably in Condorcet—he did not read sympathetically the writers commonly named, Rousseau and Montesquieu; besides, although he was deeply interested in all the events leading up to the French Revolution, and all his ideas were coloured by his experience of the five seething years passed in Paris, his democracy was seasoned, and he was rather a teacher than a student of revolutionary politics, when he went there. The *Notes on Virginia*, which were widely read in France, undoubtedly had some influence in forwarding the dissolution of the doctrines of divine right and passive obedience among the cultivated classes. On June 3, 1789, he proposed to the leaders of the third estate a compromise between the king and the nation. In July he received the extraordinary honour of being invited to assist in the deliberations of the committee appointed by the National Assembly to draft a constitution. This honour his official position compelled him, of course, to decline, for he sedulously observed official proprieties.

Secretary of State.—When he returned to America President Washington tendered him the secretaryship of State in the new Federal Government, and he reluctantly accepted. His only essential objection to the Constitution—the absence of a bill of rights—was soon met, at least partially, by amendments. Alexandtr Hamilton (*q.v.*) was secretary of the Treasury. These two men, antipodal in temperament and political belief, clashed in irreconcilable hostility; and in the conflict of public sentiment, first on the financial measures of Hamilton, and then on questions with regard to France and Great Britain, Jefferson's sympathies being predominantly with the former, Hamilton's with the latter, they formed about themselves the two parties of Democrats and Federalists. The schools of thought for which they stood have since contended for mastery in American politics: Hamilton's gradually strengthened by the necessities of stronger administration, as time gave widening amplitude and increasing weight to the specific powers—and so to Hamilton's great doctrine of the "implied powers"—of the general government of a growing country; Jefferson's rooted in colonial life, and still firmly buttressed by the hopes and convictions of American democracy.

The most perplexing questions treated by Jefferson as secretary of State arose out of the policy of neutrality adopted by the United States toward France, to whom she was bound by treaties and by a heavy debt of gratitude. Separation from European politics — the doctrine of "America for Americans" that was embodied later in the Monroe declaration — was a tenet cherished by Jefferson as by other leaders (not, however, Hamilton) and by none cherished more firmly; for by nature he was peculiarly opposed to war, and peace was a fundamental part of his politics. However deep, therefore, his French sympathies, he drew the same safe line as did Washington between French politics and American politics, and handled the Genêt complications in a manner that should have satisfied even the most partisan Federalists. He expounded, as a very high authority has said, "with remarkable clearness and power the nature and scope of neutral duty," and gave a "classic" statement of the doctrine of recognition (John Bassett Moore).

French Democracy. — But the French question had another side in its reaction on American parties. Jefferson did not read excesses in Paris as warnings against democracy, but as warnings against the abuses of monarchy; nor did he regard Bonaparte's coup *d'état* as revealing the weakness of republics, but rather as revealing the danger of standing armies; he did not look on the war of the coalitions against France as one of mere powers, but as one between forms of government; and though the immediate fruits of the Revolution belied his hopes, as they did those of ardent humanitarians the world over, he had faith that a successful reformation of government in France would insure "a general reformation through Europe, and the resurrection to a new life of their people." Three of these statements could be reversed as regards Hamilton. It is the key to an understanding of the times to remember that the Revolutionary War had disjointed society; and democracy — which Jefferson had proclaimed in the Declaration of Independence and enthroned in Virginia — after strengthening its rights by the sword had run to excesses of speech (and of acts in the Shays rebellion) that produced a conservative reaction. To this reaction Hamilton explicitly appealed in the Constitutional Convention of 1787; and of this reaction various features of the Constitution, and Hamiltonian Federalism generally, were direct fruits. Moreover, independently of special incentives to the alarmist and the man of property, the opinions of many Americans turned again, after the war, into a current of sympathy for England, as naturally as American commerce returned to English ports.

Jefferson, however, far from America in these years and unexposed to reactionary influences, came back with undiminished fervour of democracy, and the talk he heard of praise for England, and fearful recoil before even the beginning of the revolution in France, disheartened him, and filled him with suspicion. It was at this period of his life that he gave expression to some of the opinions for which he has been most severely criticized. For the Shays rebellion he felt little abhorrence, and wrote: "A little rebellion now and then is a good thing . . . an observation of this truth should render honest republican governors so mild in their punishment of rebellions as not to discourage them too much. It is a medicine necessary for the sound health of government." Again, "Can history produce an instance of rebellion so honorably conducted? . . . God forbid that we should ever be twenty years without such a rebellion. . . . What signify a few lives lost in a century or two? The tree of liberty must be refreshed from time to time with the blood of patriots and tyrants: It is its natural manure." And again: "Societies exist under three forms — (I) without government, as among our Indians; (2) under governments wherein the will of everyone has a just influence. . . . (3) under governments of force. . . . It is a problem not clear in my mind that the first condition is not the best" (*Writings*, Ford. ed., iv. 362–63, 467).

Hating as he did feudal class institutions and Tudor-Stuart traditions of arbitrary rule (he turned law students from Blackstone's toryism to Coke's political localism) his attitude can be imagined toward Hamilton's oft-avowed partialities — and Jefferson assumed, his intrigues — for British class-government. In short, Hamilton took from recent years the lesson of the evils of lax government; whereas Jefferson clung to the other lesson, which crumbling colonial governments had illustrated, that governments derived their strength (and the Declaration had proclaimed that they derived their just rights) from the will of the governed. Each built his system accordingly: the one on the basis of order, the other on individualism. The two men and the fate of the parties they led are understandable only by regarding one as the leader of reaction, the other as in line with American tendencies. The educated classes characteristically furnished Federalism with a remarkable body of alarmist leaders; whereas Jefferson, because he had a thorough trust and confidence in the people, became the idol of American democracy.

Retires from Washington's Cabinet. — Hamilton was somewhat officious and very combative, and Jefferson, although uncontentious, was very suspicious. As both men held inflexibly to their opinions, cabinet harmony became impossible when the two had formed about themselves parties whose differences were carried into the newspapers; and Washington abandoned perforce his idea "if parties did exist to reconcile them." Partly from discontent with a position in which he did not feel that he enjoyed the absolute confidence of the president, and partly because of financial embarrassments, Jefferson repeatedly sought to resign, and finally on Dec. 31, 1793, with Washington's reluctant consent, retired to his home at Monticello, near Charlottesville.

There he remained (having refused a foreign mission) until elected vice-president in 1796. He was never truly happy except in the country. He loved gardening, experimented enthusiastically in varieties and rotations of crops, and kept meteorological tables with diligence. For eight years he tabulated with painful accuracy the earliest and latest appearance of 37 vegetables in the Washington market. When abroad he sought out varieties of grasses, trees, rice and olives for American experiment, and after his return from France received yearly for 23 years, from his old friend the superintendent of the *Jardin* des *plantes*, a box of seeds, which he distributed to public and private gardens throughout the United States. Jefferson seems to have been the first discoverer of an exact formula for the construction of mould-boards of least resistance for ploughs. He was remarkably apt in the practical application of mechanical principles.

Kentucky and Virginia Resolutions. — In 1796 John Adams, the Federalist candidate for the presidency, became president; and Jefferson, the Republican candidate, became vice-president. At first the French reign of terror and the X.Y.Z. disclosures strengthened the Federalists, until these, mistaking popular resentment against France for a reaction against democracy — an equivalence in their own minds — passed the Alien and Sedition laws. In answer to those odious measures Jefferson and Madison prepared and procured the passage of the Kentucky and Virginia resolutions. These resolutions later acquired pernicious prominence in the elaboration of the States' Rights doctrine. It is, however, unquestionably true that as a startling protest against measures "to silence," in Jefferson's words, "by force and not by reason the complaints or criticisms, just or unjust, of our citizens against the conduct of our agents," they served a useful purpose. As a counterblast against Hamiltonian principles of centralization they were probably very salutary; while even as pieces of constitutional interpretation it is to be remembered that they did not contemplate nullification by any single State (all "the co-States recurring to their natural rights in cases not made federal"). Moreover, they are not to be judged by constitutional principles established later by courts and war. Jefferson's particularism increased as he grew older; owing mainly, without doubt, to his increasing fear of Chief Justice John Marshall, as that great scion of Federalism developed its doctrines in the decisions of the Supreme Court.

Twice Elected President. — The Federalist party had ruined itself, and it lost the presidential election of 1800. The Republican candidates, Jefferson and Aaron Burr (*q.v.*), receiving equal votes, it devolved upon the House of Representatives, in accordance with the system which then obtained, to make one of the two president, the other vice-president. Party feeling in America

has probably never been more dangerously impassioned than in the three years preceding this election; discount as one will the contrary obsessions of Hamilton and Jefferson, the time was fateful. In the end Hamilton—who very rightly judged Burr wholly undependable, and Jefferson, in addition to being honourable, more radical in theory than in practice—used his influence in favour of the latter, and he became president, entering upon his duties on March 4, 1801. Republicans who had affiliated with the Federalists at the time of the X.Y.Z. disclosures returned; very many of the Federalists Jefferson placated and drew over. "Believing," he wrote, "that (excepting the ardent monarchists) all our citizens agreed in ancient Whig principles I thought it advisable to define and declare them, and let them see the ground on which we can rally." This he did in his inaugural, which, though somewhat rhetorical, is a splendid and famous statement of democracy.[1]

His conciliatory policy produced a mild schism in his own party, but proved eminently wise, and the State elections of 1801 fulfilled his prophecy of 1791 that the policy of the Federalists would leave them "all head and no body." In 1804 he was re-elected by 162 out of 176 votes. Even John Adams voted for him, as a Republican elector in Massachusetts.

Republicanizing the Government.—Jefferson's administrations were distinguished by the simplicity that marked his conduct in private life. He eschewed the pomp and ceremonies, natural inheritances from English origins, that had been an innocent setting to the office of his two predecessors. His dress was of "plain cloth" on the day of his inauguration. Instead of driving to the Capitol in a coach and six, he walked without a guard or servant from his lodgings (or, as a rival tradition has it, he rode, and hitched his horse to a neighbouring fence), attended by a crowd of citizens. Instead of opening Congress with a speech to which a formal reply was expected, he sent in a written message by a private hand. He discontinued the practice of sending ministers abroad in public vessels. Between himself and the governors of States he recognized no difference in rank. He would not have his birthday celebrated by State balls. The weekly levee was practically abandoned. Even such titles as "Excellency," "Honourable," "Mr." were distasteful to him. It was formally agreed in cabinet meeting that "when brought together in society all are perfectly equal, whether foreign or domestic, titled or untitled, in or out of office." Thus diplomatic grades were ignored in social precedence, and foreign relations were seriously compromised by dinner-table complications. One minister who appeared in gold lace and dress sword for his first official call on the president, was received by Jefferson—as he insisted with studied purpose—in negligent undress and slippers down at the heel. In truth, all this was in part premeditated system, indicative of his purpose to republicanize government and public opinion, which was the distinguishing feature of his administration; but it was also the nature of the man. In the company he chose by preference, honesty and knowledge were his only tests. He knew absolutely no social distinctions. "If it be possible," he said, "to be certainly conscious of anything, I am conscious of feeling no difference between writing to the highest and lowest being on earth."

The Louisiana Purchase.—The supreme achievement of his first administration was the Louisiana purchase (*q.v.*), following which Lewis and Clark, sent by him, conducted their famous exploring expedition across the continent to the Pacific. The purchase, judged by his professed principles of constitutional construction (and also by earlier expressions of policy—made, however, long before Napoleon's acquisition of the territory confronted the United States with one of the gravest crises of its history) was the greatest "inconsistency" of his career; although also an illustration, in corresponding degree, of his essential practicality and statesmanship. "This advocate of strict economy had spent on his own executive authority an amount equal to almost three-fourths of the debt which Hamilton had assumed for the States with the sanction of Congress. This champion of the letter of the Constitution had exercised the power of acquiring foreign territory and promising foreigners admission to the citizenship of the United States, for which no clause could be found among the 'enumerated powers.' This opponent of the extension of the 'general Government' had stretched its power far beyond any point the Federalists had reached, and laid the foundation, in the creation of an immense national territory in the West, for that definitive triumph of the nation over the States which his 'countrymen' [Southerners] of the second generation fought so desperately to avert" (Muzzey).

It was consistent, however, with his past attitude toward England and Spain, respectively strong and weak, as western neighbours. It was consistent with his attitude toward American expansion westward, revealed in his writings and acts since 1776 (for 20 years before he sent Lewis and Clark he had been trying to initiate exploration of the trans-Mississippi region). Realizing fully the significance of the purchase he wrote to his envoy, James Monroe (and this when he did not dream of acquiring all of Louisiana): "The future destinies of our country hang on the event of this negotiation." In truth no other act or event in American history has been of vaster consequence. Jefferson's greatness, in statesmanship, is due to the fact that he embodied the frontier experience of colonial times, the tendencies of mind which (as Frederick J. Turner long since convinced students of history) had created American democracy. The words of McLaughlin are profoundly true: "Jefferson was not first of all, through and through, a States' Rights man, a strict constructionist, a sympathizer with France, an ambitious leader of men; he was a frontiersman or half-frontiersman. . . . Jeffersonism treated not as a spirit, but as a mode of constitutional interpretation or as a system of administration, is not Jeffersonism at all" (Amer. *Hist.* Rev., 20: 266).

Civil Service and Indian Affairs.—It is often said that Jefferson established the "spoils system" by his changes in the civil service. He was the innovator, because for the first time there was opportunity for innovation. But justice requires attention to the fact that incentive to that innovation, and excuse for it, were found in the one-party monopoly maintained by the Federalists. Moreover, Jefferson's ideals were high; his reasons for changes were in general excellent; he at least so far resisted the great pressure for office—producing by his resistance dissatisfaction within his party—as not to lower, apparently, the personnel of the service; and there were no such blots on his administration as President Adams's "midnight judges." Nevertheless, his record here showed regrettable inconsistencies'.

Another charge frequently made against Jefferson is that he was inconsistent in his treatment of the Indians. It is true. On one hand he voiced, sincerely beyond doubt, the most noble—and alas, in view of the character of American frontiersmen, impracticable—humanism in their behalf. On the other hand his efforts to extinguish Indian titles justify the harsh judgment of Henry Adams that "his greed for land equalled that of any settler on the border"; and in gratifying it he displayed in a few instances an unmoral opportunism that is incapable of condonation. It is, however, to be said in his defence, that in his mind the acquisition of Louisiana was associated with the idea (soon adopted, and followed as a national policy until very recent years) of removing the Indians to reservations of secure hunting grounds—which he (rightly) believed would end frontier wars. To crowd them from their homes east of the Mississippi was therefore, in his system, far removed from the dominant frontier view that Indians were without rights to land or life. Here again—as usually is true—Jefferson's inconsistency of acts turns out to be a lesser inconsistency of principle; and here again, as usually, he made no contemporary explanations, but left the matter to later judgment of the records.

[1] *See* also Jefferson to E. Gerry, Jan. 26, 1799 (*Writings*, vii. 325), and to Du Pont de Nemours (x. 23). *Cf.* Hamilton to J. Dayton, 1799 (*Works*, x. 329).

[1] *See C. R.* Fish, *The Civil Service and the Patronage*, *ch.* ii. (New York, 1905), and G. Hunt, in *Amer. Hist. Rev., 3:* 270–291. He would *not*, he said, retain in office extreme Federalists, because he believed them a danger to the country. Theoretically this left a safe zone for moderates; but the importunity of Republican office-seekers made it inpossible to maintain the distinction between Jefferson's principle and mere partisanship.

Struggle for Rights of Neutrals.—His second term derives most of its historical interest from the unsuccessful efforts to convict Aaron Burr of treasonable acts in the South-West, and from the efforts made to maintain, without war, the rights of neutrals on the high seas. In his first term he carried out a policy he had urged upon the government when minister to France and when vice-president, by dispatching naval forces to coerce Tripoli into a decent respect for the trade of his country—the first in Christendom to gain honourable immunity from tribute or piracy in the Mediterranean. Against greater powers he showed no such intrepidity. In his diplomacy with Napoleon and Great Britain he betrayed a painful incorrigibility of optimism. One writer has very justly said that what chiefly affects one in the whole matter is the pathos of it—"a philosopher and a friend of peace struggling with a despot of superhuman genius, and a Tory cabinet of superhuman insolence and stolidity" (Trent). All the charges against him of timidity and vacillation, so far as they have any basis, rest upon his foreign policy. In 1807 he was willing to rely chiefly on little gunboats—kept under sheds ashore except when actually needed, and then manned by a sort of naval militia!—andwrote (soon after the British "Leopard" had wrecked and searched the "Chesapeake") of "the ruinous folly of a navy!" It is fair to note, however, that Commodores Barron and Preble approved the gunboat policy. And the embargo. if dispassionately considered, must be pronounced not only amply justified by the contempt for neutral rights displayed equally by France and Great Britain, but quite as logical as the continental blockade.

His Agrarian Outlook.—Jefferson's statesmanship had the limitations of an agrarian outlook. The extreme to which he carried his advocacy of diplomatic isolation, his opposition to the creation of an adequate navy, his estimate of cities as "sores upon the body politic," his prejudice against manufactures, trust in farmers, and political distrust of the artisan class, reflect them. Jefferson favoured the wide distribution of the public land as the basis of personal independence and democracy (Hamilton might well have favoured it, in the interest of taxation and ultimate conservatism, but in fact he opposed it). In 1776 he wished to exclude from purchasing public land any man already holding 50 acres. In 1785 he wrote: "It is too soon yet . . . to say that every man who cannot find employment, but who can find uncultivated land, shall be at liberty to cultivate it, paying a moderate rent. But it is not too soon to provide by every possible means that as few as possible shall be without a little portion of land. The small landowners are the most precious portion of the State." It is probably fair to say that cheap land was the chief basis of his political philosophy *(see* C. Beard, *Economic Origins of Jeffersonian Democracy*, ch. xiv.; also pp. 328, 342, 347, 358).

When, on March 4, 1809, he retired from the presidency he had been almost continuously in the public service for 40 years. He refused to be elected for a third time, though requested by the legislatures of five States to be a candidate; and thus, with Washington's prior example, helped to establish a precedent deemed by him to be of great importance under a democratic government. His influence was little lessened in his retirement. Madison and Monroe, his immediate successors—neighbours and devoted friends, whom he had advised in their early educaticn and led in their maturer years—consulted him on all great questions (though there were few in the latter's peaceful terms); and thus there was no break of principles in the **24** years of the "Jeffersonian system."

Jefferson the Political Leader.—Jefferson was one of the greatest political managers his country has known. He had a quick eye for character, was genuinely amiable, uncontentious, tactful, masterful; and it may be assumed from his success that he was shrewd to a degree. Full explanations do not remove from some important transactions in his political life an impression of indirectness. This is mainly because he would not himself mix in debate, pamphleteering or other controversy, while urging his doctrines upon followers who did so. Nor would he, except in conversations and letters, explain his principles and apply them to his conduct although certainly, unless tested by principles, his acts were often strikingly inconsistent; and, even when so tested, sometimes remain so. But reasonable judgment must find very unjust the stigma of duplicity put upon him by the Federalists. Again, there were philosophic elements in his political faith which have led some to class him as a visionary and fanatic. But although he certainly indulged at times in dreams at which one may still smile, he was not, properly speaking, a visionary—looking backward his political prescience seems remarkable; nor can he with justice be pronounced a fanatic. He did have the full courage of his convictions. Extreme as were some of his principles, his independence in expressing and pertinacity in adhering to them were equally extreme. He felt fervently, was not afraid to risk all on the conclusions to which his heart and his mind led him and declared himself with openness and energy; he spoke and even wrote his conclusions, however bold or abstract, without troubling to detail his reasoning or clip his offhand speculations. Certain it is that there is much in his utterances at which less robust democrats will always cavil—though some of the ideas at which they hesitate are at last receiving consideration: *e.g.,* his doctrine that one generation should not and cannot bind another by paper documents. But be his doctrines and aims ever so radical, in their attainment he proceeded, as Hamilton recognized, conservatively. Indeed, when practicality so counselled he was always content to wait for time and education to do his work. Soar as he might, he was essentially not a doctrinaire but an empiricist; his mind was objective. Though he remained to the end firm in his belief that there had been an active monarchist party, this obsession did not carry him out of touch with the realities of human nature and of his time. He built with surety on the colonial past, and had a better reasoned view of the actual future than had any of his contemporaries.

Faith in the People.—Events soon appraised the Federalist judgment of American democracy, so tersely expressed by Fisher Ames as "like death . . . only the dismal passport to a more dismal hereafter"; and, with it, appraised Jefferson's word in his first inaugural for those who, "in the full tide of successful experiment," were ready to abandon a government that had so far kept them ('free and firm, on the visionary fear that it might by possibility lack energy to preserve itself." Time too is still testing his principle that that Government must prove the strongest on earth "where every man . . . would meet invasions of the public order as his own personal concern." He summed up as follows the difference between himself and the Hamiltonian group: "One feared most the ignorance of the people; the other the selfishness of rulers independent of them"; one sect "believing that the executive is the branch of our government which most need (ed) support; the other, that, like the analogous branch in the British government, it (was) already too strong for the republican parts of the Constitution." Jefferson, in short, had unlimited faith in the honesty of the people; a large faith in their common sense; believed that all is to be won by appealing to the reason of voters; that by education their ignorance can be eliminated; that human nature is indefinitely perfectible; that majorities rule, therefore, not only by virtue of force (which was Locke's ultimate justification of them), but of right. His importance as a maker of modern America can scarcely be overstated, for the ideas he advocated have become the very foundations of American republicanism. No other man's ideas have had anything like an equal influence upon the institutions of the country. So competent a scholar as Andrew D. White put him alone in each of the three groups of men who did most to found, to build, and to brace the republic *(Atlantic Monthly,* Jan. 1862). His administrations ended the possibility, probability or certainty—measure it as one will—of a calculated development of Federalism in the direction of class government. Thus by his own labours he vindicated his faith in the experiment of self-government.

Services to the University of Virginia—His last years were devoted to the establishment of the University of Virginia at Charlottesville, near his home. He planned the buildings and oversaw to the minutest details their construction; and he is to-day—for this work and the construction of Monticello and other buildings—recognized as notable in the history of American architecture. He gathered the faculty—mainly from abroad—

and shaped the organization. "A system," he wrote, "of public instruction . . . as it was the earliest so it will be the latest, of all the public concerns in which I shall permit myself to take an interest." The university was doubtless the most liberal institution of learning in the world at that time: the curriculum was wholly elective; there were no religious tests or practices; the faculty were all equals, under a rotating and elective chairman; students were under the honour system in all tests and discipline; agriculture and political science were first provided for in American education. In short many of the ideas of administration and curriculum that dominate American universities in the 20th century were anticipated by him.

Financial Troubles.—His financial affairs in these last years gave him grave concern. He had left the presidency with debts of $20,000, contracted in an over-generous maintenance of his representative position. After the destruction of the library of Congress by the British in 1814 he sold to the nation for $23,950 some 13,000 volumes of his own collection. But this gave only temporary relief. Relatives, invited guests, and strangers filled Monticello (frequently beds were made for a score and more, sometimes for fifty); they stayed for days, weeks, even months, drank his choice French wines, kept their horses in his stables. For solitude he had to retire to a second home, constructed as a refuge. Threatened with bankruptcy, a national subscription in 1826 (of $16,500) enabled him to die in peace, but a few months later his furniture, silver, pictures and Monticello, which is to-day a national memorial, were sold to pay his debts.

Features and Personality.—Jefferson was 6 ft. 2 in. in height, large-boned, slim, erect and sinewy. He had angular features, a very ruddy complexion, sandy hair, and hazel-flecked grey eyes. Age lessened the unattractiveness of his exterior. His carriage was somewhat loose and undignified. There was grace, nevertheless, in his manners; and his frank and earnest address, his quick sympathy (yet he seemed cold to strangers), his vivacious, varied, informing talk, gave him an engaging charm. Beneath a quiet surface he was aglow with intense convictions and an emotional temperament. Yet he seems to have acted habitually, in great and little things, on system. His mind, no less trenchant and subtle than Hamilton's, was the most impressible, the most receptive, mind of his time in America. The range of his interests —in geography, geology, botany, zoology, ethnology, agriculture, plantation, medicine and surgery, mathematics, aeronautics, invention, government, education, languages and literature, religion— is astounding. For many years he was president of the American Philosophical Society. Though it is a tradition that he lacked wit, Molière and Don Quixote seem to have been his favourites; and though the utilitarian wholly crowds romanticism out of his writings, he had enough of that quality in youth to prepare to learn Gaelic in order to translate Ossian, and sent to Macpherson for the originals! His interest in art was evidently intellectual. He was singularly sweet-tempered, and shrank from the impassioned political bitterness that raged about him; bore with relative equanimity a flood of coarse and malignant abuse of his motives, morals, religion, personal honesty and decency; cherished very few personal animosities; and better than any of his great antagonists cleared political opposition of ill-blooded personality. In short, his kindness of heart rose above all social, religious or political differences, and nothing destroyed his confidence in men and his sanguine views of life. Complex as was his life in interests and incidents, it can be summed up in a single word: Freedom— freedom in creed, government, thought and speech. "I have sworn," he wrote in 1800, "upon the altar of God eternal hostility against every form of tyranny over the mind of man."

He died on July 4, 1826, the 50th anniversary of the Declaration of Independence, on the same day as John Adams. For his tomb he chose the epitaph: "Here was buried Thomas Jefferson, author of the Declaration of American Independence, of the statute of Virginia for religious freedom, and father of the University of Virginia."

BIBLIOGRAPHY.—*See* the editions of Jefferson's writings by H. A. Washington, 9 vol. (1853–54), by Paul Leicester Ford, 10 vol. (1892–99); also *Works*, "Federal" ed., 12 vol. (1904–05); and A. A. Lipscomb, several editions of different name in 20 vol. (1903–04), "Definitive" ed., 20 in 10 vol. (1905). Of importance for an appreciation of his political opinions is C. Beard, *Economic Origins of Jeffersonian Democracy* (1915); and indispensable on foreign affairs are Henry Adams, *History of the United States* (1889–91); and the sketch by S. F. Bemis in *The Anzerican Secretaries of State and Their Diplomacy*, vol. ii (1927). Special studies include: G. Chinard, *Jeffersonet les Idéologues, d'après sa correspondance avec Destutt de Tracy, Cabanis, J. B. Say, et Auguste Comte* (1925), *Volney et L'Amérique d'après . . . sa correspondance avec Jefferson* (1923), which tend to overemphasize French connections; W. A. Robinson, *Jeffersonian Democracy in New England* (1916); L. M. Sears, *Jefferson and the Enzbargo* (1927); C. Becker, *The Declaration of Independence* (1922); C. E. Merriam, *A History of American Political Theories*, ch. iv (1903); H. B. Adams, *Thonzas Jefferson and the University of Virginia* (1888); W. A. Lambeth and W. H. Manning, *Thomas Jefferson as an Architect and a Designer of Landscape* (1913); F. Kimball, *Thomas Jefferson, Architect: Original Designs* (1916). J. T. Morse, *Thomas Jefferson* (1883), mainly political, is the only important biography hostile to its subject; but the writers on Alexander Hamilton (*q.v.*) supply any necessary corrective. Other biographies, all sympathetic, are: G. Tucker, *Life of Thomas Jefferson* (1837), based in part on local sources not utilized by other students; H. S. Randall, *Life of Thomas Jefferson* (1853), able, and exhaustive for its time, but sharing Jefferson's obsessions regarding "monocrats" and otherwise partisan, still the leading source of information; J. Parton, *Life of Thonzas Jefferson* (1874), brilliant, less ably reasoned; J. Schouler, *Thomas Jefferson* (1883); J. S. Williams, *Thomas Jefferson: His Perinanent Influence on American Institutions* (1913), hurried and unfinished, by a very able southern senator; T. E. Watson, *The Life aizd Tinzes of Thomas Jefferson* (1903), vivid, very partisan, by a southern Populist; D. S. Muzzey, *Thonzas Jefferson* (1918). balanced and excellent; C. G. Bowers. *Jeffersonand Hanzilton: the Struggle for Democracy in America* (1925), brilliant and important; A. J. Nock, *Jefferson* (1926), a study of character and opinions, particularly economic; F. W. Hirst, *Life and Letters of Thomas Jefferson* (1926), a friendly English view. There is an illuminating appreciation by W. P. Trent in his *Southern Statesman of the Old Régime* (1897); another by John Fiske, in *Essays, Historical and Literary*, vol. i (1902), has lesser merits. *See* also P. Wilstach, *Jefferson and Monticello;* Gilbert Chinard, *Thomas Jefferson: the Apostle of Americanism* (1929); S. K. Padover, *Jefferson* (1942); Dumas Malone, *Jefferson and His Time*, 2 vol. (1948–1951); Adrienne Koch, *Jefferson and Madison* (1950). (F. S. P.)

JEFFERSON **CITY,** the capital of Missouri. U.S., and the seat of Cole county. is on the south bank of the Missouri river. near the centre of the state. Missouri was one of the first states created from the Louisiana purchase and its capital was named in honour of Pres. Thomas Jefferson. An act of congress gave the land and set the location on the Missouri river near the mouth of the Osage. The present site was selected in 1821; Daniel M. Boone, son of the famous frontiersman, laid out the town, providing for a park on each street (not carried out); the city was incorporated in 1825. Early settlers came from the south. principally from Virginia, Tennessee and Kentucky, traveling by river boat down the Ohio and up the Missouri.

The 1830 census showed a population of 3.023, including 300 slaves. After 1848 there arrived waves of German immigrants. who introduced German architecture and a preference for brick houses (the city ordinances once prohibited the construction of frame dwellings). During the American Civil War the southern settlers sympathized with the Confederacy while the German immigrants supported the Union; a specially elected state convention voted almost unanimously to remain in the Union but the governor defied the legislature and began to recruit volunteers for the Confederacy. Union troops occupied the city in June 1861, and Missouri remained in the union.

Status as the state capital gives the city its major importance; most of the residents work for state agencies. The impressive capitol building, constructed of Carthage marble in Italian Renaissance style between 1911 and 1918, was dedicated in 1923 and cost $4,215,000. In addition to legislative chambers and executive offices, it contains a military museum and educational exhibits. Exterior decorations include James E. Fraser's statue of Jefferson and Karl Bitter's group representing the signing of the Louisiana Purchase treaty. The most famous of the interior decorations are the murals in the house lounge. depicting the history of Missouri, painted by Thomas Hart Benton; the artist's selection of unconventional aspects of Missouri history (such as the "Frankie and Johnnie" story) created spirited controversy in the legislature over his fee (eventually paid in full).

In 1833 the legislature located the state prison in Jefferson City, which later prevented the city from being considered as the site for the state university. The prison for men is a few blocks from the capitol building, and several branch prison farms' are located in the nearby countryside. Lincoln university, founded in 1866 by Negro veterans of the union army, became the state college for Negroes in 1879; it is now fully integrated. Other important state buildings include the supreme court building (which faces the capitol and houses a well-known law library), the state office building and the highway commission building.

Jefferson City is the trading centre for a large agricultural region. Local industries include the printing and binding of books and the manufacturing of shoes, clothing and electric appliances. Local libraries include the Cole County Historical library, the public library and the Missouri state library, which has a loan service for libraries throughout the state.

For comparative population figures *see* table in MISSOURI: *Population.* (J. A. *DE.)*

JEFFERSONVILLE,a city of southern Indiana, U.S., opposite Louisville. Ky., on the north bank of the Ohio river at the head of the falls and 114 mi. S.E. of Indianapolis; the seat of Clark county. Built on land which old Ft. Finney (Ft. Steuben a later designation) occupied during 1786–91, Jeffersonville was laid out in 1802 according to a plan suggested by Thomas Jefferson, for whom it was named: it was incorporated as a town in 1815 and chartered as a city in 1830.

It is the site of the southeastern centre of Indiana university and of the Howard Steamboat museum. Shipyards, foundries, chemical and aluminum plants and one of the world's largest powder plants are amonn the industries of the Jeffersonville area. The city's economy, like that of the Ohio valley generally, exoanded considerably as a result of increasing industrialization during and after World War II. For comparative population figures *see* table in INDIANA: *Population.* (G. O. H.)

JEFFREY,. FRANCIS JEFFREY, LORD (1773–1850). literary critic and Scottish judge, best known as the editor of the *Edinburgh Review,* was born in Edinburgh on Oct. 23, 1773. He was educated at the high school of Edinburgh, at the universities of Glasgow and Edinburgh and. for a brief period. at Queen's college. Oxford. Admitted, in 1794. to the Scottish bar. he discovered that his Whig politics were seriously prejudicial to advancement in his profession. Sydney Smith, then in Edinburgh. suggested that he. Jeffrey and some of their friends might cooperate in establishing a critical periodical. The result was the publication. in Oct. 1802. of the *Edinburgh Review.* The first number was edited by Smith. In 1803 Jeffrey was appointed editor; he continued in this capacity and as a writer for the *Review* until 1829. In these years he also built up a reputation as an advocate. In 1820 he was elected lord rector of Glasgow university. and. in 1829. dean of the faculty of advocates. In 1830 the Whig party. which the *Edinburgh Review* had powerfully supported. came into office. and Jeffrey was appointed lord advocate. As a member of the house of commons he introduced the Scottish Reform bill in 1831. In 1834 he was made a judge and assumed the title of Lord Jeffrey. He died in Edinburgh on Jan. 26, 1850.

The *Edinburgh Review* enjoyed an immediate triumph. "The effect." Jeffrey's biographer, Lord Cockburn, wrote of its first number. "was electrical. . . . It was an entire and instant change of every thing that the public had been accustomed to in that sort of composition. The old periodical opiates were extinguished at once." The *Review* exerted. for a considerable period, a powerful influence throughout the English-speaking world. Macaulay asserted. in 1843. that he had read and reread Jeffrey's old articles until he had them by heart. A writer in the *North American Review,* published in Boston, described Jeffrey. in 1852. as "one who. both in literature and politics, during the first quarter of the present century, did more than any other man to guide the taste. form the opinions. and direct the conduct of the thinking portion of the English people." "It is hardly possible." Lewis Gates of Harvard wrote in 1894. "to glance through the life of any literary man of the early part of the century without chancing on evidence of Jeffrey's popularity and prestige."

Part of this success must be attributed to the adroitness with which Jeffrey managed his at first inexperienced team. Cockburn asserted that not one of Jeffrey's associates could have held these elements together for a single year J. H. Millar in his *Literary History of Scotland* (1903) described Jeffrey as "certainly among the greatest of British editors." Before 1802 periodical criticism had been conducted. for the most part, by publishers' hirelings Jeffrey found among his first contributors a nervousness, which he himself shared, lest their engaging upon writing of this nature should involve a serious loss of prestige. It was at once made clear that there would be no subservience to booksellers and that all nork would be adequately remunerated For this raising of their status every subsequent writer of review articles is indebted to the *Edinburgh's* managers.

At the same time. this determination to be fearless gave rise to a savagery in criticism that later periodicals copied and from which Jeffrey cannot be absolved. It assisted, in the long run, in highlighting the occasional fallibility of his judgments This nas particularly true in connection with his criticisms of Wordsnorth. There was a tendency in the later 19th century to dismiss Jeffrey as a mere bludgeoner. hidebound by 18th-century prejudices and entirely incapable of understanding many of the greatest literary works that appeared in his period. Saintsbury. however, asserted in 1887: "As a literary critic. he is important at this very day. and perhaps more important than he was in his own" Gates spoke, in 1894, of causes that were tending to gain for Jeffrey a second hearing Merritt Hughes declared, in 1921. that Jeffrey's onginality was "only beginning to be appraised" Later scholars have suggested that. while it is unlikely that the essays Jeffrey wrote for the *Edinburgh Review* will be nidely reread except by specialists, they remain important to students who desire to discover hon the great authors of the early 19th century were regarded in their own time and that there is still room for revaluation of Jeffrey's critical findings.

BIBLIOGRAPHY—Lord Jeffrey, *Contributions to the Edinburgh Review* (4 vol., 1844, 3 vol., 1846, 1 vol, 1853); Lord Cockburn, *Life of Lord Jeffrey* (1852), Lord Brougham, *Lzfe and Times* (1871), *The Correspondence of Macvey Napier* (1879), L E Gates. *Selections Front the Essays of Francis Jeffrey* (1894); *Three Studies in Literature* (1899); D Nichol Smith. *Jeffrey's Lzterary Criticism* (1910); M. Y. Hughes, "The Humanism of Francis Jeffrey," in *Modern Language Review,* 16 (1921); J A Greig, *Francis Jeffrey of the Edinburgh Review* (1918); T. Crawford, "The Edinburgh Review and Romantic Poetry" in *Auckland Univ. College Bulletin,* 47 *(1955).* (J A G.)

JEFFREYS, GEORGE JEFFREYS, 1ST BARON OF WEM (1645–1689), lord chancellor of England, who was deeply involved in the complex and dangerous politics associated with the reigns of Charles II and James II, was born at Acton in Denbighshire, the son of John Jeffreys, whose forebears had been members of the Welsh gentry for many generations. In older accounts of Jeffreys' life his birth date is usually given as 1648; more recently discovered documents, however. appear to establish that he was born on May 15, 1645. He was educated at Shrewsbury. St. Paul's, and Westminster and spent one year. without receiving a degree, at Trinity college, Cambridge. A legend persists that Jeffreys' father advised him against entering the law. fearing that his son might come to a violent end. Nevertheless, Jeffreys was admitted to the Inner Temple in 1663 and was called to the bar in 1668.

It has frequently been asserted that Jeffreys' legal learning mas small but it cannot be doubted that he possessed shrewd intelligence great powers of interrogation and cross-examination, a forceful, if overbearing, personality and boundless ambition. Within three years of his call to the bar he was elected common serjeant of the city of London and, while holding that office. continued his practice in the courts. As common serjeant he sat at the trial of the religious sectarian Lodowick Muggleton (*q.v*), a case distinguished by Jeffreys' harsh and wrathful denunciation of the defendant when sentence was imposed on him. Feeling that continued advancement required adherence to the court party, Jeffreys attached himself to various influential persons, particularly to the king's mistress. the duchess of Portsmouth. and the king's chief minister in parliament, the earl of Danby. Preferment

followed rapidly. In 1677 he was appointed solicitor-general to the duke of York (later James II) and in the same year was knighted. In 1678, after intervention by Charles II in his behalf, he was elected recorder of London.

In the summer of 1678 Titus Oates (*q.v.*) made his first revelations of the so-called "popish plot" and implicated various individuals, some of considerable prominence, in an alleged conspiracy against English Protestantism and the life of the king. In the public hysteria that followed, numbers of persons were brought to trial and convicted of treason on the testimony of Oates, his associate William Bedlow and others. Jeffreys played a prominent role in many of these trials as prosecuting counsel or judge. Later, in 1685, when Oates was discredited and charged with perjury, Jeffreys sat at his trial and imposed a stringent sentence upon the defendant. Thereafter Jeffreys' prominence in the court party became increasingly conspicuous. He vigorously opposed the Exclusion bill, which would have barred the duke of York from the throne, and in the controversy that preceded the delay in summoning the parliament in 1680 (in order to prevent passage of the Exclusion bill) he was one of those who initiated the movement of the "abhorrers" in opposition to the demands of the "petitioners" for prompt summoning of the national legislature. In 1680 he was appointed chief justice of Chester and was sworn in as one of the king's serjeants. When parliament convened in October of the same year, Jeffreys' enemies in the commons struck out against him, demanding by resolution that the king remove him from all public offices. To avoid impeachment or other retaliation, Jeffreys surrendered the recordership of London. This incident, however, provided no serious check to his career. Shortly thereafter he became chairman of the Middlesex sessions at Hicks' Hall and in 1681 was created a baronet. In 1683 he prosecuted and obtained a conviction of Lord Russell in a case arising out of the Rye House plot. In the same year, at the age of 38, he was elevated to the office of lord chief justice of the king's bench and a few days later was sworn a member of the privy council. As lord chief justice he presided at the trial of Algernon Sidney (q v.) for high treason, which resulted in the conviction and execution of the defendant. In 1685 he was rewarded with a peerage as Baron Jeffreys of Wem, an honour never before conferred on a chief justice during his tenure of office.

Jeffreys' infamy rests primarily on his role in the "bloody assizes" of 1685. Following the abortive insurrection of the duke of Monmouth against the throne of James II, Jeffreys and four other judges were commissioned to try the rebels and to pacify the west, from which Monmouth had recruited his principal support. The trials generally were conducted with a ferocity which has, with reason, made Jeffreys' name notorious. The numbers of persons actually executed cannot be stated with certainty. Macaulay sets the fi'gure at 320; other estimates range as high as 600 to 700. Modern opinion tends to a much lower figure, perhaps between 150 and 200. Many of those convicted escaped the death penalty by being transported in slavery to the colonies. Others were permitted to purchase their pardons. To some degree, Jeffreys profited personally from these transactions. Severe as was Jeffreys' conduct, his performance was strongly approved by the king and shortly thereafter he was made lord chancellor.

In the initial period of James II's reign, Jeffreys was one of the most influential of the king's advisers. As James's measures became more extreme, Jeffreys appears to have felt considerable disquiet; despite his qualms, however, he permitted himself to be closely identified with some of the government's most unpopular policies. To govern and coerce the Church of England, James in 1686 revived the ecclesiastical commission, over which Jeffreys presided. To advance the king's policy of preferment of Roman Catholics, Jeffreys applied coercive pressure on the authorities of Cambridge university, who in 1687 refused to confer degrees on a Benedictine monk, and on the fellows of Magdalen college, Oxford, who declined to elect as their president a disreputable nominee of the king. Despite the peril of his position upon the approach of William of Orange, Jeffreys stood by the king and continued to perform the functions of his office. Not until James fled the country did Jeffreys make his own effort at escape. The attempt failed when, in the disguise of a common sailor, he was recognized and arrested at a tavern in Wapping. He narrowly escaped death at the hands of angry mobs but was ultimately conveyed to the Tower. On April 18, 1689, he died there, not having yet been brought to trial.

The generations that followed him have accepted Jeffreys as the prototype of the brutal and subservient English judge. While a completely objective appraisal of his personality and career is difficult, modem scholarship has tended to soften the indictment. The revolution of 1688 which brought about his fall, placed his reputation in the hands of his bitterest enemies. The tradition, so established, was accepted with small modification by such historians as Macaulay and Lord Campbell. Many of the examples advanced to demonstrate Jeffreys' peculiar brutality, however, are wholly typical of the harsh criminal procedures of his day. Sir James F. Stephen, the great historian of English criminal law, concluded that the trials conducted by Jeffreys of'the conspirators in the Rye House plot and of Alice Lisle (*q.v.*), the most prominent victim of the "bloody assizes," were not tainted by illegality. In his later years Jeffreys suffered from stone, and there is reason to suspect that some of his most flagrant outbursts from the bench, such as those displayed at the trial of the Puritan divine Richard Baxter (*q.v.*) were associated with the agonies of that disorder. In the trial of civil litigation Jeffreys' performance was creditable. Though his services as lord chancellor did not reach the high levels of certain of his predecessors, such as Nottingham, he succeeded in instituting valuable reforms in the chancery practice of his day. Nevertheless, it remains true that much of Jeffreys' conduct is wholly incapable of palliation. Even in an age in which the courts were employed by royal power as an instrument of political repression, Jeffreys' career is remarkable in reflecting the worst tendencies of his time.

BIBLIOGRAPHY.—The chief contemporary authorities for the life of Jeffreys are *Bishop Burnet's History of His Own Time* (1724), especially the edition "With Notes by the Earls of Bartmouth and Hardwick, Speaker Onslow and Dean Swift" (1883); Roger North, *The Life of Francis North, Baron of Guilford* (1808) and *Autobiography* (1887); "Ellis Correspondence, Verney Papers," *Annual Report of the American Historical Association;* "Hatton Correspondence," *Camden Society Publications;* Thomas Bruce, earl of Ailesbury, *Memoirs* (1890); and *Diary and Correspondence of John Evelyn,* 4th ed. (1850–52).

The only trustworthy information as to the judicial conduct and capacity of Jeffreys is to be found in the reports of the *State Trials,* vol. vii–xii; *cj.* Sir J. F. Stephen, *History of the Criminal Law of England* (1883). For details of the "bloody assizes" see *Harleian Manuscripts 4,* 689; George Roberts, *The Life, Progress and Rebellion of James, Duke oj Monmouth,* vol. ii (1844); Sir Edwin Parry, *Bloody Assize* (1929); also many pamphlets, lampoons, etc., in the British museum listed in the article "Sources of History of Monmouth's Rebellion and the Bloody Assizes," by A. L. Humphreys in *Proceedings of the Somersetshire Archaeological and Natural History Society* (1892). Later accounts are by H. W. Woolrych, *Memoirs of the Life of Judge Jeflreys* (1827); Lord Campbell, *The Lives of the Lord Chancellors and Keepers of the Great Seal of England,* 1st series, vol. iii (1845); E. Foss, *The Judges of England,* vol. vii (1864); Henry Roscoe, *Lives of Eminent British Lawyers* (1830); Lord Macaulay, *The History of England From the Accession of James II* (1849 and many subsequent editions). Most of these works, and especially those by Macaulay and Campbell, are uncritical in their hostility to Jeffreys and are based for the most part on untrustworthy authorities. A capable modern work, though unduly favourable to Jeffreys, is H. B. Irving's *Life of Judge Jeffreys* (1898). *See* also H. M. Hyde, *Judge Jeffreys* (1940).

(F. A. A.)

JEFFREYS, SIR HAROLD (1891–), British astronomer and geophysicist noted for his contributions to a wide variety of scientific topics, was born at Fatfield, County Durham, on April 22, 1891. He studied mathematics at St. John's college, Cambridge, and became a fellow of the college in 1914. His astronomical work includes researches into the origin of the solar system and the theory of the variation of latitude. In geophysics he investigated the thermal history of the earth, and calculated comprehensive and accurate travel times of seismic waves. Meteorological studies include work on wind dynamics. Jeffreys also worked on probability theory and related matters of scientific method, on hydrodynamics and elasticity and on methods of general mathematical physics. He was Plumian professor of astronomy at Cambridge, 1946–58, and was knighted in 1953. Other honours include

the gold medal of the Royal Astronomical society (1937) and the royal medal of the Royal society (1948).

Among his principal publications are: The Earth, 3rd ed. (1952), Scientific Inference, 3rd ed. (1957), Earthquakes and Mountains, 2nd ed. (1950), Methods of Mathematical Physics, with Bertha Swirles Jeffreys, 3rd ed. (1956). (R. A. L.)

JEHOIACHIN (in the Douai version of the Bible, JOACHIN), son of Jehoiakim (*q.v.*), and king of Judah. He came to the throne at the age of 18 in the midst of the Chaldean invasion of Judah, and is said to have reigned three months. He was compelled to surrender to Nebuchadrezzar II and was carried off to Babylon (597 B.C.). Eight thousand people of the better class (including artisans, etc.) were removed, and the Temple was partially despoiled. Nearly 40 years later, Nebuchadrezzar died, and his successor released Jehoiachin.

See II Kings xxiv, 8 et seq.; II Chron. xxxvi, 9 et seq.

JEHOIAKIM (in the Douai version of the Bible, JOAKIM), son of Josiah (*q.v.*) and king of Judah (II Kings xxiii, 34 et *seq.;* Jer. xxii, 13–19). On the death of Josiah at Megiddo his younger son Jehoahaz (or Shallum) was chosen by the Judaeans, but the Egyptian conqueror Necho removed Jehoahaz to Egypt, appointing in his stead Jehoiakim. For a time Jehoiakim remained under the protection of Necho and paid heavy tribute; but with the rise of the new Chaldean empire under Nebuchadrezzar II and the overthrow of Egypt at the battle of Carchemish (605 B.C.) a vital change occurred. After three years of allegiance the king revolted. Invasions followed by Chaldeans, Syrians, Moabites and Ammonites, perhaps the advance troops dispatched by the Babylonian king; the power of Egypt was broken and the whole land came into the hands of Nebuchadrezzar. It was at the close of Jehoiakim's reign, apparently just before his death. that the enemy appeared at the gates of Jerusalem, and although Jehoiakim "slept with his fathers" his young son, Jehoiachin (*q.v.*) was destined to see the first captivity of the land of Judah (597 B.C.).

JEHOL: see CK'ENG-TE.

JEHORAM (in the Douai version of the Bible, JORAM), the name of two biblical kings.

1. Jehoram, the son of Ahab and Jezebel, and king of Israel in succession to his brother Ahaziah (*qq.v.*), maintained close relations with Judah, whose king seems to have recognized his suzerainty and came to his help against Moab, who had revolted (II Kings i, 1; iii). The result of the campaign seems to have been a defeat for Israel. Together with Ahaziah, king of Judah, Jehoram endeavoured to recover Ramoth-Gilead from Hazael, king of Syria. He was wounded in the fighting around that town, and during his absence a revolution took place; Jehu (*q.v.*) seized the throne, putting to death all the living members of Ahab's family including Jehoram and Jezebel. These events seem to have occurred in or about the year 841 B.C.

2. Jehoram, son of Jehoshaphat (*q.v.*) and king of Judah, married Athaliah (*q.v.*), daughter of Ahab, and was thus brother-in-law of the Jehoram discussed above, and contemporary with him. In his days Edom and Libnah revolted (II Kings viii, 20–22), perhaps in concert with one another. The Chronicler (II Chron. xxi, 1; xxii, 1) adds many details: on ascending the throne Jehoram massacred his kinsmen, was condemned to death from disease by Elijah and was utterly defeated by a great invasion of Philistines and Arabs. He died a year before his namesake of Israel; *i.e.,* probably in or about 842 B.C.

JEHOSHAPHAT (in the Douai version of the Bible, JOSAPHAT), was the son of Asa and king of Judah in the early part of the 9th century B.C. He seems to have been a subordinate ally of the house of Omri; his son Jehoram (*q.v.*) married Ahab's daughter Athaliah. and he himself took part in Ahab's fatal expedition to Ramoth-Gilead and in the attack on Mesha, king of Moab, by Jehoram. king of Israel. He engaged in distant trading enterprises, but his attempt to establish a fleet at Ezion-Geber (near the modern 'Aqaba) failed. There is also an account of an attack on Jehoshaphat by an army of Moabites, Ammonites and Edomites, in which he was completely victorious (II Chron. xx; I Kings xxii).

JEHOVAH, the God of Israel. The pronunciation "Jĕhōvăh" is an error resulting among Christians from combining the consonants Yhwh (Jhvh) with the vowels of *'ădhōnāy,* "Lord," which the Jews in reading the Scriptures substituted for the sacred name, commonly called the tetragrammaton as containing four consonants. It is first found in manuscripts of Martini's *Pugio* Fidei (1278), belonging to the 14th century; and Galatinus (1518) is found arguing against abbreviating it to "Jova," on the analogy of the Latin Jovis (as proved by G. F. Moore).

This avoidance of the tetragrammaton, due primarily to an over-rigid interpretation of certain passages in the Old Testament (*e.g.,* Lev. xxiv. 15–23; *cf.* Exod. xx. 7), may have arisen from various motives: a feeling that a proper name for God implies the existence of other gods, the fear lest the sacred name should be mispronounced or otherwise profaned, and the desire to prevent its abuse in magical practices. If this hope was the reason, secrecy had the opposite effect; for the tetragrammaton became the greatest name in both Jewish and heathen spells and miraculous efficacy was attributed to mere utterance of it. Several centuries before the Christian era the tetragrammaton ceased to be commonly used. Some later writers in the Old Testament prevailingly or exclusively employed *'ĕlōhîm,* "God," which editors in some parts uniformly substituted for Yhwh; various periphrases also took its place. The oldest Greek versions and the books written in Greek replaced Yhwh by Κύριος, "Lord." The name war still pronounced only in the priestly benediction (Num. vi. 27) after the daily sacrifice in the temple, although a substitute was used in the synagogues, and by the high priest in his prayers and benediction on the Day of Atonement. The Rabbinic tradition that after the death of Simeon the Just (fl. 290 B.C.) it was no longer pronounced even on these occasions is contradicted by the well-attested statement that in the last generations before the fall of Jerusalem (A.D. 70) it was uttered so low that the sounds were lost in the chant of the priest. After that event the liturgical use of the name ceased, but the tradition was perpetuated in the Rabbinic schools; it continued also to be employed by healers, exorcists and magicians, and is found on many magical papyri. It is asserted by Philo that only priests might pronounce it and by Josephus that those who knew it were forbidden to divulge it.

The early Christian scholars therefore easily learnt the true pronunciation. Clement of Alexandria (d. 212) gives Ἰάουε or Ἰάουαι (or in one manuscript 'Ihov), Origen (d. 253–54) Ἰάη, and Epiphanius (d. 404) Ἰαβε (or Ἰαυε in one manuscript); Theodoret (d. 457) says that the Samaritans pronounced it Ἰαβε (or Ἰαβα) and the Jews Αἶα (if the text is rightly restored). This direct testimony is supplemented by Ἰαβε or Ἰαβα or even Ἰαωούηε in Greek magical texts and by *Yāwē* in an Ethiopic charm. Clearly a form like Yahweh underlies all these transliterations except Αἶα, which represents 'ehyeh or, in the Babylonian punctuation, *'ahyah,* "I am," a verbal form sometimes used as the Divine name (Exod. iii., 14). Diodorus Siculus (1st century B.C.) and Macrobius (5th century A.D.), in giving 'Ihw, which agrees with *Iao* in Jerome (d. 420), reflect *Yāhû;* and Porphyry (fl. 275) with Ἰεύω goes back to *Yĕhô*—as found in proper names.

MODERN THEORIES

In spite of this testimony, modern scholars have differed widely as to the true pronunciation of the name. Thus Scaliger (1598) inclined to Yahweh or Yelzweh and Genebrardus (1600) proposed Ihue (cf. Heb. *yihyeh,* "he becomes") or Iahue. Mercerus (d. 1570) suggested *Yehĕweh* (cf. Heb. 'ehyeh, "I am"), Arias Montanus (1527–98) Jeveh, and Erinton (1899) Jahva. Other scholars were led astray by supposing that Ἰάω or Iao represented the tetragrammaton; thus Drusius (c. 1604) argued for *Jahvōh,* Bellermann (1818) for *Yāhôh,* and Sayce (1894) for *Yahăvah.* The arguments, however, of a succession of learned scholars from the end of the 15th to the beginning of the 19th century gradually prevailed; the support of Eichorn (1793) and the conversion of Gesenius (1786–1842) and Ewald (1803–75), who at first favoured *Yahwōh* and *Yĕhōvāh* respectively, to Yahweh ensured the general acceptance of that form, although *Yahwōh* still finds occasional adherents.

The form Yahweh, in which the first h is voiced and the accent falls on the second syllable, is of the type of such a place-name as

Yabhneh (Eng. "Jabneh"), which is properly the imperfect tense of a verb and means "he causeth to build"; the alternative *Yabhnĕ'ēl* (Eng. "Jabneel"), meaning "God causes to build," shows that the implied subject in the abbreviated form is God. While, however, it is universally admitted that Yahweh is a verbal form, its precise sense is uncertain.

Firstly, it is disputed whether it is the intransitive or the causative theme; the former would be expected to take *i* in the first syllable, although this *i* was probably *a* originally, while the latter takes a invariably. Secondly, the root from which it is derived is open to doubt. The writer of the priestly narrative, who regards it as intransitive, identifies it with yihyeh, "he is" or "becomes," "he will be" or "become," when (having changed the third into the first person to suit the context) he explains it by the phrase 'EHYEH *'ăsher* 'EHYEH (Exod. iii., 14); this can be translated "I am that I am" or more exactly "I am wont to be that which I am wont to be" or "I will be that which I will be." The first implies that Yahweh's nature can be defined only by itself or that, while he is, as opposed to non-existent heathen deities, he exists not simply in an abstract sense but actively, ever manifesting himself under fresh aspects (Oehler); the second means that he will be with Israel in future afflictions as in the present oppression (Rashi) or that he will show himself to Israel under the manifold attributes of goodness and so on (Davidson), or that he will be it, viz., the performer of his promises (Ewald). The interpretation 6 ὤν, "he who is," of the Alexandrian version, in implying metaphysically the assertion of this absolute being, is incorrect; for *hāyāh*, "became" or "was," denotes being phenomenally, not essentially or ontologically.

Although the general idea connected with the *tetragrammaton* by the priestly writer, and after him by the Israelites, was obviously that of a being who both is and manifests his being, the possibility cannot be excluded that he intended to attach to it a theological sense totally different from its original meaning. It was already recognized in the middle ages that formally it might have a causative meaning (Aaron ben Elijah). Consequently it has been translated "he causes to be," and this has been variously interpreted as signifying that he creates or gives life (Gesenius) in the sense that he is the giver either of existence (Schrader) or of life and deliverance (Kuenen), that he calls into existence the events of history (Lagarde), or that he brings to pass, viz., performs his promises (Le Clerc).

The intransitive interpretation agrees with Hebrew tradition but is open to certain objections: that (1) *i* would be expected in place of a in the first syllable, and (2) the correct form is *hāyāh*, not *hāwāh*, "was" in biblical Hebrew. Both can be easily explained: (1) the a may be an archaism, of which there are traces in the Old Testament; (2) the form *hāwāh* is found sporadically in biblical Hebrew and, being customary in the neighbouring dialects, especially Aramaic, may once have been normal in Hebrew. The causative interpretation, apart from the doubt about *w* for *y*, is liable to far more serious objections: that (1) *hāyāh*, though used of a fulfilment of a definite promise or prediction, can hardly be abstractly so employed with no indication of the promise, and (2) the causative theme of *hāyāh* is found in no Semitic language, except late Syriac, but is replaced by that of some other root. Those, therefore, who still regard it as causative refer it to *hāwāh*, found once in Hebrew in the form *hāwā'*, "fell"; they interpret this as "he causes to fall," *sc.* the rain (Robertson Smith; *cf.* Arab. *haway*, "fell"), or "he overthrows," *sc.* with lightning (Green; *cf.* Arab. *'ahway*, "overthrew" and Heb. *hōwāh* or *hawwāh* "destruction"). But, even though Yahweh was often depicted as a storm-god, the fact that the Heb. *hāwa'*, "fell," is late and rare renders this explanation highly improbable. Even less likely are the attempts to explain it either as "he falls" like a meteoric stone or "he blows" (Wellhausen; *cf.* Arab. *haway*, "fell" and "blew"), on the grounds that his worship originated among the Kenites or Midianites or other tribes to the south of Palestine and that several places sacred to him, *e.g.*, Horeb, Sinai and Kadesh, lay in northern Arabia, or as "he loves" (Gardner; *cf.* Arab, *haway*, "loved"). Such Arabizing interpretations are a *priori* doubtful, and the traditional Hebrew explanation is in itself as reasonable as anything else hitherto proposed.

Outside the Old Testament Yhwh occurs only on the Moabite Stone (*c.* 850 B.C.); the usual form is Yh or Yhw, occurring in unvocalized texts of the 5th and 4th centuries B.C. These forms appear in the Old Testament sporadically as the independent *Yāh* and regularly as *Yāh-* or *Yāhû-* at the end and *-Yĕhô* or *-Yô* at the beginning of proper names. Elsewhere the initial and final forms in composition respectively are Yw- and *-Yw* in the 9th, *Yh-* and *-Yhw* in the 7th, *Yhw-* and *-Yhh* in the 6th, Yh- and *-Yhw* or *-Y'* in the 5th century B.C.; thereafter most of these forms seem to have been used indiscriminately. In Assyrian and Babylonian texts, which alone give the contemporary vocalization, the tetragrammaton appears in transcribed Hebrew names as Ya- in the 9th, Yau- and *-Yau* or *-Ya* in the 8th, and *Yâḫû-* and *-Yâma* (for *-Yâwa*) in the 5th century B.C. These point to *Yā* as the original pronunciation, in which case the final consonant was merely an orthographic device to avoid a final vowel; similarly, the medial h in *Yā(h)w* and *Yā(h)h* must have served merely to mark the a long. Afterwards, this h came incorrectly to be pronounced, as the hard h in *Yâḫû-* and the Biblical *Yĕhô-* and *-Yāhû* show. The forms *Yĕhô-* and *Yô-*, which arise out of *Yĕhau-* and Yau- respectively owing to a similar mispronunciation of the orthographic w and the change of aw or au into *ô* according to Hebrew practice, were fully established by the 3rd century B.C., since *ō* has replaced a almost always in the Septuagint.

It was formerly held that *Yāh* and similar forms were abbreviations of Yahweh. The arguments, however, against this view are overwhelming: (1) the short forms show that ya was the essential syllable, although on this theory it would be merely a prefix; (2) the inscriptions and papyri, as well as proper names, show that *Yh* or *Yhw*, not Yahweh, was the extra-biblical form; (3) it is a *priori* improbable that a name held so sacred as Yahweh would be commonly abbreviated; (4) no other Semitic race ever shortened the names of its gbds; (5) the endeavour to assign an abstract meaning to a divine name bears the impress of a later period of theological reflection. It has, therefore, been suggested, as Greek speculation shows, that *Yahweh* comes from an original *Yahw*, afterwards vocalized *Yāhû*, either by adding a questionable ending -ay become -eh (Grimme) or an *-h* like the Arabic vocative *-âh* (Lukyn Williams and Burkitt) or else by assimilation to yihyeh, "he is" (van Hoonacker). This last suggestion is probably correct; but, even so, it fails to account for Ydh as well as *Yāhû*. It is, however, not impossible that the primitive form was simply *Yā*, which Hebrew orthography required to be written *Yāw* or *Yāh*; later, when *w* was not thought sufficient to indicate the long vowel, *h* was inserted, giving rise to *Yā(h)w*, which came to be mispronounced *Yāhû* (on the false analogy of *sahw* developed into *sāhû*, "swimming"). This development explains the presence of *a* and *w*, where *i* and *y* would be expected if Yahweh were connected with the substantive verb; for primarily they belonged to the primitive *Ya(hw)*, but secondarily the recollection of the archaic a in the imperfect tense and of the North-Palestinian and Aramaic *hāwāh* = *hāyāh*, "became," aided their retention.

This *Yā* was probably ejaculatory in origin (*cf.* Gr. Βάκχος and Ἴακχος); for *yâ* or *yāh* is a common Semitic exclamation. At the Exodus the national unity of the Hebrews was enforced by the worship of one national God, and the adoption of the preeminent God of the patriarchs together with the alteration of his name from the meaningless *Yā* to the significant Yahweh reinforced the new idea. The transition, which was effected by a prolongation of the ejaculation natural in moments of emotion or excitement, may have been a gradual process; but its assimilation to and explanation by a simple verb was an act of inspiration. This new name, though at first widely known, as the Moabite Stone shows, was soon considered too sacred for daily use and confined to the Scriptures, while the older form persisted in profane use. On this theory there is no essential discrepancy between the statement that in the days of Enosh men began "to call upon the name of Yahweh" (Gen. iv, 26) and God's assertion that in the time of the patriarchs "by my name Yahweh I was not known" (Exod.

vi. 3); for the writer or compiler of the first passage substituted the later *Yahweh* where strict history required *Yāh*, while in the second he was right to the extent that God was known not as Yahweh but as *Yāh* before the Exodus.

It has been argued on several grounds that Yahweh was originally a non-Hebrew deity. That he was a Kenite (Tiele) or Canaanite (Land) god is little more than conjecture. Thus it has been claimed that the name *Aḥiyami*, found on a cuneiform tablet at Taanach (*c.* 1300 B.C.?), is the Hebrew *'Ăḥîyāh*, "Ahijah," meaning "brother of Yami (Yawi) = *Yah(weh)*"; but this final element may just as well be Yamu, a deity apparently found in the Hebrew *Yĕmû'ēl*, "Jemuel," which means "*Yĕmû* = *Yamu* is god," or corresponds with *-'ām* as seen in the Hebrew *'Ăḥî'ām*, "Ahijam," in which case it is a mere termination. A Babylonian connection for *Yāhû*, afterward Hebraized as Yahweh, has been urged on the ground that a god called *Yaû(m)* occurs in such names as the Bab. *Yaûm-ilum* which is compared with the Heb, *Yô'ēl*, "Yahweh is God"; but the absence of the determinative sign indicating a god before *yaûm* and the discovery of the possessive pronoun yazim, "my," makes the rendering "Mine is God" far more plausible. Similarly, in such names as *Ya'we-ilum* it is probable that *ya'we* is not a divine name but a verbal element, although its meaning is still unknown. Again, names like the Bab. *Bēliya* and *Bēliau* are not identifiable with the Heb. *Ba'alyāh*, "Yah is lord," not only because there is no mark of divinity before the final element but also because *-ya*, yau and so on are well-known hypocoristic endings in Assyro-Babylonian, as in the neighbouring languages. The argument for the existence of a Babylonian god called Yau rests entirely on proper names; and, since these can be otherwise satisfactorily explained, it must be given up. Further, the occurrence of *Yāh* in proper names outside Hebrew territory proves nothing; for *Azriyâu* ("Azariah"), lord of Ya'udi, Yau-bi'di, king of Hamath, and *Yôrām* ("Jehoram"), prince of Hamath, may have been Hebrews or descendants of Hebrews who had settled abroad and founded their own petty kingdoms; so *Yō'ēl* ("Joel," if the name is rightly interpreted) on a Maltese inscription may be the name of a Jewish settler. Names like "Uriah" the Hittite and "Tobiah" the Ammonite prove even less, since the ending may be not the divine element but a Hebraized form of the hypocoristic *-ya;* the Assyrian *Ṭābiya* and *Uriyâ*, as well as the Cassite Uriya, are the foreign counterparts of these names. Yet the common recognition of heathen gods outside their own countries as attested on monuments and in proper names makes it necessary to admit the possibility of a sporadic worship of a god called Yahweh outside Hebrew territory. Rut the evidence hitherto adduced is equivocal and indirect, and no direct evidence exists; for the identification of the Heb. *Yāh* with the Bab Ea, the god of wisdom, is a discovery periodically made by amateurs, which needs no refutation.

BIBLIOGRAPHY.—S. R. Driver, *Studia Biblica*, i, 1–20; M. Jastrow, *Journal of Biblical Literature*, xiv, 101–127; *A.* W. Hands, *Numismatic Chronicle*, iv, ix, 121–131; G. F. Moore, *Old Testament and Semitic Studies in Memory of R. W. Harper*, i, 143–164, and *American Journal of Semitic Languages*, xxv, 312–318; *A.* van Hoonacker, *Schweich Lectures*, iii, 67–73 (1915); F. C. Burkitt, *Journal of Biblical Literature*, xliv, 353–356; *A.* H. Lukyn Williams, *Journal of Theological Studies*, xxviii, 276–283; G. R. Driver, *Old Testament Essays* (ed. Simpson) 18–24. (G. R. D.)

JEHOVAH'S WITNESSES. Formerly known as International Bible Students, the movement officially adopted the name Jehovah's Witnesses in 1931. The group was organized in 1872 by Charles Taze Russell (1852–1916), popularly known as Pastor Russell. His successor in leadership was Joseph Franklin Rutherford (Judge Rutherford) (1869–1942), who in turn was succeeded by Homer Knorr (1905–). The Witnesses regard both Catholic and Protestant groups as misguided by Satan. The one true God, the Witnesses believe, is Jehovah God; the righteous in the Bible from Abel on and the modern Witnesses testify to the setting up of the Rule of God, the Theocracy. Jesus Christ, the perfect man, not,God, is God's agent in establishing the Theocracy. As the perfect man, he is now man's redeemer since his death made possible a reconciliation to God, which was broken by Adam's sin. The Witnesses do not believe in Hell; the wicked are destroyed. The present time, they hold, is the "last days"; soon the forces of evil will be pitted in a great battle, Armageddon, against the forces of Jehovah God, led by Jesus. The forces of evil will be defeated and for 1,000 years Jesus will reign with the Witnesses and the resurrected, righteous dead. At the close of this period Satan will be released for a brief time. Soon afterward he and all those deluded by him will be destroyed and Paradise will be set up on earth. This picture of the future held by the Witnesses is drawn largely, but not exclusivelv. from the book of Revelation.

The Witnesses use magazines, tracts and books as well as recordings in making contacts with the public. Full-time workers are known as Pioneers and part-time workers as Publishers. Both groups distribute tracts, sell books and magazines and make personal contacts. The local churches are called Kingdom halls. By the latter 1950s there were 16,000 congregations in the U.S. and other lands.

The Witnesses quote the Bible extensively and consider it a book of prophecy accurately describing events yet to come. They baptize by immersion. Divorce is disapproved. They also disapprove of tobacco and liquor. Two of their practices have aroused much criticism. They refuse to salute the flag, for to them such an act is idolatrous. They consider their men workers "ordained" and rightfully exempt from military service. They have always been sharply critical of other religious bodies, especially the Roman Catholic Church.

BIBLIOGRAPHY.—H. H. Stroup, *Jehovah's Witnesses* (1945); Watch Tower Bible and Tract Society, *Yearbook of Jehovah's Witnesses* (annual); *Qualified to Be Ministers* (1955); Marley Cole, *Jehovah's Witnesses—The New World Society* (1955). (J. H. CB.; X.)

JEHU, a king of Israel, son of Jehoshaphat (*q.v.*) and grandson of Nimshi. He was at first general of Ahab and Jehoram (*qq.v.*) of Israel and was noted for his furious driving of the chariot. During the joint expedition of Jehoram of Israel and Ahaziah of Judah, the former was wounded, and retired to Jezreel, uhere he was visited by the king of Judah. Instigated by the prophetic party and supported by the Rechabites, Jehu organized a revolution, hastened to Jezreel, where he put to death both Jehoram and Ahaziah, while he had the whole of the family of Ahab assassinated. The movement was the result of patriotic hostility to the foreign political theories and the religious innovations introduced by Jezebel (*q.v.*), Ahab's wife, which offended both the democratic feeling and the enthusiasm for Yahweh, which were characteristic of Israel. Thus not only Jezebel herself but also large numbers of Baal worshipers were put to death. In the course of an expedition against Damascus, undertaken in 841 B.C., Shalmaneser III received tribute from Jehu. This was probably paid in order to secure Assyrian protection for the new regime, but it did not prevent the loss of much Israelite territory to the east of Jordan, or continuous war between Jehu and Hazael, king of Damascus, after the withdrawal of the Assyrian armies.

Jehu is also the name of a prophet of the time of Baasha and Jehoshaphat (I Kings xvi; II Chron. xix, et seq.). *See* also AHAZIAH; JEHORAM.

JELGAVA (formerly MITAVA, Ger. MITAU), a town of Latvia, 29 mi. by rail S.W. of Riga, on the river Aa, in a fertile plain 12 ft. above sea level. Pop. (1939) 34,099. Jelgava is supposed to have been founded in 1266 by Conrad Mandern, grand master of the order of the Brethren of the Sword. In 1345, when plundered by the Lithuanians, it was already an important town. In 1561 it became the residence of the dukes of Courland. During the 17th century it was thrice taken by the Swedes. Russia annexed it with Courland in 1795. At high water the plain and sometimes also the town are inundated. Jelgava is surrounded by a canal occupying the place of former fortifications. The old castle (1266) of the dukes of Courland was destroyed by Duke Biren, who erected in its place (1738–72) a palace. Wax cloth, linen, soap, ink and beer are the chief manufactures.

JELLACIC, JOSEF, COUNT (1801–1859), Croatian soldier and statesman, was born at Peterwardein, in the Croatian military frontier, on Oct. 16, 1801. Entering the Austrian army (1819), he saw service in Bosnia (1845), but it was not his military capacities but his strong legitimist sympathies that led the emperor Ferdinand, on the advice of Baron Josika, to appoint him ban of Croatia

and promote him to lieutenant general on March 19, 1848, in order to counteract the national movement in Hungary. Jellacic took office on April 14, and immediately began the process of dissociating Croatia from Hungary, to place it directly under Austrian rule. The Hungarian government, which was still in name loyal and constitutional, ordered Jellacic's measures to be annulled and himself to appear in Buda on a charge of high treason. Jellacic disregarded these orders; whereupon the Hungarian Count Batthyani visited the Austrian court at Innsbruck and secured (it is said, by a trick) signature of a manifesto condemning the separatist movement in Croatia and depriving Jellacic of all his deputies. Jellacic, who only a week after (June 19) himself appeared in Innsbruck and was hailed by the court as one of its chief pillars, disregarded the proclamation and encouraged the separatist movement in the Croatian diet to run its course. On July 9, however, he prorogued it in view of the military situation, and as the movement in Hungary grew rapidly more extreme, the court grew convinced that its salvation lay in the countermovement led by Jellacic and his Croats. On Sept. 4 he was reinstated in his dignities, with a testimonial to his loyalty; and on Sept. 11 he crossed the Drave at the head of his troops. to attack Hungary. As a general, Jellacic was anything but talented, and was frequently defeated by the Magyar troops; but his regiments were largely instrumental in crushing the Magyars. Although the reorganization of Croatia carried through by the reaction was far from meeting his own wishes. he personally was loaded with honours. He was left in the post of civil and military governor of Croatia and the military frontier, created count (1855) and given command of the expedition against Montenegro. He died on May 20, 1859. He published a volume of *Gedichte* in 1851.

JELLICOE, JOHN RUSHWORTH JELLICOE, 1ST EARL (1859–1935), British naval officer, who commanded the British fleet at the battle of Jutland, was born Dec. 5, 1859, at Southampton, the son of J. H. Jellicoe, a captain in the mercantile marine. Educated at Rottingdean, he entered the navy as a naval cadet in 1872. He obtained his commission as sublieutenant in 1880, and won first class certificates in his three examinations for the rank of lieutenant. He soon developed an interest in gunnery and joined the Royal Naval college in 1883 for the theoretical part of the course for gunnery lieutenant, where he won a special £80 prize. The following year he spent in H.M.S. "Excellent," and became a fully qualified gunnery officer. From that time on gunnery was his specialty, though his interests were by no means confined to that branch.

Jellicoe's first seagoing ship as a gunnery lieutenant was H.M.S. "Monarch." He received the board of trade silver medal for his action in saving the lives of the crew of a stranded steamer (1886). After two years on the senior staff of the Gunnery school, he was appointed to the admiralty as an assistant to the director of naval ordnance. In 1891 he was promoted to commander, and shortly afterward was appointed to H.M.S. "Victoria," flagship of Adm. Sir George Tryon, commander in chief of the Mediterranean fleet. When the "Victoria" was rammed and sunk by the "Camperdown," Jellicoe had to take to the water.

Two months later he was appointed to the battleship "Ramillies," which flew the flag of the new commander in chief, Adm. Sir Michael Culme-Seymour. After a three-year commission in that ship he was promoted captain on Jan. 1, 1897, and served on the ordnance committee. In 1898 he was appointed to the command of H.M.S. "Centurion," where he became flag captain to Adm. Sir Edward Seymour, commander in chief of the China station. As the latter's chief of staff he took part in the expedition to relieve the legations in Peking during the Boxer rising in 1900. During these operations Jellicoe was badly wounded. He was subsequently appointed companion of the Bath.

Service at the Admiralty. — He returned to the admiralty in 1902 to be the naval assistant to the controller (third sea lord). In Aug. 1903 he went to sea again to take command of the armoured cruiser "Drake." The year 1905 saw him director of naval ordnance at the admiralty. During his period of office he did much to further the advance of long-range firing and to assist the development of naval gunnery on lines that more closely approximated the real conditions of war. Toward the end of his time he reached the top of the captains' list and was promoted to flag rank in Feb. 1907. In 1908 he rejoined the admiralty as third sea lord and controller of the navy, the first sea lord, Sir John Fisher (*q.v.*), having by this date decided that he was the most suitable officer to command the grand fleet in the event of war. In Dec. 1910 he was appointed acting vice-admiral in command of the Atlantic fleet, being confirmed in that rank in the following November. At the end of the year he transferred his flag to H.M.S. "Hercules," on appointment to the command of the 2nd division of the home fleet.

In 1912 important gunnery experiments were carried out by two battleships of this division, the "Thunderer" and "Orion," the former being fitted with the system of director firing that Sir Percy Scott had been perfecting. The trials culminated in competitive firings under Jellicoe's supervision, and the system was adopted as the primary one for laying and firing the guns of practically all classes of H.M. ships. After a year in this command Jellicoe returned to the admiralty to rejoin the board as second sea lord.

World War I.—On the eve of war, Jellicoe was sent to join the home fleet at Scapa as second in command under Adm. Sir George Callaghan. When war could no longer be averted, it was considered desirable that the change in this most responsible naval command should not be delayed and Jellicoe was appointed commander in chief with acting rank of admiral.

He was confirmed in his rank in March 1915, and for two years organized and trained the grand fleet and kept it ready for action. His command was put to the test at the battle of Jutland (*q.v.*). His tactics on that occasion were severely criticized at the time, but it is now accepted that he achieved a strategic victory which left the German high seas fleet ineffective during the remainder of the war. Toward the end of 1916 Jellicoe left his last command afloat to become first sea lord. During the next year his efforts to combat the new German submarine campaign were not effective until the convoy system was adopted at the insistence of the prime minister, Lloyd George, who was responsible for his retirement from the admiralty at the end of 1917. After the armistice Jellicoe was sent on a special mission to visit the dominions and advise on the postwar organization of their navies. On this tour he flew his flag in H.M.S. "New Zealand." Promoted to admiral of the fleet in 1919, he became governor of New Zealand in 1920.

For his services in World War I Admiral Jellicoe received the thanks of parliament and a grant of £50,000, and at the end of 1918 he was raised to the peerage as Viscount Jellicoe of Scapa, subsequently taking the additional title of Viscount Brocas of Southampton. On his return from New Zealand and in recognition of his services as governor he was, in 1925, created an earl. He died on Nov. 20, 1935, and was buried in St. Paul's cathedral.

He published *The Grand Fleet, 1914–16, Its Creation, Development and Work* (1920) and *The Crisis of the Naval War* (1920). *See* also R. H. Bacon, *Life of John Rushworth, Earl Jellicoe* (1936); *D.* Lloyd George, *War Memoirs* (1933–37). (E. A.; X.)

JELLINEK, ADOLF (1820/21–1893), Jewish rabbi and scholar, one of the greatest preachers in modern Judaism, a powerful apologist and an accomplished homilist, at once profound and ingenious, was born at Drslawich, Moravia. After filling clerical posts in Leipzig, Ger., he became *Prediger* ("preacher") in Vienna, Aus., in 1857. He was associated with the promoters of the New Learning within Judaism and wrote on the history of the cabala. His bibliographies (each bearing the Hebrew title *Qontres)* were useful compilations. But his most important work lay in three other directions: (1) *Midrashic.* Jellinek published in the six parts of his *Beth ha-Midrasch* (1853–77) a large number of smaller *midrashi,* ancient and medieval homilies and folklore records, which proved to be of much service in the revival of interest in Jewish apocalyptic literature. A translation of these collections of Jellinek into German was undertaken by A. Wuensche, under the general title *Aus Israels Lehrhalle.* (2) *Psychological.* Before the study of ethnic psychology had become a science, Jellinek devoted attention to the subject. There is much keen analysis and original investigation in his two essays *Der jiidische Stamm* (1869) and *Der jiidische Stamm in nicht-jüdischen Sprüch-*

wörtern (1881–82). It was he who first compared the Jewish temperament to that of women in its quickness of perception, versatility and sensibility. (3) *Homiletic.* Jellinek published about 200 sermons. in most of which are displayed unobtrusive learning. fresh application of old sayings and a high conception of Judaism and its claims. He died at Vienna on Dec. 29, 1893.

BIBLIOGRAPHY.—*Jewish Encyclopedia,* vii, pp. 92–94; S. Singer, *Lectures and Addresses,* pp. 88–93 (1908); Kohut, *Berühmte israelitische Manner und Frauen.* (I. A.)

JELLY: *see* JAMS AND JELLIES.

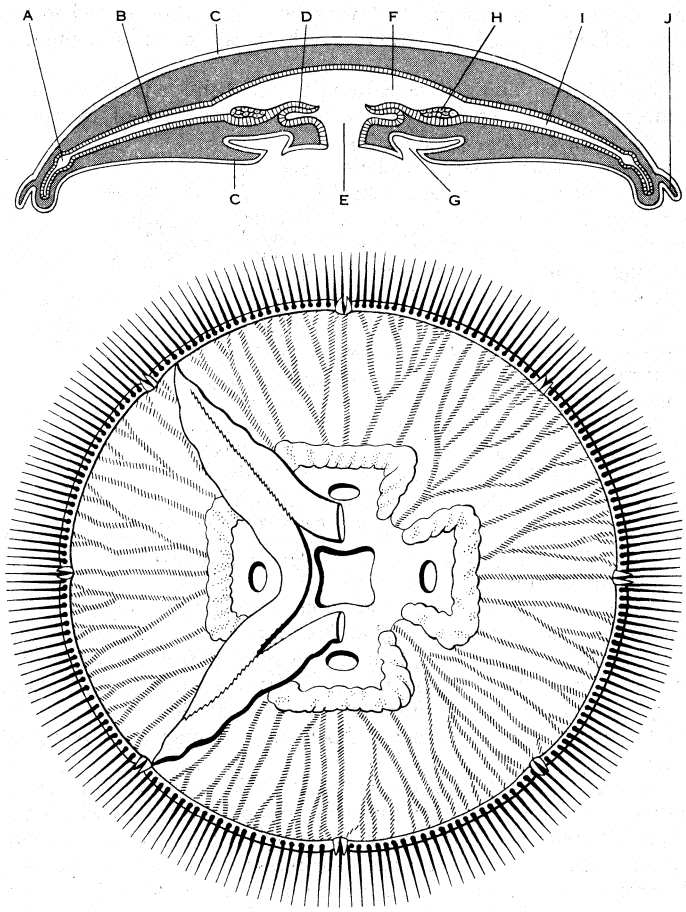
JELLYFISH, umbrella-shaped, translucent, gelatinous animals, mostly marine, free-swimming forms of the phylum Coelenterata (*q.v.*). These bluish, brownish or purplish hemispheres. occasionally somewhat cubical. may usually be found bobbing on or near the water's surface. More correctly, jellyfish are called medusae and are the sexually mature stages of scyphozoans (class Scyphozoa, *q.v.*) and certain hydrozoans (class Hydrozoa, *q.v.*) of the Coelenterata. Comb jellies and sea walnuts, members of the phylum Ctenophora, because of their superficial resemblance to medusae are often called jellyfish.

The floating portion of the medusa ranges, in different species, from about $\frac{1}{16}$ in. to over 6 ft. across. The largest species, *Cyanea arctica,* a purplish-red medusa found in the North Atlantic, has tentacles hanging from its margin to a length of 120 ft. Many jellyfish are weak swimmers, but all are at the mercy of currents. After violent storms the collapsed and battered "jelly-sacs" may be found strewn across large areas of beach.

Species and individuals are most numerous in warm tropic seas, but jellyfish are not absent from colder waters; in fact, one of the larger medusae, *Chrysaora,* is found in the North sea.

General Structure.— The main body mass consists of a bell or umbrella, from the underside of which hangs a more or less tubular projection, the manubrium, or proboscis, having the mouth at its free end. The underside of the bell is referred to as the subumbrellar surface, while the outer side is the exumbrellar side. The exumbrella may be ornamented with warts or knobby growths, which are commonly heavily armed with stinging capsules (nematocysts). At the margin of the bell hang few to hundreds of tentacles which also are heavily armed with nematocysts. Between the tentacles or at their bases, and also at the margin of the bell, there are special sensory structures. such as balance organs (statocysts), pigmented eyespots (light sensory but non-image forming structures) and special sensory bodies, rhopalia or tentaculocysts. The mouth may be a simple opening or. as in many Scyphozoa, it may be very elaborate as a result of complex growth of the lips. Typically there are four lips, and these may be simple, may bear tentacles or may be elaborately extended as long and complexly folded mouth arms. In one group of Scyphozoa, the rhizostomes, the mouth becomes subdivided into hundreds or thousands of minute pores through the fusion of the mouth arms. The mouth opens into a stomach, which is a simple cavity in the Hydrozoa and a four-chambered cavity in the Scyphozoa. In scyphozoans (scyphomedusae) there are clusters of special internal tentacles in the stomach (gastric tentacles) which bear nematocysts. There are no tentacles or nematocyst-bearing structures in the stomach of hydrozoans (hydromedusae). The stomach of some jellyfish is supported from above by a gelatinous prolongation of the subumbrellar surface, the peduncle. From the central stomach there arise centrifugal canals, the radial canals (usually four or multiples thereof). which run out to the bell margin, where they are connected to the ring canal. In the scyphomedusae, by the time adulthood is reached, the canals may be complexly interconnected by lateral branches.' The canal system provides a ready device for the disttibution of nutritive materials ingested through the mouth.

The chief body tissues are the outer epithelium, or epidermis, covering all the external surfaces; the inner epithelium, or gastrodermis, the digestive layer; and the gelatinous middle tissue, or mesogloea. The musculature of jellyfish, apparently derived from the directly overlying epithelial tissues. is restricted to the subumbrellar surface, to the manubrium and mouth arms and to the tentacles. The subumbrellar muscles are arranged in radial and



FROM PARKER & HASWELL, 'TEXTBOOK OF ZOOLOGY" (MACMILLAN)

FIG. 1.—DIAGRAM OF A JELLYFISH (AURELIA)

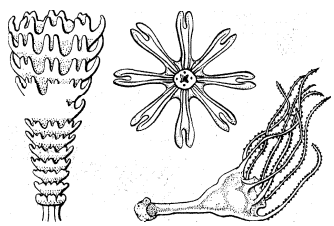
(Above) vertical section showing (A) circular canal; (B) endoderm; (C) ectoderm; (D) endodermal tentacle; (E) mouth; (F) coelenteron; (G) subgenital pit; (H) gonad; (I) radial canal; (J) marginal tentacle. (Below) view from below showing oral arms, radial canals, marginal tentacles and positions of sense organs, sex organs and the four pouches of the coelenteron

circular groups and are the primary swimming muscles. The bell itself is made up largely of mesogloea, of a very elastic nature, within which there are also complex proteinaceous fibers. The mesogloea is largely noncellular, but cells which apparently give rise to the jelly and fibers are scattered throughout. A one-layered sheet of tissue, the endodermal, or gastrodermal lamella, separates the subumbrellar surface covering from the jelly portions of the bell, and it is along this layer that the radial canals make their way. The tentacles at the bell margin may be solid or hollow, and the cavity of the hollow tentacles is in contact with the cavity of the ring canal. There are many nerve cells, neurons, present in jellyfish as a ramifying subepithelial network. In some jellyfish there are two well-defined nerve rings running near the bell margin. Actually two rather discrete nervous systems can be shown to be present, a fast-acting one, related to swimming movements, and a slower-acting one, probably having to do with the remaining body activities.

Habitat and **Distribution.**—Jellyfish occur chiefly in marine waters all over the world, although some hydromedusae inhabit fresh and brackish water; *e.g.,* the very widely distributed *Craspedacusta sowerbyi.* In marine waters both hydro- and scyphomedusae are abundant. the greatest numbers being seen in bays and shallow coastal waters *(Cyanea, Haliclystus, Aurelia, Cassiopeia* and *Rhizostoma).* In the open seas or in great depths, jellyfish are far less common. One group of scyphomedusae, the coronate medusae *(Periphylla, Linuche,* etc.), and one group of hydromedusae, the trachymedusae *(Gonionemus, Aglantha,* etc.), are characteristic of the open and deep seas. Most medusae have a tubelike polyp, or hydroid stage, in their life history, immature forms which spend their time attached to the bottom. The greater

abundance of jellyfish in shallow water is probably related to the better feeding conditions there for both the polyp and medusa stages.

While it is a valid generalization that jellyfish are free-swimming animals some exceptions can be cited. A number of hydromedusae, *e.g.,* Cladonema and *Gonionema,* possess special suckers on their tentacles and spend most of their lives walking about on marine plants, such as eelgrass. Among the scyphomedusae, *Stomolophus,* for example, we find medusae commonly resting upside down on the aboral or exumbrellar bell surface, with the mouth arms bearing the mouths pointed upward. These jellyfish can swim but seem to spend much of their adult lives in this sedentary fashion. This behaviour is assumed to reflect their mode of feeding, since they depend upon the rain of minute organisms from above for their food. One other scyphomedusan group, the *stauromedusans* (of which Haliclystus is a good example), also may be noted as an exception to the general free-swimming life of jellyfish. This group spends all of its life attached by a stalk, a special structure located on the exumbrellar side of the animal, and in its general appearance and behaviour is much more polypoid than medusoid.



FROM KUKENTHAL, HANDBUCH DER ZOOLOGIE (DE GRUYTER)

FIG 2 — ENLARGED VIEW OF THE LIFE HISTORY OF SCYPHOZOAN

(Left) Polyp (strobila) in the act of budding (strobilation); (centre) an immature medusa (ephyra); (right) polyp (scyphistoma)

Another interesting variation in the life of jellyfish is to be noted in the hydrozoan group called siphonophores, to which belongs Physnlia (Portuguese man-of-war). Among many siphonophores, which are best described as free-swimming or free-floating hydroid colonies, are found medusae built along the same pattern as other hydromedusae but as a rule lacking gonads and having as their only function the role of providing locomotion for the colony. These medusae are not released from the colony.

Life **Cycle.**—*Alternation* of Generations.——?*lost jellyfish are produced by asexual reproduction (budding or transverse fission) from polyps. the polyps in turn having resulted from sexual reproduction of the medusae. The process, an alternation of a sexual stage with an asexual one, is termed alternation of generations (see COELENTERATA) and is shown in the following life cycle in Aurelia. The segments separate from the parent (which in its dividing condition is known as strobila) successively when sufficiently developed. Each of them is found, on examination, to constitute a small flattened medusa with eight long arms and is termed an ephyra. It is quite unlike the adult *Aurelia* in shape even now but assumes the fully developed condition by degrees from this point onward. Occasionally a segment of a strobila becomes a polyp instead of a medusa. See also POLYP. In many of the Hydrozoa, however, the medusae which develop on the polyp stage are not released but, instead, reach sexual maturity while still attached to the polyp. In fact there are numerous examples which indicate that in a number of evolutionary lines within the Hydrozoa there has been a parallel evolution involving the reduction of the jellyfish or medusoid stage. In these lines one can trace a series ranging from polyps releasing free medusae, to polyps retaining well-formed medusae, to polyps producing almost unrecognizable, minute sexual structures which represent extremely reduced medusae.

Reproduction.—The length of life of medusae is highly variable. No jellyfish are known to live more than one year; however, such may be the case with huge forms, such as the giant Cyanea *arctica* (see above). Most free-swimming jellyfish have a normal free life of about one to three months. In that period the gonads mature.

As already noted above, most jellyfish are the sexually mature stage and reproductive form of their kind. The sexes are usually separate; that is, male and female individuals exist for each species. The gonads of the hydromedusae occur either beneath the radial canals or on the sides of the manubrium and are derived from epidermal cells. The gonads of the scyphomedusae are gastrodermal, however, and occur in pits within the stomach. Spawning usually consists of the release of eggs and sperm to the surrounding water, where fertilization occurs. After spawning there is normally produced a minute ciliated larva (planula), which after a short free life settles on its apparent anterior end, attaches to a rock, seaweed, etc., and assumes a polypoid form.

The polyp is commonly asexually reproductive and produces a colony of polyps. With good conditions of feeding and temperature the colony will produce and release numerous small medusae which assume a free-swimming mode of life. In the life history of some hydro- and scyphomedusae, development may be interrupted after the planula stage by an encysted resting stage. It is in this form that some species overwinter. In most species once the adult medusoid form has been attained asexual reproduction does not occur. In some cases the polyp and young of some hydrome dusae (certain trachymedusans) are parasitic on other medusae. Although the life history of most jellyfish involves a polyp, this is not always so, for no polyp stage is known for many trachymedusans and certain scyphomedusans. Their life histories seem to involve direct development from the planula to the adult jellyfish stage. although the trachymedusae do have a polyplike larval stage knonn as an actinula.

Mode of Swimming. — The motion or swimming of jellyfish is the result of the regular contraction of the subumbrellar muscles. The frequency of contraction is controlled by the sensory organs at the bell margin. These organs also determine nhether the contractions shall be symmetrical or asymmetrical. In a symmetrical contraction both the radial and circular muscles of the bell contract simultaneously, forcing the water contained in the subumbrellar space to be jetted out of the bell in an oral direction; these pulsations carry the animal in a direction anay from the mouth. After contraction the muscles relax and the bell assumes the expanded condition due to the elasticity of the jelly or mesogloea. If a jellyfish is tipped up on one edge, an asymmetrical contraction usually results. Here the muscles on the lower side of the bell contract, which causes the medusa to right itself. The statocysts, which inhibit muscular contraction as well as initiate it, control such righting reactions; if they are removed, no righting reactions occur. Furthermore, if all sensory organs are removed from a jellyfish and a ring-shaped preparation is made of the bell, one can initiate a contraction by electrically or mechanically stimulating the preparation. From the point of stimulation a wave of contraction will spread in both directions around the bell. By depressing the tissue with a straight-edged object one can block the wave of contraction in one direction, remove the block and allow the other wave to proceed round and round the bell. Such preparations have been known to continue this circular wave of contraction for several days. If only one sensory organ is left on the bell margin, however, such a continuous wave of activity cannot be started.

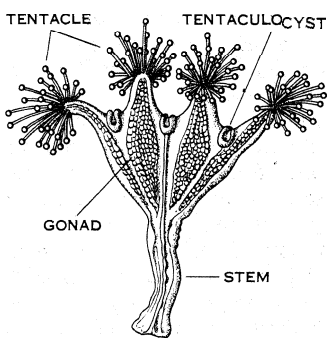
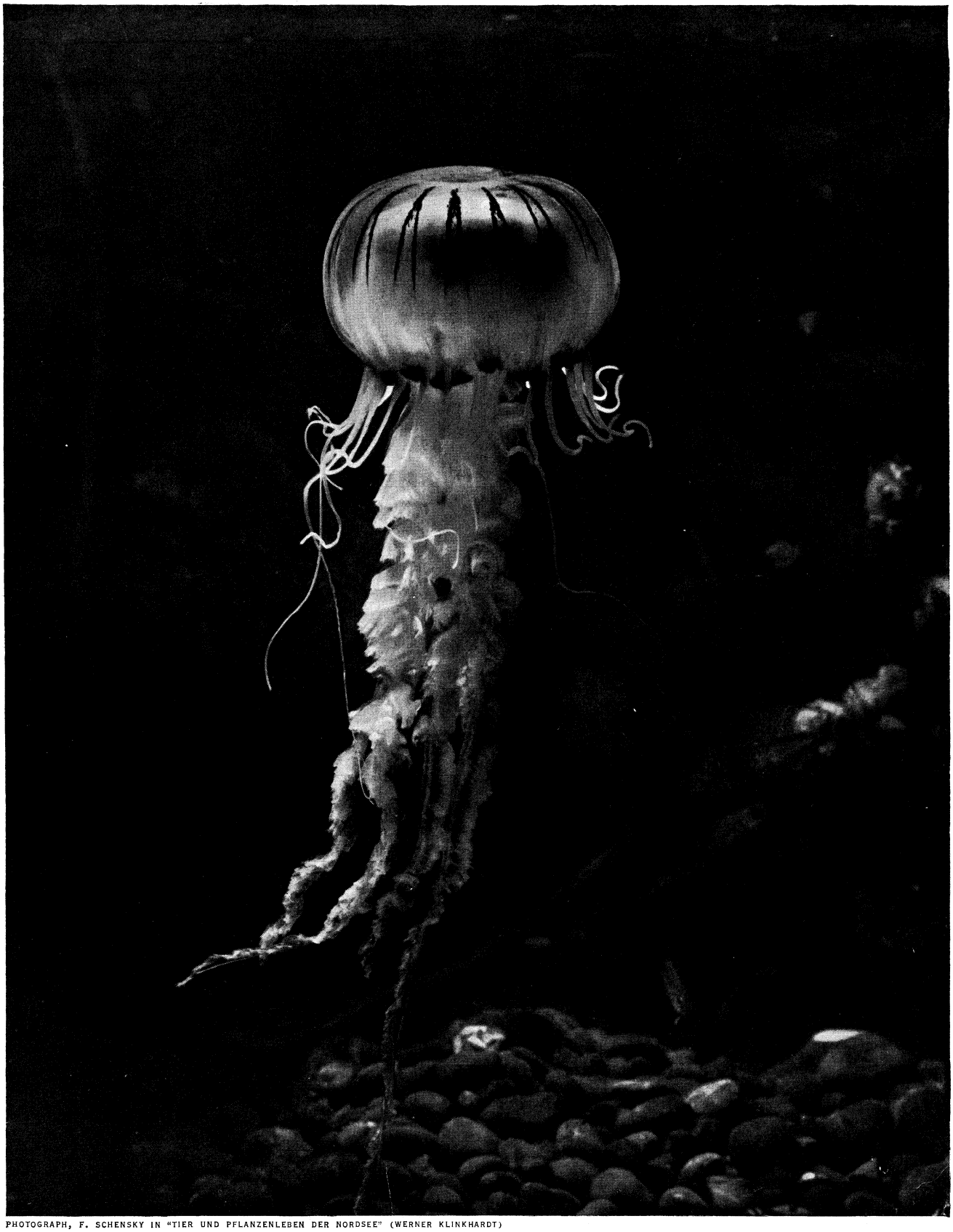


FIG. 3.—HALICLYSTUS AURICULA, A NONSWIMMING JELLYFISH WITH A STEM AND TUFTS OF KNOBBED TENTACLES

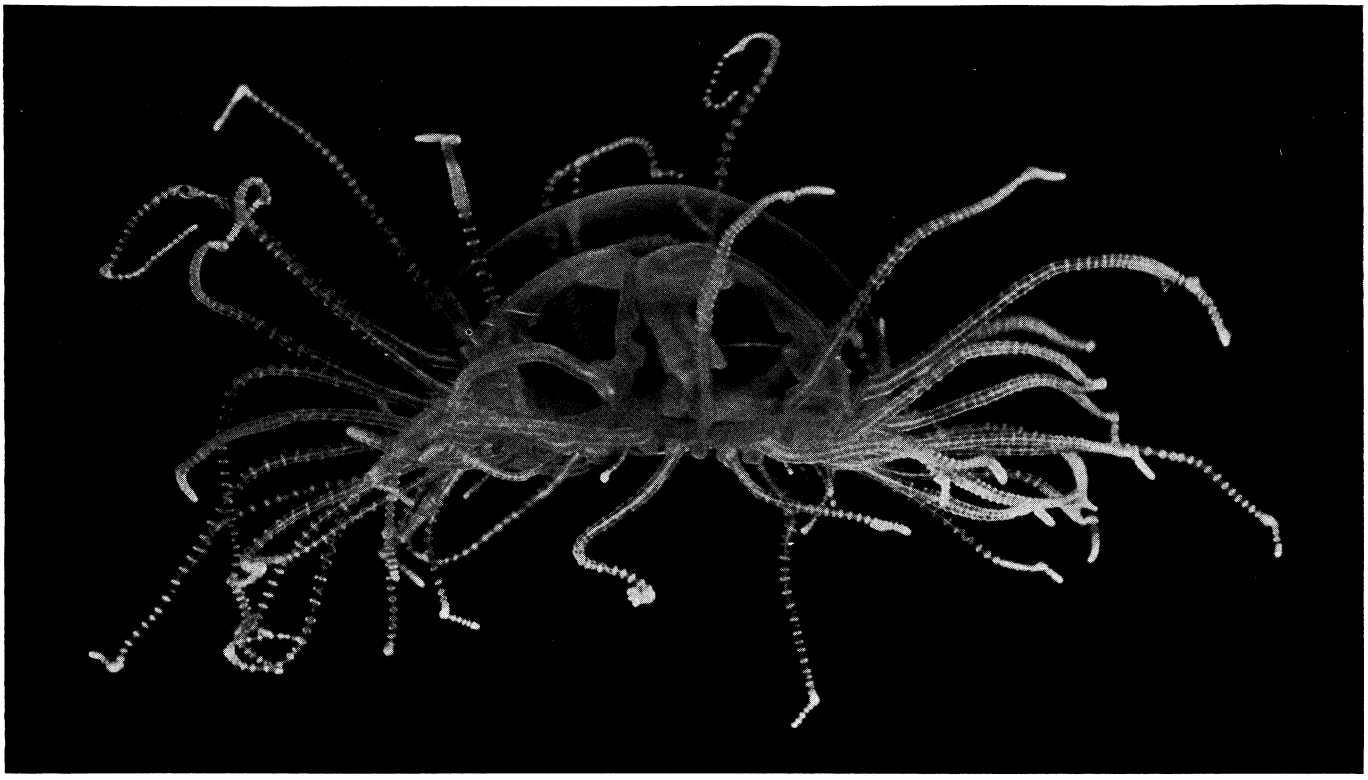
Feeding and Digestion, — Feeding is usually accomplished with the help of the nematocysts. The tentacles also are usually involved. We have already noted that certain scyphomedusae feed only on minute organisms and debris. These are the rhizostomes and their feeding does not, as a rule, involve either tentacles or nematocysts. Here, ciliary currents lead by small gutters to the many minute mouths and small objects falling on the complex mouth-arm region are entangled in mucus and carried to the mouths. But for most of the scyphomedusae, feeding is accomplished while actively snimming. These animals trail their long mouth arms out behind the bell, and as organisms run



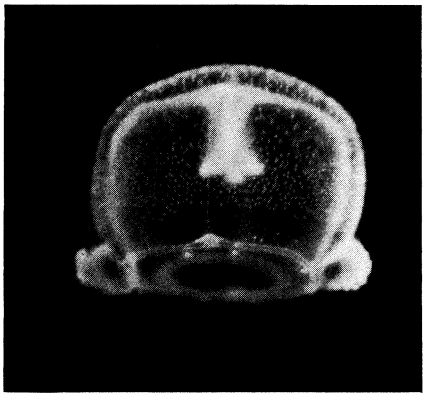
PHOTOGRAPH, F. SCHENSKY IN "TIER UND PFLANZENLEBEN DER NORDSEE" (WERNER KLINKHARDT)

A medusa of **the class** Scyphozoa, **genus** ***Chrysaora,*** **a** common **jellyfish** of **the** North **Sea**

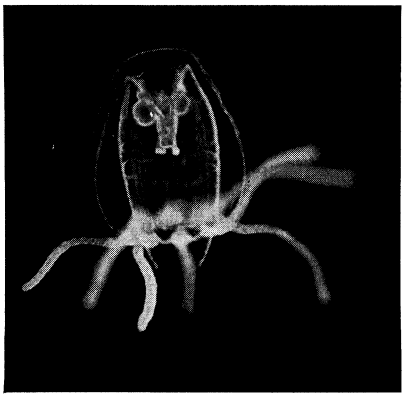
JELLYFISH



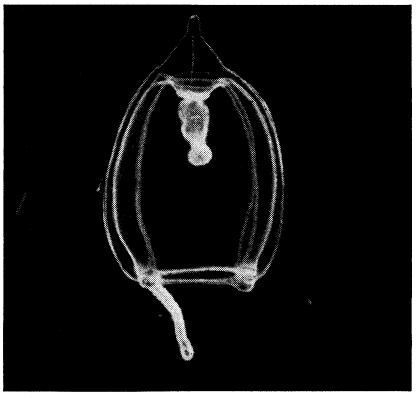
Mature Gonionemus murbachi medusa in lateral view



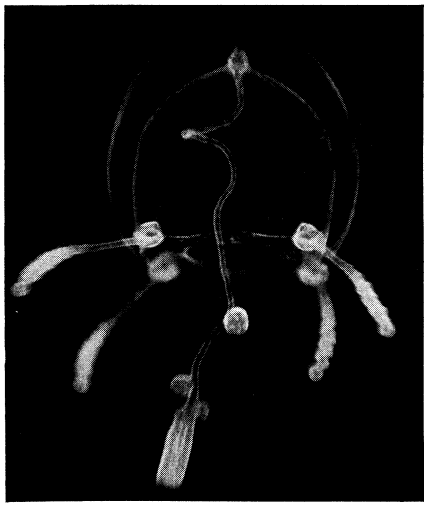
Aequorea newly liberated from the hydroid Campanulina



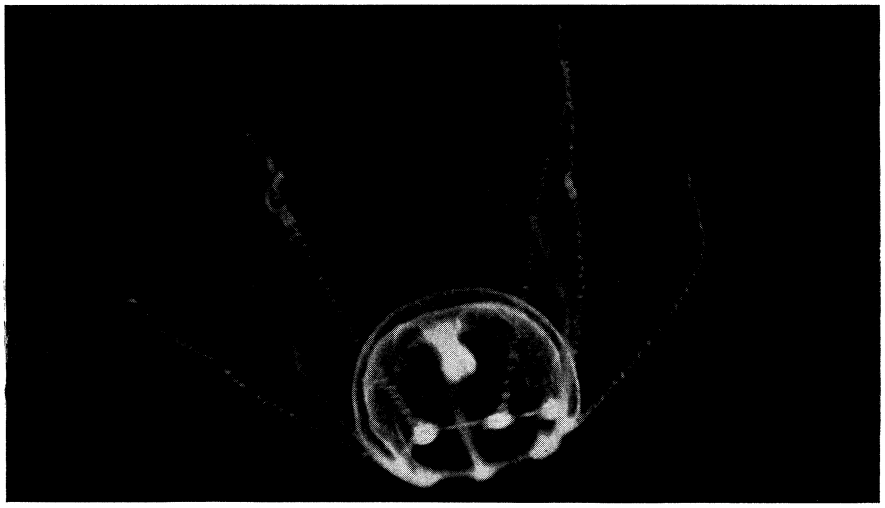
Optical section of *Lizzia blondina* with bell contracting, showing protrusion of velum through the mouth



Steenstrupia *nutans*, medusa of Corymorpha, having only one tentacle



Sarsia gemmifera, with long manubrium (centre) bearing along its length several buds and ending in an elongate stomach



Medusa from the hydroid Trichydra *lucida*

HYDROID MEDUSAE (MAGNIFIED)

PHOTOGRAPHS DOUGLAS P. WILSON

into these arms, they are stung by the nematocysts and then carried to the mouth by the contraction of the mouth arms. Hydromedusae are more dependent, in general, on their tentacles than on their mouth arms. The tentacles, streaming out behind the swimming animal, perform the same fishing function as do the mouth arms of the scyphomedusae. Another common method of fishing used by hydromedusae may be described: The medusa swims upward for awhile, commonly till it hits the surface of the water; it then stops swimming, the bell tips over (exumbrella down) and the tentacles spread far out around the bell. In this position the medusa slowly sinks, capturing small animals as they bump into the widely spread tentacles. A few jellyfish do not feed as adults, their only function being sexual reproduction. Such jellyfish are known among the hydrocorallines *(see* HYDROZOA) and do not possess tentacles or mouths.

One interesting bit of behavior may be seen in certain jellyfish which have very long manubria. When these jellyfish are touched on the subumbrellar surface they bend the proboscis in that direction and touch the bell at the point of contact. This behavior of the proboscis seems clearly to be a specialized type of feeding response, which may be seen when such jellyfish are put into a dish with small crustaceans, such as copepods; as a copepod bumps the underside of the bell, the proboscis of the jellyfish moves to that point and captures the minute animal.

Regardless of how food is taken once it is captured by the mouth it is ingested and swallowed into the stomach. In the stomach, strong protein digesting enzymes break the food down into minute particles, which move throughout the canal system. Essentially all cells lining the stomach and canals ingest these very fine particles and final digestion takes place inside the cells. The further distribution of nutritive substances takes place either by diffusion or by materials being carried about by wandering cells. Such wandering cells. often referred to as nurse cells, are particularly noticeable around the gonads, where commonly each developing ovum may have one to several such cells gathered around it.

Other Processes.—Jellyfish do not have many special structures related to such bodily processes as respiration, excretion or circulation. The general body surfaces seem to be sufficient for such processes, though the canal systems certainly must be involved. Water moves freely, with the aid of cilia, into the mouth and throughout the canals. Certain medusae also have pores which open from the radial canals to the exumbrellar surface. These may be excretory in function.

The nematocysts of jellyfish, particularly the larger jellyfish, can cause painful stings to man. The toxins present seem to affect the nervous system of organisms that they contact (neurotoxins). One type of scyphomedusae, the cubomedusans. which are restricted to tropical and subtropical waters, have such painful stings that they are called "sea wasps." The Portuguese man-of-war (*q.v.*), whose sting is perhaps the most serious to man of all coelenterates, is not a single medusa but, as mentioned earlier, a colony of hydroids and medusae. Jellyfish are commonly so abundant along seashores that they make swimming for man unpleasant because of their painful and irritating sting. Unfortunately, even when a jellyfish has been broken into small pieces, for instance by being pounded to pieces by waves, the nematocysts remain active, and swimming and wading along a beach where jellyfish are being carried ashore frequently has to be abandoned.

A number of interesting associations are known between jellyfish and other organisms. Jellyfish play host to certain fishes which are immune to the coelenterates' nematocysts, and these fish apparently share the food of their host. Crustaceans, such as amphipods (hyperiids) and crab larvae, also may be found living on the surfaces of some jellyfish. There also are certain goose barnacles which are known only as commensals of jellyfish. The tissues of some jellyfish contain small, unicellular algae, which probably provide food to the jellyfish in the form of excesses from their own photosynthetic production of organic materials. One interesting association between a jellyfish *(Mnestra)* and a planktonic nudibranch mollusk *(Phyllirhoe)* is known. In this case the jellyfish seems to serve during the early life of the nudibranch as a device for transportation and for food. As the mollusk grows it gradually eats the jellyfish until apparently it has devoured all of its host. The nudibranch then goes on its free-floating way, feeding on other coelenterates as it finds them. Certain fish, especially the giant sunfish *Mola mola,* seem to live almost entirely on jellyfish and their relatives. Jellyfish, in general, are of little economic importance, though one, *Rhopilema esculenta,* of eastern Asian waters, is the edible jellyfish prized by the Chinese and Japanese. Also of some economic significance are the large masses of jellyfish which have been known to coincide with schools of young fish, in which case the jellyfish may capture and kill great numbers of fish.

BIBLIOGRAPHY.—G. E. MacGinitie and Nettie MacGinitie, *Natural History of Marine Animals* (1949); L. H. Hyman, *The Invertebrates: Protozoa Through Ctenophora,* vol. 1, (1940); P. L. Kramp, "The Hydromedusae of the Atlantic Ocean and Adjacent Waters," *Dana Report* No. *46* (1959); A. G. Mayer, "Medusae of the World," 3 vol., Carnegie Institution of Washington, *Pub. No.* 109 (1910); F. S. Russell, *The Medusae of the British Isles* (1953). (C. HA.)

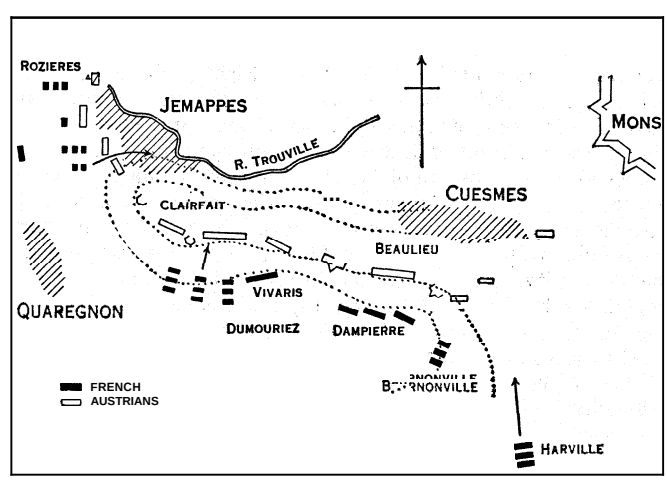
JEMAPPES, town, province of Hainaut, Belgium, near Mons, the scene of the battle at which Dumouriez, with the French Revolutionary army, defeated the Austrian army under the duke of Saxe-Teschen and Clerfayt on Nov. 6, 1792 *(see* FRENCH REVOLUTIONARY **WARS**). Pop. (1955 est.) 13,104.

The Battle of Jemappes (1792).—The wars of Louis XIV and Louis XV had shown the advantage of an offensive in Belgium, since Belgium was the weak point in the Hapsburg front. The Austrians had failed in their efforts against Lille, and Dumouriez in command of the Army of the North at Valenciennes at once issued a stirring appeal to the Belgians. Then, in order to mask his intentions, he threatened the Austrians at several points, compelling them to extend their front while with speed he advanced to crush their main forces at Mons.

The Austrians under Duke Albert of Saxe-Teschen had been strongly reinforced by Clerfait, though Dumouriez was not aware of this. Their combined forces numbered about 25,000 men and 50 guns, whilst the French army was probably 55,000 strong and was accompanied by 100 guns. The Austrian position was a strong one. Clerfait's right was entrenched at Jemappes (province of Hainaut, Belgium), his centre on a ridge south of the village, the eastern slopes of which extended to Cuesmes where his left was posted. As Dumouriez points out, the only fault in the position was its difficult line of retreat.

Dumouriez's plan was to engage Clerfait's right and centre and turn his left; for this turning movement he ordered General Harville and about 10,000 troops to move up from Maubeuge, outflank the Austrian left and cut Clerfait off from Mons. Harville's forward movement was, however, too slow to effect this, and the plan had to be modified.

Early on Nov. 6 Dumouriez dislodged Clerfait's advanced troops at Quaregnon, and then checked his advance to enable Harville to come up. As he did not appear, and as his young troops were eager to attack, he opened the battle by a bombardment on



PLAN OF THE BATTLE OF JEMAPPES, NOV. 6, 1792

the Jemappes entrenchments and batteries that crowned the slopes toward Cuesmes. Then, forming his columns of attack, he assaulted the Austrian right and centre. On the right General Beurnonville moved against Cuesmes. This attack failed all along the line except on the south of Jemappes, where a lodgment compelled Clerfait to retreat across the Trouville stream. As the centre recoiled before the enemy's cannon, Dumouriez and his staff rode forward, among whom was the young duke de Chartres (Philippe Égalité), and forming a solid column he called it *le* bataillon de *Mons*. Leading it forward he drove in the Austrian centre which was already feeling the pressure of the French at Jemappes, as these troops were beginning to threaten their rear. The batteries at Cuesmes were then taken in a hand-to-hand struggle, and the Austrians, seeing Harville's corps advancing in the distance, withdrew to Mons and on the 7th retired to Brussels.

Each side lost about 7,000 men killed and wounded. The moral gain to the French was immense; without manoeuvre they had succeeded in imposing their will, and as one historian wrote: "At Valmy they had merely stood their ground; at Jemappes they learnt to conquer."

BIBLIOGRAPHY.—Jomini, *Guerres de la Révolution,* vol. ii; *A.* Alison, *History of Europe, 1789–1815,* vol. *iii; The Cambridge Modern History,* voi. *viii* (1904); J. Holland Rose and *A.* M. Broadley, *Dumouriez and the Defence of England against Napoleon* (1909); *A. von* Boguslawski, *Das Leben des Generals Dumouriez* (1879); *A.* Chuquet, *La Première Invasion, Valmy, La Retraite de Brunswick, Jemappes, La Trahison de Dumouriez* (1891). (J. F. C. F.)

JENA, a university town of Thuringia, Germany, in the district of Gera, on the left bank of the Saale, 56 mi. S.W. from Leipzig by the Grossberigen-Saalfeld and 12 mi. S.E. of Weimar by the Weimar-Gera lines of railway. Pop. (1950) 80,309. Jena appears to have possessed municipal rights in the 13th century. It passed in 1423 from the margraves of Meissen to the elector of Saxony. In 1690 Jena was united with Eisenach and in 1741 reverted to Weimar.

To the north lies the limestone plateau, descending steeply to the valley, famous as the scene of the battle of Jena (1806) in which Napoleon defeated the Prussians. It contains, in addition to the mediaeval market square, many old-fashioned houses and narrow streets. Besides the old university buildings. the most interesting edifices are the 15th-century church of St. Michael, the university library and the bridge across the Saale. Near by is the Fuchs-Turm (Fox tower), celebrated for student orgies, while in the centre of the town is the house of an astronomer, Weigel, with a deep shaft through which the stars can be seen in the daytime. There must also be mentioned the university church; the university buildings. which occupy the site of the ducal palace (Schloss) where Goethe wrote his Hermann und Dorothea; the Schwarzer Bar hotel, where Luther spent the night after his flight from the Wartburg; and four towers and a gateway which now alone mark the position of the ancient walls. In 1547 the elector John Frederick the Magnanimous of Saxony, while a captive of the emperor, conceived the plan, carried out by his three sons, of a university at Jena. A charter having been obtained from the emperor Ferdinand I, it was inaugurated in 1558. The most brilliant professoriate was under the duke Charles Augustus, Goethe's patron (1787–1806), when Fichte. Hegel, Schelling, Schlegel and Schiller were on its teaching staff. Founded as a home for the new religious opinions of the 16th century. it was long in the forefront of German universities in liberal acceptance of new ideas. At the end of the 18th and the beginning of the 19th century, the opening of new universities, co-operating with the suspicions of the various German governments as to the democratic opinions which obtained at Jena, militated for a while against the university. Among its numerous auxiliaries may be mentioned the library, the observatory, the meteorological institute and the botanical garden. There are also veterinary and agricultural colleges in connection with the university. The book trade revived in the 20th century, and there are several printing establishments. The famous Zeiss firm of optical instrument makers has its seat at Jena. Scientific instruments, chemicals, machinery, etc., are also made. The town suffered heavy damage during World War II.

Battle **of Jena.**—This famous victory on Oct. 14, 1806, by Napoleon over the Prussian army under the prince of Hohenlohe is described under NAPOLEONIC CAMPAIGNS.

JENATSCH, GEORG (1596–1639), Swiss political leader, one of the most striking figures in the troubled history of the Grisons in the 17th century, was born at Samaden, the Upper Engadine. He studied at Ziirich and Basel, and in 1617 became the Protestant pastor of Scharans (near Thusis). He took the side of the Venetian and Protestant party of the Salis family, as against the Spanish and Romanist policy supported by the rival family, that of Planta. He headed the "preachers" who in 1618 tortured to death the archpriest Rusca, of Sondrio, and outlawed the Plantas. As reprisals, a number of Protestants were massacred at Tirano (1620), which then fell into the hands of the Spanish. Jenatsch took part in the murder (1621) of Pompey Planta, the head of the rival party, but later with his friends was compelled to fly the country, giving up his position as a pastor and thenceforth acting solely as a soldier. He helped in the revolt against the Austrians in the Prattigau (1622) and in the invasion of the Valtellina by a French army (1624), but the peace made (1626) between France and Spain left the Valtellina in the hands of the pope, and so destroyed Jenatsch's hopes.

Having killed his colonel, Ruinelli, in a duel, Jenatsch had once more to leave his native land, and took service with the Venetians (1629–30). In 1631 he went to Paris, and supported Richelieu's schemes for driving the Spaniards out of the Valtellina, which led to the successful campaign of Rohan (1635), one of whose firmest supporters was Jenatsch. But he soon saw that the French were as unwilling as the Spaniards to restore the Valtellina to the Grisons (which had seized it in 1512). So he became a Romanist (1635), and negotiated secretly with the Spaniards and Austrians. He was the leader of the conspiracy which broke out in 1637 and resulted in the expulsion of Rohan and the French from the Grisons. This treachery on Jenatsch's part did not, however, lead to the freeing of the Valtellina from the Spaniards, and once more he tried to get French support. But on Jan. 24, 1639 he was assassinated at Coire by the Plantas; later in the same year the much coveted valley was restored by Spain to the Grisons, which held it till 1797.

Jenatsch's career is of general historical importance by reason of the long conflict between France and Spain for the possession of the Valtellina, which forms one of the most bloody episodes in the Thirty Years' War. (W. A. B. C.)

See biography by *E.* Haffter (Davos, 1894).

JENGHIZ KHAN (jĕn′gĭz ċhahn) (1162–1227), Mongol emperor, born on the banks of the river Onon. His father Yesukai was absent at the time of his birth, in a campaign against a Tatar chieftain named Temuchin. The war brought success to Yesukai, who having slain his enemy returned to his encampment in triumph. He was met by the tidings that his wife Yulun had given birth to a son. On examining the child he observed in its clenched fist a clot of coagulated blood like a red stone. In the eyes of the superstitious Mongol this circumstance referred to his victory over the Tatar chieftain, and he therefore named the infant Temuchin. The death of Yesukai, which placed Temuchin at the age of 13 on the Mongol throne, was the signal also for the dispersal of several tribes whose allegiance the old chieftain had retained by his iron rule. When remonstrated with by Temuchin, the rebels replied: "The deepest wells are sometimes dry, and the hardest stone is sometimes broken; why should we cling to thee?" But Yulun was by no means willing to see her son's power melt away; she led those retainers who remained faithful against the deserters, and succeeded in bringing back fully one-half to their allegiance. With this doubtful material, Temuchin succeeded in holding his ground against the plots and open hostilities of the neighbouring tribes, more especially of the Naimans, Keraits and Merkits. With one or other of these he maintained an almost unceasing warfare until 1206, when he felt strong enough to proclaim himself the ruler of an empire. He therefore summoned the notables of his kingdom to an assembly on the banks of the Onon, and at their unanimous request adopted the name and title of Jenghiz Khan (Chinese, Chêng-sze, or "perfect warrior"; the correct

Mongolian spelling is Chingiz, and scholars of oriental studies sometimes spell it in that manner). At this time there remained to him but one open enemy on the Mongolian steppes, Polo the Naiman khan. Against this chief he now led his troops, and in one battle so completely shattered his forces that Kushlek, the successor of Polo, who was left dead upon the field, fled with his ally Toto, the Merkit khan, to the river Irtysh

CHINESE CONQUESTS

Jenghiz Khan now meditated an invasion of the empire of the Kin Tatars, who had wrested northern China from the Sung dynasty. As a first step he invaded western Hia, and, having captured several strongholds, retired in the summer of 1208 to Lung-ting to escape the great heat of the plains. While there news reached him that Toto and Kushlek were preparing for war. In a pitched battle on the river Irtysh he overthrew them completely. Toto was amongst the slain, and Kushlek fled for refuge to the Khitan Tatars. Satisfied with his victory, Jenghiz again directed his forces against Hia. After having defeated the Kin army under the leadership of a son of the sovereign, he captured the Wu-liang-hai pass in the Great Wall, and penetrated as far as Ning-sia Fu in Kansuh. With unceasing vigour he pushed on his troops, and even established his sway over the province of Liao-tung. Several of the Kin commanders, seeing how persistently victory attended his banners, deserted to him, and garrisons surrendered at his bidding. Having thus secured a firm footing within the Great Wall, he despatched three armies in the autumn of 1213 to overrun the empire. The right wing, under his three sons, Juji, Jagatai and Ogotai, marched towards the south; the left wing, under his brothers Hochar, Kwang-tsin Noyen and Chow-tse-te-po-shi, advanced eastward towards the sea; while Jenghiz and his son Tulē with the centre directed their course in a south-easterly direction. Complete success attended all three expeditions. The right wing advanced as far as Honan, and after having captured upwards of 28 cities rejoined headquarters by the great western road. Hochar made himself master of the country as far as Liao-si; and Jenghiz ceased his triumphal career only when he reached the cliffs of the Shantung promontory. But either because he was weary of the strife, or because it was necessary to revisit his Mongolian empire, he sent an envoy to the Kin emperor in the spring of the following year (1214), saying, "All your possessions in Shantung and the whole country north of the Yellow river are now mine with the solitary exception of Yenking (the modern Peking). By the decree of heaven you are now as weak as I am strong, but I am willing to retire from my conquests; asacondition of my doing so, however, it will be necessary that you distribute largess to my officers and men to appease their fierce hostility." These terms of safety the Kin emperor eagerly accepted, and as a peace offering he presented Jenghiz with a daughter of the late emperor, another princess of the imperial house, 500 youths and maidens and 3,000 horses. No sooner, however, had Jenghiz passed beyond the Great Wall than the Kin emperor, fearing to remain any longer so near the Mongol frontier, moved his court to K'ai-fêng Fu in Honan. This transfer of capital appearing to Jenghiz to indicate a hostile attitude, he once more marched his troops into the doomed empire.

While Jenghiz was thus adding city to city and province to province in China, Kushlek, the fugitive Naiman chief, was not idle. With characteristic treachery he requested permission from his host, the Khitan khan, to collect the fragments of his army which had been scattered by Jenghiz at the battle on the Irtysh, and thus having collected a considerable force he leagued himself with Mohammed, the shah of Khwārizm, against the confiding khan. After a short but decisive campaign the allies remained masters of the position, and the khan was compelled to abdicate the throne in favour of the late guest.

With the power and prestige thus acquired, Kushlek prepared once again to measure swords with the Mongol chief. On receiving the news of his hostile preparations, Jenghiz at once took the field, and in the first battle routed the Naiman troops and made Kushlek a prisoner. His ill-gotten kingdom became an apanage of the Mongol empire. Jenghiz now held sway up to the Khwārizm frontier. Beyond this he had no immediate desire to go, and he therefore sent envoys to Mohammed, the shah, with presents, saying, "I send thee greeting; I know thy power and the vast extent of thine empire; I regard thee as my most cherished son. On my part thou must know that I have conquered China and all the Turkish nations north of it; thou knowest that my country is a magazine of warriors, a mine of silver, and that I have no need of other lands. I take it that we have an equal interest in encouraging trade between our subjects." This peaceful message was well received by the shah, and in all probability the Mongol armies would never have appeared in Europe but for an unfortunate occurrence. Shortly after the despatch of this first mission, Jenghiz sent a party of traders into Transoxiana who were seized and put to death as spies by Inaljuk, the governor of Otrar. As satisfaction for this outrage Jenghiz demanded the extradition of the offending governor. Far from yielding to this summons, however, Mohammed beheaded the chief of the Mongol envoys, and sent the others back without their beards. This insult made war inevitable, and in the spring of 1219 Jenghiz set out from Karakorum on a campaign which was destined to be as startling in its immediate results as its ulterior effects were far-reaching.

SACKING OF BUKHĀRĀ

The invading force was in the first instance divided into two armies: one commanded by Jenghiz's second son Jagatai was directed to march against the Kankalis, the northern defenders of the Khwārizm empire; and the other, led by Juji, his eldest son, advanced by way of Sighnak against Jand (Jend). Against this latter force Mohammed led an army of 400,000 men, who were completely routed, leaving, it is said, 160,000 dead upon the field. With the remnant of his host Mohammed fled to Samarcand. Meanwhile Jagatai marched down upon the Syr Daria (Jaxartes) by the pass of Taras and invested Otrar, the offending city. After a siege of five months the citadel was taken by assault, and Inaljuk and his followers were put to the sword. The conquerors levelled the walls with the ground, after having given the city over to pillage. At the same time a third army besieged and took Khojent on the Jaxartes; and yet a fourth, led by Jenghiz and his youngest son Tulē, advanced in the direction of Bukhārā. Tashkent and Nur surrendered on their approach, and after a short siege Bukhārā fell into their hands. On entering the town Jenghiz ascended the steps of the principal mosque, and shouted to his followers, "The hay is cut; give your horses fodder." No second invitation to plunder was needed; the city was sacked, and the inhabitants either escaped beyond the walls or were compelled to submit to infamies which were worse than death. As a final act of vengeance the town was fired, and before the last of the Mongols left the district, the great mosque and certain palaces were the only buildings left to mark the spot where the "centre of science" once stood.

From the ruins of Bukhārā Jenghiz advanced along the valley of the Sogd to Samarcand, which, weakened by treachery, surrendered to him, as did also Balkh. But in neither case did submission save either the inhabitants from slaughter or the city from pillage. Beyond this point Jenghiz went no farther westward, but sent Tulē, at the head of 70,000 men, to ravage Khurāsān, and two flying columns under Chēpē and Sabutai Bahadar to pursue after Mohammed who had taken refuge in Nishapur. Defeated and almost alone, Mohammed fled before his pursuers to the village of Astara on the shore of the Caspian sea, where he died of an attack of pleurisy, leaving his empire to his son Jelaleddin (Jalāl ud-din). Meanwhile Tulē carried his arms into the fertile province of Khurāsān, and after having captured Nessa by assault appeared before Merv. By an act of atrocious treachery the Mongols gained possession of the city, and, after their manner, sacked and burnt the town. From Merv Tulē marched upon Nishapur, where he met with a most determined resistance. For four days the garrison fought desperately on the walls and in the streets, but at length they were overpowered, and, with the exception of 400 artisans who were sent into Mongolia, every man, woman and child was slain. Herat

escaped the fate which had overtaken Merv and Nishapur by opening its gates to the Mongols. At this point of his victorious career Tulē received an order to join Jenghiz before Talikhan in Badakshan, where that chieftain was preparing to renew his pursuit of Jelaleddin, after a check he had sustained in an engagement fought before Ghazni. As soon as sufficient reinforcements arrived Jenghiz advanced against Jelaleddin, who had taken up a position on the banks of the Indus. Here the Turks, though far outnumbered, defended their ground with undaunted courage, until, beaten at all points, they fled in confusion. Jelaleddin, seeing that all was lost, mounted a fresh horse and jumped into the river, which flowed zoft. below. With admiring gaze Jenghiz watched the desperate venture of his enemy, and even saw without regret the dripping horseman mount the opposite bank. From the Indus Jenghiz sent in pursuit of Jelaleddīn, who fled to Delhi, but failing to capture the fugitive the Mongols returned to Ghazni after having ravaged the provinces of Lahore, Peshawar and Melikpur. At this moment news reached Jenghiz that the inhabitants of Kerat had deposed the governor whom Tulē had appointed over the city, and had placed one of their own choice in his room. To punish this act of rebellion Jenghiz sent an army of 80,000 men against the offending city, which after a siege of six months was taken by assault. For a whole week the Mongols ceased not to kill, burn and destroy, and 1,600,000 persons are said to have been massacred within the walls. Having consummated this act of vengeance, Jenghiz returned to Mongolia by way of Balkh, Bukhārā and Samarcand.

APPEARANCE IN EUROPE

Meanwhile Chēpē and Sabutai marched through Azerbeijan, and in the spring of 1222 advanced into Georgia. Here they defeated a combined force of Lesghians, Circassians and Kipchaks, and after taking Astrakhan followed the retreating Kipchaks to the Don. The news of the approach of the mysterious enemy of whose name even they were ignorant was received by the Russian princes at Kiev with dismay. At the instigation, however, of Mitislaf, prince of Galicia, they assembled an opposing force on the Dnieper. Here they received envoys from the Mongol camp, whom they barbarously put to death. "You have killed our envoys," was the answer made by the Mongols; "well, as you wish for war you shall have it. We have done you no harm. God is impartial; He will decide our quarrel." In the first battle, on the river Kaleza, the Russians were utterly routed, and fled before the invaders, who, after ravaging Great Bulgaria retired, gorged with booty, through the country of Saksin, along the river Aktuba, on their way to Mongolia.

In China the same success had attended the Mongol arms as in western Asia. The whole of the country north of the Yellow river, with the exception of one or two cities, was added to the Mongol rule, and, on the death of the Kin emperor Suan Tsung in 1223, the Kin empire virtually ceased to be, and Jenghiz's frontiers thus became conterminous with those of the Sung emperors who held sway over the whole of central and southern China. After his return from Central Asia, Jenghiz once more took the field in western China. While on this campaign the five planets appeared in a certain conjunction, which to the superstitiously minded Mongol chief foretold that evil was awaiting him. With this presentiment strongly impressed upon him he turned his face homewards, and had advanced no farther than the Si-Kiang river in Kansuh when he was seized with an illness of which he died a short time afterwards (1227) at his travelling palace at Ha-lao-tu, on the banks of the river Sale in Mongolia. By the terms of his will Ogotai was appointed his successor, but so essential was it considered to be that his death should remain a secret until Ogotai was proclaimed that, as the funeral procession moved northwards to the great ordu on the banks of the Kerulen, the escort killed every one they met. The body of Jenghiz was then carried successively to the ordus of his several wives, and was finally laid to rest in the valley of Kilien.

Thus ended the career of one of the greatest conquerors the world has ever seen. Born and nurtured as the chief of a petty Mongolian tribe, he lived to see his armies victorious from the China sea to the banks of the Dnieper; and, though the empire which he created ultimately dwindled away under the hands of his degenerate descendants, leaving not a wrack behind, we have in the presence of the Turks in Europe a consequence of his rule, since it was the advance of his armies which drove their Osmanlī ancestors from their original home in northern Asia, and thus led to their invasion of Bithynia under Othman, and finally their advance into Europe under Amurath I.

BIBLIOGRAPHY.—F. von Erdmann, *Temudschin der Unerschütterliche* (Leipzig, 1862); Sir H. H. Howarth, *History of the Mongols*, vol. i. (1876–88); Sir R. K. Douglas, *The History of Jenghiz Khan* (1877); L. Cahun, "Ghengis Khan et L'Empire Mongol," *Histoire Générale du IVe siècle jusqu'à nos jours*, vol. ii. (ed. E. Lavisse and A. Rambaud, 1893–1901); F. E. A. Krause, "Cingis Han," *Heidelberger Akten der von-Portheim-Stiftung* (Heidelberg, 1922); contains *good* bibliography; Harold Lamb, *Genghis Khan, Emperor of all Men* (1927). *See* also article MONGOLS and *Histoire Ginirale (vide supra)*, p. 972, for references to original sources and other works. (R. K. D.)

JENKIN, HENRY CHARLES FLEEMING (1833–1885), British engineer who joined Sir William Thomson (later Lord Kelvin [*q.v.*]) in his work on submarine cables, was born near Dungeness on March 25, 1833. He was educated in Scotland and later at Genoa university, subsequently joining R. S. Newall and Co., makers of submarine telegraph cables at Birkenhead. He was one of the principal witnesses before the government select committee which inquired in 1859–60 into the construction and laying of submarine cables. He became well known as a consultant telegraph engineer and was elected a fellow of the Royal society in 1865. In the same year he was appointed professor of engineering at University college, London, and, three years later, he was appointed to the corresponding chair at Edinburgh university. His publications include *Electricity and Magnetism* (1870), a volume containing much original work. He died in Edinburgh on June 12, 1885. (G. R. M. G.)

JENKINS, SIR LEOLINE (1623–1685), English lawyer and diplomatist, was the son of a Welsh country gentleman. He was born in 1623 and was educated at Jesus college, Oxford. During the civil war and the commonwealth he was an ardent royalist; in 1661 he was made registrar of the consistory court of Westminster; in 1664 deputy judge of the court of arches; about a year later judge of the admiralty court; in 1689 judge of the prerogative court of Canterbury. In these offices Jenkins did enduring work in elucidating and establishing legal principles, especially in relation to international law and admiralty jurisdiction. He was selected to draw up the claim of Charles II. to succeed to the property of his mother, Henrietta Maria, on her death in 1666, and while in Paris for this purpose he succeeded in defeating the rival claim of the duchess of Orleans, being rewarded by a knighthood on his return. He was one of the English representatives at the Congresses of Cologne in 1673, and of Nijmwegen in 1676–79. He was made a privy councillor in 1680 and became secretary of state in April of the same year, in which office he was the official leader of the opposition to the Exclusion Bill. He resigned office in 1684, and died on Sept. 1, 1685. Jenkins left his impress on the law of England in the Statute of Frauds, and the Statute of Distributions, of which he was the principal author, and of which the former profoundly affected the mercantile law of the country, while the latter regulated the inheritance of the personal property of intestates. He was never married.

See William Wynne, *Life of Sir Leoline Jenkins* (2 vols., 1724), which contains a number of his diplomatic despatches, letters, speeches and other papers. *See* also Sir William Temple, *Works*, vol. ii. (4 vols., 1770); Anthony à Wood; *Athenae Oxonienses* (Fasti), ed. by P. Bliss (4 vols., 1813–20), and *History and Antiquities of the University of Oxford*, ed. by J. Gutch (Oxford, 1792–96).

JENKINS, ROBERT (*fl.* 1731–1745), English master mariner, is known as the protagonist of the "Jenkins's ear" incident, which, magnified in England by the press and the opposition, became a contributory cause of the war between England and Spain (1739) which ultimately merged into the War of the Austrian Succession. Bringing home the brig "Rebecca" from the West Indies in 1731, Jenkins was boarded by a Spanish guarda-costa, whose commander rifled the holds and cut off one of his ears. On arriving in England Jenkins stated his grievance to the

king. At first the case created no stir, but in 1738 the repetition of his story before a committee of the House of Commons created much political excitement.

Jenkins was subsequently given command of a ship in the East India Company's service, and later became supervisor of the company's affairs at St. Helena.

JENKS, JEREMIAH WHIPPLE (1856–1929), American economist, was born in St. Clair, Mich., on Sept. 2, 1856. He graduated from the University of Michigan in 1878; was admitted to the Michigan bar; taught languages in Mt. Morris college (Ill.); studied in Germany at the University of Halle; taught political science and English literature at Knox college, Galesburg, Ill., (1886–89); was professor of political economy and social science at Indiana State university (1889–91); was professor of political economy and politics at Cornell university (1891–1912); was professor of government and director of the division of public affairs at New York university (1912–17) and thereafter director of the division of oriental commerce and politics. In 1899–1901 he served as an expert agent of the U.S. industrial commission on investigation of trusts and industrial combinations in the United States and Europe. In 1901–02 he was special commissioner of the U.S. war department on colonial administration, and wrote a *Report on Certain Economic Questions in the English and Dutch Colonies in the Orient,* published (1902) by the bureau of insular affairs and he later served the United States and other governments as adviser on currency. In 1907–10 he was a member of the U.S. immigration commission; he also held many administrative positions. Among his principal works are *The Trust Problem* (1900; enlarged ed. with W. E. Clark, 1917); *Citizenship and the Schools* (1906); *Principles of Politics* (1909); *The Immigration Problem* (with W. J. Lauck, 1913; 6th ed. revised by R. D. Smith, 1925); *Business and the Government* (1917).

Jenks died in New York city on Aug. 24, 1929.

JENNER, EDWARD (1749–1823), English physician and discoverer of vaccination, was born at Berkeley, Gloucestershire, on May 17, 1749, the son of a clergyman. After his early education at Wotton-under-Edge and Cirencester, he began the study of medicine under Daniel Ludlow, a surgeon of Sodbury, near Bristol. In 1770 he went to London as a pupil of John Hunter. During this period he was employed by Sir Joseph Banks to prepare and arrange the zoological specimens which Banks had collected on Captain Cook's first voyage in 1771. In one of his papers contributed to the local medical society, Jenner appears to have anticipated the discoveries of others concerning rheumatic heart disease. He also studied ornithology and geology, and constructed a balloon. He was a favourite in society, a fair musician and poet. In 1788 he married Catharine Kingscote, and in 1792 obtained the M.D. from St. Andrews.

Meanwhile, the idea of vaccination matured slowly in Jenner's mind. While still an apprentice, he had noted a popular belief in Gloucestershire as to the antagonism between cowpox and smallpox (*q.v.*). He first investigated this subject about 1775 and satisfied himself that cowpox really included two different forms of disease, only one of which protected against smallpox, and that many failures to protect could thus be explained. He further ascertained that the true cowpox protected only when it was communicated at a particular stage of the disease, and at the same time concluded that the disease of horses called "the grease" was the analogue of cowpox and smallpox. Cowpox being scarce in his county at that period, Jenner had no opportunity of testing his theory until May 14, 1796, when he was able to inoculate an eight-year-old boy with matter from the cowpox vesicles on the hands of a milkmaid. In the following July, the boy was inoculated for smallpox, but the disease did not follow. Jenner was unable to repeat his successful discovery before 1798, in which year he published his *Inquiry into the Cause and Effectsof the Variolae Vaccinae.*

Henry Cline, surgeon of St. Thomas' hospital, London, made a number of successful inoculations against smallpox and thereby brought vaccination before the medical profession, which had been prejudiced against it by the formidable criticism of J. Ingenhousz, a celebrated surgeon. But its adoption was delayed by the rash advocacy of George Pearson, who, without seeing a case of cowpox, lectured on the subject and supplied a defective vaccine that frequently produced not the mild disease described by Jenner but somewhat severe eruptions resembling smallpox. Jenner had first to show (in 1799) that the vaccine supplied by Pearson was accidentally contaminated with variolous matter, and then to secure (in 1800) the abandonment of Pearson's project for establishing in London an institution for free vaccination with the defective vaccine.

In 1803 the Royal Jennerian society for the proper spread of vaccination in London was established. In the first 18 months 12,000 persons were inoculated, and the annual average of deaths from smallpox fell from 2,018 to 622. Dissensions within the society, however, led to its disbanding in 1808, when the national vaccine establishment was founded. In 1802 a parliamentary grant of £10,000 was voted for Jenner, who continued to vaccinate the poor without charge, often as many as 300 a day.

In England his merits were slowly recognized. Lord Henry Petty proposed an address to the crown, praying that the College of Physicians should report on vaccination. The report being favourable, the chancellor of the exchequer proposed a further £10,000 for Jenner. Finally the sum was raised to £20,000, and at about the same time India raised a subscription of £7,383.

In 1813 Oxford conferred on Jenner an honorary M.D. He published his last work, *On the Influence of Artificial Eruptions in Certain Diseases,* in 1822; and in the following year presented to the Royal society his final paper, *On the Migration of Birds.* He died in January 1823.

See also VACCINATION.

BIBLIOGRAPHY.—J. Baron, *The Life of E. Jenner* (1827); *C.* Creighton, *Jenner and Vaccination* (1889); *F.* Dawtrey Drewitt, *The Life of Edward Jenner* (1931).

JENNER, SIR WILLIAM, BART. (1815–1898), English physician, was born at Chatham on Jan. 30, 1815, and educated at University college, London. In 1847, at the London Fever hospital he began investigations into cases of "continued" fever, which enabled him finally to make a clinico-pathologic distinction between typhus and typhoid on which his reputation principally rests, although in this he had been preceded by other workers. In 1849 he was appointed professor of pathological anatomy at University college and also served as physician or consulting physician to several hospitals. He was successively Holme professor of clinical medicine and professor of the principles and practice of medicine at University college. He was president of the Royal College of Physicians (1881–88) and was elected in 1864 a fellow of the Royal society. In 1861 he was appointed physician-extraordinary and in 1862 physician-in-ordinary to Queen Victoria, and in 1863 physician-in-ordinary to the prince of Wales. In 1868 he was created a baronet. Jenner died at Bishop's Waltham, Hampshire, on Dec. 11, 1898.

JENNINGS, (JAMES) HENNEN (1854–1920), U.S. consulting engineer described in 1918 as "an eminent consulting engineer, whose advice is sought in matters of great importance from San Francisco to London and from London to Johannesburg," was born at Hawesville, Ky., on May 6, 1854. After graduating from Lawrence scientific school, Harvard, in 1877, he was engineer at the North Bloomfield and New Almaden mines in California. In 1887 he went to Venezuela as manager of the El Callao mine and in 1889 moved to South Africa, where he became consulting engineer to Wemher, Beit and Co. and did much to develop the gold mining industry on the Rand. Jennings played a major part in the establishment of the School of Mines in Johannesburg and advised on the reorganization of the Royal School of Mines in London. He was awarded the gold medal of the Institution of Mining and Metallurgy in recognition of his services to the mining industry, to the profession and to technical education; and he was president of that institution from 1903 to 1905. He returned to the United States in 1905 to become a consultant in Washington, where his services were in great demand by the U.S. bureau of mines. He died at Washington, D.C., on March 5, 1920. (C. W. D.)

JENOLAN CAVES, probably the most famous tourist resort in Australia, occur in a belt of Silurian limestone, about 500 ft.

thick, which runs northwest along the western margin of the Blue mountain plateau in New South Wales. About 70 mi. due west of Sydney, the limestone has been uncovered by the valleys of two converging streams which have burrowed into it, dissolving the lime to create a series of beautiful tunnels and caverns. The caves are on different levels and contain unique limestone formations, particularly stalactites (*q.v.*); about a dozen caves have been opened for tourists, and exploratory work has revealed others. The caves were discovered in 1838 and were made a government reserve in 1866. but the roundabout route to them from Sydney meant that they were not frequented until after 1896, when a more direct road was built from the main western highway. By the 1960s, more than 100,000 persons visited the caves annually.

JENSEN, JOHANNES VILHELM (1873–1950), Danish poet, novelist and essayist who received the Nobel prize for literature in 1944. Born, Jan. 20, 1873, in Farsø, Himmerland, the son of a veterinary surgeon of old peasant stock, Jensen went to Copenhagen in 1893 to study medicine but gave it up to live by his pen. A visit to the United States in 1896 began a long period of travel, culminating in an 18-month tour round the world.

His first books, *Danskere* (1896) and its sequel, *Einar Elkjær* (1898), were psychological novels and show that Jensen was influenced by, even while he rebelled against, the pessimism and introspectiveness of the 1890s. In *Den gotiske Renaissance* (1901), intoxicated by the wonders of modern machinery and inspired by Walt Whitman, he proclaimed a matter-of-fact view of life, pointing to England and the United States (the gothic nations) as heralds of a new world.

During these years, Jensen widened the boundaries of literary Copenhagen in many directions. In *Himmerlandsfolk* (1898), a series of tales, he reached back to the soil of his boyhood; and in *Singapore noveller* (1907) he was inspired by his travels, rivaling Kipling as the poet of the east. Reacting against the naturalist novel with its detailed descriptions, in about 1900 he used the word *myter* ("myths") to describe the new attitude and impressionistic technique of his short narrative sketches, a collection of which, *Myter og Jagter*, appeared in 1907. These early myths are accounts of personal experiences, but reality is heightened and given symbolic meaning by the power of imagination. The most daring work of his youth, *Kongens Fald* (1900–01; Eng. trans., *The Fall of the King*, 1933), is a historical novel, set in the reign of Christian II, but its lyric-symbolic structure makes it a myth expressive of growth and decay, life and death. During this intensely felt early period he was also writing poetry, collected in *Digte* (1906), expressing his own struggle between loneliness and happy acceptance of the goodness of the world. His use of free verse and modern idiom renewed the Danish lyric tradition.

In 1904 Jensen married and settled down in Copenhagen. His attitude to life began to change. Darwinism became the keystone of his outlook, explained in *Den nye Werden* ("The New World," 1907), in *Introduktion til vor Tidsalder* (1912) and in the four concluding books of essays on evolution (1923–28).

Jensen broke completely with the naturalist conception of Darwinism and with Nietzsche's theory of the superman, his conclusions being more akin to those of Julian Huxley in his *Evolution: the Modern Synthesis* (1942). According to Jensen, the object of evolution is the development of the norm of the species, not the individual, and he emphasized the ascent, rather than the descent, of man. He saw in Darwinism a bridge between man and nature, and this gave him a sense of kinship with all creatures, "a sympathy of the whole." Nature taught him intellectual humility and piety: he was even reconciled to death, as the common lot of all creation. His longing for immortality was satisfied by the thought of being a link in the chain of universal evolution.

The subjective myth of his early period now became the myth of evolution, and he sought to understand the essence of things through the history of their origin. As well as writing a stream of volumes containing more than 100 short myths, he produced the epic cycles of myths that form *Den lange Rejse* (6 vol., 1908–22; Eng. trans., *The Long Journey*, 3 vol., 1922–24), with a postscript *Æstetikog Udvikling* ("Aesthetics and Evolution," 1923), explaining his intentions. This tells the story of man from the pre-Ice Ages in the "lost country" of semitropical Scandinavia. ending on the threshold of modern times with Columbus, conceived as the Viking captain. As a painter of nature, Jensen is unsurpassed. His characters, sculptured with monumental outline, embody common human feelings and faculties. All momentary and particular events have a universal aspect: present, past and future blend in one. *Den lange Rejse* lives for its poetry and its conception of man's fabulous story as a longing to become man: loving, not killing. Jensen's idealized Darwinism led him to create a modern classicism, acknowledging Öhlenschlæger, Goethe and the Greeks as his masters.

After his period of great prose, Jensen struck a new, rich vein of lyric poetry, classical in its concentrated imagery and weighty verse, the expression of the loving severity which marked his affirmation of life. His poetry was collected in *Digte, 1901–43* (1943).

His strong convictions often involved Jensen in violent controversy, but his supremacy as a poet was recognized even by those who opposed his theories. He died in Copenhagen, Nov. 25, 1950.

BIBLIOGRAPHY.—0. Gelsted, *J. V. Jensen* (1913; new ed. 1938); A. Henriques, *J. V. Jensen* (1938); *L.* Nedergaard, *J. V. Jensen* (1943); *F.* Johansen and Aage Marcus, *J. V. Jensen: En Bibliografi*, 2 vol. (1933–51). (O. A. F.)

JENSON, NICOLAS (*c.* 1420–1480), French publisher and printer, who completed the development of the roman letter from a reproduction of handwriting into the forms still used for printing types, was born at Sommevoire, Haut-Marne, about 1420. He was apprenticed as a cutter of dies for coining and became master of the royal mint at Tours. In 1458 he was chosen to go to Mainz to learn the art of printing from movable types under Johann Gutenberg. In 1470 he appeared in Venice as a printer and publisher; and in the first work he produced, the printed roman minuscule achieved proportions, shapes and arrangements on which five centuries of printing have inflicted no radical change. He died in Rome in 1480.

As a type designer, Jenson produced Greeks and black letters as well as his famous roman. As a printer, he composed his types in a meticulously even style, but did not always print them with the accuracy they deserved. As a publisher, he produced more than 150 titles, soundly edited by scholars of authority.

In general appearance similar to the roman letter of Jenson, the old-face types most widely used today derive details of finish from those used by Aldus Manutius in 1495 and from similar designs perfected by Claude Garamond in the 16th century. But Jenson's achievement in the design of purely roman letters for printing is agreed to be the first, and is widely believed to be the most beautiful. (H. A. F. W.)

JENYNS, SOAME (1704–1787), English author, was born in London, Jan. 1, 1704, and was educated at St. John's college, Cambridge. In 1742 he was chosen M.P. for Cambridgeshire, in which his property lay, and he afterward sat for the borough of Dunwich and the town of Cambridge. From 1755 to 1780 he was one of the commissioners of the board of trade. He died on Dec. 18, 1787. Jenyns wrote poems: *Art of Dancing* (1727) and *Miscellanies* (1770): and, in prose, *Free Inquiry into the Nature and Origin of Evil* (1756), and *View of the Internal Evidence of the Christian Religion* (1776). He is chiefly remembered by the slashing review by Samuel Johnson in the *Literary Magazine* on the *Free Inquiry*, and by references in Boswell's *Life of Johnson*.

JEPHTHAH (in the Douai version of the Bible, JEPHTE), one of the judges of Israel, was a son of Gilead by a secondary wife; being expelled from his father's house by his brethren, he took refuge in the Syrian land of Tob, where he gathered around him a powerful band of homeless men like himself. The Ammonites pressing hard on his countrymen, the elders of Gilead called for his help, which he consented to give on condition that in the event of victory he should be made their head (Judg. xi, 1–xii, 7). His name is best known in history and literature in connection with his vow, which led to the sacrifice of his daughter on his successful return. The annual lamentation of the women for her death suggests a mythical origin (*see* ADONIS). Attached to the narrative is an account of a quarrel between Jephthah and the Ephraimites. The latter were defeated, and their retreat was cut off by the

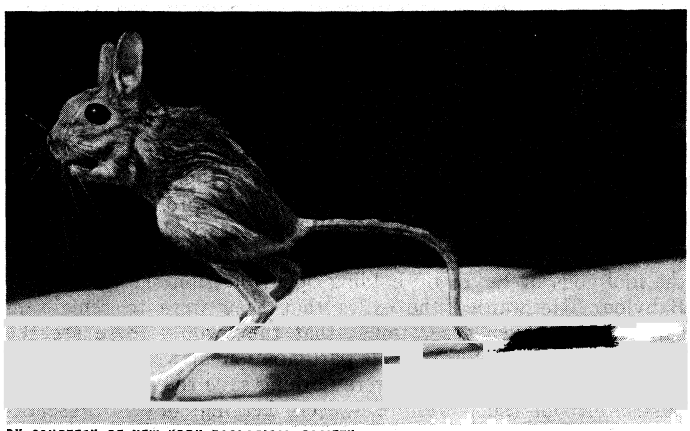
Gileadites, who had seized the fords of the Jordan. As the fugitives attempted to cross they were bidden to say "shibboleth," and those who said "sibboleth" (the Ephraimites apparently being unused to *sh)* were put to death.

JERAHMEEL, in the Bible, a clan which with Caleb, the Kenites and others occupied the southern steppes of Palestine *(1* Sam. xxx, 29), and was subsequently incorporated into Judah *(q.v.).*

The *Chronicles of Jerahmeel* (M. Gaster, *Oriental Translation Fund, 1899)* is a late production containing a number of apocryphal Jewish legends of no historical value.

JERBA: *see* DJERBA.

JERBOA, the name of an Arabian and north African jumping rodent mammal, *Jaculus aegyptius,* typifying the family Dipodidae; but in a wider sense applied to most of the representatives of that family, which are distributed over the desert and semidesert tracts of the old world, although unknown in Africa



BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

EGYPTIAN JERBOA (JACULUS JACULUS)

south of the Sahara. (For the characteristics of the family *see* RODENTIA.)

In the Egyptian jerboa the length of the body is eight inches; and that of the tail, which is long, cylindrical and covered with short hair terminated by a tuft, is ten inches. The five-toed front limbs are extremely short, while the hind pair are six times as long. When about to spring, the jerboa raises its body by means of the hinder extremities, and supports itself at the same time upon its tail, while the forefeet are so closely pressed to the breast as to be scarcely visible. It then leaps into the air and alights upon its hind feet, and instantaneously erecting itself, it makes another spring, and so on in rapid succession. It is a gregarious animal, living in burrows. which it excavates a-ith its nails and teeth in the sandy soil of Egypt and Arabia. In these it remains during the day, emerging at night in search of the herbs on which it feeds. It is exceedingly shy. and this, together with its agility. renders it difficult to capture. The Persian jerboa *(Allactaga indica)* is also a nocturnal burroning animal, feeding on grain, which it stores up in underground repositories, closing these when full, and only drawing upon them uhen the supply of food above ground is exhausted. *(See* also JUMPING MOUSE.)

JEREMIAH, the son of Hilkiah, of a priestly family of Anathoth, three miles northeast of Jerusalem, was the last of the great pre-exilic prophets of Israel.

His Life and Times.—Jeremiah's life falls in an important transitional period in the history of the ancient near east. The last strong king of the Assyrian empire was Assur-bani-pal *(668–626* B.C.); after his death the empire declined rapidly, and Nineveh fell in *612* to a coalition of Chaldeans and Medes. Egypt under the 26th dynasty attempted to regain world power but was decisively defeated by the Chaldeans in the battle of Carchemish (605). The Neo-Babylonian empire, under a Chaldean dynasty, rose upon the ruins of the old Assyrian empire. In Palestine the Deuteronomic reform of Josiah in 621 sought religious purification, centralization of sacrificial worship in Jerusalem and independence from Assyria. After Josiah was put to death at Megiddo by Pharaoh Necho (609), Judah became a vassal of Egypt, and later, after the battle of Carchemish, of Babylon. When it rebelled against the latter, Judah was invaded by the Babylonian king, Nebuchadrezzar, who besieged Jerusalem and subsequently received the surrender of Jehoiachin *(597).* The latter's uncle and successor, Zedekiah, remained loyal to Babylon for a time but eventually revolted; again Jerusalem was besieged by a Babylonian army and in *586* was captured. The temple and much of the city were destroyed, and political independence came to an end.

Jeremiah spent most of his public career in Jerusalem. His call is usually dated in *626,* from Jer. i, *2,* and xxv, *3,* and the poems in the early chapters referring to a foe "from the north" are connected with the Scythian invasion of Palestine. Jeremiah's attitude toward the reforms of Josiah is a matter of dispute among scholars. Many hold that at first he enthusiastically supported the reforms (xi, 1–8) but later turned against them when they failed to bring about genuine spiritual improvement. An increasing number of scholars, however, discount the importance of the Scythian invasion and of the dates in i, 2; xxv, 3, and think that the prophet's career began about 616 or later, perhaps even after the accession of Jehoiakim in 608. In that case, the foes "from the north" were the Chaldeans and their allies, and Jeremiah was not prophesying at the time of Josiah's reform. A number of passages suggest opposition to basic ideals of that reform (ii, 8; vi, 20; viii, 8 *ff.*; xi, 15 *ff.*).

Soon after the accession of Jehoiakim, Jeremiah delivered a message in the temple court in which he predicted the destruction of the temple if the people did not show moral amendment (vii, 1–15; xxvi). This led to his arrest because of the opposition of priests and prophets but the influence of the common people and rinces ec d i release. In 605 he dictated to his secretary, Baruch, all his prophecies uttered to that date and h the resulting document read before t] ft this was destroyed by the king, J t a second scroll, adding further prophecies (xxxvi).

In the reign of Zedekiah (597–586), the prophet continued to protest against the moral and religious degradation of his people. During the final siege of Jerusalem he advocated the unpopular course of surrender to Babylon. When Jeremiah attempted to leave the city to go to Anathoth, he was arrested and put in prison. His enemies tried to starve him to death by placing him in an old cistern, but he was rescued by an Ethiopian, Ebedmelech, and survived the fall of the city. He was allowed to remain at Mizpah with Gedaliah, the Jewish governor who served under the Babylonians. Upon the assassination of Gedaliah, Jeremiah was taken to Egypt by the panic-stricken survivors. The last we hear of him is his denunciation of his fellow countrymen for worshipping the Queen of Heaven.

The Man and **His** Message.—There is no other Old Testament prophet of whom we have so much genuine material as Jeremiah, both his own words and biographical matter. Especially valuable for the study of his personality are a series of passages often called his "confessions"—xi, *18* to xii, *6;* xv, 10–21; xvii, *9–10, 14–18;* xviii, *18–23;* xx, 7–12. They reveal him as a man of varying moods and deep conflict. By nature Jeremiah was shy, reticent and introspective, desiring a life of peace and good will. But obedience to the divine compulsion to prophesy led him to denounce his neighbours, champion unpopular causes and predict doom. The result was a conflict in which he could describe the divine impulse to prophesy as a burning fire within his bones which he could not contain (xx, 9). Nevertheless, the outstanding characteristic of his public life was courage, which enabled him to condemn priests, other prophets and ruling kings.

In his message Jeremiah built upon the work of preceding prophets, especially Hosea. He emphasized absolute fidelity to God, whom he called a "fountain of living waters" (ii, 13), and Jeremiah's own Life exemplified a relationship with God more intimate than other prophets had experienced. In his confessions he engages in dialogue with the Deity, questioning at one time the justice of God (xii, *1),* and at another time even declaring that God has deceived him (xx, 7). Jeremiah's denunciations were

concerned more with the religious sins of idolatry and false worship than with social injustice, although he did not ignore the latter. He taught that sin is caused by "the stubbornness of the heart" (vii, 24; ix, 14; xiii, 10; etc.) and can be overcome only when the sinner turns to God in genuine repentance. The climax of his message was expressed in the prophecy of the New Covenant, in which men should have the law written in the heart and know God directly without need of mediator (xxxi, 31–34). Although the genuineness of the New Covenant passage is denied by B. Duhm and a few others, the majority of Old Testament scholars believe that it represents Jeremiah's own thought.

The outstanding contribution of Jeremiah to the history of Hebrew religion was in the realm of personal religion but was made more by implication than by express teaching. He believed that true religion did not depend upon the temple or the Holy Land, but upon sincere personal seeking of God. His own life encouraged the ideal of personal religion. Nevertheless, Jeremiah did not wholly transcend nationalistic thinking, for he conceived even of the New Covenant as being with the house of Israel and the house of Judah.

The **Book** of Jeremiah.— This book consists of three types of material: genuine prophecies of Jeremiah, biographical material about the prophet and secondary additions. The disentangling of these three elements presents unusual difficulties, and Biblical scholars have reached no consensus regarding the problems involved. Many attempts have been made to recover the second scroll of Baruch as the first edition of this book. This cannot be recovered by any formal criteria but probably is contained within the genuine oracles of the prophet — mostly poetry — in chapters i–xxv. Many sections of the book, especially iii, 6–11, 14–18; vii, 1–27; vii, 30 to viii, 3; xi, 1–14, 17; xxi, 1–10; xxiv, and much of xxvi–xlv, betray the style, vocabulary and ideas of the Deuteronomists, who wrote Deuteronomy and edited Joshua, Judges and I, II Kings. It is probable that a Deuteronomic edition of Jeremiah's life and message was prepared between 587 and about 550. Baruch may have been its editor, but it is more likely that the editor was someone who used materials written by Baruch. This edition sometimes accurately reports Jeremiah's actions and ideas, as in the temple address (vii, 1–15; xxvi) and the New Covenant passage; sometimes it emphasizes ideas of the editor which were not prominent in Jeremiah's thought, such as the predictions of return from the exile and restoration of the Davidic dynasty. Certain portions of the book are even later than this edition, notably x, 1–16, which shows dependence on II Isaiah and late Psalms; much of the "book of comfort" in xxx–xxxi; and the oracles against foreign nations in xlvi, 13 to li, 58.

The Greek Septuagint version frequently differs widely from the traditional Hebrew text. It is approximately one-eighth shorter than the Hebrew and sometimes offers a different arrangement of materials. The best illustration of difference in arrangement is in the position of the large collection of oracles against foreign nations. In the common Hebrew text this collection is placed near the end of the book, occupying chapters xlvi–li; in the Septuagint it appears between verses 13 and 15 of xxv in our familiar arrangement. The Septuagint text is sometimes superior to the Hebrew, but every variation must be considered on its own merits.

BIBLIOGRAPHY.—TEXT: Eberhard Nestle, ed., *Das Buch Jeremia, Griechisch und Hebräisch* (Stuttgart, 1924). GENERAL: T. K. Cheyne, *Jeremiah* (1888); W. Erbt, *Jerernia und seine Zeit* (Gottingen, 1902); John Skinner, *Prophecy and Religion* (1922); Sir G. A. Smith, *Jeremiah* (1923); W. F. Lofthouse, *Jeremiah and the New Covenant* (1925); A. C. Welch, *Jeremiah, His Time and His Work* (1928). COMMENTARIES: B. Duhm, *Das Buch Jeremia* (1901); C. H. Cornill, *Das Buch Jeremia* (Leipzig, 1905); F. Giesebrecht, *Das Buch Jeremia* (Göttingen, 1907); A. S. Peake, *Jeremiah* (1911); L. E. Binns, *Jeremiah* (1919); Paul Volz, *Der Prophet Jeremia* (Leipzig, 1928); W. Rudolph, *Jeremia* (1947). (J. P. HY.; T. **H.R.**)

JEREMY, EPISTLE OF, an apocryphal book of the Old Testament. The letter purports to have been written by Jeremiah to the exiles who were already in Babylon or on the way thither. The author was a Hellenistic Jew, and not improbably a Jew of Alexandria. His work, which shows little literary skill, was written with a serious practical purpose. He veiled his fierce attack on the idol gods of Egypt by holding up to derision the idolatry of Babylon. He warned the exiles that they were to remain in captivity for seven generations; that they would there see the worship paid to idols, from all participation in which they were to hold aloof; for that idols were nothing save the work of men's hands, without the powers of speech, hearing, or self-preservation. They could not bless their worshippers even in the smallest concerns of life; they were indifferent to moral qualities, and were of less value than the commonest household objects, and finally, "with rare irony, the author compared an idol to a scarecrow (v. 70), impotent to protect, but deluding to the imagination" (Marshall).

The date of the epistle is uncertain; possibly it belongs to the 1st century B.C.

See Ball in Charles's *Apocrypha and Pseudepigrapha*, vol. i. (R. H. CH.)

END OF VOLUME TWELVE

PRINTED IN THE U. S. A. BY R. R. DONNELLEY & SONS CO.

the manufacturer and the licensing authorities.

Depending on the condition of the recovered bullet the expert can determine the make, calibre, type, approximate serial number, and the approximate date of manufacture of the gun from which it was discharged. This information is obtained by studying the following points on the bullet:--number of rifling lands, pitch or twist of rifling, width of grooves and lands, depth of grooves, calibre and weight of bullet, and the individual characteristics found in the barrel of every firearm, such as rough spots, gouges, imperfections and emery marks. These peculiarities are impressed upon the bullet when fired from the gun.

If a weapon is subsequently discovered in the possession of a suspect, test bullets are fired from it and a comparison is made of the rifling marks on the evidence and the test bullets. This examination is ordinarily performed under a comparison microscope. The evidence and test bullets are placed under separate objectives and by means of a prism arrangement the images are juxtaposed in a single field. Thus groups of lines on the test bullet will appear to be extensions of similar lines on the evidence bullet. The identification of the weapon depends upon the fact that no two firearms are manufactured exactly alike. Small defects in the manufacturing tools and differences in their application together with the effects of use and age result in barrel characteristics that are impressed as fine striations on the bullet in its passage. The success of the examination is related to the number of unique, identifiable characteristics present.

Identification of cartridge cases discharged from an automatic weapon is made by examining the scratches on the side of the case which are produced by the several mechanical operations connected with automatic loading and unloading; the marks made by the extractor hook; the firing pin imprint on the primer; the breech face imprint on the primer and the shell base; and the imprint of the ejector blade or shoulder. When the cartridge has been exploded in the revolver, the firing pin and the breech face impressions on the primer and shell base furnish means for identification. A comparison of the evidence cartridge case with a cartridge case fired in a suspected weapon is accomplished with a comparison microscope in the same manner as described for bullets.

Gunpowder is also a source of information. A chemical analysis of unburnt powder can sometimes reveal the manufacturer's formula. The pattern of powder grains surrounding a bullet hole can yield information concerning the distance from which the gun was fired. For this purpose Joseph T. Walker devised a procedure for determining the spatial distribution of the nitrites found in the powder residue present on a fabric. Low-voltage X-rays also are used to produce a radiograph pattern of the lead fouling surrounding a bullet hole. These techniques are of great value in cases where it is doubtful whether the deceased is a suicide or the victim of a homicide.

Document Examinations. — A great part of the work of a police laboratory is concerned with the examination of questioned documents. Problems of handwriting, typewriting, paper and ink are continually arising in connection with investigative work, particularly that dealing with forgery.

The classical problem of document examination is the comparison of handwriting to determine the true author of a questioned document. At its simplest this problem is a straightforward comparison of the questioned writing with the known writing of a suspect. Such a case would occur, for example, in connection with a threatening letter or a ransom note.

The more difficult problems are those of forgeries and disguised writings. To establish the identity of the author of a questioned writing the document expert searches for certain characteristics of penmanship. Only a small part of an adult's handwriting is written consciously. The greater part is written without adverting to mechanical details. It is for this reason that a forger cannot imitate another person's writing exactly and will include, unconsciously, fundamental movements ingrained in his own writing habits. Line flow, relative slant, pen pressure, letter connections and spacing, line curvature, tremor, proportion, base alignment, and shading are the most important characteristics. These elements, if sufficiently individual, will serve to identify the writing. In a successful handwriting examination there must be an adequate combination of significant similarities between the questioned and the known writing without any unexplained major differences.

Typewritten documents offer kindred problems, although here the emphasis is on identifying rhe machine and thus indirectly locating the author of the document. Among the questions which the expert is called upon to answer are the following: Was the questioned writing typed with *this* typewriter?; what is the make and model of the typewriter used?; was the entire document written with the same typewriter?; does the model of the typewriter set a maximum age to the writing? The identification of a typewriter as being *uniquely* the machine employed depends upon the discovery by the expert of a set of individual characteristics of the type faces.

In examining a specimen of typewriting the expert studies the design, alignment. slant, footing, and defective forms of the letters. Most typewriters possess individuality with respect to the alignment of the letters and the relative perfection of the type faces. Normal wear and abuse introduce additional defects. The resulting set of characteristics is often sufiiciently numerous to establish the unique character of the typewriting and the machine.

The detection and deciphering of alterations is another major problem of document examination. Checks. wills, insurance policies, passports, licences, birth certificates, and other official records are often altered by erasing or obliterating. By examining such a document with the aid of a microscope or under ultra-violet light the erasure or obliteration may become apparent. Deciphering is ordinarily achieved by chemical methods and by special photographic techniques such as the use of infra-red films.

Photography is also the most effective method of revealing the writing on charred documents, carbon paper. and on the indentations of the undersheet of a pad or checkbook. Chemical methods are employed to detect secret writing, to differentiate types of ink, and to estimate within broad limits rhe age of an ink writing.

BIBLIOGRAPHY.—J. F. Stephen, *A History of the Criminal Law of England,* 3 vol. (1883); H. Gross, *Criminal Investigation,* 3rd *ed. by* Norman Kendal (ed.) (1934); A. S. Osborn, *Questioned Documents* (1929); A. Lucas, *Forensic Chemistry and Scientific Criminal Investigation,* 2nd ed. (1931); A. Lichem, *Die Kriminalpolizei* (1935); J. S. Hatcher, *Textbook of Firearms Investigation, Identification and Evidence* (1936); T. A. Gonzales. M. Vance and M. Helpern, *Legal Medicine and Toxicology* (1937); E. Locard, *Manuel* de *technique policière,* 3rd *ed.* (1939); B. C. Bridges; *Practical Fingerprinting* (1942); F. E. Inbau, *Lie Detection and Criminal Interrogation,* 2nd ed. (1948); C. E. O'Hara and J. W. Osterburg, *An Introduction to Criminalistics* (1949); O. W. Wilson, *Police Administration* (1950); H. Söderman and J. J. O'Connell, *Modern Criminal Investigation,* 4th ed. (1952).

(C. E. O'H.)

INVESTITURE, the formal installation into an office or estate. which constituted in the niiddle ages one of the acts that betokened the feudal relation between suzerain and vassal. The suzerain, after receiving the vassal's homage and oath of fealty, invested him with his land or office by presenting soine symbol, such as a clod, a banner, a branch, or some other object according to the custom of the fief. The sword and sceptre, emblematic respectively of service and military command and of judicial prerogatives, became the usual emblems of investiture of laymen. The word investiture is later than the 9th century; the act itself mas an outcome of feudal society.

It is in connection with the Church that investiture has its greatest historical interest. The Church quite naturally shared in feudal landholding; in addition to the tithes she possessed immense estates which had been given her by the faithful from early times. and for the defence of which she resorted to secular means. The bishops and abbots, by confiding their domains to laymen on condition of assistance with the sword in case of need, became temporal lords and suzerains with vassals to fight for them, with courts of justice, and in short with all the rights and privileges exercised by lap lords.

Investiture of ecclesiastics by laymen had certain serious effects which were bound to bring on a conflict between the temporal and spiritual authorities. In the first place the lay authorities often rendered elections uncanonical by interfering in behalf of

some favourite, thereby impairing the freedom of the electors. Again, benefices were kept vacant for long periods in order to ensure to the lord as long as possible the exercise of his regalian rights. And, finally, control by temporal princes of investiture, and indirectly of election, greatly increased simony. The main investiture struggle with the empire took place when Hildebrand became Pope Gregory VII (*q.v.*). To Gregory it seemed intolerable that a layman should invest a churchman with the symbols of office. To the emperor Henry IV it was highly undesirable that the advantages and revenues accruing from lay investiture should be surrendered; it was reasonable that ecclesiastics should receive investiture of temporalities from their temporal protectors and suzerains. Although the full text of the decrees of the famous Lenten synod of 1075 has not been preserved, it is known that Gregory on that occasion denounced the marriage of the clergy, excommunicated five of Henry IV's councillors on the ground that they had gained church offices through simony, and forbade the emperor and all laymen to grant investiture of bishopric or inferior dignity. The struggle was complicated throughout its course by political and other considerations; there were repeated rebellions of German nobles, constant strife between rival imperial and papal factions in the Lombard cities and at Rome, and creation of several anti-popes, of whom Guibert of Ravenna (Clement III) and Gregory VIII were the most important. Final settlement of the struggle was retarded, moreover, by the question of the succession to the lands of the great Countess Matilda, who had bequearhed all her property to the Holy See; Henry claiming the estates as suzerain of the fiefs and as heir of the allodial lands. The efforts of Gelasius II to settle the strife by a general council were rendered fruitless by his death (1119). At length in 1122 the struggle was brought to an end by the concordat of Worms, the provisions of which were incorporated in the eighth and ninth canons of the general Lateran council of 1123.

In France the course of the struggle was somewhat different. As in the empire, the king and the nobles, each within his own sphere of influence, claimed the right of investing with ring and crozier and of exacting homage and oaths of fealty. The struggle, however, was less bitter chiefly because France was not a united country, and it was eventually terminated without formal treaty. The king voluntarily abandoned lay investiture and the claim to homage during the pontificate of Paschal II, but continued to interfere with elections, to appropriate the revenues of vacant benefices, and to exact an oath of fealty before admitting the elect to the enjoyment of his temporalities. Most of the great feudal lords followed the king's example, but their concessions varied considerably, and in the south of France some of the bishops were still doing homage for their sees until the closing years of the 13th century; but long before then the right of investing with ring and crozier had disappeared from every part of France.

England was the scene of an investiture contest in which the chief actors were Henry I and Anselm. The archbishop, in obedience to the decrees of Gregory VII and Urban II, not only .refused to perform homage to the king (1100), but also refused to consecrate newly-chosen bishops who had received investiture from Henry. The dispute was bitter, but was carried on without any of the violence which characterized the conflict between papacy and empire; and it ended in a compromise which closely foreshadowed the provisions of the concordat of Worms and received the confirmation of Paschal II in 1106. Freedom of election, somewhat similar in form to that which still exists, was formally conceded under Stephen, and confirmed by John in Magna Carta.

Many documents relating to the investiture struggle have been edited by E. Dümmler in *Monumenta Germaniae historice, Libelli de lite imperatorum et pontificum saeculis xi et xii* (3 vols., 1891–1897). *See* Ducange, *Glossarium*, s.v. "Investitura."

On investiture in the empire consult C. Mirbt, *Die Publizistik im Zeitalter Gregors VII* (Leipzig, 1894); E. Bernheim, *Das Wormser Konkordat* (Xresiau, 1906), and *Quellen zur Geschichte des Investiturstreites* (2 vols., 1907); R. Boerger, *Die Belehnungen der deutschen geistlichen Fürsten* (Leipzig, 1901); K. E. Benz, *Die Stellung der Bischofe von Meissen, Merseburg und Naumburg im Investiturstreite unter Heinrich IV und Heinrich V* (Dresden, 1899); H. Feierabend, *Die politische Stellung der deutschen Reichsabteien während des Investiturstreites* (1913); W. Martens, *Gregor VII sein Leben und Wirken* (2 vols., Leipzig, 1894); H. Fisher, *The Medieval Empire, c.* 10 (London, 1898). B. Schmeidler, *Kaiser Heinrich IV und seine Helfer im Investiturstreit* (1927); W. Schum, "Kaiser Heinrich V und Papst Paschalis II im Jahre 1112; Eine Beitrage zur Geschichte des Investitur-Streites," *Preussische Akad. gemeinnütziger Wissenschaften zu Erfurt*. Jahrb. (1877). For France, *see* P. Imbart de la Tour, *Les Élections épiscopales dans l'eglise de France du XIe au XIIe siècle* (1891); A. Luchaire, *Histoire des institutions monarchiques de la France sous les premiers Capétiens 987–1180* (2nd ed., 1891); P. Yiollet, *Histoire des institutions politiques et administratives de la France* (1898); Ibach, *Der Kampf zwischen Papsttum und Königtum von Gregor VII bis Calixto 11* (Frankfort, 1884); A. Dantzer, "La querelle des investitures dans les évéchés de Metz, Toul et Verdun de 1075 au Concordat de Worms, 1122," *Annales de l'Est* année 6 (1902). For England, *see* J. F. Bohmer, *Kirche und Staat in England und in der Nornzandie im XI und XII Jahrhundert* (Leipzig, 1899); E. A. Freeman, *The Reign of William II Rufus and the Accession of Henry I* (1882); H. W. C. Davis, *England under the Normans and Angevins* (1905); T. Klemm, *Der Englische Investiturstreit unter Heinrich I* (1880); M. Schmitz, *Der Englische Investiturstreit* (1884).

INVESTMENT, ECONOMIC ASPECTS OF. An individuai is said to invest if he puts some money into a business, usually with the expectation of getting a return in the future out of the profits to be made by the business. Investment is also used in a wider sense. An individual can invest by lending money to individuals, to businesses or to governments; by buying a house or furniture or diamonds or a college education; by building himself a house with his own hands, or by accumulating cash. He may even invest in intangibles such as safeguarding his health or making friends.

Whenever an individual invests he adds to his capital. Because of this his capital is sometimes loosely called his "investments." But for a clear understanding it is essential never to confuse capital with investment. There are a number of easy ways of telling which is being considered. A man's capita! is the sum of investments made and of gifts and inheritances received by him in the past. It is something that exists at a point of time. It is a stock measured simply as being worth so much money. Investment is none of these. It is not the sum of past additions to capital, but the rate at which capital is currently being added to. It is not something that exists but something that happens. It refers not to a point of time (in which nothing can happen) but to a period of time within which the investment takes place. It is measured not as a stock worth so much money, but as a flow or rate of investment of so much per week or so much per month or other period.

The essential difference is that capital is a stock, while investment is a flow. In this investment is like income. An income of $100 may mean $100 a week or $100 a month. In the same way investment cannot be measured without indicating (or implying) some period to which the figure refers. A rate of investment of $100 a month is not the same as a rate of investment of $100 a year, but it is the same as a rate of investment of $1,200 a year.

To obtain an individual's total investment in any period me must add the different investments he makes during the period. But when a man sells some shares in a business and invests the proceeds in another business, this is not an addition to his capital but only a substitution of some assets for others, If buying shares constitutes investment, selling them constitutes negative investment, or disinvestment, and the disinvestment must be subtracted from the positive investment before we get the proper figure for his total investment.

An individual's income is the amount he can consume without eating into his capital. If he consumes less than his income! the difference is called his saving. If he consumes more than his income the difference is negative saving or dissaving. His consumption and his saving thus add up to his income. R e may invest some of his saving in buying additions to his capital stock. The rest of his saving remains in his possession as unspent money income added to his stock of cash, and is called hoarding.

Hoarding is here a flow, just like investment, income and saving. It means, not the individual's stock of cash, but the rate at which it is being increased over time. If the stock of cash is being decreased, we have dishoarding.